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NFTs, Blockchain, Cryptocurrency, Metaverse

The Web3 Revolution That Has Transformed the Art Market

Edited by
Elena Sidorova

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Guest Editor

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Preface

Beeple's record-breaking NFT sale at Christie's in 2021 was not just a headline-grabbing event; it signaled a seismic shift in the art world. Suddenly, digital art, once relegated to the fringes, exploded onto the global stage, capturing the imagination of investors and the mainstream media alike. The meteoric rise of NFTs, culminating in Collins Dictionary declaring it "Word of the Year," undeniably ushered in a new era. However, this revolution has not been without its turbulence. The market, once fueled by speculative frenzy, has faced a sobering correction, grappling with volatility and the very real environmental concerns associated with blockchain technology. This Special Issue delves into this captivating and complex journey of the NFT art market. It examines how NFT art evolved from a niche experiment into a global phenomenon, exploring the triumphs, the challenges, and the uncertain future that lies ahead.

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Editorial

NFTs, Blockchain, Cryptocurrency, Metaverse: The Web3 Revolution That Has Transformed the Art Market

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Kevin McCoy's "Quantum" (2014) sold at Sotheby's in 2021 for USD 1.4 million is often considered the first NFT ever created (Sotheby's 2021). Indeed, Non-Fungible Tokens (NFTs) have emerged as a disruptive force in the art market, fundamentally altering the landscape of art ownership and challenging traditional models of art collecting. Built on the robust foundation of blockchain technology, NFTs function as unique digital certificates, each representing ownership of a specific digital asset. This encompasses a wide spectrum, from digital artworks and music to even virtual real estate within the burgeoning metaverse.

The core value proposition of NFTs is compelling: to revolutionize the art market by empowering artists, democratizing access, and enhancing the transparency and authenticity of art transactions (Benhamou and Heinich 2024). This potential arises from several key factors. Firstly, NFTs address the long-standing challenge of digital ownership and copyright. In the digital realm, where duplication and distribution are effortless, establishing and maintaining ownership rights can be a significant hurdle. NFTs, however, provide an irrefutable record of ownership on an immutable blockchain. This transparent ledger allows for easy tracking of an artwork's history and provenance, significantly enhancing its authenticity and value. In addition, NFTs can be programmed with smart contracts, enabling artists to retain a share of future sales. This innovative approach, known as royalties, ensures that artists continue to benefit from the long-term success of their work, fostering a more equitable and sustainable economic model for the contemporary art market.

Beyond these economic benefits, NFTs have the potential to democratize access to art. Traditionally, the art market has been characterized by barriers to entry, such as the need to navigate the complexities of physical galleries and intermediaries. NFTs, however, eliminate these barriers, allowing artists to connect directly with global audiences (Whitaker 2022). This direct-to-consumer model is particularly attractive for emerging artists who may have faced significant challenges in gaining visibility and recognition within established art circles. Furthermore, NFTs make it possible for collectors, regardless of their location or background, to easily access and invest in a diverse range of digital artworks. This increased accessibility expands the reach of the art market, fostering a more inclusive and diverse community of collectors.

The global NFT market size was valued at USD 19.39 billion in 2023 and is projected to reach USD 171 billion by 2032 (Business Research Insights 2024). However, the rapid rise of NFTs also raises several critical concerns. The substantial energy consumption associated with minting and trading NFTs creates alerts about its potential negative impact on climate change. Questions remain about the intrinsic value and long-term sustainability of many NFTs (Kent 2022). While some NFTs represent unique and valuable digital artworks, others appear to be driven by speculative hype, leading to inflated prices and risks of market bubbles. Likewise, the lack of clear regulatory frameworks surrounding NFTs presents significant challenges (Clark 2021). Issues related to copyright, intellectual property rights,

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consumer protection, and taxation require careful consideration and appropriate regulatory oversight to ensure a fair and equitable market for all participants. A robust regulatory framework is crucial to address potential risks, protect consumers, and foster a sustainable and responsible NFT ecosystem (Fitzpatrick 2023).

In 2024, the NFT market experienced a significant decline, with trading volumes and sales dropping to their lowest levels since 2020 (DappRadar 2024). Thus, NFT trading volumes plummeted by 19% in 2024, reaching USD 13.7 billion, the lowest level since 2020. NFT sales also dipped by 18%, falling to approximately USD 50 million from over USD 60 million in 2023. This market cooling has led to increased competition among artists and greater emphasis on building sustainable communities within the NFT space. Moving forward, the success of the NFT art market will depend on its ability to address these challenges. The development of more energy-efficient blockchain technologies, such as proof-of-stake mechanisms, is crucial for mitigating environmental concerns. Moreover, a greater focus on artistic merit and community building, rather than short-term speculation, is essential for fostering a sustainable and thriving ecosystem. Continued dialog and collaboration among artists, collectors, regulators, and technologists will be vital to navigate the complexities of this evolving landscape, and to ensure that the potential of NFTs to revolutionize the art world is fully realized.

This Special Issue of *Arts* provides a comprehensive overview of the rise of NFTs and their potential impact on the art world. It analyzes the key benefits and challenges associated with this technology, while also acknowledging the evolving nature of the NFT market. By critically examining the opportunities and risks, this volume unites ten academic contributions that provide a socio-cultural framework for understanding the future of NFTs and their role in shaping the future of the art ecosystem. As the Special Issue demonstrates, the rise of NFTs has not only transformed the art market but has also sparked a broader conversation about the nature of art, ownership, and value in the digital age. By challenging the traditional notions of art collecting and empowering artists, NFTs democratize access to art, foster new models of arts patronage, and redefine the relationship between artists and their audiences. However, the success of this nascent technology hinges on addressing the critical challenges of sustainability, regulation, and the long-term value of digital assets. As the NFT market continues to evolve, it is crucial to prioritize artistic integrity, environmental responsibility, and the creation of a sustainable and equitable ecosystem for all participants.

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Commentary

Questioning the NFT "Revolution" within the Art Ecosystem

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Abstract: Three years after the sensational debut of non-fungible tokens (NFTs) on the art scene, it seems timely to reflect on their presumed revolutionary attributes. The speculative fascination at the beginning has gradually given way to mixed outcomes, with hardly predictable future directions. However, once recontextualized in the art ecosystem and its value chain, one may question the ability of NFT technology to lead to radical changes. Our main argument is that although they offer perspectives that are worth considering regarding contracts, authors' rights management, and provenance, blockchain-based technologies do not substantially modify the typical characteristics of the art world. Based on recent press articles and academic publications, we comment on the effects of this technology on producers (artists' creative process and career development), intermediaries (art market gatekeepers), and consumers (quest for authenticity, collecting habits, and museum intervention in the art market). Our main conclusions suggest that NFTs perpetuate oversupply and job precarity in cyberenvironments and reinforce existing purchasing behaviors driven by the quest for authenticity and conspicuous consumption. Our goal is to mitigate some statements found in the literature and the press, especially regarding the democratization of the art market, and to help art market stakeholders approach this technology most objectively.

Keywords: NFT-secured art; authenticity; artists; intermediaries; collecting habits; museum practices

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1. Introduction

Non-fungible tokens (NFT) are a blockchain-based crypto-technology that has gained outstanding visibility during the COVID-19 pandemic. Although the origins of digital art date back to the early 1960s, its association with blockchain has had the effect of a bombshell in the art world, allowing anyone to issue, sell, and buy an NFT-secured piece of art. Through specialized platforms, artists can easily upload digital works and specify certain conditions—such as the percentage of their resale rights and number of sellable editions—before paying fees and issuing a unique tradeable numeric code. For the very first time, a code attached to metadata can provide buyers with proof of authenticity and ownership in the digital realm (Reinmoeller and Schmedders 2022). The possibility for artists and collectors to own digital assets is perceived as a significant advance in the art world, especially regarding the tracing of works' provenance, fair remuneration, and intellectual property rights (Wilson et al. 2021; Nadini et al. 2021; Whitaker 2019). As a result, several authors envision NFT technology as a "radical innovation" (Wilson et al. 2021; Wang et al. 2021), a "paradigm shift," and a "radical transformation of the art market" that is profoundly disrupting its traditional inner working (Hughes et al. 2019; Popescu 2021).

Despite receiving strong recent media coverage, NFTs are not a new topic in academic literature. As rightfully pointed out by Nadini et al. (2021), researchers from various disciplines—including economics, computer science, and law—have explored the potential of this technology to address issues related to copyright, as well as blockchain's technical aspects, protocols, and regulations, with several papers providing a comprehensible

introduction to the complexity of NFTs (Wang et al. 2021; Salman and Abou Elnasr 2021). According to Frye (2022), NFTs can be defined as "digital assets that represent objects like art, collective, and in-game items. They are traded online, often with a cryptocurrency, and are generally encoded within smart contracts on a blockchain." Wilson et al. (2021, p. 5) further specify that "each NFT sits on a block resembling a digital ledger that is secured through mathematical cryptographical algorithms and verified through blockchain processes." Embedded in an NFT, the smart contract allows the owner to manage a set of information related to the ownership and transferability of the digital file, itself linked to the NFT.

Several authors have reflected on the transposition of this technology into the art field and anticipated some of its effects. Sidorova (2019) addresses the potential of cryptocurrencies, blockchain, and artificial intelligence for the art trade, reminding us that discussions and experiments on art and NFTs already occurred before the craze that followed the pandemic outbreak. Whitaker (2019) highlights three main areas in which blockchain technology is expected to make a difference in the art ecosystem: the blurring of the for-profit and non-profit sectors, changes in the ownership structure of art, and the potential for new forms of public and private support. Whitaker (2019, p. 21) particularly insists on the fact that "blockchain holds the potential to tip the role of the arts toward democratic availability through collective ownership structures or toward further commodification of cultural assets." According to Abbate et al. (2022), managing authors' royalties, provenance, and authenticity issues will be facilitated thanks to NFTs, just as blockchain has some potential for cooperative financial arrangements, including fractional ownership. However, alongside these optimistic views on NFTs, a handful of authors are progressively tempering the hopes placed on this technology. Reinmoeller and Schmedders (2022) believe that "like other markets driven by exuberance, impulse purchases, and hype, the fast-moving and speculative NFT market could burn many investors. The current frenzy invites comparisons with the Dutch *tulip mania* from 1634 until 1637, when some bulbs fetched extremely high prices before the exuberance dissipated and the bubble collapsed."[1] Ippolito (2022) also critically discusses the storage potential of blockchain, using Warhol and the tokenization of his work as a case study. More pessimistic views are expressed by Gibson (2021), who compares the "absurdist tale of NFT" with Edgar Allan Poe's rhetoric of art, addressing the tensions between tradition and innovation. Similarly, Notaro (2022, p. 377) spotlights the contradictions of this new economy, which "mixes avant-garde and conservatism, experimentalism and dogmatism, anarchism and techno-scientific capitalism with a splash of gamification for good measure." The dramatic crash of this market segment reported in fall 2022, as well as the collapse of the cryptocurrency exchange FXT, has gradually undermined the most optimistic predictions regarding NFTs, whose critical mass has not been reached yet (Escalante-De Mattei 2022; Yaffe-Bellany 2022).

Building upon this prior research, we believe that the recent media hype, taken up by researchers, is overstating the role of NFTs in the art world. As stated by Heinich (2014), a "paradigm shift" entails a radical rupture, with new ways of thinking, designing, displaying, and distributing art. While we acknowledge the novel perspectives offered by NFTs, we argue that many practices and behaviors typical of the traditional art market still perpetuate through NFT technology, which mitigates its "revolutionary" nature. The recent press articles and academic publications mostly focus on the top of the iceberg, leaving aside more fundamental questions regarding the sustainable contributions of this technology to the art ecosystem. Historiography indeed tells us that the history of art has gone through several innovations across centuries. While NFTs may be one of those, a better understanding of NFT technology, its benefits, and its limitations is essential to avoid anticipated or reductive conclusions. Consistent with what Walter Benjamin and Theodor Adorno did with the development of photography, our paper intends to critically reflect on the current digital evolution of the art ecosystem, as well as its practices, values, and consumption patterns. According to Perrin (2021), this reflective process is essential to anticipate future changes in the digital sphere, especially around key notions such as authorship, authenticity, and originality.

Our goal is to contribute to the debate by putting into perspective NFTs with behaviors and practices traditionally encountered in the art market. Given the broad scope of this subject, we chiefly address a few issues related to the impacts of NFT technology on the following factors:

(i) Producers (artists' creative process and career strategies);
(ii) Intermediaries (role of art market gatekeepers);
(iii) Consumers (quest for authenticity, collecting habits, and museum interventions in the art market).

More specifically, we reflect on the extent to which NFTs are truly affecting the mechanisms that underlie the production, circulation, and consumption of art. Our exemplification-based analysis and critical discussion result from a review of press articles and academic papers published during the past years, in various media. Taking the viewpoint of producers, we argue that NFTs contribute to perpetuating oversupply and quality uncertainty and do not entirely solve the issues of financial precarity and the lack of diversity and democracy in the art market. When it comes to intermediaries, we show that NFT platforms act themselves as gatekeepers and that prospective buyers will increasingly require quality signals to assess the quality of NFTs in the context of oversupply. From the perspective of the consumers, our main argument is that NFTs are exacerbating our Western obsession with authenticity, authorship, and ownership, at least in the higher ends of this polarized market segment. In many instances, the purchase of NFTs reflects conspicuous behaviors that are emblematic of the upper-end market, while making profitable resales in the lower ends is unlikely, as is the case in the traditional art market. In each section, we provide several recommendations for future research. More broadly, through this contribution, we aim to make this technology more accessible to stakeholders of the art world and to raise attention to issues that must be explored in the future.

2. NFT-Secured Art and Producers

2.1. Disrupting the Artist's Creative Process?

Creativity is the cornerstone of any original work of art, and while new technologies can stimulate human creativity (Sidorova 2019), NFTs as a technology are no substitute for the creative process itself.

Firstly, it is crucial to dissociate the technology from the work of art. The definition provided in the introduction suggests that an NFT is not a new form of art per se but merely a numeric code associated with an existing digital file (JPEG, GIF, pdf, etc.). The file itself can be a digital work of art or the digital reproduction of a physical painting, drawing, or sculpture (e.g., the picture of Hokusai's famous *Great Wave of Kanagawa* hanging in the British Museum). Virtually any kind of work, irrespective of its mode of creation, can be integrated into a blockchain through a numeric code. As a result, NFTs cannot be assimilated to revolutionary production in themselves. In fact, the conflation between the technology and the artistic output can lead to serious confusion among less informed stakeholders of the art world. At best, it is a "simple form of digital certification" or an instrument that alters the financial structure of the market to create scarcity in the digital sphere. For this reason, we will favor the terminology NFT-secured art throughout this essay; a term that better reflects the purpose of this technology.

Secondly, the creation of digital works of art is not a new practice. Early forms of digital art appeared in the 1960s with cybernetic creations and the proliferation of digital pictures, either fixed or animated. What is known as "Internet art" or "Net art" is now acknowledged in art history and museums, thanks to the work of pioneering figures such as Slovenian artist Igor Štromajer. Recently, artists have increasingly been exploiting the potential of digitalization to undertake artistic experiments, using 3D images, artificial intelligence (AI), virtual reality (VR), or neural and generative adversarial networks (GANs). However, artists active in the NFT economy remain visual artists above all, with the term "crypto-artist" being occasionally used to emphasize their self-identity as programmers involved in the production of self-referential works reminiscent of 'memes' (Lawson-Tancred 2021).

Thirdly, the novelty and originality of the composition are what will determine the value of a digital item. Akin to contemporary art, envisioning NFTs as works of art requires a shift in mindset to enable viewers to appreciate the work's originality and the artist's computational skills (Heinich 2014). The creative process remains, therefore, essential in the digital sphere to provide innovative iconography and style that will allow the artist's works to distinguish them from the rest and to generate new aesthetic value in the context of oversupply (Caves 2000). However, an interesting feature of NFTs is the possibility to tend towards more interactive creative processes between artists and owners, consistent with the notion of co-creation and participatory art.[2] However, as observed in the contemporary art market, the rapid growth of the market for NFT-secured art may constrain artists to accelerate their rhythm of production, with an impact on their creative process. To gain a reputation in the crypto-art market, an artist may be tempted to produce more art and at a faster pace to meet the demand, as suggested by the blue chip artist Beeple. Again, the pressure for higher production rates is not radically different from what artists active in the primary market experience nowadays. The prior research indeed suggests that the international art fair agenda, and the corollary pressure put on artists, may affect, to a certain extent, the originality and quality of their products (Adam 2012). The growing attention paid by leading gallerists such as Gagosian to the NFT phenomenon may lead to similar situations in the short run.

In light of this, it is, therefore, crucial to dissociate the artists' creative process (the design and creation of a digital work of art) from the process of issuing an NFT on the blockchain (the association of a numeric code to the digital file). Building upon Lenain's (2011) terminology, NFT technology should be envisioned as involving an exotechnique process that does not affect the work per se, in contrast to the endotechnique's creative process itself. While the former is of little interest in the context of art history, the latter has already been discussed by digital art specialists. Contrary to common beliefs, creating a digital piece of art can be a costly and time-consuming endeavor. While the labor and material costs may be lower (in comparison with other art forms, such as the applied arts), there are substantial costs related to computational devices and training that artists must invest upfront (Paul 2015). Such investment can be viewed as an obstacle, as traditional fine art artists eager to venture into crypto-art need to learn new digital skills—a process that comes up with its own challenges.

Although we currently lack enough distance to assess the impact of the art market on the artist's creative process, art historians should begin to pay serious attention to crypto-art and its rapid evolution in order to define what quality and originality mean in this production and how both dimensions may be assessed scientifically. Recurring iconographic and stylistic peculiarities (e.g., the predominance of stylized and pixelized figures, flashy colors) or the influence of other art movements and artists on this art form (CryptoKitties and pop art-influenced editions of Takashi Murakami, for example), require further analysis. The existence of polysemic categorizations and practices in the crypto-art world, from digital files to printed works of art that incorporate a USB stick containing the numeric code, also calls for more precise artistic terminology. Developing a lexical, iconographical, and stylistic vocabulary is essential to capture the essence of this production process and help NFT-secured art pass on to posterity.

2.2. Disrupting Artists' Career Strategies?

The use of NFTs is sometimes presented as a new method of democratization of the art world, allowing any artist to enter the art market, gain visibility online, and sell their digital work (originals or reproductions) in a profitable manner (Whitaker 2019; Catlow et al. 2018). In the vein of prior research on creative entrepreneurship (Chang and Wyszomirski 2015; White 2013; Beckman and Essig 2012), the new business model involving blockchain technologies offers two interesting perspectives for freelance artists.

Firstly, NFTs are presented as a promising way for unknown or less-represented artists to gain a reputation and to make a living with their digital output, "outside the

gate-keeping systems and taste hierarchies" (Kapoor et al. 2022, p. 2). Beeples, Pak, and other mediatic artists who emerged from the NFT hype were indeed newcomers in the art world, who were largely unknown to the stakeholders who traditionally participate in the process of value co-creation (Preece and Kerrigan 2015). NFTs are also allowing other types of creative people to enter the visual art market, such as graphic designers, digital illustrators, and cartoonists, who are usually engaged in other businesses. These less-established artists may indeed gain some visibility by using NFT platforms for self-promotion and branding, as they do via social media platforms (e.g., Instagram) or online sales platforms (e.g., SaatchiArt or Catawiki). Female artists, whose art is notoriously less-represented and underpriced in most levels of the art market (Cameron et al. 2019; Marchenko and Sonnabend 2022), may also find some opportunities in the NFT-secured art trade. Notaro (2022) provides a series of examples of artists from emerging economies who previously struggled to make their place in the conventional visual art markets and have succeeded in differentiating themselves through NFT-based technologies (e.g., South African artist Lethabo Huma, Nigerian artist Osinachi). Although convincing, these duly selected examples prevent us from assessing how representative they are of the artistic community, and whether this new modus operandi will guarantee long-term success for the artists, especially in the context of a declining market. Furthermore, empirical evidence is needed to see whether artists from minority groups and female artists are truly the most inclined to access and adopt NFT technologies. Regardless, NFTs can act as reputation enhancers can be used by lesser-known artists for career development or by established artists to launch new trends, as evidenced by Damian Hirst's recent dive into the NFT economy. The prevalence of anonymity in the crypto-art world (Wang et al. 2021) also offers interesting research perspectives for art historians regarding the use of pseudonyms and reputation-building mechanisms.

A second important innovation offered by NFTs is the possibility for artists, either established or emerging, to gain more systematic royalties and resale rights in cyberenvironments (Van Haaften-Schick and Whitaker 2022; Abbate et al. 2022; Popescu 2021).[3] Digital artists have indeed long struggled to generate revenues with intangible works of art, especially because of ownership issues (Wilson et al. 2021). This situation has been perceived as being highly problematic, as the purpose of royalties is specifically to generate long-term revenues, according to Caves' *ars longa* principle (Caves 200), and to stimulate creativity. From a legal perspective, guaranteeing fair royalties on the use or sale of a digital work of art is nothing but a daunting task, due to the ambiguous notion of ownership and the lack of legal control, making digital art a public good subjected to opportunistic behaviors and free-riding (Sullivan 1996). The existing literature on public governance indeed suggests that implementing systematic legal control is one of the main challenges faced by public authorities, as it requires an efficient state apparatus (Ranchordás 2019). Such a situation is notoriously observed in the art market, where controlling the validity of each attribute of the works put up for sale is unmanageable (Oosterlinck and Radermecker 2023). To alleviate the limitations of the traditional art market and legal system, blockchain-based technologies now offer unprecedented opportunities for a more systematic tracing system of copyrights and resale rights in the digital sphere to the benefit of creative people.

The potential of NFTs to launch an artist's career is, however, mitigated by a series of challenges traditionally faced by artists in the labor market. Demand uncertainty, oversupply, fierce competition, job precarity, and job combination are well documented in the academic literature (Caves 2000; Abbing 2002) and seem to apply to cyberenvironments as well. We address below four issues in particular.

A polarized market: Aspirant artists should not think that starting a career in crypto-art is easier or that any digital work will automatically fetch substantial prices, as suggested by the media. Like the traditional art trade, digital art evolves in a polarized market, divided into the primary and secondary markets. This market is vertically segmented, with at the top a handful of artists capable of selling crypto-art at skyrocketing prices, and at the bottom an unquantifiable number of NFT-secured collectibles of low value produced by

unknown individuals. According to Rea (2021), the average price of an NFT is $15 in 75% of cases. One percent fetches prices that are higher than $1594, and only a few works sell for more than a million dollars, as observed in the traditional art market. Similarly, some famous CryptoKitties went for millions, but the average price of these items is about $175 (Criddle 2021). The odds for an artist to break through are, thus, rather low. A recent survey revealed that according to 37% of crypto-artists, luck remains a key factor that correlates with the artist's preexisting patronage and self-branding skills.[4] The brand value of art has been the focus of recent studies in contemporary art (Angelini et al. 2022), having equal importance in cyberenvironments.

Relative market accessibility: From an entrepreneurial perspective, the possibility for artists to directly sell their NFTs through specialized platforms echoes the practice of selling physical works online, although additional tasks fall on the crypto-artist. Third-party platforms such as SaatchiArt or Catawiki allow unknown artists to easily fulfill their demand and promote and sell their physical works on their own, leading to a more "democratic" art market. This discourse has been transposed into the NFT-secured art market. However, claiming that the barriers to entry are lower in crypto-environments is reductive, since the NFT economy requires a minimum of familiarity and specialized knowledge regarding the technical terms and tasks. As mentioned earlier, embarking on this process is not necessarily accessible and affordable to all artists. The gas and electricity fees that are necessary to issue NFTs are extra costs that artists must also bear (Salman and Abou Elnasr 2021; Wang et al. 2021). As a result, production costs can rapidly exceed sales revenues, leaving the artists in a situation of financial loss in cases of limited sales. Such a situation may prevent emerging artists from starting an NFT venture, especially at the beginning of their career. Investing without any guarantee of ex post success is costly and risky. In this respect, the notion of democratization needs to be mitigated.

Oversupply: Fierce competition due to oversupply is another issue faced by emerging artists in this new market segment. Such a competitive environment is typical of the cultural and creative industries (CCI), where anyone can claim to be an "artist." Creating a basic digital file and converting it into an NFT has become accessible to many creative people. As a result, the crypto-art market entails extra competition and uncertainty for artists who are constrained in finding alternative strategies to differentiate themselves from the mass. Here, the distinction between NFT-secured arty items and actual crypto works of art produced by official artists becomes crucial to avoid putting on an equal footing incomparable products resulting from distinct processes. Our views support that of Botz (2021), who contends that most NFTs are nothing but creative collectibles that compose an umpteenth niche segment of the art trade.

Financial precarity: Due to the current lack of reliable data, the proportion of artists who benefit from revenues generated by the sales of their NFT-secured works remains difficult to estimate, as are the frequencies of transactions and their amounts. Claiming that the majority of crypto-artists can make a living from digital art is premature, for this claim has little robust evidence. As the market is currently experiencing a decline, we may assume that the royalties generated online remain marginal for crypto-artists, and even less for more traditional artists who have not embraced the NFT hype yet. The proportions of private galleries and collective authors' rights management companies that apply this system to ensure fairer remuneration for the artists they represent are also unknown at this juncture. It, therefore, seems reductive to think that NFT-secured art is the new economic El Dorado for emerging or more established artists whose production may not suit this technology or whose clientele may not be receptive. Such a claim runs the risk of making creative people believe that any digital item can be viewed as art and is likely to fetch high prices, with dramatic delusional effects. In fact, it is likely that Abbing's (2002) provocative question, "why are artists poor?", also applies to creative people active in the NFT economy. Aggregate data are needed to assess whether the income generated by NFTs is enough for an artist to be self-sufficient or is part of a larger diversification strategy for artists (combined with, for example, physical sales, grants, public funding, and auxiliary activities,

including art jobs and non-art jobs). One should, therefore, approach with caution economic recommendations urging young artists to exploit the potential of blockchain to develop their career, as observed in some studies compelling emerging artists to brand themselves (Hernando and Campo 2017) or to use big signatures to perform better in the art market (Zhou 2017).

3. NFT-Secured Art and Intermediaries

Disrupting the Role of Gatekeepers?

The greater autonomy that a decentralized economy can offer to artists has led some authors to claim that NFTs could accelerate the process of desintermediarization, undermining the role of brick-and-mortar gatekeepers and middlemen (Morkunas et al. 2019; Angelis and Da Silva 2019; Bowden and Jones 2021). Again, such a statement must be interpreted critically, as we have reason to believe that this desintermediarization process is not as drastic as expected.

Firstly, Wilson et al. (2021) remind us that crypto-technologies themselves require peer networks and are based on a system of decentralized "core" and "related" intermediaries. While the former ensures the proper inner-working of blockchain technologies and secures the ledger, the related intermediaries are involved in after-sale and resale activities, such as accounting and taxation. The inner working of the blockchain, thus, means that intermediaries still operate in this new economy.

Secondly, indirect signals of quality are needed in a situation of oversupply to reassure buyers and increase their willingness to pay, as is the case for the traditional art market (Spence 1973). Currently, the NFT platforms' reputation and artists' market performance are the two main signals that buyers can rely on to circumvent information asymmetry and quality uncertainty. Sellers and buyers join these platforms, whose brand names often recall the most sought-after characteristics of NFTs (i.e., "rarity" with Superrare, Rarible, and KnownOrigin) and convey different reputation signals, based on their technical efficiency, ability to attract successful artists, and curatorial choices. Relying on intermediary brand names is another typical behavior found in the traditional art market, with top-tier players reassuring buyers regarding the quality of goods (Bocart and Oosterlinck 2011). Put differently, NFT platforms operate as intermediaries that foster transactions between suppliers and buyers. As with any other intermediary, their core business is also based on charging fees on sale prices.

Thirdly, the role of more traditional brick-and-mortar intermediaries should not be minimized in this new economy. The impact of digitalization on experts, agents, auction houses, and galleries has already been widely discussed, with the conclusion that gatekeepers are expected to play an ever-growing role in cyberenvironments (Towse and Handke 2014). Arora and Vermeylen (2013) argue that the increased flow of information and data complicates the consumer decision-making process and compels them to seek the expertise of specialized intermediaries. The NFT-secured art economy is no exception. According to Whitaker (2019) and Lena (2019), democracy not only relies on popular participation but also on judgments by experts. How expertise will develop with crypto-art and how to assess quality in a situation of oversupply must be scrutinized in future research. Smee (2021) argues that the assessment of NFT quality mostly depends on subjectivity and the importance of storytelling, as is the case for any kind of art form. However, the selection and curation criteria currently used by NFT platforms remain relatively opaque. It is, therefore, likely that the NFT craze will make the role of intermediaries—from and outside the NFT community—all the more crucial to study these products, highlight their specificities, and participate in their historical legitimization. Traditional art dealers and auctioneers have the knowledge and skills to sort out the vast quantity of NFTs and to create value (Smee 2021), as evidenced by their business diversification and extension to the virtual world. Several leading auction houses and art galleries (Christie's, Sotheby's, Millon, Gagosian) are currently capitalizing on the economic potential of NFTs by developing, controlling, and securing the market for digital artists. Reciprocally, the inclusion of tangible works

in Sotheby's metaverse betrays the will of top-tier players to attract digital buyers into the physical market. By exploring the benefits of new technologies and combining them with their unique selling proposition, Christie's and Sotheby's are investing in the art market of tomorrow (Gilbert 2005; Knight and Harvey 2015; Smith and Lewis 2011). These experiments, albeit costly, are essential to allow intermediaries to face the next shifts that the art market is expected to go through in the digital era. The relationships that many gallerists maintain with the institutional field (i.e., museums, academia) are also crucial to avoid crypto-artists being reduced to "mediatic artists" and falling into oblivion in the long run (Moureau and Sagot-Duvauroux 2016). Put differently, traditional gatekeepers are still expected to play a crucial role in legitimizing and inscribing this phenomenon into the history of art.

Finally, as blockchain technology and metaverse environments develop, new generations of digital-born art buyers will fancy new forms of art and need guidance, as was the case for previous generations in other contexts. As a result, one may expect the emergence of new profiles of intermediaries, such as NFT-specialized managers or agents with computational skills, to assist and equip artists and buyers eager to enter the crypto-art market. Future research should pay attention to the shifting profiles of traditional and novel intermediaries, as well as to new forms of expertise in the market for NFT-secured art. Furthermore, what are the quality signals that buyers consider ex ante? Can we identify varying degrees of expertise and reputation—some being more reliable than others—among NFT stakeholders? These are important questions that need be addressed.

4. NFT-Secured Art and Consumers

4.1. Disrupting the Quest for Authenticity?

As mentioned earlier, securing authorship has long been a major challenge faced by stakeholders in the digital sphere. Unlike regular visual arts, digital works of art are not physically touched by the artist but are created through the intermediation of a computer. Providing evidence of ownership is another daunting task, as any digital file can be copy-pasted, downloaded, or screenshot for free, despite the existence of copyright laws. What makes NFTs appealing to buyers is the technology's capacity to create uniqueness in the digital realm and to guarantee authorship and ownership, through a decentralized system of authentication (Whitaker 2019). Despite this non-negligible advance, we argue that NFTs perpetuate—if not exacerbate—well-known purchasing behaviors observed in the traditional art market.

Quest for authenticity: The quest for authenticity is not a new issue within the art ecosystem. This cultural construct, inherited from the 19th century, is particularly revealing of how Western societies value art and authorship (Lenain 2011). What matters for viewers and buyers is to feel the connection with the artist's hand and creative gestures according to a contagion effect (Newman et al. 2011). In the art market, the guarantee of the artist's hand is indeed paramount, for it has critical financial implications for art buyers (Radermecker 2021). The quest for authorship is particularly reflected in the importance attached to the artist's name and any evidence of it, including a signature or a certificate of authenticity. In the digital world, the latter takes on a new dimension thanks to NFTs. According to Nadini et al. (2021), the revolutionary aspect of NFTs resides in their function as digital certificates in the cyber art market, allowing buyers to claim ownership of a numeric code linked to an image. This property is explicitly stated in the term "non-fungible," which indicates that the certificate cannot be replaced by any equivalent. Moreover, non-fungible tokens are unalterable and cannot be forged, which is a significant difference from written certificates of authenticity. A typical challenge faced by art market stakeholders is indeed the forging of certificates, which traditionally take the form of a small piece of paper on which the artist him- or herself or an expert expresses an opinion on the work's authorship. Manipulating this crucial document is relatively easy, as evidenced by the deceptive practices of famous art forgers (Lenain 2011; Koldehoff and Timm 2013). Just as for the attribution of a painting, the authentication of a certificate requires a social consensus

among experts. A common misconception is, however, to envision NFTs as certificates of authenticity stricto sensu. According to Frye (2022, p. 6), "NFTs reinvented certificates of authenticity, while largely misunderstanding their point", for they cannot guarantee that the work is truly genuine. As mentioned above, buying an NFT means buying access to a digital file through a numeric code that is linked to the digital work. Whether or not is the digital file is an authentic work created by a given artist is another issue. Additionally, buyers do not acquire copyright ownership, but merely the NFT itself under the form of a numeric code. This suggests that unlike the traditional certificate of authenticity, NFTs fail to create this meaningful connection with the works they are supposed to authenticate. At best, blockchain technologies allow art buyers to possess and control the use of a digital asset (Clark 2021). Still, they seem to create this sought-after feeling of owning "authorship" in the digital art world, accentuating our modern obsession for authenticity. Far from challenging it, the NFT phenomenon contributes, in fact, to feeding it by falsely giving auctorial value to the intangible.

The quest for authenticity is also reflected in the importance given to provenance. A non-negligible advantage of a decentralized system of authentication is the information that stakeholders can have on the provenance of a digital work of art. A well-documented and detailed provenance is particularly valued by buyers in the traditional art market (Radermecker 2021). As any transaction or shift in ownership is enacted through a smart contract in the blockchain, retracing a work's pedigree and history of ownership becomes feasible in the digital sphere. According to Wilson et al. (2021) and Gibson (2021), the originality of crypto-art specifically resides in its reinterpretation of provenance in the cyber-environment, rather than the certification of authorship per se. Blockchain technologies are, therefore, presented as potential solutions to alleviate crucial issues encountered in the art market, including the market for antiquities, which is known for its opacity, inefficiency, looting, and forgeries (Fincham 2019). Put simply, applying this technology to a tangible work consists in associating it with its NFT-secured reproduction. By doing so, the art market may tend towards more transparency, although the implementation of this system also raises some challenges in practical terms. Non-official transfers of ownership are still possible, especially when reproductions of tangible works of art linked to an NFT are concerned.

Furthermore, while the hedonic benefit of "owning uniqueness" in multiplicity may be new in the digital realm, it is not in the history of art. The issue of seriality versus uniqueness has extensively been discussed in art history (e.g., Benjamin 1936; Steiner 1999; Lazzaro 2006; Tummers and Jonckheere 2008), and envisioning NFTs as a radical change in people's conception of uniqueness may be misleading. The process of creating exclusivity by issuing a limited series of NFT-secured items is not a revolutionary practice, as traditional artists have long used this strategy. By producing a limited series of prints and destroying the original plate, old masters such as Dürer and Rembrandt created exclusivity within multiples (Benhamou and Ginsburgh 2006; Lazzaro 2006), a technique later exploited by major artists such as Andy Warhol or Jeff Koons. Doodle's limited production of nine "aliens" sold for several million each follows the same logic. The reaction of DJ Steve Aoki was revealing in that regard, by proudly claiming that he had acquired the 7th alien in the middle of his DJ set. In other words, serial NFT-secured works of art are nothing but derivatives of ancestral art practices, transposed into the digital sphere and creating the same feeling of "exclusivity" for consumers.

Finally, despite the feeling of security generated by NFTs, one should not forget that opportunistic behaviors still occur in this market segment. While a buyer can pretend to own the digital code associated with a work of art in their digital wallet, the digital file can be subjected to copies and screenshots by others for personal or illegal use. Buyers benefit from the ownership of a digital work that remains reproducible by others, just as anyone can claim to own a copy of a famous work of art via a postcard, poster, or photograph. As for other traditional media, property is not synonymous with copyright (Kapoor et al. 2022), and providing a legal solution to the illegal tokenization of NFT-secured works of art is still

a major challenge faced by art market stakeholders (Chow 2021). For example, one may screenshot an NFT-secured art piece and turn it into a new NFT, challenging the notions of authenticity, uniqueness, and scarcity (Gibson 2021). In this respect, NFTs do not solve the long debate about originals and copies in the art world, with some artists even playing with this tension in their digital works.[5] More severe digital art frauds are also happening, taking the form of cybercrime (wallet hacking), the illegal production of NFTs, and copyright infringement, with varying degrees of gravity depending on the sophistication of the owner's protection system. Major artists such as Anish Kapoor and Banksy have already experienced such deceitful practices, including non-authorized copies or illegal sales of their NFTs (Escalante-De Mattei 2021; Tidy 2021). OpenSea, the largest NFT marketplace, acknowledges that some 80 percent of its NFTs are fakes (Mercier 2022). Mercier (2022) also notes that the resale rights enjoyed by the author of an original work of art or their heirs when resold on the secondary market are difficult to follow.[6] Crypto-stakeholders, therefore, engage in risky transactions within a highly unregulated cyber-environment that imperatively requires further due diligence protocols to counteract tax evasion, money laundering, criminality, and the financing of terrorism (Das et al. 2022; Salman and Abou Elnasr 2021).

Each point discussed in this section thus requires further investigation. As the market for crypto-art is mostly made up of cheap collectibles, one may wonder whether the notions of authenticity, uniqueness, and provenance are also valued in its lower ends, or what the risk aversion degrees are for buyers in this market segment. Semi-structured interviews need to be conducted with purchasers active at different levels of the crypto-art market to better understand their consumption experiences.

4.2. Disrupting Collecting Practices?

While further empirical research is also needed on NFT buyers' profiles and incentives, several indicators can allow us to identify some consumption patterns that do not substantially differ from existing collecting practices. According to the press, NFT technologies enable any buyer to enter the art market, open a crypto-wallet, support their favorite artists, and build a collection based on their preferences and budget constraints (Clark 2021). In reality, such facilitated access to the primary art market is already permitted since the proliferation of online third-party platforms specializing in low-brow art or emerging artists. The democratic access to the art market offered by NFTs must also be mitigated by the fact that in 2021, people owning a crypto-wallet only represented one percent of the global population or approximately 74 million individuals.[7] Despite the attempt of some NFT platforms to enhance the user-friendliness of their website and transaction system—by allowing credit cards (Salman and Abou Elnasr 2021)—envisioning the NFT economy as democratic appears to be quite optimistic, since only educated buyers can navigate through this complex and costly interface.

Moreover, as pointed out by Clark (2021), the crypto-market is merely reproducing existing collecting patterns that are typical of the fine arts sector. High-end NFT-secured works of art are viewed as luxury "Veblen"" goods and used for conspicuous consumption (Mandel 2009), being displayed in virtual environments to signal a certain social status and level of wealth. Recent price records could even suggest that NFTs have made conspicuous consumption reach its paroxysm, with buyers willing to spend millions on digital items to satisfy their self-esteem aspirations. Social media platforms such as Twitter play a crucial role in this process, not only in the artists' self-promotion but also in the buyers' self-distinction. The digital nature of NFT-secured works fits particularly well those applications, either to openly display conspicuous behaviors (by claiming and showing publicly the acquisition of a given work) or from a utilitarian perspective, as NFT-secured art pieces can be used as personal avatars, profile pictures, or gathered into a publicly-accessible file similar to a private art gallery. It is, therefore, not surprising to notice that most social media platforms now include an NFT option in their settings.[8]

In the art market literature, the notion of conspicuous consumption also closely relates to that of investment. The sudden entry of wealthy newcomers in this segment has led to a temporary speculative "bubble," with large sums of money being invested in non-institutionalized works of art (Gibson 2021; Wilson et al. 2021; La Monica 2021; Ossinger 2021). In the upper ends of the crypto-art market, acquiring rare digital items has become a way of diversifying investment portfolios, with short-term speculative opportunities permitted by the high volatility of both NFTs and cryptocurrencies (Wilson et al. 2021). Levy (2021) and Botz (2021) designate this category of buyers as speculators, for whom making money largely prevails over the NFTs' artistic and aesthetic peculiarities—a reductionist vision of art that is not uncommon in the traditional art market. Recent studies have, therefore, paid attention to the market performance of NFT-secured art in comparison with other currencies. Using the Foundation platform as a case study, Popescu (2021) explored the market dynamics of NFTs and showed that their performance at auction is similar to that of other NFT clusters. Through machine-learning algorithms, Nadini et al. (2021) analyzed 6.1 million datapoints from Ethereum and WAX blockchains to map the NFT market and detect certain interactions between NFT objects, trades, and sectors. Dowling (2022) and Ante (2021) explored three submarkets of NFTs and examined their relationships with cryptocurrencies, highlighting the relative immaturity and inefficiency of this market segment. Just as for traditional fine arts, the recent research also suggests that a set of hedonic attributes are good predictors of NFT prices. Provenance, through sales history saved in the blockchain, and "the recognition of the creator and the overall marketing around the NFT itself"[9] are the main drivers of the economic value of these digital assets (Nadini et al. 2021).[10] This is extra evidence that the market for NFT-secured art perpetuates the superstar economy typical of the CCI, where the quest for big names, authenticity, and scarcity often prevails over the works themselves.

Needless to say, this profile of buyers only represents a portion of the crypto-art market. In addition to speculators, a widespread group of consumers is composed of digital natives, who are savvy in computer science and digital technology and who have made substantial profits by investing early in crypto-money (AFP 2022). More specifically, Griffith (2021a) associates NFT buyers with "fans" who envision NFTs as an alternative form of entertainment. For these buyers, the NFTs' utility resides in their status as collectibles, bearing a decorative and small investment value. What these early adopters purchase is an emotional feeling, the pleasure of owning an intangible asset, just as older generations show a strong attachment to material objects such as antiques. Other incentives to purchase NFTs are the phenomenon known as FOMO ("fear of missing out") and the "nostalgia" argument, with buyers acquiring NFTs to reconnect with their past experiences (Griffith 2021b). The pixelized aspect of many NFT-secured items such as crypto-punks indeed recalls Game Boy devices and games that have marked an entire generation. One may, therefore, argue that the motivations of this category of buyers do not differ much from those of less-elite art buyers who acquire affordable contemporary pieces of art and antiques as a hobby or for decorative purposes. However, unlike traditional low-end galleries and auction houses, entering the market for NFTs requires significant search costs and computational skills for novice buyers. The lower value of those digital collectibles also shows that the NFT market is highly concentrated, with only 10% of traders performing about 85% of all transactions (Nadini et al. 2021). According to Criddle (2021), "unless you are prepared to spend a lot of money and time learning the market—it is hard to imagine making money from NFTs." What has been mentioned for artists, thus, applies to buyers as well; despite some opportunities for fragmented ownership (Whitaker and Kräussl 2020), the investment potential of NFTs is relative.

That being said, this parallel economy, where individuals invest in digital life and buy and display immaterial collectibles, is expected to generate new kinds of consumption behaviors that scholars should investigate, especially using a comparative approach. To what extent digital purchases and lifestyles differ from physical ones and how online and offline tastes differ from each other are pending questions that require further research.

4.3. Disrupting Museums' Interventions in the Art Market?

Museum curators are important stakeholders in the traditional art market, who make direct purchases to enrich the collections of their institution. Whilst some of them are already involved in the acquisition, preservation, study, and display of NetArt (Perrin 2021; Lartigaud and Thély 2008), the NFT hype is compelling public and private organizations to pay increased attention to blockchain-based technologies, either from an artistic perspective or to enhance their internal efficiency. For museums, the areas that are concerned with such innovation are provenance research (Whitaker and Kräussl 2020), archive management (Quirion 2021; O'Dair 2019), audience participation through gaming activities (Wang et al. 2021), collection management (storage and preservation) (Lo Duca et al. 2020), and innovative business models (Reyburn 2021). NFT-secured art is also raising new exhibition and conservation challenges for public institutions. Digital storage and obsolescence, cyberattacks, and digital display modes are issues that curators are seriously considering (Thibault 2021). Finding optimal resolutions and formats that best suit the peculiarities of digital works of art and allow audiences to appreciate these peculiarities other than through a cell phone or laptop screen is a recommendation already expressed by the sector (Devi 2021). As pointed out by Siri et al. (2018, p. 201), "faithful high-quality digital reproductions of works of art could be as arousing as the original works of art, but at the same time, they cannot replace the experience of standing in front of an authentic work of art in terms of explicit hedonic attributed values." Blockchain-based technologies still require further research to exploit their potential in line with museums' missions, including the acquisition of NFT-secured works of art, the study of their production, and the curatorship of exhibitions.

More problematic is the sale of NFT-secured works by public museums, which is a new form of museum intervention in the art market. Public institutions are increasingly expected to become more accessible, inclusive, diverse, and sustainable. In this respect, the tokenization of masterpieces from major institutions such as the British Museum and the State Hermitage Museum (Valeonti et al. 2021), through collaborations with private firms, is questionable.[11] Recently, NFTs of Hokusai's works were put up for sale through the LaCollection platform,[12] while the digital asset company Ezel.life began to sell reproductions of furniture from the Casa Roja, Frida Khalo's family home. While certain museums envision this practice as an alternative form of patronage (AFP 2022), one may argue that the sale of original digital reproductions of works owned by a public museum echoes some forms of deaccessioning. Deaccessioning is the practice of removing a tangible asset from a public collection through sale, restitution, transfer, donation, or destruction (Piazzai and Vecco 2015). According to the "inalienability" principle of public collections, this practice is forbidden in Europe. Arguably, selling an NFT-secured digital version of a painting or a print is not a deaccessioning practice per se, since the physical work remains the property of the museum or the government and is still available to audiences. However, the sale of a unique (or limited) reproduction of a public good by a public institution inevitably raises the unaddressed question of "digital deaccessioning." Unlike postcards or posters—whose value rarely exceeds a few dollars and therefore remains affordable to most visitors,—NFTs issued and sold by museums give a handful of people the exclusive privilege of owning a public good's authentic digital pictures, at prices that are far from being democratic. In the case of Hokusai's NFT-secured digital prints, several levels of rarity were proposed to create sophisticated price discrimination. The fixed prices were around $500, while some editions were auctioned with low estimates close to $4000 and with auction results fetching five-to-six figures.[13] What is done with the money resulting from those sales remains unclear, although this extra income derives from public money, as is the case for deaccessioning. New opportunistic behaviors may also emerge, including the tokenization of official museum NFTs for personal profit. While they remain non-competitive, NFT-secured reproductions of museum masterpieces become excludable, partly losing their status as a public good. This controversial practice has recently led the Italian government to prohibit all forms of contracting between public museums and NFT companies (Batycka 2022). However, as American and Northern European institutions are more open to deaccession-

ing practices (Piazzai and Vecco 2015), one may expect increased commercial use of this technology by public institutions, with potential abuses in terms of social welfare. Similarly, the environmental costs of issuing an NFT should be seriously considered by practitioners before embarking on the NFT venture, especially since sustainability has become a top priority of the museum sector.[14] In this shifting context, supranational organizations such as the International Council of Museums (ICOM) should update their deontological codes and provide professionals with well-informed recommendations.

In light of this, reflecting on the long-run opportunities offered by NFTs should prevail over short-run benefits, and the ethical questions raised by the entry of publicly funded museums in the crypto-art market need to be addressed critically. More broadly, empowering museum practitioners regarding cutting-edge technologies is crucial to allow them to keep up with the rapid evolution of digital environments and to develop appropriate responses and migration strategies. The uncertainty that currently surrounds NFTs and blockchains makes such developments costly and risky investments for museums, a reason why many initiatives remain exploratory at this stage and many practitioners relatively risk-averse (Greve 2007).

5. Concluding Note

In this paper, we have questioned the "revolutionary" nature of NFT-based technologies in the art ecosystem. The recent NFT mania, largely fueled by the press and social media, calls for more critical reflection among researchers and practitioners to disentangle the opportunities and limitations of radical innovations in a well-informed manner. At this juncture, the benefits of blockchain technology for the art field chiefly deal with copyright management and provenance research (Abbate et al. 2022; Nadini et al. 2021; Whitaker 2019; Catlow et al. 2018). Our thinking on the effects of NFTs on producers, intermediaries, and consumers mitigates the claim that NFT technologies have deeply and durably disrupted the entire art ecosystem. Not only is such a claim premature, but it is also reductive epistemologically. Throughout this essay, we have demonstrated that NFTs perpetuate, and even accentuate, long-standing behaviors and challenges encountered in the CCI, including oversupply, the competitive environment, the likely limited income possibilities, the quest for authenticity, and the moderate art returns. Discourses on NFTs should, therefore, avoid conveying simplistic or over-optimistic statements regarding the possibility for artists and collectors to earn substantial revenues from tokenization or the presumed democratic dimension of the NFT economy. If one may argue that our conclusions are self-evident—as the market for both tangible and intangible art is inherently part of the creative economy—our paper contributes to the fast-growing number of publications on the topic by focusing on the main stages of the CCI's value chain and reflecting on the extent to which NFTs have disrupted each of them. As we are still in an exploratory phase (Purtill 2021; Shilina 2021), it would be presumptuous to conclude on the future directions that this technology will take in the forthcoming years or on how receptive art market stakeholders will be towards its next incremental innovations. Enhancing the awareness of the current opportunities and limitations and closely monitoring the market's evolution are, however, crucial to enable the art ecosystem to welcome future developments in the most responsible and sustainable manner. Throughout this paper, we have also highlighted several research avenues that art historians, cultural economists, sociologists, artists, and curators should explore jointly. How to assess the quality of NFTs and intermediaries' reputation signals, how to deal with unofficial digital reproductions, and how to make sure that NFTs serve artists' careers and museums' missions above all are open questions that must be addressed to ensure that this technology supports the core values of the CCI.

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Notes

1 See Garber (1989) for an excellent survey of the rise and fall of the tulip mania.

2 This strategy has been experimented by the music band HLMTD, by decomposing an album into six NFTs and allowing the owners to compose their songs. Available at https://async.market/music/master/0xb6dae651468e9593e4581705a09c10a76ac1e0c8-1605/player (accessed on 10 January 2023).

3 Note that this is in contradiction with Mercier (2022).

4 See https://cryptoart.humanities.uva.nl/ (accessed on 13 December 2022).

5 See, for example, the *Replicator* by Canadian artist Mad Dog Jones which replicates itself and generates a new NFT every 28 days.

6 See Ginsburgh and McAndrew (2020) and Van Haaften-Schick and Whitaker (2022) for details on resale rights.

7 See Blockchain.com, 2021.

8 On the potential of social media for NFTs marketing, see https://chuckisaacaikens.com/social-media-marketing-for-nfts/ (accessed on 18 January 2023). See also https://nftnow.com/news/almost-every-social-media-company-is-adding-nft-features/ (accessed on 18 January 2023).

9 See https://cryptoart.humanities.uva.nl (accessed on 27 December 2022).

10 In his study focused on crypto-punks, Pérez le Maignan (2021) has also shown that the avatars' gender, skin color, and accessories affect prices differently.A compelling example is the opening of the first private museum dedicated to NFTs in Seattle.

11 According to the International Council of Museums' new definition, "a museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing." Available at https://icom.museum/en/news/icom-approves-a-new-museum-definition/ (accessed on 28 December 2022).

12 Available at https://lacollection.io (accessed on 16 August 2022).

13 See, for example, https://www.theguardian.com/technology/2021/sep/24/british-museum-nfts-digital-hokusai-postcards-lacollection; https://www.theartnewspaper.com/2021/09/24/british-museum-to-sell-nfts-of-200-hokusai-worksincluding-the-great-wave (accessed on 18 January 2023).

14 Available at https://www.ne-mo.org/advocacy/our-advocacy-work/museums-and-sustainability.html (accessed on 20 July 2022).

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Article

The Shape of International Art Purchasing—The Shape of Things to Come

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Abstract: This article is about the role of cryptocurrencies, for example, decentralized autonomous organisations (DAOs) and non-fungible tokens (NFTs), in the international art market. These are cryptocurrencies which can be used to work with local governments to deliver non-state-funded consultancy in, for example, funding bid writing or community risk assessment. Self-polycentric and cause-based DAOs typically focus on actively listening to their token owners, utilizing the group's skills under a transparent incentive structure fostering trust. This article delivers a critical evaluation of DAOs as an organisational management structure and business operations vehicle. This evaluation considers DAOs' utility in supplying goods and services, through the critical lens of facilitating the international art market. The objective of this article is to raise wider awareness and understanding of DAOs as a legal entity. This paper acts to introduce the uninitiated to the business, societal value and legal uncertainties of DAOs and NFTs. DAOs are internet-based organisations built upon a set of instructions presented in and controlled by a computer programme, i.e., a smart contract. Effectively, DAOs are an artificial, electronic, online, digital technology entity, with no physical form.

Keywords: decentralised autonomous organisations (DAOs); arts-based DAOs; non-fungible tokens (NFTs); corporate mutualisation; cryptocurrency

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1. Introduction

This study's objective is to inform art-world stakeholders of the many potential benefits of using DAOs and/or NFTs and also of some of the pitfalls, for example, sudden devaluation of an organisation's NFT or cryptocurrency, in the future. The research aims of this paper are to analyse the effect of DAOs and NFTs on digital corporation mutualisation in the international art market and Web3 governance of art sales. There is a paucity of knowledge that explains the following: How business-for-profit DAOs who choose to collaborate in digital corporate mutualisation arrangements operate; How that differs to not-for-profit community enterprises, who choose to acquire art for the public good. The dawn of Web3 has appeared over the horizon in the international art world, reducing the role of third-party intermediaries in art acquisition. Web3 is a piece of the internet acquired or even created by art producers, which they own and control. This has created new relationships between art-world stakeholders, which raise a number of Web3 governance issues that need to be resolved.

Figure 1 provides a user-friendly precis of the main issues to consider, regarding the likely development trajectory of arts-based NFTs and DAOs in the 2020s. Although specifically labelled arts-based, the issues mentioned apply to all DAOs, NFTs and corporate mutualised DAOs going forward. Nuanced in the precis is identification of the need for a franca, which enables all art stakeholders to participate in the same space (B (@beatyandpunk) 2022, 5:45 m–7:45 m).

DAOs are a digital technological tool that can enable and oversee profit and not-for-profit business production in a more efficient manner (Glaveski 2022). There are numerous very complex aspects of DAOs which need to be considered. For example, how

an arts-based (or other type of) DAO manages; early starter and later-stage members; democratisation; changing priorities; choice of human or non-human governance; multiple jurisdictions regarding external regulations; and remaining non-hierarchal and leaderless in art collection purchases, business or philanthropic service delivery (Hackl 2021).

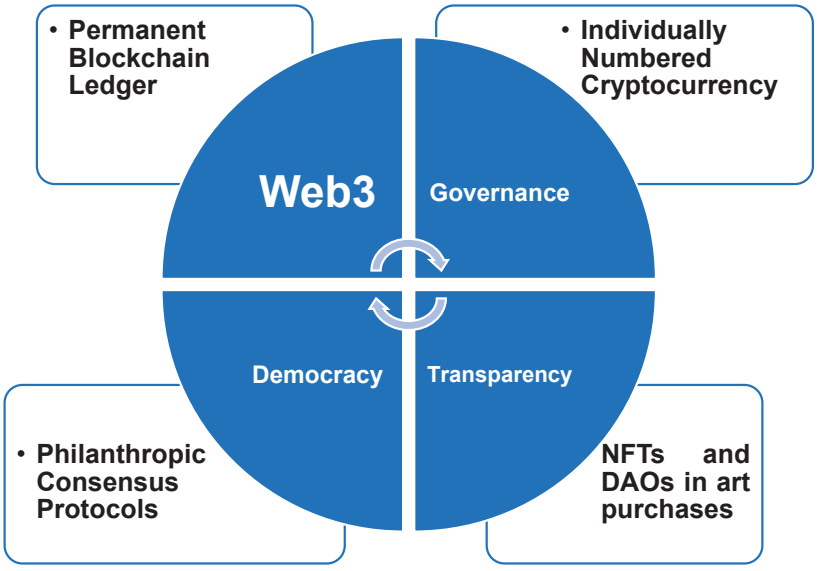

Figure 1. Arts-Based NFTs and DAOs Consortiums.

In the context of this paper, the following definitions of DAOs and NFTs provide a backdrop to the various concepts discussed as the paper develops. DAOs are run by a group of people and/or a computer program. NFTs are digital assets that are unique to the property they are associated with; they cannot be replaced by another different NFT. Both DAOs and NFTs come into being by the production of a smart contract. These are two types of digital technology which can be linked, as NFTs can be used to confirm ownership of property in a DAO. As a consequence of the proliferation in DAOs and NFTs in the 2020s, a wide range of new art-world stakeholders have been created, an art-world community of new hierarchies with different metrics of success. Artists have more of a say of what happens to their assets (McKenna 2023). DAOs, NFTs and blockchain technology have heralded a period of disintermediation (Denny 2023). The pre-technological era relationships between artist, arthouse and buyer, have been fundamentally changed by the arrival of DAOs and NFTs (Ambolis 2023). Issues of ownership, provenance and artist payment can all be verified by publicly accessible blockchain ledgers (see Figure 1).

NFTs and DAOs relate to each other on two main interfaces. One interface is manifest in the rise of collector DAOs. A collector DAO can be a for-profit business or not-for-profit social organisation that pools funds together to acquire and issue NFTs. This is an important concept and definition in the art purchase and collection world. Collector DAOs have a spread-the-costs utility, enabling multiple individuals to own a fragment of an expensive NFT (Binance 2022). For example, people could buy a small proportion of a NFT used to purchase a yacht. This yacht can be rented out to people throughout the year. People with a fragment of a large NFT that was used to purchase the yacht receive an annual rental income on their investment as well as the NFT valuation (see Figure 1). This same concept can be used in the purchase of expensive art, yielding business revenue for NFT holders from art exhibitions fees and art sales. This is the business model used by PleasrDAO, an art collective DAO that "*purchased the "Doge" meme for $4m in June 2021. They subsequently*

fractionalised the NFT (broke it up into many individual tokens) to allow anybody to buy a portion" (Andrew 2023).

The importance of the relation between NFTs and DAOs can be seen in their role in community and corporate governance (Park et al. 2023, p. 11). DAOs can help NFTs to create social goods, by enabling technological oversight of the activities and efficacy of community projects. The activities of community members, social-good creators and the future direction of NFTs can be monitored by the DAO's computer program. This is an important facet of a relationship between NFTs and DAOs, as this decides who owns art purchased by the NFTs, alongside decisions regarding art exhibition appearance and future re-sale (Stanescu and Velea 2023). In this sense, DAOs have efficacy and governance oversight utility. In practice, DAOs can monitor if a certain level of business has been achieved then authorise and implement payment of staff salaries and any bonuses. In community enterprises, DAO owners act as shareholders controlling the activities of what NFTs, acting here as social assets, can be used for. This DAO–NFT relationship would enable art to be purchased for cultural and humanity purposes (see Figure 1), so the art remains publicly accessible.

Web3 is a description of how the worldwide web (www) will evolve as the 2020s progress. Web3 incorporates decision-making decentralisation and digital encryption blockchain technology, alongside digital token-based organisational governance, purchasing and selling, manifest in the proliferation of NFTs (Fan et al. 2023, p. 5). Web3 is different to the Web1 phase of the www internet evolution of people, consumers and simply viewing static pages of information. Web3 is different to the Web2 phase in that people use the www to access or create digital platforms to give and receive information (Ehrlich 2023). In this sense, Web2 is interactive, not passive. The current phase of Web2 enables internet users to display their ideas so they also become content creators. The interactive utility of Web2, manifest mainly as digital platforms, makes Web2 an ideal medium to buy and sell goods. The era of Web2 has enabled art consortiums to acquire and sell digital and traditional art items successfully between people who have never met. Web3 is rapidly evolving in addition to Web2, which itself will remain constant, as the internet of things develops during the 2020s. The blockchain version of Web3 (as opposed to the semantic machine readability version of Web3) fills operational gaps in the art world (Drake 2022). Management of legal ownership of art alongside the payment of royalty to artists have become easier and more transparent (Schindler and Wilson-Milne 2023). Web3 addresses four fundamental aspects that are relevant in the international and national purchasing of art. These are: privacy, cooperation, openness and interoperability (Fan et al. 2023, p. 4). Web3 has enabled the creation and maintenance of decentralised digital platforms and delivered interoperability between mutualised platforms, alongside verifiable art ownership via digital blockchain technology. The distributed blockchain ledger (see Figure 1) utility of Web3 is of particular importance in the art world (Kaul 2023, p. 3). Businesses, community enterprises and individuals are able to use the ledger to establish the provenance of digital and/or traditional art, alongside previous owner history. Art-world confidence, efficacy and transparency are facilitated by distributed blockchain ledger availability in Web3.

2. Materials and Methods

This paper provides a conceptual theoretical review, which is compiled using the existing literature. Works in the published literature in this review were extracted from Elsevier, Google Scholar, MDPI, Sage Publications, Science Direct, Scopus and Springer, among other databases. Numerous well-informed individual and organisation blogs and webpages were included. These websites had particular issue-specific expertise and pragmatic knowledge, relevant to an analysis of DAOs and NFTs in the international art market. Suitability of a literary source was decided by its title, abstract content and any keywords made available. To search for articles likely to be relevant, a basket of keywords and phrases were used to ensure that the articles chosen fell within the category. Some of the keywords and phrases used in internet searches included: "Arts based DAOs"; "Decentralised Au-

tonomous Organisations in the art world"; "Art purchase using Non-Fungible Tokens (NFTs)"; "Corporate Mutualisation"; "Cryptocurrencies"; "Distributed blockchain ledger (DBL)"; "Multiple jurisdictions"; "Art, DAOs and NFTs"; "Web3 governance"; "business and non-profit"; "ownership"; "provenance"; and "artist recognition and royalties". The results of the research comprise the analysis detailed in the critical evaluation that unfolds and in the discussions contained in the headed sections that follow.

3. Discussion

3.1. Digital Corporate Mutualisation:

How DAOs and NFTs Facilitate Business and International Art Acquisition

DAOs access conscious agency through their human members: the people who wrote the smart contract and/or own the DAO (Schillig 2023, p. 8). Most people initially become members of a DAO by buying NFTs, which are its native trading cryptocurrency. These are digital tokens which give people DAO membership, voting rights and a say in the governance of the organisation. In this sense, DAOs and NFTs don the clothing of stocks and shares in a traditional business organisation. This is particularly important for art-, charity-, crowdfunding- and philanthropic-type DAOs, where aspects of the good cause being supported could have changed overtime (Makridis and Larson 2023; Smith 2022). The rights afforded to DAO members by the NFTs they have purchased include recognition rights, which are vitally important in international art purchases (see Figure 1). How this works for DAOs and NFTs in business is by voting: DAO membership recognises that a certain standard of business production has been achieved. This results in the payment of an agreed level of remuneration. DAOs are programmed to assess contract compliance automatically, so no human is called upon who could make an arbitrary decision. In the art world, the role of the traditional Board of Trustees is being eroded. An increasing number of art gallery and museum day-to-day decisions are made by DAO smart code. Web3, which includes blockchains, DAOs and NFTs, is used by international art dealers to address business challenges, for example, governance, provenance and traceability (Ali et al. 2023, p. 7; Bron 2023; Ray 2023, p. 233; Shilina 2022, p. 14). Token-based DAO work practices are radically different to traditional organisational management, due to the 100% democratisation and public transparency ethos of DAOs. An ethos which means all NFT and DAO token members are jointly and severally liable if something is perceived to have gone wrong and an individual or organisation pursues a claim. Biais et al. (2023) articulate a number of reasons why people choose to use cryptocurrencies, identifying transactional advantages that using DAOs and NFTs attract. "*For example, such benefits can stem from the ability to send money, possibly to another country, without using the banking system and without being controlled by the government, or from the ability to use more easily smart contracts and tokenised assets*" (Biais et al. 2023, p. 974).

In pragmatic terms, NFTs are a digital currency, where each token is unique and cannot be replicated. Each NFT is assigned a unique identifier by its manufacturer when recorded on a blockchain, which enables independent verification of the NFT, its ownership and authenticity (GFS IT Solutions 2023; Mukaddam 2021). As each NFT is unique, they can be bought, sold and exchanged for goods, much the same as traditional hard currency. One of the benefits of NFTs is they can be used to transfer the ownership not only of digital assets but also of traditional art. An arts-based blockchain can be defined as a publicly accessible digital database that records the unique identifying code of every NFT manufactured by any source (Stublic et al. 2023, p. 3802). The blockchain would also deliver a public record of everything that was purchased using NFTs (see Figure 1). This utility enables a blockchain to identify at any time the ownership of, for example, business or digital assets of art, which were purchased using NFTs (GFS IT Solutions 2023). Blockchains also provide a record of the different manufacturers who have created NFTs which are now in circulation. This historical digital record of who has been active in a sector resonates in the international art market. Such record keeping can help with consensus protocol policy formation and innovative smart contract development (Gilbert 2022, p. 4). New entrants

to the art market, individuals or businesses considering digital corporate mutualisation, will value the immutable record delivered by distributed blockchain ledgers. Freeman Law (2022) informs us that blockchain technology is not a new concept.

> "Almost forty years ago, cryptographer David Chaum proposed a blockchain-like protocol in his 1982 dissertation entitled Computer Systems Established, Maintained, and Trusted by Mutually Suspicious Groups. This work formed the bedrock of the current blockchain technology, but the notion of blockchain as a form of cryptography traces back to the 1970s".
>
> (Freeman Law 2022)

The blockchain is essentially an irrefutable digital ledger. It records NFT transactions and due its public transparency, records of each transaction along with the NFT's unique identifying code cannot be altered or deleted (GFS IT Solutions 2023). NFTs can be created as part of a smart contract which itself is a digital code with no physical form. Smart contracts verify ownership by accessing the NFT's unique identifiers, recorded on the blockchain. Arts-based digital smart contracts check compliance with the agreement terms, then enact the transaction by issuing new NFTs, each being uniquely numbered for verification purposes (Cornelius 2021, p. 6). In essence, a process of tokenisation has occurred to facilitate business transactions of ownership of, for example, intellectual property rights or some artwork. The publicly available blockchain enables the sale and subsequent acquisition of pieces of art, without intermediaries being involved (GFS IT Solutions 2023). One of the more common uses of NFTs is when a recording artist releases individual songs or an album. People buy NFTs to be able to access and/or download music from the artist's website on the internet. This can also be achieved with popular films and/or sporting events such as a football or boxing match. People pay a fee for an NFT to access the art entertainment content (British Phonographic Industry (BPI) 2021, p. 26). NFTs can be used to buy shares in DAOs as well as be the cryptocurrency DAOs use to pay investors, shareholders and business suppliers. This is the type of security utility that artists, business entrepreneurs and humanitarians seek, to solve ownership and payment challenges "*in the art, culture and philanthropic domains*" (Layton 2022). Chalmers et al. (2022) found three perspectives of NFTs when analysed through the critical lens of the needs of small creative industry entrepreneurs. The most relevant perspective of the three for this discussion is the material lens (Chalmers et al. 2022, p. 2). NFTs can be used to control access to art created by individual unique artists, who are then able to charge a fee. This is the security utility described by Layton (2022). The material creative artists deliver is protected in regards to distribution, exhibition, renumeration and royalty rights by the provenance recorded on the blockchain ledger. A prime example of how NFTs enable artists to earn money from their creations is when they make individual songs only accessible on the internet (Chalmers et al. 2022, p. 2). NFTs remove the need for creative artists to pay third-party intermediaries to distribute their art and then pass on artist royalty after purchase. There has been a significant sea change in the music industry since 2010: traditional record companies are finding they have fewer acts on their rosters, large and small (Alex 2023). NFTs enable small creative music-making artistic entrepreneurs to sell their music direct to listeners who pay the artist directly for their content. The security utility of NFTs also overcomes payment problems for arts-based community enterprises; people are able to see the expenditure of the not-for-profit company they support on the irrefutable blockchain ledger. Music NFTs have helped shift the ownership of music from record companies to the artists who write the songs.

DAOs can be programmed to ensure the funding criteria of a grant application have been met (Arts Council 2023).[1] People can also be kept informed by DAO-generated notifications keeping track as the bid goes forward for the purchase of art (see Figure 1). The greater level of transparency afforded by a DAO builds up additional trust and security between business consortium partners or philanthropic art groups (Ritter-Doring et al. 2023). The bulk of artists are small independent traders who are yet to establish themselves or become famous. Many such artists find they are earning at best the average wage in their

country of residence; they often rely upon national funding streams to be able to practice their art. DAOs are able to inform artists of various fundings sources and democratise funding bids due to their transparency, enabling art entrepreneurship to flourish (Layton 2022). DAOs can help alleviate jurisdictional problems related to art creation and innovation in certain countries (see footnote 1). Tennessee's proposed legislation provides an example of how DAOs enable business and art to operate in tandem (See Mateus and Sarkar 2023, p. 3; Debbie Blockchain and Ensembl 2021).[2]

> "DAOs are a vehicle which will drive idea in music, fintech and healthcare. Tennessee is winning whenever DAOs are established in our state that help transform industries", noted TN representative Jason Powell. "I proposed the DAO legislation because I believe in democratizing the ability to participate in various ventures previously not open to most people. I am hoping that more high-impact legislation will be passed as web3 initiatives evolve and transform the business landscape".
>
> (Layton 2022)

The initial intentions of art, charity, crowdfunded and philanthropic DAOs can change over time as new information emerges, changing the DAOs' priorities, remit and scope (Weinstein et al. 2022). The digitalized-tokens aspect of DAOs is useful for equality of ownership purposes. Essentially, the DAO management structure enables corporate mutualisation of company assets, which are digital tokens. This means the DAO is owned by its members, who now decide as a collective how the DAO should be run. Company members own the DAO's remit alongside any liability, such as an unforeseen change in the socioeconomic climate, resulting in non-recognition of their cryptocurrency. Chainlink (2022) notes that although DAOs are set up to operate automatically, they are not fully autonomous.

> "DAOs are made up of humans and therefore require manual actions from users to function, such as needing users to conduct votes, deploy code, and debate proposals. The use of autonomous in the term DAO stems from the idea of hardcoding specific function of the DAOs as immutable smart contracts. However, humans still need to interact (provide inputs) with the smart contracts (code) for them to execute actions (outputs)".
>
> (Chainlink 2022)

Fritsch et al. (2021) explain how distributed ledger technologies (DLTs), for example, blockchains, can enable business and/or not-for-profit organisations to work towards common goals. The DLT-based commissioning approach to global commoning, as articulated by Fritsch et al. (2021), can clearly be adapted to the art world. DLT commissioning can be used to deliver social goods, for example, arts-based DAOs, which provides a platform for emerging creative artists. DLT commissioning can enable corporate mutualisation of company assets (Mues et al. 2023). Fritsch et al. (2021) describe how the novel aspects of DLTs can deliver both the ethos of the common good and businesses for profit. "*Moreover, they share an ideological commitment to creating market-like structures that do not rely on the axiom of capitalism to maximise shareholder profits*" (Fritsch et al. 2021, p. 8). Mutualised art businesses can develop schemes to import little known cultural art, which they can market and sell in niche art markets. Arts-based DLT-commissioned businesses would implement corporate mutualisation of company assets by the complimentary purchase of different types of Global South art. This is a hybridisation of the business model of South South Art, an online community of international art-market stakeholders who specialise in Global South art (South South Art 2023). There would be no competing overlap between different mutualised businesses, importing and selling cultural artefacts and indigenous Global South art. This will protect indigenous art sourced from Global South countries, which is sold in Global North art houses, generating a profit to mutualised businesses. The original source, provenance and supply of Global South art can be tracked and verified using DLTs. Mutualised arts-based businesses can showcase the art and facilitate exposure by only enabling the purchase of Global South art by using NFTs.

Friends with Benefits (FWB) provide a pragmatic example of a cause-based DAO, being highly profitable whilst delivering mutually decided benefits for its members. FWB works just like a small local mutual aid organisation, but on a much grander scale, hence the reason for the high joining fee. For FWB, this fee is 75 $FWB tokens, or about USD 4000 (Roose 2022). DAOs owners, in this case, FWB members, have direct control over the organisation's digital assets, DAO ownership being in the form of $FWB tokens, which are used in votes that subsequently appear on the permanent blockchain ledger. The blockchain is a decentralised network of token owners, who must agree on what areas and how the DAO will conduct its business affairs. Transparency is key for the public good at for-profit self-polycentric DAOs; similarly, for not-for-profit cause-based DAOs, transparency and trust are also key (De Filippi et al. 2020, p. 2). For corporate mutualised cause-based DAOs, how members voted would be made available to the public. This is the democratisation utility of DAOs; every member is able to determine the location of every cause-based DAO's cryptocurrency token. Cause-based DAOs using individually marked tokens can be set up (see Figure 1) so that there are no hidden benefactors, private investors, shareholders or shell companies. This is not always the case with for-profit DAOs. Here, corporate-sector DAO cryptocurrencies carry an element of digital surveillance, an invasion of people's privacy utility (Huang and Mayer 2022, p. 338). Token-centric businesses have the ability to record and track their owners' movements without consent. This is clearly illegal in most jurisdictions in the Global North and represents a legal uncertainty which is under-theorised and under-researched.

3.2. Web3: A Governance Instrument with Double Utility to Oversee the Acquisition of International Art Using DAOs and NFTs

It is beneficial to recap the definitions of DAOs, NFTs and Web3 at this juncture—prior to further discussion of their current and likely future role in the international art market. DAOs (decentralised autonomous organisations) are internet-based, blockchain-monitored, collectively owned organisations. The latter element is key. There is no single authority, for example, a government in control. Instead, DAOs are created, controlled and governed by their members (Legge 2023). Due to the increasing use of DAOs in society, for example, by digital platform workers, or in GameFi, DAOs "*are having a profound impact on the revolutionary rise on Non-Fungible Tokens (NFTs)*" (Carter 2023). Many DAOs have their own NFTs, which can be used to signify ownership and voting rights and as a treasury. NFTs are exchangeable, identifiable, traceable, tradeable units that are unique, as each NFT has its own individual number (Hilsberg 2023). The traceable utility of NFTs has particular resonance, in regards to establishing the provenance of art items prior to their sale in the international art market. Web3 is a decentralised version of the worldwide web. Using Web3 would give creative artist entrepreneurs more data control of their digital art and more ownership of non-digital traditional art. This is because artists can use decentralised identification systems to sell their art and also to collect payment, without relying on a third-party intermediary (Hedera.com 2023). DAO investors and/or members would provide their own decentralised computers to effectively self-create and then own a section of Web3, accessible by authorised NFTs. Blockchain technology and the use of individually numbered NFTs (see Figure 1) would provide irrefutable evidence of art-item provenance and ownership. Trust and confidence are enhanced when DAOs make their blockchain digital ledger publicly available in Web3, transparency being an essential facet of governance. In this sense, the decentralised Web3 is better than Web2 which is accessed by centralised internet servers. Web3 has duality, able to offer transparency or privacy in business and not-for-profit operations, including international private art acquisitions and sales transactions. The Gen Z global population, people who were born between 1996 and 2010, are particularly attuned to Web3 due to its futuristic art presentations, often with social consciousness (Foucher et al. 2023, p. 10). Web3 enables artists to co-produce their art with potential buyers online; they can also show how they are aligned to the social issues their consumers care about. Gen Z and millennials are more likely to purchase art

from artists who are in tune with their social values and worldview (Foucher et al. 2023, p. 10). In this sense, there has been Web3 governance between the artist and the purchaser at the art production stage. Web3 enables co-production between an artist and a buyer who perhaps have never met before on the internet in real time.

Generically, DAOs and NFTs are permissionless, unregulated, digital, multipurpose vehicles: technological entities that anyone can engage with if they have the capital and choose to do so (Rennie 2022, p. 15; Salman 2019, p. 123). The main function of an NFT is to provide a unique verifiable digital currency that cannot be counterfeited, deleted or replicated. DAOs provide governance in the form of voting power, supported by uniquely numbered NFTs which, when used, are recorded on a blockchain ledger (Elzeweig and Trautman 2023, p. 315).[3] This is a digital dashboard accessible by all cryptocurrency holders. DAO governance can be cause-based, community-led and/or not-for-profit. They can apply a philanthropic ethical code formulated by founding partners, ensuring compliance with the DAO ethos (Saito and Rose 2023, p. 5).

Danto (1964) discusses an aspect of governance that is replicated in these contemporary times, heralding the need for DAO governance of art purchases and sales (see Figure 1). The aspect is that of art acceptance and recognition (Danto 1964, p. 573). For example, the CryptoPunk series of digital images first need to be recognised by contemporaries as being good art worthy of consideration. There then needs to be a system in place, for example, DAO governance, to decide if acquisition of CryptoPunk images should take place. It can be argued that Danto's (1964) philosophical contribution in contemporary times explains why we need DAO governance and recognition. Crane (1976) articulates two issues which have contemporary relevance in this paper: how "cultural innovations" should be recognised (Crane 1976, p. 719), which harmonises with Danto (1964, p. 572), alongside the existential threat of "gatekeepers" in the form of government agencies with overall control. The latter issue is nuanced in an early recognition by Crane (1976, p. 721), that society may need some form of decentralised governance mechanism to uphold multiple stakeholders' interests. By proxy, Crane (1976) identified the need for non-hierarchical decision-making and governance approaches in multiple disciplines including art. Becker (1982) provides further examples of issues that resonated in the pre-digital art world, which have contemporary relevance regarding governance in the 2020s. One issue Becker (1982, p. 93) raises is that of distribution in the art world. In contemporary 2020s application, DAO governance rules are enacted by smart contract implementation, enabled by technological blockchain oversight. Digital distributed ledgers and NFTs can verify which art items have been distributed, where and when. Becker (1982) resonates with Danto's (1964, p. 584) concern, as to who recognises and accepts new innovative art, alongside harmonising with Crane's (1976, p. 723) fear of bureaucratic "gatekeepers" in the art world. This is manifest in Becker's (1982, p. 107) notation "*that the government may have a monopoly over the making and distributing work*". The decentralised nature of DAO governance enables DAO members to pursue their art interests, recognising, distributing and acquiring artistic pieces on the international market. The operational activity of DAOs in both art-based businesses and not-for-profit organisations must be within rules agreed by DAO members. Giuffre (1999) elucidates that up to the end of the 20th century, artists had to be connected with a gallery in order to be able to sell their work. This underlines Crane's (1976) bureaucratic "gatekeeping" concern, alongside Becker's (1982) focus on "distribution". Technological advances have enabled DAO governance structures to break the art galleries' virtual stranglehold; people's art can be viewed on digital platforms. The 21st century internet age has enabled more people to be exposed to a whole gamut of innovative art from multiple sources for free. Creative artists are now able to design their own websites that act as art galleries, to display and sell their artwork. Artists now have direct control of who gets to own their art and immediate possession of the proceeds the buyer pays. Giuffre's (1999) contribution acts to inform us that sections of the art production market in the 1990s were a fundamentally flawed cartel: a self-serving cabal, of which only artists who were connected to certain people received an invitation to enter, regardless of the quality of their art. De Nooy's

(2002, p. 147) study discussing "artistic prestige" continues along a similar vein. As with Crane's (1976, p. 720) "Reward Systems in Art" study, De Nooy (2002, p. 159; citing Van Rees 1983, p. 404) identifies that "*artists have to pass gatekeepers who admit them to a new level of activities and esteem in an art world which consists of prestige strata*". In contemporary times, as the internet era has progressed through the 2020s, this artificial barrier has been broken down by DAO governance protocols (see Figure 1). Velthuis (2005, p. 12) articulates how the modern art market is governed by a "dealer-critic" system, which has duality incorporating Crane's (1976) "gatekeeping" and agenda-setting utility. Art dealers active in the early 21st century promoted their artists by persuading galleries and curators, profit and not-for-profit, to exhibit their work. Often, the art dealer had already purchased the artist's work, creating a vested interest to encourage curators to exhibit a particular artist's work in future shows. It is, at best, unethical if the art dealer does not disclose this relationship they have with the artist to a museum or gallery they approach. These early 21st century unedifying situations indicated by Velthuis (2005) can be addressed by DAO governance. Digital blockchain technology, when made publicly available, would disclose the name of the artist who created the art owned by the DAO membership. DAO governance can ensure that any gallery or museum approached is informed; the DAO making the offer are themselves the owner of the art.

Governance is manifest by people being able to raise issues, put forward proposals, agree to vote and publicly audit the DAO code. Members of an arts-based DAO can be thousands of miles apart (Flamingo 2023). Governance is enforced when a DAO smart contract decides if organisational activity is compliant to what has been programmed into the code. This enables international art consortiums to form a DAO, which is effectively a trading community that buys and sells art. Trading via the DAO is subject to an agreed set of rules which is enforced by the blockchain. Neither sale nor art acquisitions can be completed without compliance with the DAO (SuperRare® Labs 2023). This allows international art dealers physically located in different continents to be able to trade safely and securely with each other. They can also trade with other individuals and organisations who are not members of their DAO, provided other existing DAO members agree. In this sense, DAOs are internet-native entities which are collectively owned and managed by their members, each of whom could live in different countries (Penningtons Manches Cooper 2023).

Crane (Sotheby's 2023) makes the critical observation that Web3 is disrupting the art world, breaking the status quo. Power has shifted away from art galleries and museums to decentralised networks and artist-to-fan-based communities. Art houses were at the seat of power, having a bureaucratic gatekeeping role, being entrusted to validate the provenance of contemporary or legacy art (Yanger and Davis 2021, 5–7 m and 46–48 m; Natalee 2022). Unestablished artists need to attend art fairs, degree shows and incubator galleries to present their wares. New artists hope to receive favourable recognition from long-established internationally respected institutions, attending these low-level art exhibitions (Crane 2023). Artists are now able to display their art on social media platforms and increase their exposure, as new people say they "like" what they have seen on social media. The new artist receives exposure from another source of people, who are on the friends list of a person who initially "liked" the art they directly saw. With this approach, an emerging artist is able to build up a public profile of their art, occasionally receiving an income, based on the number of visits to their social media website (Dwivedi et al. 2023, p. 56). The dawn of Web3 in the 2020s has added to the social media era of the early 21st century. "*In Web3, artist and collectors connect directly with each other, participating in the same communities and transacting without an intermediary. Artworks (in their digital form) can be displayed and distributed at the touch of a button, both in interactive virtual spaces and in the physical realm* via *projections and screens*" (Crane 2023). The decentralisation utility of Web3 has broken down traditional barriers of art institutions, enabling constituent parts of the art world to interact. In this sense, the governance role of Web3 is delivered on a decentralised surveillance basis. Here, decentralised surveillance can be defined as Web3's

ability to track the movement of every artist who has chosen to engage with a privately owned section of Web3. This helps in establishing art-item provenance, alongside issues of copyright, intellectual property rights and plagiarism. For example, the ARTRACX curator platform applies a blockchain solution to provide unique digital identities for art stakeholders' artwork and collectibles (Zhen 2023). Governance is enhanced by the fact that the blockchain technology used is supplied by an independent third party, not controlled by the ARTRACX platform. DAO governance's decentralised surveillance is able to identify who first came up with an original art image and/or a novel approach to art creation, where and when. Decentralised surveillance can also be manifest as the roles of artists, collectors, curators and producers becoming merged, delivering day-to-day surveillance as work is delivered. Every art stakeholder can see what every other constituent part is doing (Wieder 2023). These art-world stakeholder constituencies are onboarding onto art project partnerships, which facilitates decentralised art surveillance by using DAOs for governance and transparency. The art world is transitioning rapidly. In this context, Web3 is not so much about authentication and verification, but more about validation of approach, changing the status quo to reflect the diffuse nature of the art world in the 2020s. In this sense, Web3 does not seek to destroy the traditional international art market and the established systems which have developed to facilitate the process (Crane 2023). Web3, including DAOs and NFTs, will work in harmony with traditional systems, by providing outlets for the sale and purchase of international art pieces (see Figure 1).

There is the governance utility of DAOs enhanced by the development of Web3. Web3 enables each DAO to have its own individual space on the internet for business operations, alongside enabling DAOs to demonstrate how they are trading in public (Stackpole 2022). As such, Web3 is an ideal intermediary medium to acquire pieces of art when they appear on the international market. In this sense, Web3 is a chunk of the internet which has been developed by DAO users, for DAO users (Goyal 2022). The individualisation and transparency afforded by Web3 provide a governance utility, enabling it to have oversight of DAO activity. Rasmussen (Rasmussen 2021) critically articulates the ethos of cause-based DAOs. Rasmussen (2021) highlights the importance of public transparency and accountability in DAOs, to underpin and build trust and confidence in their activities. "*DAOs are part of the latest web3 movement that is decentralizing the internet by building on pubic blockchains. You can think of web3 as a kind of bookkeeping where many computers at once host data that's searchable by anyone. It's operated by users collectively, rather than a central authority*" (Rasmussen 2021).

In the process of their work, arts-based DAOs can have a number of responsibilities, for example, an organisational environmental, social and governance mandate. This is a crucial aspect that can be challenging for investment-type DAOs, who do not have the philanthropic or transparency ethos of cause-based DAOs (Mao 2023). There is also the process of disbursing funds to external accounts to fund charity work and the non-state voluntary sector's provision of public goods (see Jones 2022).[4] This must be done ideally by a supermajority of the cause-based DAOs' mutualised membership. Humans must access cause-based DAOs and positively vote in favour of significant disbursements, through individual digital account dashboards. There is an arbitrating dispute's role. Once again, this is easily implemented by mutualised members being able to vote for or against various issues that have arisen in cause-based DAO activity towards the delivery of charitable, philanthropic public goods (Sharma et al. 2023, p. 6; Troncoso 2019, p. 107). This governance factor also applies to arts-based DAOs who use NFTs to purchase art on the international market (see Figure 1) (Murray 2022, p. 58). Another legal uncertainty is manifest in consideration of where the DAO or token-centric business is actually located. DAOs have no physical form; they are a digital smart code which only exists on the internet. Similarly, many DAOs operate across multiple countries and legal jurisdictions (OECD 2022, p. 12). A requirement for an individual or organisation to disclose a 40% stake in a business operation might apply in some jurisdictions but not others. Health and safety

legislation will differ between individual countries in a similar bloc of countries. These legal questions are yet to be resolved, regarding token-centric businesses (WEF 2022, p. 8).

Governance of DAOs including cause-based DAOs is clearly crucial (Marr 2022). In the 2020s, Web3 developed, in part, to address a fundamental issue: traditional corporate governance systems had failed to prevent societally damaging business practices. Web3 is founded upon digital technology, which minimizes the reliance upon human trust and judgement. Arts-based digital blockchains enable complete transparency at each step of the DAO production process, alongside every transaction being accessible to its members (Huynh-The et al. 2023, p. 408). Previously agreed upon by humans, consensus protocols are programmed into digital cryptocurrency tokens, enabling governance, scrutiny and enforcement of the protocol by the DAO (See Figure 1). By using 2020s technology, DAOs can transition away human oversight, who can tire, make mistakes or somehow be accidentally or malevolently corrupted. Instead, Web3 delivers technologically enforced guaranteed business practice on a non-human digital basis, ensuring compliance with the human-decided consensus protocol for the DAO. This is a concept known as cryptographic truth (Chainlink 2022). I argue that, pragmatically, cryptographic truth is a digital record enabling external independent verification, that DAO activity is within the human-agreed consensus protocol (See Figure 1). Cryptographic truth carries a paradox, especially for cause-based DAOs. On the one hand, key corporate practices are carried out manually by humans; for example, boards of management vote on mergers, acquisitions or whether a new supplier be allowed onto the approved contractors list. On the other hand, governance of DAO corporate activity is enacted digitally by Web3, guaranteeing certain business practices, with no human decision making or involvement. The humans who authorised the consensus protocol and the code that was programmed into the DAO blockchain and/or humans who subsequently own DAO tokens are ultimately legally responsible for any disputes of art ownership claimed by a third party (Flick 2022, p. 12). In one sense, investment-type DAOs outperform cause-based DAOs, as they could function better with automated Web3 governance, ensuring compliance, whereas cause-based DAOs may not be able to respond as quickly or as well to curb reputational damage if the cause they are supporting somehow becomes tainted due to a publicised scandal. In practice, it may be difficult for an arts-based or cause-based DAO to coerce sufficient numbers of its mutualised members, a supermajority, to change direction (Veitch 2023; Sims 2020, p. 452). This has legal implications for not-for-profit DAOs if there are complaints that organisational delay in responding has resulted in maladministration, causing distress. An arts-based or cause-based DAO may not have sufficient agility to change the parameters of its previously agreed-upon charitable remit or the consensus protocol controlling its business operations quickly enough (See Figure 1). A business remit is the strategic investment DAO equivalent of a corporate or ESG (environmental, sustainability, governance) consensus protocol (Petratos et al. 2020, p. 87).[5]

Dwivedi et al.'s (2022) "Metaverse beyond the hype" study analyses a number of aspects of governance regarding Web3. When Dwivedi et al. (2022) use the phrase "metaverse", by proxy, they are referring to the latest development of the worldwide web internet, Web3. Stefan Koos makes a telling contribution to Dwivedi et al. (2022), which encapsulates the paradox between the use of DAOs and NFTs in Web3. There needs to be a balanced approach when interacting with Web3 that incorporates access to human agency for governance and oversight. NFTs can be used to buy and sell property, unique travelling adventures and digital images in Web3. As more and more societal services are consumed during Web3 access, who governs Web3 will become an increasingly pressing societal concern. How Web3 will be regulated will have a profound effect upon arts-based DAOs who use NFTs for verification and governance purposes. There are issues of jurisdiction (where did the art purchased originate from) and intellectual property rights (who created the art, who owns it). Profit and not-for-profit DAOs have differing remits and functionalities. There is growing recognition that we must consider the governance of behaviours of people using arts-based DAOs and NFTs in Web3, not the technology itself (Bleach 2023).

> "**Proposition.** Stakeholders and governance entities need to discuss how future law can capture the ambivalence of the person in a hybrid real-digital society and the interdependence between the personality interest and economic interests of gatekeepers. Generally, the problem of distribution of responsibility and liability between platform operators and users is becoming evermore challenging for social and e-commerce platforms".
>
> (Dwivedi et al. 2022, p. 11)

Digital art has no physical form: it can be viewed electronically on a computer screen or as an augmented or virtual reality image, for example, an avatar. Theoretically, an avatar image that somebody bought the rights to could disappear, with no means or designer software to reproduce the digital meme after loss. This possibility needs to be addressed by DAO governance ensuring the purchaser of a digital art piece has a Web3 image retrieval mechanism. Digital blockchain technology can ensure there is no counterfeiting of digital art images or unauthorised access.

3.3. The Future of Web3 Governance: When DAOs and NFTs Are Used in Corporate Business and the International Art Market

Ganatra (2022) inform us that NFTs have been used in shared-ownership house purchases. Art, business and philanthropic causes can easily be linked for humanitarian purposes (G'sell and Martin-Bariteau 2022, p. 24). Military actions in Afghanistan and Ukraine have resulted in numerous art projects using NFTs to raise funds for medical equipment and emergency supplies. R3lief is an art project where 57 different artist provided work for an art collection. People then made donations and/or paid to view the art collection by purchasing an NFT (see Figure 1) (Ganatra 2022). Some of the art donated by the artists was subsequently sold; payments were made using NFTs. All the funds raised by donation entrance fees and art sales were visible on the blockchain. The funds have been used to provide medical personnel and equipment, emergency food, fuel and shelter in war-torn areas (See also Takac 2022). The most vitally important part of these international art initiatives, often supported by corporate business, is transparency and verification. Web3 has the governance utility of "*crucially providing irrefutable evidence of the usage of these funds*" (Ganatra 2022).

WEF (2023, p. 28) discuss how value-transfer DAOs use investment and acquisition strategies to achieve both corporate and philanthropic objectives. For example, the Gitcoin DAO enables people to donate to a community cause or make art purchases by way of donation grants. How the Gitcoin DAO scheme works is through people buying cryptocurrency which is then matched by other Gitcoin DAO subscribers. People then apply to the Gitcoin DAO for donation grants to advance a particular project such as an art purchase (see Figure 1), which are then approved by DAO members. Successful Gitcoin DAO bidders see various public goods delivered, which can include art purchases (Gitcoin 2023a). Art fraud is a perennial issue within the international art market, especially as people can use a DAO to remain anonymous. The Gitcoin DAO has a governance process which offers a Price of forgery (PoF) protocol, which is effectively a standard NFT and/or human verification (HV) method (Gitcoin 2023b).

> "Upala protocol ensures that Price of forgery (PoF) is defined by the market which makes Upala, accurate, responsive, and reliable (even bots cannot beat the market 😉). Every human verification method can be fairly and accurately measured with PoF".
>
> (Gitcoin 2023b)

Gitcoin (2023b) indicate that PoF is important in establishing trust and confidence in their DAO. By proxy, this issue applies to the provenance and efficacy of any art purchased by Gitcoin DAO donation grants. The PoF protocol can also identify if various human verification systems have been hacked into or compromised in some way. Similarly, HV methods will become outdated to be replaced by other alternatives as technology advances

over time. The PoF protocol can keep track of the effectiveness of other HV methods as technology develops, being able to adapt to suit. New consensus protocols (see Figure 1) will need to be formed to combat art theft and fraud in light of technological advances in the embryonic stage coming to fruition in the 2020s. In addition to the Gitcoin DAO, the WEF (2023, p. 28) identified other DAOs that operate for philanthropic purposes. The business models of MolochDAO, EduDAO, KlimaDAO and LeXPunK that deliver their objectives by using NFTs can all be adapted to enable international art purchase for investment, profit or public good.

Holcombe-James (2022, p. 44) explains how Web3 has multiple approaches to provenance which are quite innovative. The blockchain metadata enables the tracking and verification of who owns a particular piece of art at the present time. An artist, gallery, museum or private collector's NFT wallet can be checked, as all the information is made publicly available online (Vasan et al. 2022, p. 2). Guilds can form wherein multiple art collection stakeholders not in a DAO can collaborate to use a permissioned blockchain to register documented provenance information (Holcombe-James 2022, p. 45). Such an approach would address interoperability issues between independent competing galleries and museums. Web3, DAO and NFT use has gained credibility, because these systems are able to deliver the verification and valuation functions that traditional art houses provide (Kostopoulos et al. 2021, p. 13). Fine art institution valuations and DAO valuations are becoming more closely aligned and equally accepted by the industry. Authenticated provenance enables content creators, art investors and philanthropic organisations to write funding bids and reinforce marketing campaigns (Holcombe-James 2022, p. 45). Established traditional institutions have more of an insight on ancient art, the avant-garde, exoticism, impressionism and legacy art valuation. DAOs can work in tandem with traditional art houses on the hybrid delivery of physical and virtual art collections, alongside aligning art valuations.

DAO governance via Web3 is far from perfect; it is in its infancy, developing all the time as we progress through the 2020s. Web3 offers flexibility in design governance systems, which can be weighted to reflect various aspects of arts-based DAOs (Sadowski and Beegle 2023, p. 7). Some Web3 governance will be completely automated, whilst other governance approaches will be manual, hands-on and human-controlled after agreement among members. Most DAO governance will be a hybrid balance of the two. Future designs of DAOs must increase Web3 governance, scrutiny and transparency (S&P (Standard and Poor) Global Ratings, 13 July 2022, p. 22). They need to include a more user-friendly DAO alarm system. If a 10% proportion of DAO members feel there is some form of business practice problem, a general online DAO meeting must be held. This would be particularly beneficial for art collection/purchase DAOs, who may need to address some adverse information which has recently come to light (Garbers-von Boehm et al. 2022, p. 17). Often, there can be fast-moving situations, wherein art collector- or cause-based DAO members, alongside external critical observers, funders, regulators and the media, urgently request clarification. In practice, token-centric DAO members receive governance and economic returns for being token holders of a DAO. Often, there is no legal relationship between NFT and/or DAO (effectively shareholders) token holders and their DAO (See et al. 2022; WEF 2022). Votes cast are enacted by individuals who are essentially business intermediaries to implement DAO actions voted in (Mosley et al. 2022, p. 4).[6]

People who have made art purchases on the international market using NFTs might face claims that they do not own the art they have purchased (see Figure 1). NFT and/or DAO token holders also do not know the extent of their legal liabilities; this puts cryptocurrency token holders at significant risk (UK HM Treasury 2023, p. 39; Morris 2022), for example, if there was an art collection scandal where it was alleged a certain piece of art is said to have been stolen or the provenance of an art item has been seriously brought into question (Liden 2022, p. 4; Beckett 2022). From the cause-based DAO or NFT perspective, this may be an Exxon Valdez-type environmentally damaging incident or some other catastrophic event. Critical reporting could inform us that the situation which led up to the

negative event had been funded and enabled by a particular cause-based DAO. This would tarnish the reputation of that cause-based DAO, devaluing its work. If this was an international art-purchasing DAO or NFT organisation (see Figure 1), the catastrophic event would devalue current and future cryptocurrency from this source (Fundraising Regulator 2022; see also Salman and Razzaq 2019, p. 4).[7] The value of the art purchased would also decrease. This particular digital consortium would have considerable difficulties purchasing art on the international market. Other art dealers would be reluctant to let them acquire their art, for fear of reputational damage to their own art houses. Art dealers would be fearful of being seen to be associated with this particular international art digital consortium, which is said to be responsible and liable for the catastrophic event that has occurred. A late realisation that what appeared to be a traditional art piece had been created using artificial intelligence or ChatGPT may face similar opprobrium (Kuta 2022). Salman and Razzaq (2018) articulate concerns regarding cryptocurrencies, for example, Bitcoin. The world, technological implementation in the art world and individual cryptocurrency valuations can all change very quickly. "*With the market trends going anywhere with prediction, the shift is incorrigible, the facts are surprising and more shocks are due*" (Salman and Razzaq 2018, p. 271). In the early 2020s, the jury is still out regarding the use of cryptocurrencies or NFTs to fund international art purchases; they could be devalued at any time. Another financial risk is that of "wash trading", where rogue actors manipulate the market by buying and selling the same asset repeatedly; this is an illegal, fraudulent activity that artificially inflates the price of said asset (Bonifazi et al. 2023, p. 1; see also UK Parliament 2022). There is an existential threat that in-house NFTs could become derecognised. In practice, this would mean that international art dealers would not accept that particular NFT as payment. Similarly, an art house's entire collection could be deemed to be worthless, due to future derecognition of an individual set of NFTs. There could be internal reputationally damaging issues, for example, a hack of a particular blockchain resulting in the theft of large sums of money or a computer hack which brings the art's recorded history and subsequently its recognition of ownership and provenance into question. Another example would be if an NFT holder and content creator gave support to an inappropriate cause on social media or wrongly announced their art was to be exhibited at an internationally respected establishment, which subsequently did not take place (Morris 2023; Perper 2023).

4. Limitations of Study

The main limitation of this study is the rapidly evolving nature of DAOs, NFTs, technological advances and Web3, alongside Web3 governance. Six months is a long time in the digital international art market. Legal case law, multi-jurisdictions, DAOs and NFTs being recognised differently in neighbouring jurisdictions and the constant threat of NFT or cryptocurrency devaluation and/or derecognition are just some of the issues which are under-theorised and under-researched. Many of these issues in the art world are not really being discussed. The art world finds itself having to wait until these clearly foreseeable crises present themselves then devising post-crises responses. This paper intended to provide a critical overview of the main issues, which art stakeholders need to consider. Regarding DAOs and NFTs in the art world, due to the constant state of flux, this paper provides a critical snapshot of the effect of technological advances on international art purchases at this moment in time.

5. Conclusions

Arts-based, business and cause-based DAOs need to obtain the funds they raise for their philanthropic work to the intended causes or people relatively quickly (Fu 2022; Smith 2022). Corporate mutualised DAOs should consider having a portal on their website that informs people which causes were paid how much, where and when. As part of democratisation and transparency, people should be able to establish the percentage of DAO members who voted against or in favour of each payment per scheme. Web3 governance will be crucial, especially in corporate mutualised cause-based DAOs where consensus is

a must (LinkedIn 2023; Weill 2023). Cryptographic truth and computerised enactment of mutually agreed, easily measurable business activity are ideal in many cases. However, in business as in life, it is important that humans remain in control and able to steer a DAO away from its predicted path. This emphasis on human agency becomes particularly acute if it becomes apparent that support of a previously agreed-upon scheme will cause reputational damage to the arts-based DAO (Newberry 2023; Weinstein et al. 2022; Khan et al. 2021, p. 2917).

Engaging with Web3 will be made more user-friendly as the 2020s progress (Mesidor 2023). Artists, business entrepreneurs and philanthropists will be able to use DAOs and NFTS in their work. People will be able to use emails and credit cards that automatically update public blockchains as they offer their business services or publish their art (Radermecker and Ginsburgh 2023, p. 10). Any individual or organisation will be able to onboard themselves, building their own niche in Web3. NFTs facilitate an interface between business and artists and their customers or fans wanting access to the goods or content supplied (Natalee 2023).

NFTs' established footholds in facilitating purchases in fine art institutions (see Figure 1) will stabilise if not increase in the 2020s. Auction houses, for example, Christie's and Sotheby's, will continue to sell contemporary digital art and legacy art using NFTs (Christie's 2023; Sotheby's 2023). Using cryptocurrency will help auction houses demonstrate the provenance of the art items they are selling. NFTs will act to connect emerging, not-yet-established, creative artists to new audiences (Evans 2023; Bogomolny 2022). Art galleries and museums will also continue to do business, delivering art and virtual reality displays. They will commission artists and content creators to create interactive and/or immersive experiences using Web1 and Web3 to engage with younger audiences. Art galleries and museums will offer parts of their services by enabling people to buy tickets to certain exhibitions using NFTs. DAOs will be used to facilitate the process, providing business governance of how fine art institutions are managed (Jing Culture & Crypto 2023; Liddell 2022, p. 79; Zhang 2022). As the 2020s progress, physical art gallery and museum closures will continue apace, due to dwindling attendances and business running costs. The service will deliver interactive experiences, which are accessed by purchasing a NFT to visit art galleries and museums online. Museums will drop specialised, commemorative NFTs occasionally, alongside the selling of NFT token images of classic art (Hickley 2022, p. 33). There will be a proliferation of NFT museums which feature NFTs themselves, exhibiting visual displays of codes that brought a particular NFT into being. Traditional and digital art houses should adopt a policy of auditing and checking any item they deal with to authenticate NFTs. They should also audit any smart contract by checking the blockchain to provide their clients with a true record of previous ownership (Oleh 2023; Schroeders Wealth Management 2022). There have been notable NFT hacks during the early 2020s, where malicious internet actors have seized valuable assets and funds from their rightful owners. Azuki's Twitter hack enabled the spread of a phishing link amongst this anime's NFT collection followers. As part of the OMNI Real Estate exploit, people bought fraudulent accommodation tokens for non-existent hotel rooms (Oleh 2023). Both these examples would result in a significant loss of trust and confidence, a vital ingredient in the international art market.

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Notes

1 A DAO could be programmed to comply with state or non-state funding agencies within a particular country or jurisdiction, for example, Arts Council funding in the UK.

2 Debbie Blockchain is a Publishing DAO who went dormant 5 February 2021. Ensembl is an Ethereum-based platform for decentralised organising of artistic production.

3 Elzeweig and Trautman (2023, p. 320) observe: The United States Security and Exchange Commission' 2017 'DAO Report' describe DAO token holders afforded voting rights as limited.

4 Jones' (2022) article advises readers to keep an eye on, amongst other things, 'Blockchain' and 'Cryptocurrencies', charity governance is key. Jones (2022) provides an early indication that many small charities and voluntary sector groups will transform into cause based DAOs during the 2020s.

5 Petratos et al. (2020) discuss the emergence of blockchain technology in technological innovations, investment and sustainability. Digital finance is mentioned, which has a key role in purchasing, alongside marketing, exchange, and recording transactions in the international art market.

6 Mosley et al.' (2022) 'systematic understanding of blockchain governance' study, identifies how DAOs can have a number of potential voting vulnerabilities. These are governance vulnerabilities that can subvert the outcome of proposals, which are then subsequently actioned by DAO intermediaries.

7 Salman and Razzaq (2019) discuss Bitcoins and how this cryptocurrency can wildly fluctuate in value. Salman et al' pre-2020s study, warned then of the problems of the lack of regulation of cryptocurrencies. A sudden devaluation of a cryptocurrency would have a significant effect upon the reputation of an art house. A museum or gallery who bought an art piece using a particular cryptocurrency a few short weeks before its exchange rate fell sharply; would find that not only has the value of the art piece purchased fallen, but so would the art house's reputational stock on the international market. This financial risk problem has not been solved by art based DAOs using NFTs to buy and sell art. NFTs have solved provenance, ownership and historical transaction problems; they have not solved the financial risk posed by a sudden devaluation or de-recognition of a particular NFT in the open art market.

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Review

When the NFT Hype Settles, What Is Left beyond Profile Pictures? A Critical Review on the Impact of Blockchain Technologies in the Art Market

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Abstract: In 2021, online marketplaces such as Nifty and Opensea gained popularity, and digital art creations, including Beeple's pieces, made headlines worldwide. This attracted traditional fine art practitioners, artists, dealers, digital content creators, and crypto entrepreneurs who wanted to participate in this trend. Several significant investment and token-funded projects took place in Asia, fueling high hopes of revolutionizing the art market with nonfungible token (NFT) technology. However, the numbers suggest a different story, as NFT transactions have reached a historical low. Critics from both sides challenge the value of NFTs, and there is minimal empirical research on the topic of blockchain technologies in the art market. This paper explores the challenges and misunderstandings in the art market through the lens of the researcher's insight as an art tech entrepreneur. Its aim is to provide an explorative account of the use cases of NFT and blockchain technology vis-a-vis the traditional art market. The paper discusses the current work in progress at the Art ID Standard consortium, covering decentralized identity, blockchain, and use cases, and provides insights into the implications of these challenges for artists, collectors, and the broader art ecosystem.

Keywords: art; blockchain; nonfungible token; NFT; tokenization; digital identity; artracx; art id

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1. Introduction

The rise of online marketplaces and nonfungible token (NFT) technologies has had a significant impact on the art world in 2021. Online marketplaces like Nifty and Opensea have been trending since the beginning of the year, with digital art creations such as Beeple's famous auctioned pieces making headlines around the world. This has caught the attention of traditional fine art practitioners, artists, dealers, digital content creators, and crypto entrepreneurs, all of whom are eager to jump on the bandwagon. Several large investment and token-funded projects in Asia have contributed to the growing interest and optimism around NFT technologies in the art market, fueling high hopes for the future of the industry.

There are many definitions of the term NFT—a popular online periodical Coin Telegraph explains NFT as a means to provide verifiably unique representations of digital and physical goods that differ in value (Coin Telegraph 2023). Dalton (2023), however, defined NFT as a special block within a blockchain network that is unique, and data stored or minted inside this block hold a one-of-a-kind digital item known as a token. Allen et al. (2022) defined the ownership of an NFT as nothing more than the ability to control a string of characters on a blockchain and the authors further posit that it is mystifying for most people to understand how it is possible to attach so much monetary value to blockchain linked art. Besides Beeple's multi-million sales of a graphic file (Reyburn 2021), there were also many famed artists that joined this NFT mania. One of them is the contemporary artist Damien Hirst who successfully launched his 10,000 NFTs with each physical piece of

unique colourful dotted artwork being burnt if the customer chooses to keep the digital derivative of his work instead (Morton 2022).

2. The Hype Cycle

The NFT market exploded in popularity in early 2021, with sales reaching record highs and artists and collectors flocking to NFT marketplaces to buy and sell their digital assets. However, the market has experienced a sharp decline, with sales and prices dropping significantly (DappRadar 2023). One of the factors that contributed to the rise and fall of the NFT market is the hype cycle. The Gartner technology hype cycle is a phenomenon where a new technology or trend experiences a surge of interest and excitement, leading to a rapid rise in adoption and prices (Perez and Kreinovich 2018). However, once the hype dies down, the market experiences a decline in interest and prices. In a nascent industry such as NFT and blockchain technologies, there will always be the presence of innovative and enterprising project ideas which will be conceived to profit from hyping such novel concepts, much like the tulip mania in the 17th century (French 2006). NFT mania is no different from the tulip mania. NFT was even once tipped as one of the hottest technologies that will revolutionize the entire art industry. Critics, however, are quick to argue that the traditional art community is very different from the NFT art community.

Allen et al. (2022, p. 4) posit:

> "Despite their oblique representation of ownership—or perhaps because of the resulting flexibility—NFTs have become the cornerstone of a vibrant new art market. This market differs starkly from traditional art markets in the makeup of its community of participants. It also differs in its commission and royalty structures, market dynamics, means of recording provenance, community interactions, and forces shaping the tastes of buyers."

The NFT mania has been quoted by many observers, media, and scholars alike (Allen et al. 2022; Dalton 2023; Murray 2022a, 2022b; Reyburn 2021; Tabuchi 2021). In May 2023, DappRadar (2023) cited that the NFT market has achieved a lot less volume in trading when compared to May 2021. Huobi Research (2022) on the other hand has stated that the NFT market has cooled down and shrunk significantly while the market is adjusting to a more healthy and rational sentiment. The NFT market followed a similar pattern, with early adopters and enthusiasts driving up prices and sales. However, as the hype cycle subsided, the market experienced a decline in demand and prices. According to a report by NonFungible.com, the NFT market experienced a peak in sales in May 2021, with a total of USD 102 million worth of NFTs sold in a single day (NonFungible 2021). However, the report also noted that the market segment for NFT sale transactions related to art is a mere 9% only. These data reflect that the use of blockchain with respect to NFT related to art is not significant.

Another factor that contributed to the decline of the NFT market is market saturation. With the rise in popularity of NFTs, many artists and creators jumped on the bandwagon, flooding the market with more supply than demand. As a result, prices and sales dropped, and many artists struggled to sell their NFTs. According to a report by Art Basel, the NFT market saw an influx of new entrants in early 2021, with over 80% of NFT sales made by first-time sellers (Art Basel and UBS 2021). However, the report also noted that this trend did not translate into sustained demand as the market experienced a significant drop in sales and prices in the following months (Art Basel and UBS 2021). This decline can be attributed to the saturation of the market, as buyers were overwhelmed with too many options and too few standout assets.

The lack of regulation in the NFT market is also a factor that contributed to the decline of the market. Unlike the traditional art market, the NFT market is largely unregulated, with few rules and guidelines governing the buying and selling of digital assets. This lack of regulation led to fraudulent activity such as fake NFTs and scams, which eroded trust in the market and deterred buyers from investing in NFTs. The secondary market for NFTs is another factor that contributed to the decline of the NFT market. The secondary market

refers to the resale of NFTs by collectors and investors. While the primary market for NFTs saw a surge in sales and prices in early 2021, the secondary market experienced a decline in demand and prices. Many collectors and investors who bought NFTs in the primary market were unable to resell them at a profit in the secondary market, leading to a lack of liquidity and a drop in prices. According to a report by DappRadar, the secondary market for NFTs saw a decline in sales and prices towards the end of the year in 2022 (DappRadar 2023). This decline can be attributed to a lack of liquidity in the market, as many buyers were unable to resell their NFTs at a profit, leading to a drop in demand and prices as there were also a series of scandal-ridden stable coin projects and cryptocurrency exchange in 2022 (Bloomberg 2022). Furthermore, the use of the crypto wallet (with crypto wallet addresses) to hold NFTs and any digital assets had been prohibiting growth as the user experience is still very clunky and prone to attack and phishing scams (Henry et al. 2018; Gupta et al. 2022).

In his seminal work, Murray (2022a) provided six common myths of NFT and these are listed in Table 1. The introduction of NFTs has brought about a range of challenges and misunderstandings within the art market. Critics argue that NFTs lack intrinsic value, as they are primarily based on perceived worth and speculative market trends (Reyburn 2021). Additionally, concerns have been raised about the environmental impact of NFT transactions due to the energy-intensive nature of blockchain technology (Tabuchi 2021).

Table 1. Myths of NFT (Murray 2022a).

No. of Myths	Myth Descriptions
Myth 1	NFTs are artworks.
Myth 2	NFTs create a false artificial scarcity in artworks.
Myth 3	The valuation of NFTs is unlike any rational process of valuation for any other artwork or asset.
Myth 4	Smart contracts are like regular contracts.
Myth 5	NFTs have created the ability for artists to receive resale royalty rights.
Myth 6	NFTs will allow all artists the chance to make serious money from their art.

In addition to the presented myths, others have pointed out that the introduction of NFTs presents challenges for artists in determining value and authenticity. Traditional art markets have long relied on established frameworks, such as physical ownership, provenance, and valuation expert—to determine the value of artworks. However, in the digital realm, these parameters are not easily applicable. Critics argue that NFTs lack inherent value as they are primarily based on perceived worth and speculative market trends and therefore do not guarantee the underlying artistic merit or value of the artwork itself (Reyburn 2021). This raises concerns about the long-term sustainability and reputation of NFTs as a legitimate form of artistic expression. NFTs, therefore, have emerged as a potential solution to address only part of the challenges in the art world by providing a digital token and storing immutable records on the blockchain database.

Another significant concern for artists is the environmental impact associated with NFTs. The energy-intensive nature of blockchain technology, particularly the proof-of-work consensus mechanism used by popular blockchain networks, has raised questions about the carbon footprint of NFT transactions (Tabuchi 2021). Artists, who often advocate for sustainability and eco-consciousness, may face criticism for participating in a market that consumes substantial amounts of energy. Recent adoption in the use of proof of stake consensus mechanism for blockchain networks appears to have provided some claims as being more environmentally friendly albeit this has not been proven when comes to electricity consumption (Wendl et al. 2023).

Lastly, NFTs have introduced new complexities regarding copyright and intellectual property rights for artists. While NFTs can provide artists with a more direct and decentralized means of selling their digital creations, they also raise questions about

ownership, licensing, and the potential for unauthorized reproductions or infringements (Murray 2022b).

3. What Is the Future of the Use of Blockchain in the Art World?

Despite the recent rise and fall in the NFT market, many experts believe that the market still has potential for growth and development. The use of blockchain technologies has the potential to revolutionize the art world by providing a new way for artists to monetize their digital creations and for collectors to own and trade unique digital assets (Sidorova 2019; Mcavoy and Kidd 2022). However, for the market to reach its full potential, there needs to be more regulation, transparency, and innovation. Many technology companies are already working on solutions to address the challenges facing the art market targeting solving the main problems in the art market using blockchain technologies and smart contracts. For example, some platforms developed title management and authenticity solution using chipsets and blockchains like ARTRACX[1] while ARCUAL[2] has placed focus on payment and royalty settlement of secondary market transactions in fiat currency. These are just some small examples of art tech companies that are founding members of the Art ID Standard consortium[3] and exploring new digital business models in the traditional fine art world. According to Fernandes and Afonso (2020); there are also many other online art technology platforms that are exploring different new business models and e-commerce Janzon and Regefalk (2020); and some are focused on creating e-commerce, scarcity, and valuation in the art market (Mcavoy and Kidd 2022). Sidorova (2019) supported the argument presented by the Art Market Report 2019 that the online art market's future will be based primarily on the successful deployment of three key technologies namely cryptocurrency, blockchain, and artificial intelligence. The author agreed but also provided the argument that the brighter future in the use of blockchain in the art industry will rely heavily on the ability to provide a data standard in governing the metadata associated with each piece of artwork. These data standards are critically important to support the adoption of all three key technologies because each piece of artwork will need to have a unique and universally recognizable identity, to begin with.

Standardising the Digital Fabric in the Art World

In the traditional art market and the value of art and collectibles are often rooted in the ability of the gallery and auction house to be able to provide credentials, full history, and provenance of the artifact. It is now possible for artists themselves to self-certify their existence and art. In the digital world, there are many previous attempts to standardise the data format commonly used by art practitioners. One of these projects named Art Tracks by the Carnegie Museum of Art tried to provide a data model to store and capture the provenance data in artworks in a machine-readable format. (Art Tracks 2016); this project however did not take off and this standard also did not adopt the use of blockchain technologies. Another project called the codex protocol also tried to use blockchain technologies to keep track of valuable data in a proprietary system (Whitaker 2019). The Art ID Standard intends to offer the art ecosystem and its practitioners the ability to share these data by way of creating a global standard for identifying and cataloguing provenance data of artworks. The key driver will be to use prevalent blockchain technologies and decentralized identity which is governed by the W3C Consortium (Abbate et al. 2022). The standard includes a unique identifier for each artwork, which can be used to track its provenance, ownership history, and other relevant information. The objective is, therefore, to allow different online platforms to be able to build applications based on a standard and therefore providing greater transparency and elevating the trust fabric in the traditional art world. With a standard in place, traders, valuers, auction houses, insurers, and buyers can rely on the trusted data stored in different online application systems and this can help to reduce disputes and provide greater security for artists and collectors. Table 2 summarises the pros and cons of the Art ID Standard.

Table 2. Pros and cons of the Art ID Standard (Prepared by author).

Pros	Cons
Enhanced Provenance and Authenticity—aims to establish decentralized and tamper-proof provenance records for artworks and mitigating the risks of forgeries and ensuring the long-term value of the artwork.	Adoption and Integration Challenges—complexity of implementation with existing systems. Market consists of diverse stakeholders, with their own established practices, databases, and system infrastructure.
Increased Art Market Efficiency—reducing the need for intermediaries and enhancing the speed and accuracy of transactions. This can result in a more streamlined and cost-effective art market ecosystem.	Limitations and Scalability—face challenges in handling large-scale art transactions and the associated data. May exclude artists and participants who lack access to the necessary technical resources.

4. Increasing the Access and Liquidity of Traditional Fine Art

The use of blockchain technology can also enable fractional ownership and tokenization of artworks. Fractional ownership refers to the division of ownership of an artwork into smaller shares ownership or entitlement, which can be sold to multiple buyers (Whitaker and Kräussl 2020). Tokenization refers to the creation of digital tokens that represent full or partial ownership of a specific asset or part of an asset (Lotti 2019). An asset could be a tangible asset such as a piece of artwork, a boat, or even a piece of land. By using blockchain-based smart contracts, fractional ownership, and tokenization can be facilitated (Barbereau et al. 2022); this allows for greater access to artworks for a wider range of buyers and collectors. This can also reduce the risk and eliminate the traditional one-to-one relationship between owner and artwork—making it easier for buyers and sellers to transact in the art market. According to a report by Deloitte, the use of blockchain technology for fractional ownership and tokenization has the potential to unlock new opportunities in the art market, enabling greater liquidity, transparency, and accessibility (Deloitte 2021). The report notes that this trend is already emerging in the NFT market, but it has the potential to expand to other areas of the art market, such as fine art and collectibles. In Europe, there are already private banks that have successfully tokenized higher-value art like Andy Warhol's Marilyn Monroe (VP Bank 2021; Sygnum Bank 2022). In many jurisdictions, the tokenization of assets could be viewed as securities investment and, therefore, subject to various regulatory compliances. This itself also makes it harder for the actual realization of the liquidity of high-value art contrary to its original intent.

5. Conclusions

The NFT market rose to unprecedented levels in early 2021, but it subsequently experienced a sharp decline, with sales volume and prices dropping significantly. The factors that contributed to the rise and fall of the NFT market include the hype cycle, market saturation, lack of regulation, and challenges in the secondary market. While the future of the NFT market remains uncertain, it is clear that the market sentiment of the use of NFT in the art community remains only relevant to celebrity artists and top-tier auction houses. It was clear that there are still gaps in understanding blockchain technologies amongst the art communities, initiatives such as the Art ID Standard and the use of blockchain for title management, tracking provenance, and authentication offer opportunities for restoring trust in the traditional art market (Art Critique 2020). Furthermore, the adoption of new blockchain protocols and smart contracts to support fractional ownership and tokenization offers new opportunities for both the buy-side and the sell-side in the art market to transact. While the art market continues to grapple with challenges and criticism surrounding the NFT term and the underlying technologies, there are still opportunities for better use cases. NFT on the other hand has already created a lot of misunderstandings and mistrust in the art market filled with plagiarism, phishing attacks, and scandalous projects. As the art market continues to evolve, the use of blockchain technologies will

undoubtedly play a significant role in shaping its future—addressing pain points and real-world problems faced by the traditional art market. The Art ID Standard consortium, with its plan to standardize the metadata format in the art market, could potentially harness the transformative power of blockchain technologies to create a more inclusive, transparent, and sustainable ecosystem for artists, collectors, and enthusiasts alike.

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Notes

1 www.artracx.com (accessed on 15 August 2023).

2 www.arcual.art (accessed on 15 August 2023).

3 www.artidstandard.org (accessed on 15 August 2023).

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Article

Comprehensive Analysis of the Trade of NFTs at Major Auction Houses: From Hype to Reality

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Abstract: On 11 March 2021, amidst the lingering grip of the COVID-19 pandemic, the art world witnessed an extraordinary event. Christie's, the renowned auction house, hosted a groundbreaking auction counting just one lot: a Non-Fungible Token (NFT)—a digital asset that had been generating buzz in recent times. The astounding price fetched by the NFT sent shockwaves through the art world. While the 255-year-old auction house was known for selling unique assets, its auctioning of an NFT was surprising as Christie's online marketplace was not on the blockchain, contrarily to NFT platforms such as Opensea, Nifty Gateway, etc. The resounding success, however, of its historic auction was followed by a surge of NFT off-chain sales at Christie's, Sotheby's, and Phillips. While extensive research has been done on the trade of NFTs on the blockchain, little research exists on the trade of NFTs at public auction houses. Based on more than two years' tracking of NFTs auctioned at major auction houses, our research identifies three phases in the development of the trade and provides valuable insights into the unique factors that contributed to the growth of NFTs at public auctions between the springs of 2021 and 2023.

Keywords: art market; public auction; auction house; NFT; non-fungible token; cryptocurrency; metaverse; W3; live auctions; online-only auctions; COVID-19 crisis; estimates on request; guarantees; irrevocable bids

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1. Introduction

By the time Christie's launched its first NFT auction, NFTs had been traded on dedicated NFT marketplaces on the blockchain for a few years already. The introduction in 2017 of the NFT standard in Ethereum ERC721 allowed for the standardization of the processes of creation (minting) and transfer of NFTs on the blockchain (Valeonti et al. 2021)[1]. This was shortly followed by the emergence of dedicated NFT marketplaces to trade NFTs on various blockchains. In their systematic study on the current NFT ecosystems, Wang et al. (2021)[2] note that the sales of NFTs on these platforms exploded at the beginning of 2021 from an estimate of USD 12 million in December 2020 to USD 340 million by February 2021. The authors list more than 30 marketplaces on which one can trade NFTs, out of which 6 marketplaces focus on the art market: SuperRare, Rarible, Cargo, Async Art, Nifty Gateway, and KnownOrigin. While there has been extensive research covering NFT trading on blockchains (Taherdoost 2023)[3], very little research has been conducted on the volume and value of NFTs auctioned at the three leading auction houses. Multiple reasons come to mind as to why: first, historical data for public auction sales are not easily available. In fact, the auctions of NFTs arranged by the public auction houses were for the most part handled off the blockchain with the final results entered post-sales on an on-chain marketplace (mostly on Nifty Gateway or Opensea). It is only after the fall of 2022 that Christie's and Sotheby's launched their fully on-chain marketplaces for NFTs (Christie's 2022)[4]. Second, while some of the most expensive NFTs were sold at the three leading auction houses, the volume of NFTs auctioned at Christie's, Sotheby's, and Phillips stands ridiculously small compared to the volume of NFTs traded on dedicated NFT marketplaces, making any quantitative analysis challenging. But although sparse and off-chain, sales of NFTs at

public auctions undeniably impacted the NFT landscape as the notoriety and credibility that the venerable auction houses brought to the NFT market participated in increasing the visibility and awareness of NFTs, especially outside of the core crypto community.

In their research, Wang et al. (2022)[5] identified three specific time periods during which trading of NFTs on blockchain marketplaces shows great volatility and signs of bubble behaviors. Did the same happen to NFTs on the public auction market? The purpose of this research is to present the history of public auctions of NFTs at Christie's, Sotheby's, and Phillips and highlight the critical factors that contributed to their success. Hopefully, this will open the door to further research analyzing in detail the role and influence of public auctions on the performance of NFT trade on other marketplaces on the blockchain. In the absence of easily available public sources, our research is based on a systematic and exhaustive tracking of public auctions of NFTs at Christie's, Sotheby's, and Phillips from 11 March 2021, to April 2023. Via the identification, monitoring, and analysis of multiple public auctions parameters, we address the following Research Questions (RQs):

- RQ1: What was the state of NFT trade at the three leading auction houses?
- RQ2: What critical factors played a key role in the rise of NFTs at public auctions?
- RQ3: How will the trade of NFTs at public auction evolve in the coming years?

This paper is organized as follows: the second section covers in detail the research methodology used to identify and track public auction sales of NFTs at the three leading auction houses, with the purpose to record and categorize sales parameters overtime. The third part includes the key learnings drawn from our research, presented as answers to our research questions. The conclusion is addressed in the last portion of the research.

2. Research Methodology—Exhaustive Tracking of Public Auction Sales of NFTs

2.1. Planning the Research

Our research was prompted by Christie's auctioning of Beeple's "Everydays: the First 5000 Days". On 25 February 2021, as Christie's started its first NFT auction online, there was little to indicate that this would be a remarkable event. However, within the following two weeks, it became clear that something was happening as more than 200 early bids were placed on the NFT, the single lot offered at the auction. Slowly but surely the highest bid increased from USD 100 to USD 13.2 m just before 10 a.m. on 11 March 2021. Then, as the online-only auction started closing, bidders engaged in a fierce online battle, vying to possess this unique digital artwork. The suspense finally came to an end as the virtual gavel fell promptly after 10:03 a.m. (Eastern Time) and set a historic hammer price of USD 60.25 m for an NFT. The USD 69.35 million of revenue (as over USD 9 m of commission was added to the hammer price) that Christie's generated through the sale of a single NFT lot was truly remarkable as it surpassed by far the USD 48 million generated by the auction house during the preceding months of January and February 2021 from the offering of 3048 lots worldwide. It is this realization that prompted the current research. Over the following weeks, we started to plan for the systematic tracking of all upcoming NFT auctions at the three leading auction houses. While there are many more auction houses worldwide, Christie's, Sotheby's, and Phillips were not only the first auction houses to offer NFTs but they alone also generate more than 50% of the public auction trade worldwide according to the 2022 Art Basel & UBS Report (McAndrew 2023). As such, we felt confident that a comprehensive analysis of their sales would provide a valuable barometer for assessing the overall state of the NFT market at public auctions.

2.2. Data Collection Process

The goal of our research was to capture not only the results of the auctions but also multiple parameters potentially contributing to the results of the public auctions of NFTs. While tracking sales of NFTs traded on the blockchain is facilitated by the availability of historical data on the blockchain, tracking sales of NFTs auctioned at Christie's, Sotheby's, and Phillips is challenging as the historical data are not always on the blockchain and the data published on the auction houses' websites are often limited if at all available. To

achieve our goal, we developed the following strategy and process to capture a reliable dataset by identifying sales before they even started (D-n), capturing key parameters one day ahead of the sale (D-1), viewing the sales live (D), and confirming the results the following day (D + 1) (Figure 1).

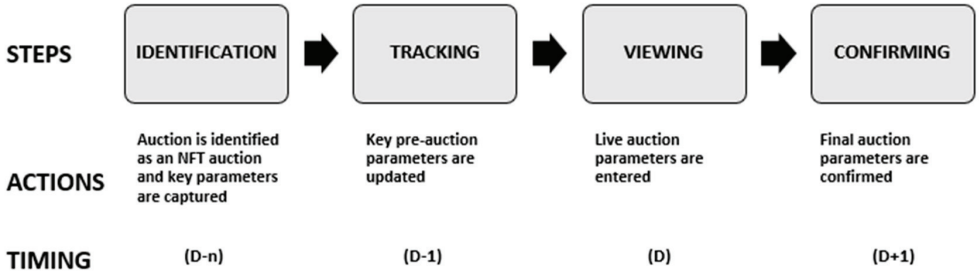

Figure 1. Diagram depicting the process used to track information about each NFT sale at public auctions.

Within a period of more than two years (from February 2021 to April 2023), we collected data from all of the 61 dedicated NFT auctions arranged worldwide at Christie's, Sotheby's, and Phillips. We also identified additional NFTs sold in auctions combining both NFT lots and non-NFT lots. These were added to our dataset. Finally, in the absence of a large body of academic research, we used press articles covering the various NFT sales at public auctions to cross-reference our information and confirm details and impact of the auctions.

2.3. Research Criteria

To understand both the context in which the NFTs were sold and the specificities of each NFT, we tracked criteria related to both the auction itself and the NFT lots (Figure 2):

Figure 2. List of criteria tracked for NFTs sold at public auctions.

2.4. Research Analysis

The challenge with analyzing the performance of NFTs auctioned at Christie's, Sotheby's, and Phillips is that the dataset is very small, especially in comparison to the total number of NFTs traded on the blockchain. While insufficient data may lead to inaccurate conclusions in statistical analysis, this does not apply to our research as our dataset includes every single NFT auction and NFT lot offered at Christie's, Sotheby's, and Phillips from 11 March 2021, to April 2023. Our conclusions may not apply to the entire public auction market, but they fairly represent historic trends at the three leading auction houses since we captured the entire data history.

3. Results and Discussion

Over a period of more than two years, from March 2021 to April 2023, the trade of NFTs at Christie's, Sotheby's, and Phillips has evolved significantly as shown by our research. Specifically, the answers to the three RQs set in the Introduction are as follows:

3.1. RQ1: What Was the State of the NFT Trade at the Three Leading Auction Houses?

Our analysis identified three distinct time periods (Figure 3) based on the review of multiple criteria: revenue generated, volume of lots catalogued, types of estimates provided ahead of the sales, performance of auctions, coverage provided by irrevocable bids, etc. (Figure 2):

- Phase 1: from March 2021 to September 2021: the explosion phase consisting in seven months of incredible success following the Beeple ignition boost;
- Phase 2: from October 2021 to February 2022: the trouble phase: a rollercoaster ride of success and disappointments over a period of 5 months;
- Phase 3: from March 2022 to April 2023: the back to reality phase: the long harsh return to market-anchored valuations.

The first phase saw an explosion of enthusiasm and creativity as the auction houses outdid themselves to offer intriguing auctions featuring NFTs. Ahead of Christie's first NFT sale, combined revenue at Christie's, Sotheby's, and Phillips had fallen to one of its lowest levels in the midst of the COVID-19 pandemic and, despite arranging more auctions than ever, the auctions houses found it difficult to convince their core customers to buy art online (Bourron 2021).[6] At the same time, prices for cryptocurrencies and NFTs traded on the blockchain were exploding as the COVID-19 pandemic was having the reverse effect on digital assets (Maouchi et al. 2022).[7] In this context, it is hardly surprising that the auction houses saw the offering of NFTs as the perfect solution to boost their sales and target new potential customers who were comfortable trading online only. While none of the following auctions managed to match the Beeple sales results (USD 69 m), revenue from NFT sales reached USD 179 m as an additional USD 110 m (USD 92 m through dedicated NFT auctions plus USD 18 m via NFTs sold in traditional auctions) was generated between April and September 2021. Remarkably, not one NFT offered ended up unsold, as the appetite for NFTs offered at public auctions seemed bottomless. Appendix A retraces month after month the various NFT sales arranged by Christie's, Sotheby's, and Phillips during Phase 1.

The second phase was marked by mixed performances with still some excellent results but also more last-minute withdrawn lots, a notable increase in unsold lots (bought ins), and cancelled sales. By the end of Phase 2—almost a year after the groundbreaking Beeple sale—it appeared that the NFT frenzy at the three leading auction houses had subsided. The same could be observed for NFTs traded on the blockchain. In their research covering bubbles in the NFT markets, Wang et al. (2022)[8] highlight an increase in volatility in 2021 with a series of bubbles followed by periods of calm. Multiple factors could be seen as contributors to the upcoming downturn: (1) the rapid fall of cryptocurrencies: by February 2022, ether, the leading cryptocurrency for NFTs, was already worth only 60% of what it was at its peak in November 2021. While research by Dowling (2022)[9] concludes that NFTs are

a distinct new asset class, he does observe some strong evidence of co-movement between the cryptocurrencies and the NFT market; (2) the global economy was also struggling to restart after the pandemic, and the invasion of Ukraine by Russia on the exact day of the "Punk it!" auction at Sotheby's did not announce great prospects of growth for the coming months. (See Appendix B for the monthly list of public auctions at the three leading auction houses in Phase 2).

Phases	PHASE 1: The Explosion	PHASE 2: The Troubles	PHASE 3: Back to Reality
Timing	March 2021 to September 2021	October 2021 to February 2022	March 2022 to April 2023
Total Revenue (including buyer's premium) (USD)	$179m	$62m	$20m
Total number of NFT lots catalogued	134	149	480
Average number of NFTs catalogued per month	19	30	34
Number of Estimates on Request (EOR)	122	135	136
Number of Withdrawn Lots	2	8	4
Number of Lots with Hammer Price (HP) < Low Estimate (LE)	2	-	212
Number of Lots unsold	-	10	51
Value covered by IRB	$36m	$37m	$2m

Figure 3. Key parameters for each of the three phases highlighted in the trade of NFTs at Christie's, Sotheby's, and Phillips from March 2021 to April 2023.

Despite the downturn, the trading of NFTs did not come to a halt at the leading auction houses. In Phase 3, an average of 34 NFTs were catalogued per month. This figure surpasses the average of 19 and 30 NFTs auctioned per month, respectively, during the first and the second phase. Most striking, however, in Phase 3 is the increase in NFTs offered with estimates ahead of the auction (i.e., without an estimate on request). This is a significant

shift as the auction houses offered most of the lots with estimates on request in Phase 1 and Phase 2. This new transparency, especially as regards pricing, could explain why the value generated by NFTs sold at the leading auction houses between March 2022 and April 2023 plummeted to its lowest level. Over the 14-month period, none of the dedicated NFT auctions yielded more than USD 2.5m. The largest revenue was brought in by the Sotheby's "Natively Digital 1.3: Generative Art" sale arranged on 25 April 2022, which generated USD 2.26m with 15 lots. By 2023, most NFT lots sold at public auction sales achieved prices less than USD 50,000. (See Appendix C for an overview of public auctions in Phase 3).

3.2. RQ2: What Critical Factors Played a Key Role in the Rise of NFTs at Public Auctions?

What were the critical factors, specific to the public auction process, that played a pivotal role in explaining both the rise and fall of NFTs? Exploring the elements that fueled the initial surge and the subsequent challenges provides valuable context for comprehending the trajectory of NFTs at public auctions. Our research identified four key factors that propelled NFTs to prominence and subsequently led to their decline: 1. paying and bidding in cryptocurrency, 2. online-only format of auctions, 3. Estimates on Request (EORs), and 4. irrevocable bids.

3.2.1. Paying and Bidding in Cryptocurrency

An essential factor contributing to the success of Christie's Beeple NFT sale on 11 March 2021, was the introduction of cryptocurrency payment options (Sansom 2021).[10] By enabling bidders to pay in Ether (ETH), Christie's not only facilitated the process for crypto investors, eliminating the need to convert their digital assets into fiat currency, but it also provided them with a potential hedge against the volatility of the crypto market (Reyburn 2021).[11]

In March 2021, when Christie's auctioned Beeple's NFT, Ether was experiencing a robust rebound following two years of a bear market. In fact, Ether's value had surged from USD 600 per ETH at the beginning of December 2020 to USD 1800 by the start of March 2021. Despite the positive trend, Ether remained highly volatile, leaving few options for cryptocurrency investors to safeguard their newfound wealth from drastic market fluctuations. In this context, purchasing an NFT through a reputable auction house seemed like a convenient and prudent investment strategy, offering stability and potential long-term value appreciation within the volatile crypto landscape.

Recognizing the importance of attracting new wealth from crypto investors, auction houses embraced the acceptance of cryptocurrency payments for most of their NFT offerings. Sotheby's went even further by allowing payment in Ether for a physical artwork by Banksy during its May 2021 Contemporary Evening Auction and even for a 101.38-carat, pear-shaped D color flawless diamond (Kinsella 2021b).[12] Both Christie's and Sotheby's also took the innovative step of conducting live bids in Ether, showcasing their commitment to integrating cryptocurrencies into the auction process. Christie's even claimed the distinction of organizing "the first ever live auction with bidding in Ether" during its 1 October 2021 "Post-War to Present: The NFTs" auction, where the auctioneer successfully placed bids in Ether for the two lots on offer (De Saro 2021).[13] Sotheby's extended this concept beyond NFTs, enabling bids in Ether for physical artworks by Banksy at its 18 November 2021 "The Now Evening Sale".

While offering the option to pay in Ether proved successful, the introduction of bidding in Ether added complexity to the process and limited the pool of potential bidders to those who held cryptocurrencies. The limitation became evident during Christie's sale on 1 October 2021, as the top lot, Lot 1Y "Full sets 1, 2 and 3–31 Projects" by Art Blocks Curated, ended up being unsold after an unsuccessful bid of ETH 560. Further challenges also became obvious when the value of Ether and other cryptocurrencies started to plummet in November 2021. The trade of NFTs at the auction houses benefited positively from the growth of cryptocurrencies but their ultra-reliance on cryptowealth became a liability when the cryptocurrency markets started to plummet.

3.2.2. Online-Only Format of Auctions

Out of all dedicated NFT auctions conducted by the top three auction houses between March 2021 and April 2023, a staggering 89% were held as online-only auctions, while a mere 11% took place as live evening and day auctions (Figure 4/Table 1). Although a few additional NFTs were included in existing recurring live sales, the majority of NFTs sold by the auction houses were featured in online-only events. Interestingly, the online-only format was seen as a drawback in the traditional art world, but it proved to be a distinct advantage for NFT sales.

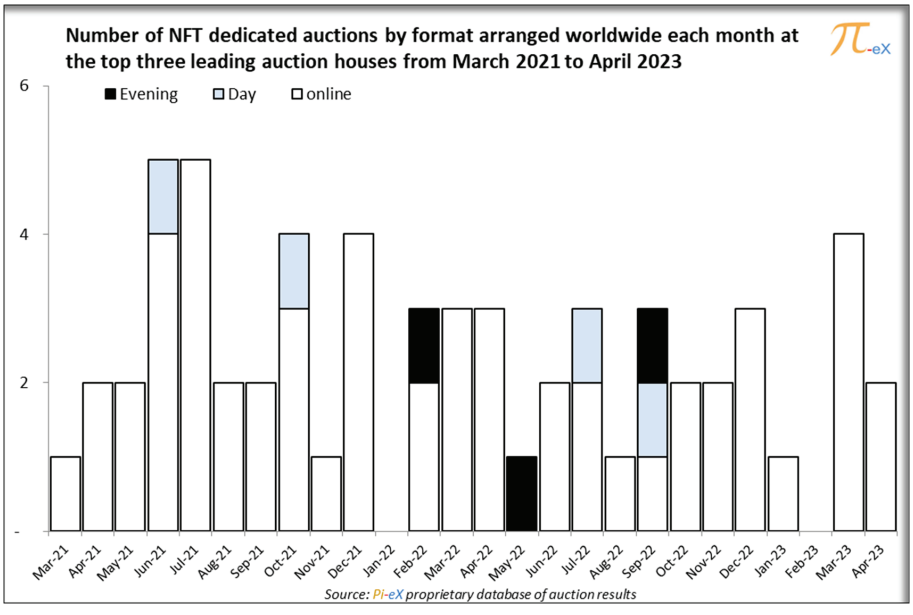

Figure 4. Number of dedicated NFT auctions by format arranged worldwide each month at the top three leading auction houses from March 2021 to April 2023.

Table 1. Number of dedicated NFT auctions by format arranged worldwide each month at the top three leading auction houses from March 2021 to April 2023.

Month	Day	Evening	Online
Mar-21			1
Apr-21			2
May-21			2
Jun-21	1		4
Jul-21			5
Aug-21			2
Sep-21			2
Oct-21	1		3
Nov-21			1
Dec-21			4
Jan-22			
Feb-22		1	2
Mar-22			3
Apr-22			3
May-22		1	

Table 1. *Cont.*

Month	Day	Evening	Online
Jun-22			2
Jul-22	1		2
Aug-22			1
Sep-22	1	1	1
Oct-22			2
Nov-22			2
Dec-22			3
Jan-23			1
Feb-23			
Mar-23			4
Apr-23			2

Source: Pi-eX Ltd proprietary database of auction results

Given that most NFTs are best experienced and appreciated through digital platforms, there was no requirement for potential buyers to physically visit an auction house. Instead, the entire auction process could be conveniently, and cost-efficiently, conducted online. Furthermore, the promotion and marketing of these sales were easily executed through social media channels and discussion groups on platforms like Discord and Twitter, thus reaching a wide audience of potential buyers and easily linking them to the online-only auction. The shift to online-only auctions not only catered to the unique nature of NFTs but also embraced the digital realm's potential for broader exposure and accessibility, providing a convenient and efficient platform for public auctions of NFTs.

3.2.3. Estimates on Request (EORs)

An overwhelming majority of NFTs sold in Phases 1 and 2 (90%) were offered with an Estimate on Request (EOR) (Figure 5/Table 2). Traditionally, auction houses utilize EORs when dealing with exceptionally high-value lots. For instance, in 2020, lots featuring EORs achieved an average hammer price of USD 22 million. Noteworthy examples of lots sold with EORs include Leonardo da Vinci's "Salvator Mundi", which fetched over USD 450 million in New York in 2017, and more recently, Pablo Picasso's "Femme assise près d'une fenêtre (Marie-Thérèse)", which sold for USD 103 million in May 2021.

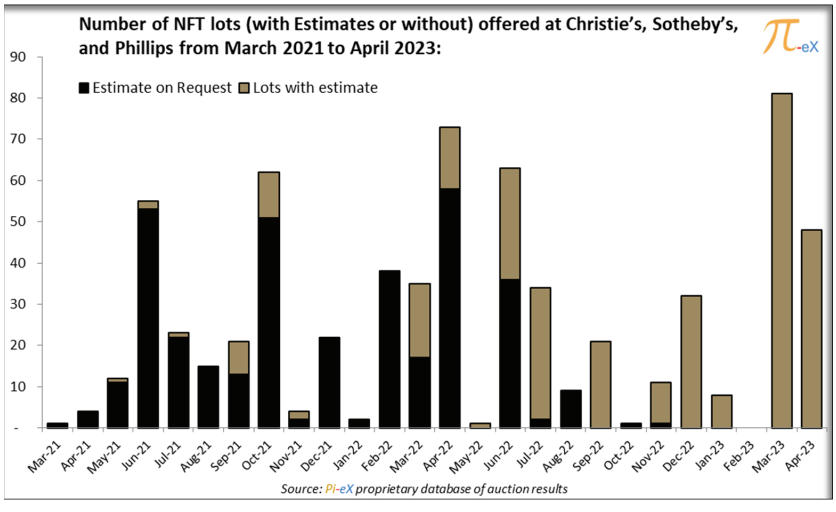

Figure 5. Number of NFT lots (with estimates or without) offered at Christie's, Sotheby's, and Phillips from March 2021 to April 2023.

Table 2. Number of NFT lots (with estimates or without) offered at Christie's, Sotheby's, and Phillips from March 2021 to April 2023.

Month	Lots with Estimate	Estimate on Request
Mar-21		1
Apr-21		4
May-21	1	11
Jun-21	2	53
Jul-21	1	22
Aug-21		15
Sep-21	8	13
Oct-21	11	51
Nov-21	2	2
Dec-21		22
Jan-22		2
Feb-22		38
Mar-22	18	17
Apr-22	15	58
May-22	1	
Jun-22	27	36
Jul-22	32	2
Aug-22		9
Sep-22	21	
Oct-22		1
Nov-22	10	1
Dec-22	32	
Jan-23	8	
Feb-23		
Mar-23	81	
Apr-23	48	

*Source: Pi-eX **Ltd** proprietary database of auction results*

As the first NFT was presented by Christie's on 11 March 2021, the auction house opted to offer it with an EOR, or—as they wrote—an "Estimate Unknown". This decision was likely due to the challenge of determining a precise valuation for the NFT, given the lack of historical data at the time regarding NFTs' performance in major public auctions. The strategy worked well since Beeple's NFT achieved an impressive price of USD 69 million, including the auction house's commission. Interestingly, this approach persisted for several months, as all listed NFTs at Sotheby's were auctioned with an "Estimate Upon Request", while Christie's continued to employ the "Estimate Unknown" designation.

The immense interest in NFTs and the prevalent Fear of Missing Out (FOMO) combined with the online-only bidding format which extended over several days allowed prices to soar to new heights. Without the presence of estimates, particularly the high estimate, bidding at public auctions remained uninhibited, leading to exceptionally high prices. The lack of pricing clarity in the public auction setting is surprising as trade of NFTs on the blockchain featured continuous transparent bidding and pricing. The prestige associated with being offered in top public auction settings—as opposed to "just" on the blockchain—allowed, however, for enough interest and hype to boost prices, at least for some time. It is worth noting that the first lot offered with an estimate at an NFT online-only auction, "PROOF OF SOVEREIGNTY: A Curated NFT Sale by Lady PheOnix", held by Christie's on 3 June 2021, achieved a hammer price of USD 45,000, falling far below its estimated range of USD 100,000 to USD 200,000. Consequently, it is not surprising that auction houses and sellers were hesitant to provide estimates and continued to list the majority of NFTs with EORs or "Estimates Unknown" labels.

Eventually, in Phase 3, auctioning lots with estimates became the norm, which most likely participated in the pricing correction of the NFT trade at public auctions.

3.2.4. Irrevocable Bids (IBs)

Irrevocable bids, also known as third-party guarantees, are special arrangements made between an auction house and a third party prior to the auction of a specific lot. Under this agreement, the third party commits to purchasing the lot at a predetermined price. In essence, the lot is pre-sold to the third-party guarantor, and potential bidders can only acquire it if they surpass the bid offered by the guarantor. In return for their early commitment, the third-party guarantor receives a fee from the auction house.

This practice has become increasingly prevalent at significant recurring live public auctions, particularly those featuring top lots, but was relatively uncommon in online-only auctions before the emergence of NFTs.

The first instance of an irrevocable bid on an NFT took place at Sotheby's during its 10 June 2021, auction titled "Natively Digital: CryptoPunk 7523" (Kinsella 2021d).[14] The auction consisted of a single lot, CryptoPunk 7523 by Larva Labs, which was listed with an estimate upon request. The auction format combined online pre-bidding with live bidding. Tracking the online and live bids reveals how the presence of an irrevocable bid led to the price inflating to USD 10 million in the final bid, despite the previous bid being under USD 2 million (Figure 6). It is more than likely that the lot was ultimately sold to the third-party guarantor involved in the irrevocable bid agreement, making this case a good example of how irrevocable bids can inflate prices.

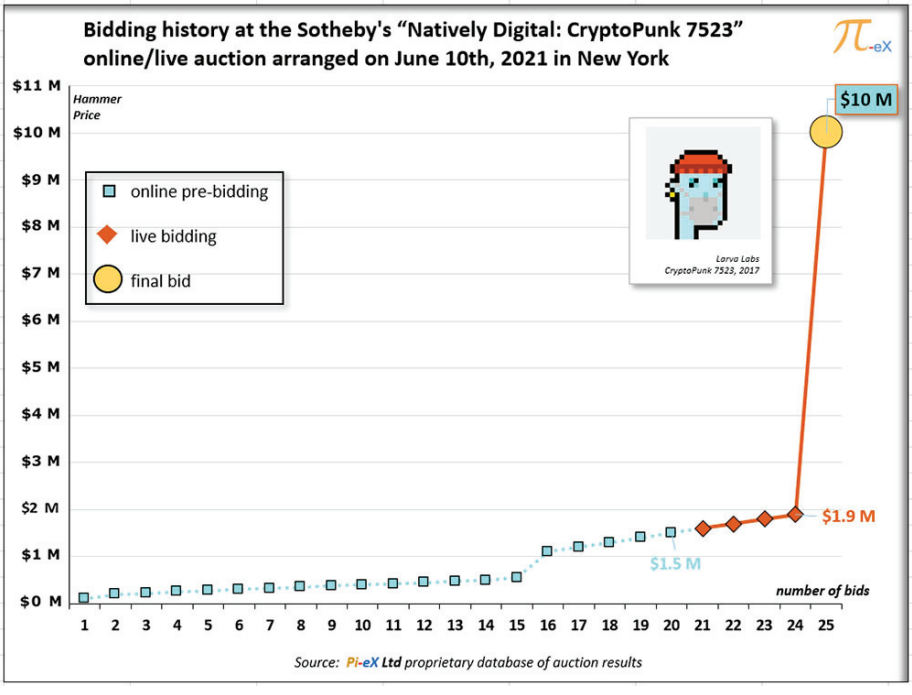

Figure 6. Online and live bids at the June 10 dedicated NFT auction "Natively Digital: CryptoPunk 7523" at Sotheby's New York.

During the autumn of 2021, the utilization of irrevocable bids gained momentum, after Christie's witnessed its first-ever bought-in (unsold) NFT lot at auction. Five more irrevocable bids were introduced into significant NFT sales during this period. In total, these bids, secured by third-party guarantors, contributed to a substantial portion of the hammer price value. Specifically, USD 52 million, representing 65% of the total hammer

price value achieved between September and November 2021, was underwritten by these third-party arrangements (Figure 7/Table 3).

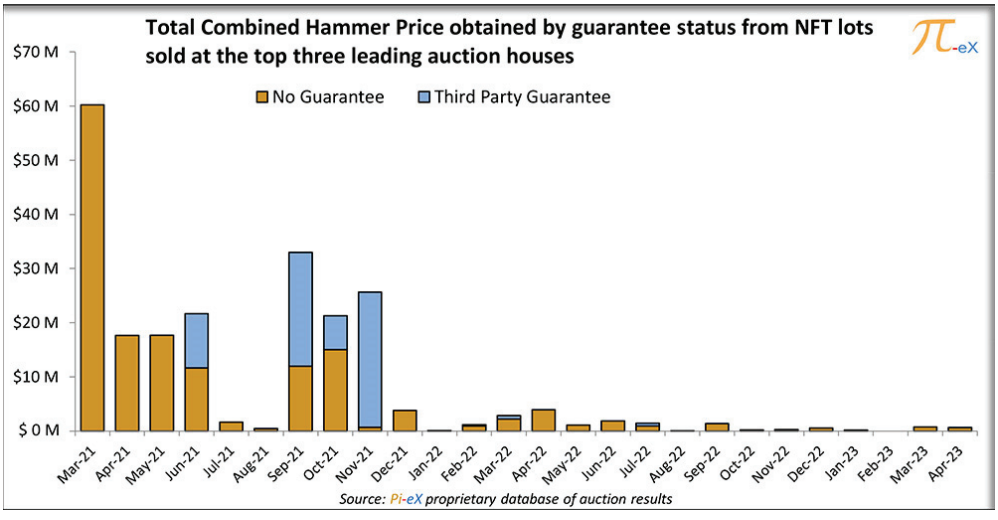

Figure 7. Total combined hammer price obtained by guarantee status from NFT lots sold at the top three leading auction houses from March 2021 to April 2023.

Table 3. Total combined hammer price obtained by guarantee status from NFT lots sold at the top three leading auction houses from March 2021 to April 2023.

Month	No Guarantee	Third Party Guarantee
Mar-21	$60,250,000	
Apr-21	$17,658,363	
May-21	$17,675,000	
Jun-21	$11,662,000	$10,000,000
Jul-21	$1,626,302	
Aug-21	$438,496	
Sep-21	$11,986,458	$21,000,000
Oct-21	$15,047,608	$6,250,000
Nov-21	$687,588	$25,000,000
Dec-21	$3,796,936	
Jan-22	$60,372	
Feb-22	$936,619	$220,000
Mar-22	$2,213,884	$665,750
Apr-22	$3,938,052	
May-22	$1,100,000	
Jun-22	$1,896,190	
Jul-22	$912,794	$550,000
Aug-22	$10,607	
Sep-22	$1,420,400	
Oct-22	$246,137	
Nov-22	$272,300	
Dec-22	$541,276	
Jan-23	$192,000	
Feb-23	$-	
Mar-23	$761,922	
Apr-23	$626,576	

*Source: Pi-eX **Ltd** proprietary database of auction results*

3.3. RQ3: How Will the Trade of NFTs at Public Auction Evolve in the Coming Years?

As shown in RQ1, the most recent Phase 3 has seen a correction of the NFT market at the three leading auction houses. Although there has been an increase in the number of NFTs auctioned, public auctions of NFTs have significantly evolved compared to the initial year of trading, especially as regards pricing. The increased price transparency observed in Phase 3 and discussed in RQ2 enables a clearer evaluation of NFTs' performance at the top three auction houses. Of particular interest is the analysis of how many lots obtain a Hammer Price (HP) above or below the initial Low Estimates (LEs) offered by the auction house.

In fact, the lukewarm performance of lots with estimates in Phase 3 provides some hints about the future of trading at public auctions. Almost 50% of lots offered at public auctions in Phase 3 were sold with an HP at or below their LE when they were not bought-in (unsold) or withdrawn (Figure 8/Table 4).

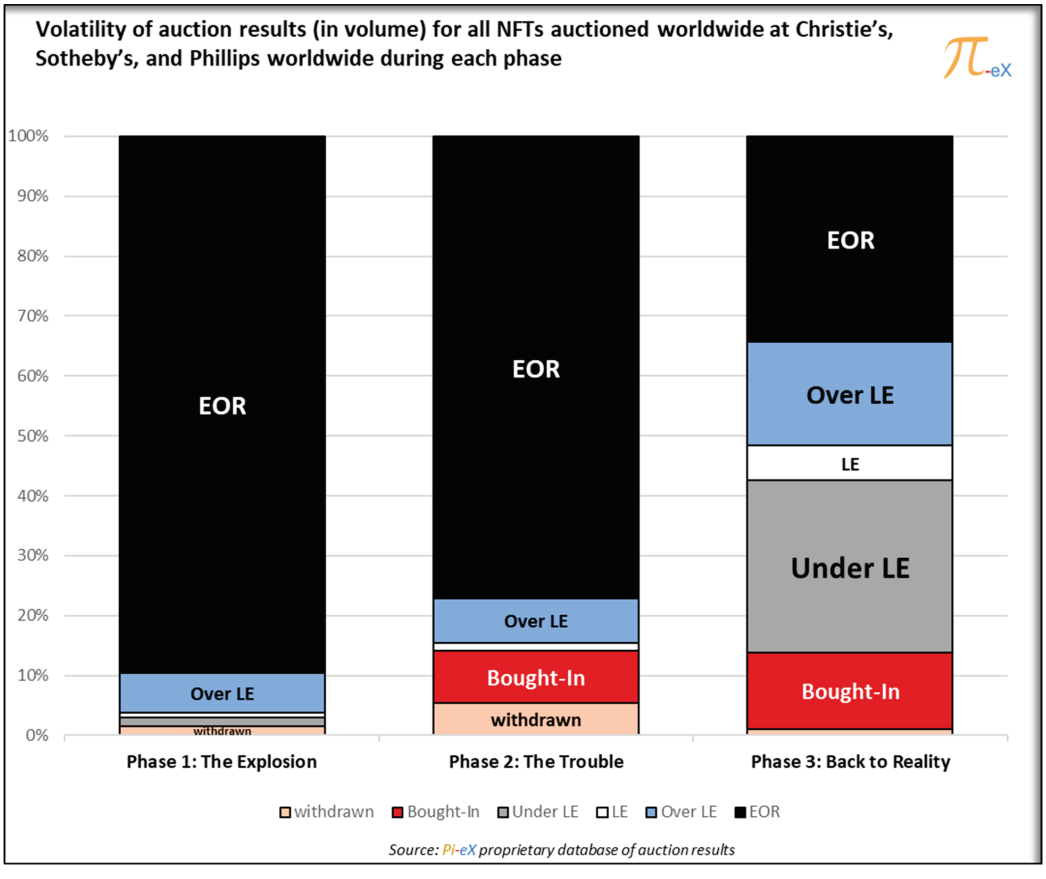

Figure 8. Estimates and volatility of auction results (in volume) for all NFTs auctioned worldwide at Christie's, Sotheby's, and Phillips worldwide during each phase.

Table 4. Estimates and volatility of auction results (in volume) for all NFTs auctioned worldwide at Christie's, Sotheby's, and Phillips during each phase.

	Phase 1	Phase 2	Phase 3
Number of NFTs auctioned	The Explosion	The Trouble	Back to Reality
Estimates On Request	120	115	124
Hammer Price above Low Estimate (Over LE)	9	11	63
Hammer Price at Low Estimate (LE)	1	2	21
Hammer Price below Low Estimate (Under LE)	2		104
Unsold Lots		13	46
Withdrawn Lots	2	8	4

Source: Pi-eX Ltd proprietary database of auction results

This suggests that sellers now possess a better understanding of pricing and are more willing to sell their NFTs at lower prices rather than hold onto illiquid assets. The consequence is a sharp price correction, as shown by the plummeting of the average HP obtained for NFTs at public auctions (Figure 9/Table 5).

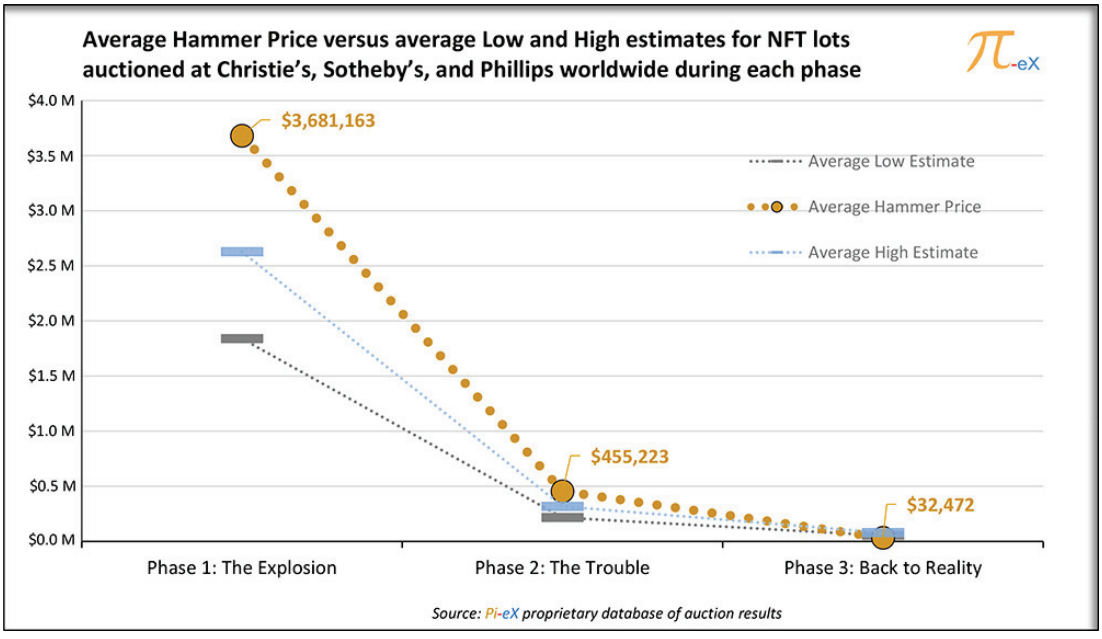

Figure 9. Average hammer price obtained by NFTs sold with estimates at Christie's, Sotheby's, and Phillips worldwide compared to initial average low and high estimates during each phase.

The recent correction, driven by less hype and more price transparency, is likely to continue as Christie's and Sotheby's have both launched full on-chain trading platforms, respectively, in September 2022 (Christie's 2022)[15] and May 2023.[16] Both platforms (Christie's 3.0 and Sotheby's Metaverse) are separate from the auction houses' traditional websites.[17] Interested bidders can connect via their cryptocurrency's wallets and their trade is recorded directly on the blockchain. A full bidding history for each lot is available, not only during the sale, but also after the sale, which is an important step for public auctions. While additional transparency is welcome news for the public, the trading on both platforms has been limited. The number of auctions arranged by both auction houses remains small while interest by potential buyers seems lukewarm. This could explain why the auction

houses continue to arrange NFT auctions off the blockchain on their traditional websites, to target not only cryptocurrency holders but also traditional art collectors.

With NFT trading at the top three auction houses having adjusted to the realities of the market, it is difficult to imagine how this segment could recover. As observed with other categories of items traded at public auctions, it is very possible that the trade of NFTs will slowly but surely dwindle as buyers and sellers gradually abandon the market. If this were to happen, NFTs at public auctions could experience a further decline until they quietly disappear.

Table 5. Average hammer price obtained by NFTs sold with estimates at Christie's, Sotheby's, and Phillips worldwide compared to initial average low and high estimates during each phase.

	Phase 1	Phase 2	Phase 3
NFT lots with estimates (in USD)	**The Explosion**	**The Trouble**	**Back to Reality**
Average Low Estimate	$1,839,574	$216,043	$53,235
Average High Estimate	$2,627,905	$317,832	$78,490
Average Hammer Price	$3,681,163	$455,223	$32,472

*Source: Pi-eX **Ltd** proprietary database of auction results*

4. Conclusions

While the trade of NFTs on the blockchain has been extensively researched in academic papers, there has been very little research of the auctioning of NFTs at public auctions, especially at Christie's, Sotheby's, and Phillips. The three leading auction houses, however, have arranged multiple sales of NFTs since March 2021. Compared to the volume of NFTs sold on the blockchain, the number of NFTs sold at public auction sales is relatively small, but the impact of the sales has been huge given the pristine reputation of the auction houses and the extraordinarily high prices obtained by the lots. Based on more than two years of observation, this research presents a detailed and exhaustive timeline of the various NFT sales arranged at Christie's, Sotheby's, and Phillips and identifies three distinct phases that have marked the trading of NFTs at the three leading auction houses: (1) Phase 1—the explosion: launched by the inaugural sale of Beeple's NFT at Christie's in March 2021 and followed by a series of highly creative auctions. (2) Phase 2—the trouble: a 5-month period from September 2021 when successes followed disappointments as multiple signs started to indicate that the crypto bubble may soon burst. (3) Phase 3—back to reality: the maturation of the NFT market at public auctions, which brought about a more realistic valuation framework. Our research also shows how four critical factors, specific to the trade at public auction, contributed to the rollercoaster ride observed at Christie's, Sotheby's, and Phillips: (1) the acceptance of cryptocurrency payments, (2) the convenience of online-only auctions, (3) the absence of estimates, and (4) the inclusion of irrevocable bids. Each of these factors played a significant role in shaping the NFT market at public auctions in its early days. More than two years after the incredible sale of Beeple's NFT at Christie's, the future of NFT trading at public auctions does not look bright. While both Christie's and Sotheby's have invested in their own on-chain trading platforms, one can wonder whether the high level of transparency on the blockchain is at all sustainable within the business model of a public auction house.

Funding: This research received no external funding.

Data Availability Statement: Data were obtained from Pi-eX Ltd. All data were collected independently by Pi-eX Ltd. over the past 2 years from public information published by Christie's, Sotheby's, and Phillips and by attending live or viewing online auctions. The data presented in this article are available with the permission of Pi-eX Ltd. Restrictions apply to the availability of any further data related to the subject.

Conflicts of Interest: The author declares no conflict of interest. Pi-eX Ltd. is an independent third-party data and research provider whose mission is to independently highlight trends in the global art market.

Appendix A Phase 1

From March 2021 to September 2021: the explosion phase consisting in seven months of incredible success following the Beeple ignition boost (Figure A1):

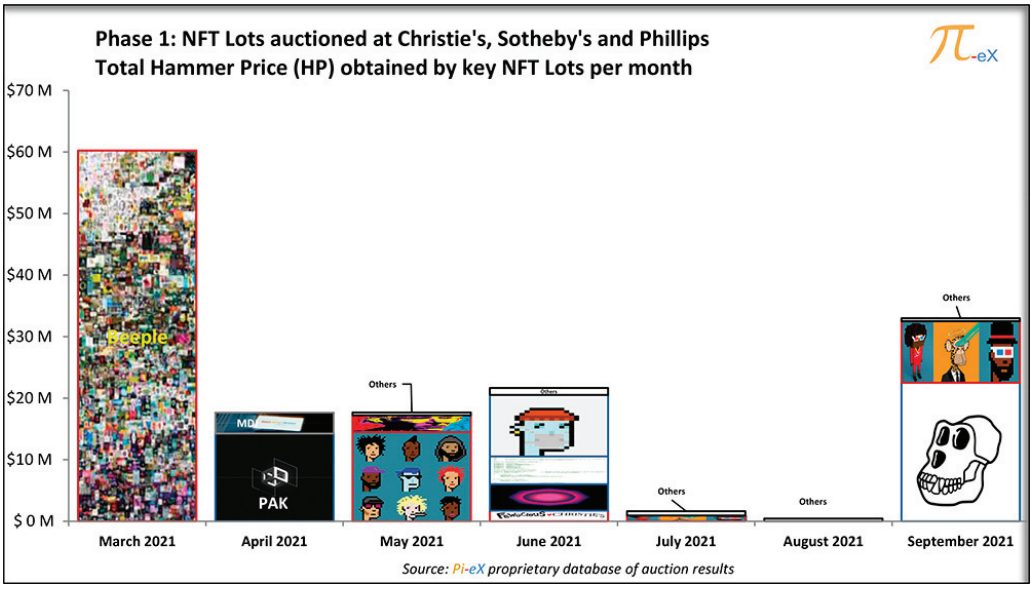

Figure A1. Phase 1: Total Hammer Price (HP) obtained by NFTs sold at Christie's, Sotheby's, and Phillips from April 2021 to September 2021.

March 2021:

On 11 March 2021, amidst the lingering grip of the COVID-19 pandemic, the art world witnessed an extraordinary event that etched its name in history. Christie's, the renowned auction house, hosted a small yet groundbreaking online auction that would captivate the imagination of art enthusiasts worldwide. The curated auction titled "Beeple | The First 5000 Days" counted just one lot: a Non-Fungible Token (NFT)—a digital asset that had been generating buzz in recent times. The astounding price fetched by the NFT on offer sent shockwaves through the art world (Kinsella 2021a),[18] instantly sparking an unprecedented fervor surrounding NFTs.

April 2021:

Just a month after the astonishing success of the Christie's Beeple sale, both Sotheby's and Phillips joined the trend by organizing their own NFT sales. On 16 April 2021, Sotheby's conducted a highly anticipated auction of "The Fungible Collection by PAK", fetching an impressive USD 16.83 million (including the auction house commission) (Villa 2021b).[19] Not to be outdone, Phillips joined the NFT frenzy on 23 April 2021, presenting "MDJ × Phillips: A Multi-Generational NFT", which achieved a notable sale price of USD 4.14 million (with fees) (Villa 2021a).[20]

May 2021:

In May 2021, Christie's continued its exploration of the NFT market by introducing an NFT lot in its highly anticipated 21st Century May Marquee live evening sale held

in New York. Lot 11A, which consisted of nine CryptoPunks by Larva Labs (including CryptoPunks 2, 532, 58, 30, 635, 602, 768, 603, and 757), exceeded all expectations with a USD 14.5 million hammer price, surpassing the estimated range of USD 7 million to USD 9 million and reaching the remarkable sale price of nearly USD 17 million (including commission). In addition to the CryptoPunks, Christie's also presented a collection of five unique NFTs featuring digital artworks created by the iconic artist Andy Warhol in the mid-1980s. These digital works had been recovered from obsolete floppy disks in 2014. The auction of these rare NFTs generated an additional USD 3.38 million in revenue for Christie's in May 2021, further solidifying the market's growing interest in digital art and collectibles (Block 2021).[21]

June 2021:

In June 2021, Sotheby's stepped again into the realm of NFT sales and made significant strides in the market. Across three distinct auctions, Sotheby's successfully sold NFTs with a combined value of nearly USD 23 million with fees. These auctions were as follows:

- "Natively Digital: CryptoPunk 7523": this live day auction, held on 10 June 2021, featured a single lot and achieved an impressive result of USD 11.8 million, inclusive of commission.
- "Natively Digital: A Curated NFT Sale": taking place on the same day, this online auction added to the success by generating an additional USD 5.4 million in sales.
- "This Changed Everything: Source Code for WWW x Tim Berners-Lee, an NFT": this creative auction revolved around a unique NFT that included a historical artifact related to the invention of the World Wide Web by the renowned British computer scientist Sir Tim Berners-Lee in 1989 (Hern 2021).[22] The lot garnered considerable attention and ultimately sold for USD 5.4 million, commission included.

July–August 2021:

Following a period of relative calm in the summer of 2021, both Christie's and Sotheby's set their sights on additional NFT sales in the upcoming fall.

September 2021:

Sotheby's made a significant splash with its online auction titled "Ape in!" closing on 9 September 2021. The auction featured two highly sought-after Apes created by Yuga Labs. The results were outstanding, as the two Apes fetched a remarkable sum of over USD 26 million, including commission (Escalante-de Mattei 2021a).[23]

During the same month, Christie's made its debut in the Asian NFT market by organizing its first NFT sale in Hong Kong. The online-only sale, titled "No Time Like Present", was arranged from 17–28 September 2021, and featured a remarkable single-owner private collection offered by Mr. Shawn Yue, a prominent actor and collector in Asia. The auction garnered significant attention, resulting in the successful sale of all 14 NFTs from Mr. Yue's collection. The total value achieved for these digital assets amounted to an impressive USD 9.5 million, including the auction house's commission.

From March to September 2021, 134 NFTs were offered at auctions at Christie's, Sotheby's, or Phillips and almost every single one of them found a buyer. Only one online-only sale "PROOF OF SOVEREIGNTY: A Curated NFT Sale by Lady PheOnix" arranged by Christie's on 3 June 2021 saw two lots withdrawn (Lot 17 and 21), most likely because they had not received any bid ahead of the closing of the sale.

Out of the 134 lots, only 12 (9%) had estimates provided by the auction houses while 91% of NFT lots were offered without estimates. This was highly unusual as lots without estimates are usually reserved for extremely valuable lots and this is often interpreted at public auction as a sign of extreme rarity.

Appendix B Phase 2

From October 2021 to February 2022: the trouble: a rollercoaster ride of success and disappointments within 5 months (Figure A2).

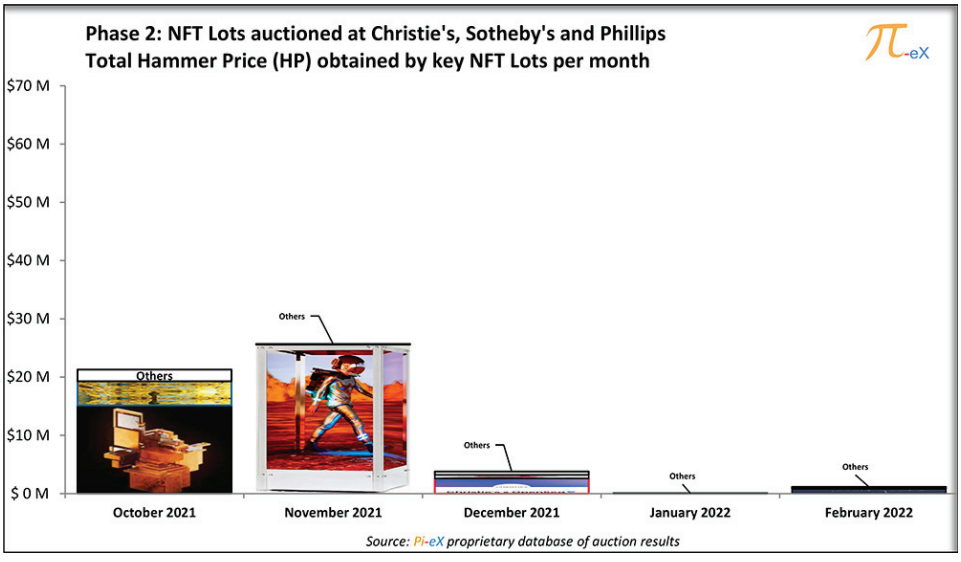

Figure A2. Phase 2: Total Hammer Price (HP) obtained by NFTs sold at Christie's, Sotheby's, and Phillips from October 2021 to February 2022.

October 2021:

October 2021 marked a significant turning point in the history of NFT auctions at Christie's, Sotheby's, and Phillips. It was the first month where success was no longer a guaranteed outcome for NFT sales. Indeed, two out of the four NFT sales organized by the auction houses included lots that did not find buyers, an unprecedented occurrence in the world of NFT auctions.

The first auction, titled "Post-War to Present: The NFTs", was conducted by Christie's and garnered extensive pre-sale coverage due to the auction house's announcement that it would accept bids in cryptocurrencies for the first time ever (Larkin 2021).[24] This auction consisted of two unique lots:

- Lot 1X featured a complete set of 30 curio cards, known as 17b, which were the initial artworks created on the Ethereum blockchain. The lot was offered with estimated values of ETH 250 to ETH 350 (approximately USD 750,000 to USD 1,050,000 based on an exchange rate of 1 ETH = USD 3,000 on 1 October 2021).
- Lot 1Y comprised a set of 31 artworks from the Art Blocks Curated project. Although the estimates were provided upon request, the anticipated minimum price for the lot was ETH 600.

During the live auction, as bids were announced in Ether (Figure A3), Lot 1X achieved a hammer price of ETH 320, thanks to 12 successive bids surpassing the starting bid of ETH 190. However, Lot 1Y did not enjoy the same level of success, as it was declared unsold after the maximum bid received (ETH 540) fell short of the reserve price set by the seller, likely around ETH 600. Although the auctioneer swiftly moved on and declared the sale a success, those who witnessed the auction in person or virtually were taken aback, as it marked the first time an NFT went unsold at one of the top three auction houses.

A few days later in Hong Kong, it seemed that the earlier setback in New York had little impact, as Sotheby's NFT sale titled "Machine Hallucinations—Space: Metaverse", featuring works by artist Refik Anadol, appeared unaffected. The auction generated over USD 5 million with eight lots, demonstrating an ongoing strong demand in Asia. Additionally, Sotheby's successfully sold two more NFTs as part of the October Hong Kong series sales, further highlighting the continued interest in this market.

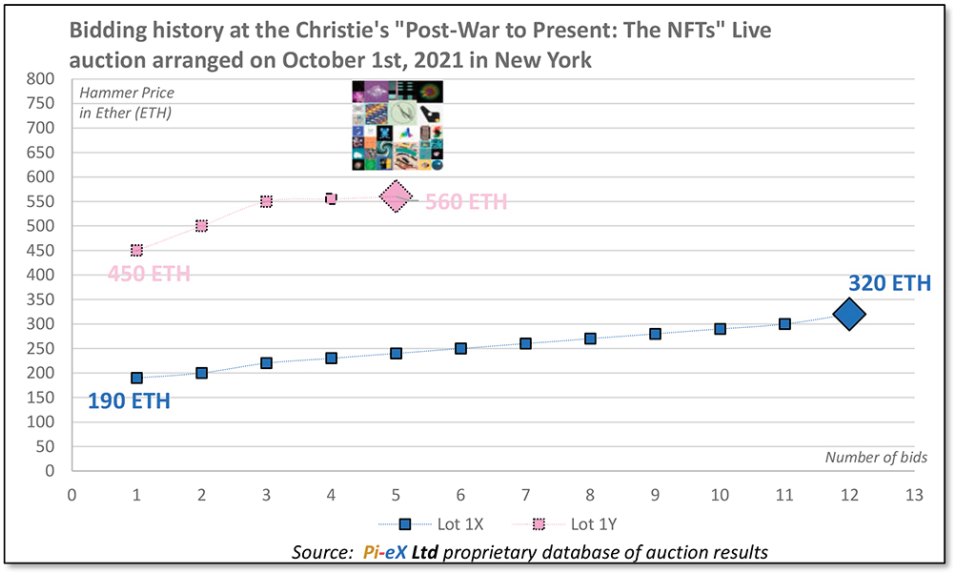

Figure A3. Total Hammer Price (HP) obtained by 2 NFT lots sold at Christie's "Post-War to Present: The NFTs" live auction on 1 October 2021.

Back in New York, however, it was more difficult to ignore what happened at Christie's. Indeed, the Phillips sale titled "CASCADE: An NFT Project by Jen Stark" held on 8 October 2021, just a week after the unsold Lot 1Y seemed to mirror the shifting sentiment in the market. Despite the absence of estimated values, the three lots on offer garnered a meager total of only USD 52,000, a stark departure from the previously robust results achieved by Phillips.

A few weeks later, on 26 October 2021, Sotheby's made a significant move by launching its new Metaverse platform and hosting its inaugural on-chain auction titled "Natively Digital 1.2: The Collectors" (Kinsella 2021c).[25] This auction showcased 53 lots from esteemed NFT collectors' vaults and was generally regarded as a success, amassing a total of USD 18.7 million in sales. However, a closer analysis reveals a bought-in rate of 9.4%, with five lots remaining unsold out of the 53 offered. While this may seem relatively small compared to public auctions, it is noteworthy considering the bought-in rate had been close to zero from March to September 2021.

As the month of October 2021 ended, the sales from the NFT realm painted an overall impressive picture, with a grand total of over USD 25 million generated from the auctioning of 66 lots. However, the presence of six unsold lots amid this otherwise remarkable performance started to stir doubts that would linger in the following months, particularly in the context of the New York NFT market.

November 2021:

In November 2021, Sotheby's planned a significant NFT charity auction titled "Gifted: The 140 Collection". Marketed as the largest of its kind, the auction featured seven NFTs originally gifted by Twitter to random followers (Hernandez 2021).[26] However, despite initial anticipation, the auction failed to gain traction. By the morning of November 30, none of the lots had surpassed USD 4500, and one lot did not even reach USD 2000. Consequently, Sotheby's made a short sudden announcement on Twitter, stating that the auction would be postponed, ultimately leading to its cancellation.

In November, while there were no other dedicated NFT sales at Christie's, Sotheby's, and Phillips, a few NFTs found their place in the traditional November Marquee sales

in New York. Following the success of the "21st Century Evening" auction in May 2021, where nine CryptoPunks by Larva Labs were sold, Christie's continued to include NFTs in its traditional live evening auctions. The November "21st Century Evening" auction featured three NFTs. Urs Fischer's "Chaos #73 Consumer, Chaos #74 Bliss, and Chaos #75 Denominator" achieved a hammer price of USD 180 K (estimated at USD 80 K to USD 120 K), while "Arcadia" by Arch Hades, Andrés Reisinger, and RAC, with undisclosed estimates, sold for USD 420 K. However, the highlight of the auction was lot 7A, "HUMAN ONE" by Beeple, a physical artwork accompanied by a non-fungible token, which became the second most expensive NFT ever sold, second only to "Everydays: the First 5000 Days". Although Christie's presented the work as a "triumphant follow-up" to Beeple's renowned piece, they mitigated risk by arranging a third-party guarantee prior to the sale. This meant that the artwork had already been pre-sold to a third-party guarantor at an undisclosed price, and the guarantor would receive a share of the profits if the lot sold above the agreed-upon amount. After intense bidding both in the auction room and online, the work was ultimately sold to an online bidder for a hammer price of USD 25 million, resulting in a final selling price of nearly USD 29 million, inclusive of the auction house commission (Escalante-de Mattei 2021c).[27]

December 2021:

In December 2021, after the second success of Beeple's sale at Christie's, the NFT market experienced a new surge with multiple sales. Christie's, Sotheby's, and Phillips all joined in again, offering a variety of NFTs.

Christie's collaborated with Opensea for their largest and most successful December sale, titled "CHRISTIE'S x OpenSea". The auction featured 25 lots and concluded on 7 December 2021, after a week of bidding. The sale generated revenue of ETH 827. However, not all lots found buyers, with six lots remaining unsold. The highest-priced lot achieved a value of ETH 185, equivalent to over USD 800,000 according to the conversion rate at the time. While still a substantial amount, it fell short of previous records set in the NFT market.

The second most successful sale was also a Christie's sale entitled "The Birth of Wikipedia", offering two lots connected to the early days of the online encyclopedia. The first lot was a physical artifact: Jimmy Wales's home computer—a strawberry iMac—which was purportedly used during the launch and development of Wikipedia. The second lot was an NFT representing the first edit made by Jimmy Wales on 15 January 2001, deemed a significant moment in Wikipedia's history. Interestingly, the NFT garnered more attention and fetched a higher price than the computer. The NFT sold for USD 750 K (including commission), while the computer achieved a price of USD 187.5 K. This outcome exemplifies the continued appeal and value placed on NFTs in the market, especially at lower price points. There were also two notable single-lot sales conducted by Sotheby's and Phillips:

- Sotheby's featured the artwork "Chromie Squiggle: MINT IT!" by Snowfro on their Metaverse platform on 13 December 2021. The sale, with undisclosed estimates, concluded at a price of USD 478.8 K, including fees.
- Phillips presented "Will Your Heart Pass the Test" by Drue Kataoka on their regular website on 15 December 2021. The artwork achieved a selling price of USD 252 K.

As 2021 drew to a close, Christie's, Sotheby's, and Phillips had reason to celebrate their NFT sales, totaling nearly USD 240 million over a span of 10 months, from March to December. While the revenue from NFTs did not constitute a significant portion of their overall annual revenue, the vibrant energy and enthusiastic bidding witnessed at each sale injected new life into the public auction market at a much-needed time (Gerlis 2021).[28]

However, there were more and more signs that the initial excitement had begun to wane, in line with a decline in cryptocurrency prices, particularly of Ether, which gradually but surely was returning to lower levels after reaching a peak of over USD 4600 by mid-November 2021.

January 2022:

As 2022 kicked off, Sotheby's shifted its focus to Hong Kong for its initial NFT sales.

Throughout January and February, the auction house managed to sell eight NFTs, fetching an average price of HKD 171,000 (USD 22,000). These prices reflected a significant decline compared to the previous year's figures.

February 2022:

Soon, all attention turned to New York as Sotheby's unveiled its highly anticipated evening sale dedicated exclusively to NFTs, titled "Punk it!" and scheduled on 24 February 2022. The centerpiece of the sale was a single lot featuring 104 "CryptoPunks", a renowned and historically significant PFP NFT collection created by Larva Labs in 2017. The lot carried an undisclosed estimate, speculated to be in the range of USD 20 to USD 30 million. The event was set to be a grand affair, held at Sotheby's headquarters in New York, complete with pre-auction cocktails and a panel discussion. An after-party was even planned, featuring a performance by DJ Seedphrase.

However, as the auction's start time arrived, Sotheby's stunned the audience by announcing the withdrawal of the lot and the cancellation of the entire auction. The decision sparked a wave of speculation and conspiracy theories among the prominent members of the NFT community in attendance, questioning the motives behind the seller's sudden change of heart. Notably, the lot did not have an irrevocable bid in place, leaving various possibilities open, including a bought-in scenario or a potential sale at a lower price point. Such outcomes would have had far-reaching implications for the entire NFT market (Escalante-de Mattei 2021b).[29]

Disappointed guests left Sotheby's with a sense that the party had come to an abrupt end.

Appendix C Phase 3

From March 2022 to April 2023: back to reality: the long harsh return to normal valuation (Figure A4).

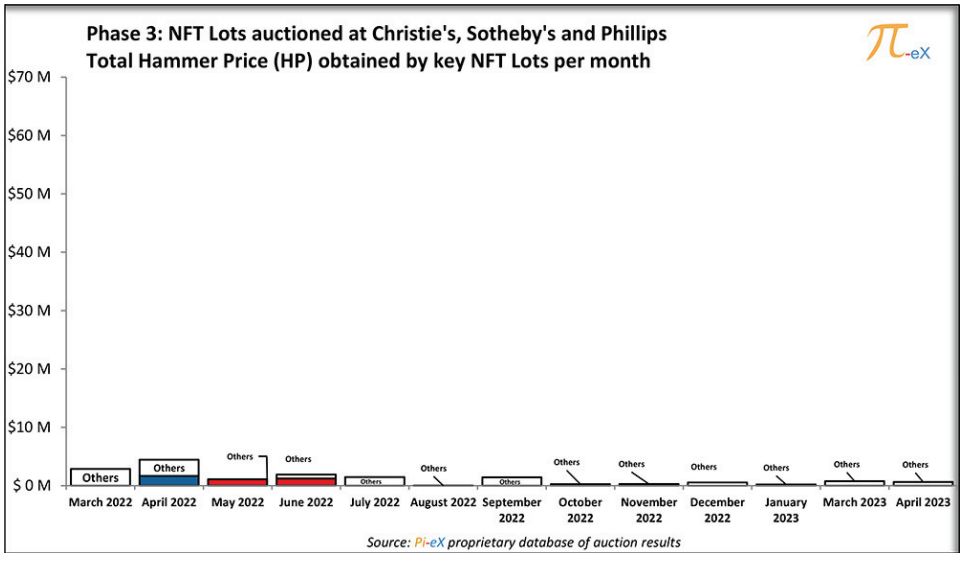

Figure A4. Phase 3: Total Hammer Price (HP) obtained by NFTs sold at Christie's, Sotheby's, and Phillips from March 2022 to April 2023.

After the very public failure of Sotheby's inaugural dedicated NFT evening sale, the trading of NFTs did not come to a halt at the leading auction houses but the characteristic of Phase 3 is that there are no high-profile NFT auctions nor notable NFT lots being auctioned. This resulted in the value generated by the NFTs sold at the leading auction houses since March 2022 to plummet to its lowest level. Over the 13-month period, none of the dedicated NFT auctions yielded more than USD 2.5 m. The largest revenue was brought in by the Sotheby's "Natively Digital 1.3: Generative Art" sale arranged on 25 April 2022 (Escalante-de Mattei 2022),[30] which generated USD 2.26 m with 15 lots. By 2023, most NFT lots sold for less than USD 50,000, except for a couple of exceptions which for one reason or another managed to reach prices above USD 100,000. The majority of NFT auctions, however, achieve prices at much lower levels:

- Christie's, for example, raised USD 242,000 from its auction "The Next Wave: The New York Edit" arranged on 19 April 2023 and counting 16 NFTs.
- Sotheby's raised almost USD 480,000 from its auction "Glitch: Beyond Binary" arranged on 26 April 2023, and counting 34 NFTs.

As of end of April 2023, it seemed clear that the magic was gone and NFT lots, like most other lots at public auction, were affected by the simple rules of offer and demand.

Notes

1 See Valeonti et al. for a detailed explanation of the definition and emergence of NFTs.
2 See Wang, Q. et al. for a detailed evaluation of the state of NFT trading on the blockchain in 2021.
3 See Taherdoost, H.'s systematic review of publications about NFTs in scientific reviews.
4 See Christie's press release:. Christie's 3.0: Revolutionary Platform Established Christie's as First Global Auction House to Host Fully On-Chain Sales.
5 See Wang, Y. et al.'s analysis of multiple bubble behaviors in the NFT and DeFi markets.
6 Review Bourron, C. for more information on how COVID-19 affected the public auction market.
7 See Maouchi, Y. et al.'s investigation of digital financial bubbles amidst the COVID-19 pandemic.
8 Wang et al. use the time-series NFT Index (NFTI) as a composite indice to represent the wider NFT market.
9 Dowling, M. reflects on whether the pricing of NFTs is driven by cryptocurrencies.
10 See The Art Newspaper article "Christie's to accept cryptocurrency for first time" (Sansom 2021).
11 See The Art Newspaper article "The cost of a single tulip bulb surged to the same price as a mansion 400 years ago: are NFTs the 'tulipmania' of the 21st century?" (Reyburn 2021).
12 See Artnet article "Christie's and Sotheby's Are Now Accepting Cryptocurrency for Big-Ticket Items, Including for a $5.4 Million Keith Haring" (Kinsella 2021b).
13 See the Be(in)crypto article "Christie's Auctioning Rare NFTs with Live ETH Bidding" (De Saro 2021).
14 See Artnet article "*Sotheby's 'Natively Digital' NFT Sale Lands at $17.1 Million, With More Than Half the Total Racked Up in the Final Minutes*" (Kinsella 2021d).
15 See Christie's press release: Christie's 3.0: Revolutionary Platform Established Christie's as First Global Auction House to Host Fully On-Chain Sales.
16 While Sotheby's launched its separate Metaverse platform in October 2021, it only started to offer a fully on-chain peer-to-peer marketplace in May 2023, allowing not only primary sales but also secondary sales.
17 Christie's 3.0 is accessible via the web address https://nft.christies.com/ (accessed on 30 September 2023) while Sotheby's Metaverse can be reached at https://metaverse.sothebys.com/ (accessed on 30 September 2023).
18 See Artnet: "*An NFT Artwork by Beeple Just Sold for an Unbelievable $69 Million at Christie's—Making Him the Third Most Expensive Living Artist at Auction*" (Kinsella 2021a).
19 See ARTnews: "*In a First, Sotheby's Collaborates with Major NFT Player for Pak Sale*" (Villa 2021b).
20 See ARTnews: "*Amid Crypto Craze, Phillips to Auction Self-Generating NFT 'Experience' by Mad Dog Jones*" (Villa 2021a).
21 See Barron's: "*Five Andy Warhol Works Are Minted and Auctioned as NFTs*" (Block 2021).
22 See the Guardian article "*NFT representing Tim Berners-Lee's source code for the web to go on sale*" (Hern 2021).
23 See ARTnews article "*Sotheby's Brings in $26 Million with Bored Ape NFT Bundle*" (Escalante-de Mattei 2021a).
24 See ONE37pm article "*Christie's Post-War to Present Auction: Blurring the NFT and Art Worlds*" (Larkin 2021).

[25] See Artnet article "*Sotheby's Launches Metaverse, a Dedicated Digital Art Platform, With a Little Help From Pak, Paris Hilton, and Time Magazine*" (Kinsella 2021c).

[26] See Cointelegraph article "*Sotheby's Metaverse announces latest and largest NFT charity auction*" (Hernandez 2021).

[27] See ARTnews article "Swiss Venture Capitalist Revealed as Buyer of $29 M. Beeple Sculpture" (Escalante-de Mattei 2021c).

[28] See Financial Times article "*No NFT, no comment—how digital art dominated 2021*" (Gerlis 2021).

[29] See ARTnews article "*Sotheby's Withdraws CryptoPunks Sale, Leading to Widespread Speculation in Crypto Space*" (Escalante-de Mattei 2021b).

[30] See ARTnews article "Sotheby's Is Launching Another Digital Art Auction, This Time on the Art Before NFTs" (Escalante-de Mattei 2022).

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Article

The 'Assetization' of Art on an Institutional Level—Fractional Ownership Implemented in the Royal Museum of Fine Arts Antwerp

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Abstract: This article explores the innovative collaboration between the Rubey platform and the Royal Museum of Fine Arts, Antwerp. Through the tokenization of the artwork *Carnaval de Binche* by James Ensor, this platform made it possible for interested investors to purchase blockchain-registered Art Security Tokens within this artwork and become co-owners of it—at least from an economic perspective. Although fractional ownership platforms for art have been established before, this is the first time an art investment opportunity like this has materialized itself in an explicit partnership with a museum. The tokenized artwork will be held on public display within the Royal Museum of Fine Arts Antwerp, for a period of ten years—a significant departure from the usual practice of storing such pieces in a storage vault—before it will be sold again. This article contextualizes this practice within both the 'assetization' of art that has increased in recent decades and the financial challenges facing Belgian—more broadly speaking, European—public museums. Based on a limited number of interviews with the stakeholders and desk research, this article subsequently explores the more practical benefits and concerns of a collaboration like this and presents an analysis of this practice drawing upon publications within the field of economic sociology. Since we find ourselves only at the beginning of this partnership, some questions will be raised for further research.

Keywords: art market; assetization; fractional ownership; museum; economic sociology

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1. Introduction

This article explores the innovative collaboration between the Rubey platform and the Royal Museum of Fine Arts Antwerp. This art investment platform has tokenized the artwork *Carnaval de Binche* (1924) by the Belgian artist James Ensor, while keeping it on display in the partnering museum. In concrete terms, interested parties can buy blockchain-registered Art Security Tokens that represent part of the financial rights to the painting that serves as collateral itself. This makes them—at least from an economic point of view—'co-owners' of the Ensor (Rubey n.d.; KMSKA 2023). The painting will be held on loan in the Royal Museum of Fine Arts in Antwerp for a period of ten years, after which it will be sold, and the token holders will share in the profit or loss.

Although fractional ownership and the tokenization of artworks have been developed before within the art market through various art investment platforms, this is the first time this idea has crossed over to the museum field and has taken shape as an explicit partnership with a public museum. Therefore, this article will explore this collaboration as a case study and focus on the practical implementation of fractional ownership as an alternative way to finance (temporary) collection expansion for museums. Given that this practice is fueled by the 'assetization' of art, this research situates itself—on a macro level—in the broader discourse about the art market and the European institutional sphere not being as separate as they used to be.

Therefore, the first section will start by contextualizing this project within this increased 'assetization' of art occurring during recent decades, and the financial challenges Belgian museums are facing nowadays—representative of the situation of underfunded public

museums in Europe. Hereafter, a brief introduction to the main concepts related to fractional ownership and the history of its implementation within the art market will be provided, before turning to the case study in which the mission of Rubey and the practicalities of this collaboration will be addressed. Subsequently, this article will explore the benefits and concerns of this practice and present an analysis of it, drawing upon publications within the field of economic sociology. These results were generated by synthesizing the theoretical background of the first sections with the expectations of the different stakeholders—the managing partner of Rubey and the director of the Royal Museum of Fine Arts—that were extracted from interviews.

As will be set out, implementing fractional ownership within a public museum encompasses an alternative way of financing (temporary) collection expansion and provides opportunities to publicly disclose artworks that were previously privately owned. However, based on the economic sociological analysis, this article will also cite a more critical perspective regarding it—given that this practice raises questions about the role of public museums within the valuation practices of art as a financial asset.

Since we find ourselves only at the beginning of this collaboration, the last section will raise some questions for further research. It will be worth following up on whether this practice will find resonance with other public museums. An additional study midway through or at the maturity date of this innovative collaboration would be a desirable addition to this exploratory article.

2. Arts as an Asset Class and Underfunded European Public Museums

2.1. The 'Assetization' of Art

The tokenization of art can be contextualized within the recent developments of art into an asset class. Investors have gained an expanded interest in art investments in the past decades for a variety of reasons—with the main ones being artworks' noteworthy financial performance and the failure of conventional assets to deliver attractive returns (Eckstein 2008). Artworks' low correlation with abstract financial products, their ability to serve as a storage hedge against inflation, and the positive role they may play in portfolio diversification are all considered financial benefits for investors and have been discussed extensively by various authors (see for example: Mei and Moses 2005; Eckstein 2008; Pownall 2009; Picinati di Torcello 2010; Velthuis and Coslor 2012). Transportability, the possibility of discrete transactions, and the possibility of quick sale are, furthermore, considered determinants in assessing an object's suitability as an asset—all of which apply to art (Eckstein 2008; Boltanski and Esquerre 2020).

As Birch and Muniesa argue, 'assetization' implicates a socially transformative act (Birch and Muniesa 2020, p. 4). Things are 'turned' into assets in a process that implies a broad variety of different actors. The ongoing 'financialization' and 'assetization' of art—taking off from the 1960s and 1970s onwards—are implicated in the broad variety of financial transactions related to art and the growing financial industry entirely built on art as assets existing today. Examples include services that are seeking to turn art into working assets such as asset-backed lending, the structuring of art investment funds, and art securitization (Picinati di Torcello 2010; Velthuis and Coslor 2012). These developments are, furthermore, strongly supported by, and intertwined with, recent technical evolutions within the art market (Robertson and Chong 2008).

There are, however, a few consequences to this growing business of art investing. One of them, according to Georgina Adam, is the rising demand for storage facilities (Adam 2018, p. 112). Due to an increased amount of art solely purchased for investment purposes, 'more work sleeps in warehouses rather than in collectors' homes' (p. 2). Negotiations about artworks only bear on the title of ownership and financial arrangements are set up to keep transactions discreet—all while the artworks remain stationary within storage facilities or freeports (Boltanski and Esquerre 2020, p. 247). The latter are thereby widely used to escape taxation on assets and although regulations have tightened up—they continue to be a fruitful environment for criminal activities such as money laundering by providing

opportunities to store dubiously acquired cash (Adam 2018; Post and Calvão 2020; Weeks 2020; Zarobell 2020; Rausch et al. 2020). It is against the backdrop of these developments that this practice is worth exploring—this will be elaborated on further in the following sections.

2.2. Financial Challenges for European Public Museums

This project can equally be contextualized within the challenges Belgian museums are facing—this is representative of the situation of underfunded public museums in Europe. In recent decades, these institutions have faced substantial cuts in government subsidies (Lindqvist 1990; Faro 2016; Zarobell 2017). This, in combination with increased competition in the funding pool and the rising costs of security and storage facilities, has led to the financial pressure they are experiencing today (Lindqvist 1990; Zarobell 2017). This urged a re-thinking of both a museum's tasks and its day-to-day operations. One of the direct consequences is that museums increasingly have to demonstrate their societal relevance and are subject to instrumentalist funding policies (Woodward 2012; Bell and Oakley 2015). They, furthermore, have increased their ambitions in community building an developing participatory practices (Simon 2010)—driven by financial interest, declining attendance and the so-called new museology, as is also reflected in the new ICOM definition that was recently adopted (see, for example, Vergo 1989; Hooper-Greenhill 1996; International Council of Museums 2022). As museums are assigned much broader social roles in addition to their core tasks, they consider it increasingly difficult to commit to exhibiting, preserving, and researching their collection (Alexander 1999; Faro 2016; Merriman 2008). These obligations, set by an increasing range of stakeholders, require a steady flow of resources (Woodward 2012).

'Too small or non-existent acquisition budgets' make collection expansion almost impossible, as noted in the 2016–2020 vision note for the Belgian museum sector (Faro 2016). The lack of resources also means that European museums can often no longer compete within the international art market to acquire pieces. Recently, museums have made joint purchases of artworks as an answer to this increased financial pressure. This can in a sense also be seen as a form of 'fractional ownership', or at least as 'shared ownership'. One of the most famous examples is the purchase of two Rembrandt portraits by the Louvre and the Rijksmuseum (The Guardian 2015).

Another direct result of lesser government support and illustrative of the privatization of the European museum field is that museums are increasingly run as actual businesses, becoming more entrepreneurial (Alexander 1999; Zarobell 2017). They often apply a more market-driven approach as an answer to the struggle to find funding—leading to the sometimes criticized 'blockbuster exhibitions'— and the adaptation of various branding strategies (Alexander 1999; Woodward 2012; Zarobell 2017). Other museums turn to private citizens and corporations to generate income—thereby moving closer to the American model—and develop various stakeholder relationships as these contribute to financial stability (Lindqvist 1990; Alexander 1999; Fabrikant 2016). An example of these are the widespread 'friends-of-the-museum' initiatives (Lindqvist 1990)—some of them explicitly mentioning collection expansion as one of their aims.

Lastly, many museums experience overflowing depots due to the scale of existing collections—which are also financially burdensome—leading to a 'profusion struggle' between the wish to collect more and the burden of preserving what already has been collected, and ongoing debates about de-collecting, or dynamic museum collections (Merriman 2008; Morgan and Macdonald 2018; Jones 2018).

3. Bridging the Gap between the Art Market and the Institutional Sphere

3.1. Collection Value and Asset Value

Recent contributions within the field of economic sociology recognize the distinctive nature of how value is created within the art market and approach the exchange value of artworks as a social institution (see for example: Smith 1989; Karpik 2010; Orléans 2014).

Boltanski and Esquerre thereby distinguish between value creation within what they call a 'collection form' and an 'asset form'—both are applicable to art and prevalent in what they argue is the 'enrichment economy' we currently find ourselves in (Boltanski and Esquerre 2020). The first form draws upon the 'memorial power' of objects—a 'socially attributed' quality referring to the closeness of objects to historically significant persons or events, and the latter to the transformation of a commodity into 'money, treated as quasi-money, or treated as a substitute for money', aimed to build up wealth (pp. 192, 241). Asset value, according to the authors, is thus encapsulated in the relationship between an object's price and its anticipated 'meta price' or its possible future price.

Within the broader discourse about assets, Birch and Muniesa state similarly that the 'true value of an asset, as the vernaculars of financial valuation have it, is the one that stems from its capacity to create value', making 'asset value' thus inherently tied to expectations about the object's future value (Birch and Muniesa 2020, p. 3). Asset value and valuation practices are dynamic as they are 'constituted by an active and ongoing management of that value by social actors' (p. 7), making them inherently subjective (p. 4). As the authors argue, assetization is a process of 'narrative transformation', which implies a reframing of these involved social actors (p. 18). Assets are *made*, the authors argue; they are socially constructed.

Institutions—both for-profit and non-profit—can according to them, by their authority shape and/or augment the value of objects within the 'collection form'. Museums can, for example, assign value in relation to a narrative of the past that gives them memorial force and by preserving them in collections that cannot be sold (Boltanski and Esquerre 2020, p. 126). In this case, it can be hypothesized that the 'collection value' of this artwork will be enhanced by its narrative presentation in a museum context, also by shedding light on a lesser-known period of the artist. The authors continue that 'while museums may seem to offer "spaces for resisting the effects of the growing commercialization of art" (. . .) it is precisely when they present works of art in a context that distinguishes them from "commercial products" that museums help solidify the presence of these works in the economy of enrichment' (ibid.). Regarding this specific pilot project, a crossover of these dynamics can be observed since an artwork that will be sold is inserted in a prestigious museum collection—this is, however, equally true for works of private collectors that are (temporarily) included in museums collections, as will be touched upon later.

Following the argumentation of Boltanski and Esquerre, it can be hypothesized that the value of this work (or its so-called 'metaprice') will increase due to its exposition in the Royal Museum of Fine Arts. Similar remarks in relation to the contemporary art market have been made by Olav Velthuis, who states that gallerists continue to persuade curators to include their artists in museums or other noncommercial exhibitions as a way to establish value for their artworks (Velthuis 2005). Based on the same principle, a previous narrative analysis of auction catalog entries led to the conclusion that auctioneers often refer to visual resemblances to pieces in a museum collection as an active attempt of increasing the value of the goods offered for sale (Kalbermatten and Rausch 2021). This illustrates how the artwork's exhibition in the museum possibly embodies an increase in both its collection and asset value, and, that the art market and the institutional sphere mutually influence each other.

3.2. Fractional Ownership, Blockchains, and Asset Tokenization

Fractional ownership, an idea that originated within the sphere of business jets, allowing businesses to purchase shares in a jet, quickly passed on to real estate and penetrated, more recently, the art market (Petterson 2022). The boom of the art market in recent decades and the subsequent 'assetization' and 'financialization' of art provided a fruitful environment for this development to appear—it might be even seen as symptomatic of it as it converges the ownership of art with that of financial investments (Charlesworth 2018).

Fractional ownership provides a way for buyers to purchase shares or tokens of an artwork that represent a percentage of total ownership rather than buying the entire artwork

at its prohibitive price (Casiraghi 2022). At first sight, it thus encompasses the possibility to structurally disrupt the notion of what it means to 'own' an artwork. The idea behind it is, however, not new (Petterson 2022), and is in fact very similar to the ambitions of art funds (see for example Robertson and Chong 2008; Horowitz 2014; Velthuis and Coslor 2012). For private investors, fractional ownership used to take shape as the purchase of comparatively low-value shares of a securitized art fund (Barbereau et al. 2022). More recent initiatives have implemented blockchain technologies—thereby expanding the concept of fractional ownership to a global pool of investors who are no longer obliged to register with a custodial broker or a company-owned stock exchange (ibid.). The emergence of blockchain technologies and their relation to the art market have already been discussed by various authors—including its application in for example provenance title registries and the payment of artist's resale rights (Charlesworth 2018; Whitaker and Kräussl 2018; Whitaker 2019; Barbereau et al. 2022).

This article limits itself by mentioning the two basic concepts that are at the core of these technologies: 'distributed, decentralized peer-to-peer computing'—which removes the need to trust a central authority for keeping official records (Whitaker 2019); and, the 'promise of an unalterable, mutually guaranteed, and transparent record of past events and transactions' (Charlesworth 2018). Peer-to-peer computing is supported by distributed ledger technology (DLT), making it possible to transfer economic value, rights, and claims—of both digital and physical assets—without custodial intermediaries such as banks or other financial institutions, but directly via peer-to-peer transactions. A successful transfer is achieved when a new record is appended to the blockchain—'to a distributed ledger's transaction history' (Barbereau et al. 2022).

Before assets can be bought, sold, or traded on the blockchain, they need to be tokenized—a principle which has, since 2017–2018, been applied to 'all sorts of assets from diamonds to luxury boats, and artworks' (Sazandrishvili 2020; Folaron 2023). To tokenize an asset, the physical object needs to be digitized. This digitized asset can subsequently be divided into subunits, with every one of these units being represented by a digital token (Ibid., p. 68). As Sazandrishvili explains, this makes all tokenization intrinsically a digitization; however, not all digitization is tokenization. Tokenization is a form of digitization that supports fractional ownership as these asset tokens can be compared to digital certificates of ownership in real assets, with the bearer of the token being the owner of a percentage of the underlying asset (Maecenas n.d.).

Through the representation of real assets as digital tokens, various benefits for investors are achieved. They enjoy the 'security, liquidity, and immutability' of cryptocurrencies, applied to real-world assets and the provenance of the tokenized artworks registered on the blockchain (Clavien 2020). Tokenized claims can pertain both to digital artworks or physical artworks, fungible or non-fungible; and to custodied assets or assets without a custodian (Barbereau et al. 2022). In the case of Rubey, a physical artwork is being tokenized—therefore, digital collectibles (such as for example 'Cryptokitties' released by Dapper Labs) will not be discussed any further.

3.3. Fractional Ownership within the Art Market: A Brief History

Since the most recent decade, various platforms offering fractional ownership opportunities for art have emerged. The 'first market cycle' of startups can be situated as early as the financial crisis when the first initiative—'Art & Cultural Exchanges'—was set up in China (Anapur 2022; Petterson 2022). However, due to its speculative behavior, the Chinese government quickly imposed restrictions, leading to a closure not long afterward. Europe followed in 2011, with 'A&F Markets' in Paris and 'SplitArt' in Luxembourg, but both initiatives failed (Petterson 2022). Six years later, attempts started to re-emerge—this time intrinsically linked to the rapid developments manifesting themselves in blockchain technologies and initial coin offerings (ibid.). In 2017, Maecenas managed to acquire USD 15.38 m through ICOs for a work by Andy Warhol, and the company subsequently divided it into ART tokens, selling 31.5% of them in 2018 (Whitaker 2019). This second wave of start-

ups that originated circa 2017—including ArtSquare, Malevich, and Feral Horses—was quickly slowed down due to the lack of a regulatory framework, an issue that somewhat continues today (Petterson 2022).

In 2018, when the main regulatory problems were solved, the development gained momentum again and one of today's market leaders, Masterworks, was founded—at the moment of writing, this company has purchased a total of 239 artworks (Masterworks n.d.). Masterworks allows investors to build portfolios of shares in artworks and to sell these shares on a company-owned exchange. This differs from Maecenas, which operates a DLT-based exchange and uses the ERC-20 fungible token standard (Barbereau et al. 2022). The main difference between securitization (Masterworks) and tokenization (Maecenas), according to Barbereau et al., is the media of storage and exchange: 'shares are registered on a proprietary exchange like the Nasdaq', where asset tokens are on a distribution ledger (p. 217). Tokenization makes it possible to buy fractions directly from an asset's custodian, without requiring intermediating parties (ibid.).

Other companies were inspired to do the same: Mintus, Sygnum, Artemundi, Fractional.art, Yieldstreet, Particle, Rares, and Arttory/Winston Art Fund soon followed, leading to today's wide variety of platforms (Petterson 2022). In 2021, the world's first digital asset bank Sygnum, together with Artmundi, tokenized Picasso's *Fillette au Beret*; the practical result was, however, the same—the work ended up in a storage vault. As Anapur notes, the practice of fractional ownership as it has established itself over the past ten years was mainly tailored for investors, and not for traditional art lovers; buyers cannot enjoy their artworks in the usual manner by putting them up on the wall (Anapur 2022). As argued in the first chapter and illustrated by this example, many art investments remain in storage vaults for years, disappearing out of the public domain. The website of Maecenas reads (Maecenas n.d.):

> 'the most likely scenario would be for the artwork to be stored in a purpose-built art storage facility that provides high-security access. This has the benefits of preserving the artwork in optimal conditions (humidity, temperature, lighting) and significantly lowering the risk of damage or theft, which is reflected in the lower premium that would be charged by the insurance company'.

According to their website, it is 'also possible to store the artworks at museums or certain galleries given that they meet our guidelines and are approved by the insurance provider'. It is very unlikely though that such a partnership has been established or will be established in the near future given that Maecenas has only successfully tokenized one artwork, and their art investment platform is currently disabled, making it seem that the company is not actively tokenizing other artworks anymore.

Recently, some fractional ownership platforms have addressed the issue of reduced visibility for art investments. For example, the Korean company TESSA—which operates via a digital application—exhibits the works it has purchased in their own museum (TESSA n.d.). The platform Particle wants to loan its purchased works to the Particle Foundation, which aims to preserve and display the collection globally through collaboration with 'galleries and institutions' (Particle Collection n.d.).

Although many of the artworks offered via fractional ownership end up in a storage vault, authors have identified a couple of advantages for those willing to buy art. The most mentioned ambition of enterprises developing these shared investment opportunities is to 'democratize' the art market and art investments. Because of fractional ownership, 'low-net worth individuals and small investors, who have so far found it difficult to make meaningful purchases in art', now have the opportunity to invest in blue-chip artwork and to diversify their asset portfolios (Clavien 2020).

Besides the purchase price, the often-high maintenance costs of an artwork can be split among the token holders—depending on the token model — further enhancing a democratic investment opportunity and lowering financial barriers (Clavien 2020). Not only is 'a share' of an artwork less expensive than the entire one, these platforms also generally charge lower fees in comparison to auction houses and galleries, and tokens can

be traded 'easily' on a liquid exchange. Investors can furthermore diversify the investment risk by buying shares or tokens in various artworks (Blignaut 2023). With regard to the primary art market, tokenization may also provide opportunities for collectors who 'don't have the time or knowledge to spot up-and-coming artists and evaluate which works to purchase' (O'Neill 2018).

By fundamentally changing the way in which art purchases are made, and by lowering the financial entry barriers of the industry, fractional ownership has the capacity to disrupt the traditional art market—however, more critical voices are starting to emerge. Additionally, the truly revolutionary character of cryptocurrencies is also increasingly being questioned, since they seem to reinforce pre-existing economic principles and are therefore not necessarily emancipatory (Lottie 2019).

At the time of writing—a year after the crypto crash and possibly slowly recovering from it (Schiller 2023)—only few of the benefits mentioned above have actually been able to materialize into socially valuable applications. It is therefore worth considering whether a public–private partnership such as this is a possible way forward. With respect to this particular case— it can be added that there are voices recognizing the crypto winter as a reason that explains why the time for tokenization of real-world assets may have come; investors seem to be heading towards it against the backdrop of this crash of cryptocurrencies (Casey 2023).

4. How to Own a 'Piece' of an Ensor?

The following subsection will provide an in-depth analysis of the collaboration between Rubey and the Royal Museum of Fine Arts, Antwerp.

4.1. Mission Rubey

Although various fractional ownership opportunities for artworks have been established in the last decade, this is the first case in which a company has the public disclosure of the tokenized artworks explicitly embedded in its mission. Rubey's mission statement is, therefore, threefold: 'people, society and museums' explained the managing partner of Rubey (Van Doorslaer, personal interview, March 2023). This points to the platform's ambition to democratize fine art investments by enabling investment at a very low entry price, to be of societal relevance through the public disclosure of artworks that were previously in private hands, and to increase the relevance of their partnering museums through branding and active asset management, respectively. The other aspects of their mission—which will be briefly discussed later—include the creation of a 'community' of investors around the artwork and the development of more structural partnerships with museums.

Rubey targets, in contrast to other art investment platforms, not only 'people who want to invest in art but don't have the budget to buy a masterpiece' but also 'people looking for an investment with a positive social impact' (Rubey n.d.). It is exactly this strong aim for societal impact, through loaning the tokenized artwork to a museum, which differentiates the company from other fine investment platforms and makes its collaboration with a public museum notable for analysis from an academic point of view.

4.2. A Two-Stage Rocket Launch: Private and Public Investors

Although in the future it may be possible to purchase an artwork directly through crowdfunding, the company has chosen a two-stage approach in this pilot tokenization of *Carnaval de Binche* (1942). The artwork was first purchased by a target company based in Luxembourg. This target company, which in the case of *Carnaval de Binche* consists of 15 private investors who all pooled together approximately EUR 100, 000, is (and will remain) the legal owner of the physical artwork (Van Doorslaer, personal interview, March 2023).

However, the financial rights related to the work are divided into virtually equal parts represented by Art Security Tokens, distributed to the private investors following the purchase of the artwork, and subsequently re-offered to public investors via the Rubey

platform. This makes it so that, from an economic point of view, 'the investors subscribing to the Art Security Tokens become indirect 'owners' of a piece of art' (ibid.).

In concrete terms, *Carnaval de Binche* was acquired through a private sale by the target company for EUR 1.2 million and 'divided into 1 million Art Security Tokens to raise a sum of 1.41 million euros'. The difference between the amount raised by the token offering and the purchase price amounts to EUR 210, 000 and is intended to fund the costs associated with the tokenization process and maintenance of the systems, as explained by the managing partner (Van Doorslaer, personal interview, March 2023). In the future, it might also be possible to offer the tokens directly for public sales to raise funds for the actual purchase. Nevertheless, the current approach also has advantages, as it diminishes the risk of the artwork being 'burned' when the purchase would fail, and provides an opportunity to 'democratize at public level and at private investment level', as Van Doorslaer added in our interview.

4.3. Management

After the tokenization of the artwork, 25% of the tokens are made available for public sale. This means that the private investors will retain 75% of the Art Security Tokens and it means that the majority of the tokens can never be acquired through public sales. Despite their large stake, however, even the private investors have no say in what happens to the artwork. This is a conscious choice by Rubey as one cannot assume that all token holders are reasonable decision makers in terms of both art and finance, as explained by the managing partner (Van Doorslaer, personal interview, March 2023). The token holders do have consultation rights, which means that their opinions can be determined through a survey, but these results are not binding. In practice, as explained in the previous section, token holders only hold a share in the financial rights to the artwork and not the physical ownership, as this would only complicate the decision-making process. In addition, investors often do not want to be bothered with all the practical details regarding their investment according to him; Rubey takes care of the practicalities of the partnerships with the museums with the aim of removing the burden from the investors.

4.4. Maturity Date

After the maturity date of the Art Security Tokens, which is set to be ten years, the artwork will be sold. Investors will thereby by directly exposed to the fluctuation of the work's value as the target company will sell it and will 'use the painting's entire net realizable value (after deduction of realization costs and taxes) to repay the investor's deposit and to pay out the agreed return' (Rubey n.d.). The ASTs thus have a fixed term of 10 years; however, as Rubey aims to sell the work under 'favorable market conditions', this period can be extended by a period of one year a maximum of three times (10 + 1 + 1 + 1). Additionally, it has been agreed upon that, if the issuer of the ASTs receives an interesting offer for the painting in question, it may accept it during the final thirty-six months of the contract (ibid.). In practice, this means that Rubey will sell the painting between seven and thirteen years after tokenizing it.

The collaboration between the museum and Rubey is thereby not different from a traditional private loan agreement—the difference here is that the work belongs not to one private owner but to a group of investors. Therefore, the same principles are adopted as with any other loan: the museum is responsible for the presentation of the work in the best possible conditions, the insurance of the work, and it manages it with due diligence by reporting any possible damages to the owners. It is, however, not responsible for the conservation and restoration of it (Willems, personal interview, May 2023).

4.5. Art Security Tokens

The Art Security Tokens (ASTs) Rubey uses for the tokenization of *Carnaval de Binche* can be compared to an electronic form of a traditional security or tradable financial asset (Rubey n.d.). This means that the issuer is 'bound by the financial legislation and the moni-

toring of this by supervisory authorities'; according to Rubey, this is the main characteristic which distinguishes ASTs from unregulated tokens and NFTs. It also means that there are legally enforceable rights and obligations for the token holder against the issuer. Another important difference to note is that Rubey's ASTs "represent a value of an art collectible that exists in the real world"—unlike NFTs, their website states, which mainly represent digital artworks (Rubey n.d.). Furthermore, ASTs are fungible—since each token has the same value, they are interchangeable (Van Doorslaer, personal interview, March 2023).

The ASTs are registered on the Ethereum/Polygon blockchain and can subsequently be traded according to smart contracts that automatically define whether a transaction is valid or not. One of the conditions registered in this smart contract is that the exchange of tokens is only possible with registered users on the Rubey platform and, therefore, are verified according to the Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations, according to the website (Rubey n.d.). Lastly, as mentioned before, the target company always remains the legal owner of the physical painting and only transfers the financial rights to the token holders through these tokens. The company's website reads:

> 'Note the quotation marks around 'Co-owner'. This is because any investor who purchases Rubey Art Security Tokens effectively becomes the legal owner of these Art Security Tokens, even though they do not directly own the piece of art itself. The official ownership of the piece resides with a specific target company of Rubey. Each Rubey target company owns one piece of art and transfers the financial rights related to the piece to the token holders' (ibid.).

5. Analysis

The aim of this section is twofold: the first part will address the more practical benefits and concerns of a public–private partnership like this—partly based on the museological challenges that were set out previously, and the second part will analyze the case through the lens of economic sociology and its theories of 'assetization'.

5.1. Practical Benefits and Concerns

Implementing fractional ownership within a museum encompasses an alternative way to finance (temporary) collection expansion. The first and foremost reason why a European museum would consider implementing fractional ownership, and why the Royal Museum of Fine Arts decided the enter this pilot project, lies exactly in this reason. As Whitaker argues, one of the greatest areas in which the implementation of blockchain technologies within arts entrepreneurship can have an impact is by providing 'novel funding structures for organizations and governments' (Whitaker 2019, p. 38).

As mentioned before, the acquisition budget for European museums is limited and museums are facing financial pressure for various reasons; this makes purchasing new artworks difficult or practically impossible. The director of the Royal Museum of Fine Arts in Antwerp considers the tokenization of an artwork—as is now happening with *Carnaval de Binche* of James Ensor—a third strategy, that can be added to the acquisition strategies the museum currently adopts; these are soliciting the 'Topstukken' fund or relying on long-term loans from private collectors (Willems, personal interview, May 2023).

Besides providing an alternative way to generate funds for collection expansion, fractional ownership may also contribute to the disclosure of cultural heritage that is currently held in private hands—this is an advantage that is directly interwoven with the previous one. Via tokenization, Van Doorslaer explains, capital can be raised to acquire works from important Belgian artists that are currently hidden abroad and would be valuable additions to the collections of Belgian museums (Van Doorslaer, personal interview, March 2023). Otherwise, these acquisitions would be financially impossible. The public display of these previously privately owned works may also come with augmented research possibilities for the artwork in question; this will, thereby, possibly lead to a more holistic image of an artist's oeuvre, as artworks in private collections are often under-researched. In the case of *Carnaval de Binche*, this means that the work will be included in the Ensor

Research Project, a research project which aims to map out the entire oeuvre of this Belgian artist (Willems, personal interview, May 2023).

Another reason why the museum decided to partake in this collaboration is the possibility of establishing interesting contacts within the token holders' community. After all, the Rubey platform and the museum aim to create a community of co-owners around the work—in return for their investment, the fifteen private investors receive a life-size print of the artwork and a free pass to the museum. The public investors are invited to a yearly evening in which all public investors gather in the museum and they can ask questions of experts about 'their' painting (Van Doorslaer, personal interview, March 2023). With this, Rubey aims to maintain a link between the investors and the painting, as is stated in its mission. This is facilitated by the public display of the work in the museum, making it possible for token holders to visit their asset—in contrast to other investment platforms, where the artwork disappears for years into a vault.

The museum and Rubey consider the token holders within this 'community' to function as ambassadors of both the artwork and the museum in general—as it might be expected that they will visit the museum and speak with friends and family about 'their' investment. They are therefore comparable to 'friends of' the museum, who, while being an ambassador of the museum—as described by Lindqvist—may also contribute to the financial stability of the museum (Lindqvist 1990). This tokenization can, therefore, be considered to be some sort of participatory practice; however, one could critically engage with the notion of 'community' and ask whether the investors purchasing these tokens via an online platform can be called an actual community. There will, after all, also be absent investors who will not be engaging in these activities and never visit the museum. Next to the above-mentioned benefits, a few practical concerns or thresholds for why museums might choose not to engage in a practice like this are worth mentioning. Some museums simply do not work with loan agreements; they only work with their own permanent collection. Meanwhile, others might only work with temporary exhibitions and would not be able to display the work for a continuous period of ten years (Van Doorslaer, personal interview, March 2023). Bearing the responsibility of managing and insuring the artworks is considered too financially burdensome for some institutions.

The main benefits for the token holders have been set out before—such as the possibility to partake in art investment and 'co-own' a museum piece at a democratic entry price. There are, however, some potential risks for the investors—some are related to art investments in general, while others are specific to the relatively recent nature of these technologies; this market is still in its infancy, and it is important to acknowledge the somewhat uncertain future of blockchain applications. Because of these, there is a liquidity risk for the tokens—as well as a 'risk of regulatory compliance'—given that the legal frameworks for these practices are not yet fully formed (Rubey n.d.). Lastly, scholars point towards some general uncertainties about the future of fractional ownership—the idea that all artworks are a suitable investment is 'simply wrong', according to Adam. Additionally, the lack of expertise in both art and finance in past platforms made it so that only a few initiatives could truly pierce the market (Adam 2021). This is an issue that, in this particular case is mediated through close collaboration with museum professionals. Furthermore, Adam stated that the use of tokens and cryptocurrencies poses problems for 'oversight wrong-doing', and she questions whether there is 'really much of an appetite for what is a very speculative field' (Adam 2021). As these platforms acquire pieces at historically high prices, Petterson notes that 'the promised exchanges have yet to materialize' and 'prices need to keep going up much further' for investors to expect any profit (Petterson 2022); this uncertainty, however, also manifests itself in more traditional forms of arts investment.

5.2. Creating Value

If we approach this project from an economic–sociological perspective, following the argumentation of Boltanski and Esquerre, it can be hypothesized that the 'collection value' and the 'asset value' of this artwork will be enhanced by its presentation in a prestigious

museum such as the Royal Museum of Fine Arts—as partly touched upon by D'hoore and Schramme (D'hoore and Schramme 2023). Rubey wants to contribute to this by actively managing its asset and promoting the museum (Van Doorslaer, personal interview, March 2023). In this specific case, the tokenization can also be situated within the branding strategies of the museum. As the Royal Museum of Fine Arts recently re-opened with great celebrations after a renovation period of ten years, it has been pays great attention to its promotional activities. The museum saw its chance to be the first in Europe to acquire an artwork in this manner, as it consciously brands itself as an innovative museum (Willems, personal interview, May 2023).

However, the expected increase in asset value due to this partnership has also led to more critical questions regarding the role of a public museum in the valuation practices of art as a financial asset and whether a public museum may be 'used' to increase the financial value of the financial assets of a few. It is important that clear agreements are made around these intentions (Schramme cited in Gordts 2022). These critical remarks are rooted in the traditionally government-funded European museum field—in which an aversion to private money is more prevalent, contrary to the Anglo-Saxon model.

The Royal Museum of Fine Arts, however, distances itself from this value-increasing approach. The director argues that the museum is not involved in this speculative aspect and that a possible increase in the value of the work is independent of its exhibition at the museum (Willems, personal interview, May 2023). Some awareness about the role of museums within the valuation practices of particular artworks is, however, valuable; this is because the art market and the museum sphere are not two strictly separate domains but mutually influence each other, as argued within the economic sociological literature. A project like this, furthermore, does not operate in a 'vacuum'; rather, it operates in a web of dynamics between social actors. In this context, it is worth mentioning that the idea of private owners trying to get their works exhibited in a museum's collection to increase their value is not new; this is prevalent in both the primary and the secondary circuit (see, for example, Velthuis and Coslor 2012).

The managing partner of the Rubey platform furthermore convincingly adds that this project does not differ much from a 'Public Private Partnership structure', being a collaboration between the government and private companies for the development of public infrastructure (Vlaams Kenniscentrum Publiek-Private Samenwerking 2018). Various authors have recently explored the practice of a PPP within the cultural heritage sector as an answer to the funding struggles that are being faced in the preservation of this heritage (see, for example, Macdonald and Cheong 2014; Riches Think Paper 07 2016; Borin 2017; Jelinčić et al. 2017). In addition, the Flemish government has recently commissioned research on the 'Cooperation between private collectors/private collection managing institutions and (semi-) public cultural heritage institutions in Flanders', highlighting interest in further public–private partnerships in the future as a sustainable heritage practice (D'hoore and Schramme 2023).

Lastly, this practice conceptualizes the role of a museum as the mere 'custodian' of the artwork; however, one could wonder whether this is in line with the increasingly diverse expectations placed on museums and the findings of recent museum studies.

6. Concluding Remarks

This article explores the innovative collaboration between the Rubey platform and the Royal Museum of Fine Arts in Antwerp. Through the tokenization of the artwork *Carnaval de Binche* by James Ensor, this platform made it possible for interested investors to purchase blockchain-registered Art Security Tokens within this artwork and become—at least from an economic point of view—co-owners of it. This is the first time that an art investment opportunity like this has materialized in an explicit partnership with a museum, since the tokenized artwork will be held on public display for a period of ten years. Therefore, this project was contextualized within both the 'assetization' of art—that has expanded during

recent decades—and the current financial challenges Belgian (and, more broadly speaking, European) museums are facing.

After exploring the main concepts related to fractional ownership of art, this article shed light on how the implementation of fractional ownership within a museum setting could provide practical benefits for European public museums that are constrained by tight acquisition budgets. In addition to offering an alternative way of generating funds for (temporary) collection expansion, fractional ownership may contribute to the disclosure of cultural heritage in private hands. Furthermore, it can fit within museum branding strategies, community-building strategies, and art historical research projects—as can be seen in this case.

Additionally, this article illustrates that the art market and the institutional sphere are not as separate as they used to be. With regard to this, it can be argued that the exhibition of this particular asset within a prestigious museum like the Royal Museum of Fine Arts probably leads to a value increase for this artwork, based on findings within economic sociology. Therefore, more critical questions are raised surrounding the role of public museums in a collaboration like this that could use further reflection. Nevertheless, a counterargument for these can be provided by stating that this collaboration does not differ much from 'PPP structures' that are implemented in other domains of society and that this loan agreement is similar to a 'traditional' loan agreement with a private party—who may or may not also have ulterior financial motives.

At the moment of writing, it remains unclear what exactly will happen with the painting after this specific time period. Although there will definitely be a 'hard exit' for the current token holders, according to the director, the sale of the painting does not necessarily mean that it will disappear from the museum—possibilities include the issue of a new tokenization or willingness to buy among a few investors who might re-lend it to the museum (Willems, personal interview, May 2023). Nevertheless, if the work is sold and possibly returned to a (foreign) private collection, there are still benefits to this partnership according to Willems, such as the art historical knowledge gained and the acquired public disclosure. After the expiry of a 'traditional' private loan—this case being very similar, as argued by the stakeholders—many artworks equally disappear from the public domain.

As we find ourselves only at the beginning of this partnership, it is not yet possible to formulate definitive conclusions. Concerning the broader museum field, it will be interesting to follow up on whether this practice finds resonance with other museums. To determine whether fractional ownership is to be applied on a large scale, comparative studies may be useful. Given the fact that it encompasses an innovative way of financing (temporary) collection expansion and fits within the increased entrepreneurial spirit of European museums, chances are that this is the case. However, there remain some general uncertainties with regard to the future of blockchain technologies and their ability to truly penetrate the art market—especially against the backdrop of the 'crypto crash' in 2022. As asset tokenization is a quickly emerging field, and legal frameworks are not yet fully confirmed, research from a legal perspective is equally necessary. More evidence-based studies about the impact of these partnerships on museums which are part-way through or at the end of the ten-year period would be equally useful additions to this exploratory article.

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Article

Tokenized and Tactile: Frank Stella's *Geometries* (2022)

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Abstract: On 8 September 2022, the American artist Frank Stella launched a series of twenty-two digital art works minted as Non-Fungible Tokens (NFTs) in collaboration with Arsnl, the in-house platform by the Artist Rights Society (ARS). Titled Geometries, each "package," included the NFT that would affirm ownership and the corresponding geometric model designed by Stella in JPG (image), MP4 (video), SLS (3D printing), GLB (virtual reality and model manipulation), and USDZ (augmented reality). This range of digital formats alludes to two of Stella's innovations in this space: the license to remix and manipulate his models, and the ability to 3D print Geometries at any color, scale, and material. Taking Stella's foray into the NFT-space as a starting point, my article focuses on an emergent trend by artists engaging with Web3: the effort to bridge the physical and the digital by giving tangible form to NFT artworks and what this suggests for the future of digital materiality. The paper at its core seeks to examine the relationship between the physical referents to NFTs at the very moment when new media returns to historical forms.

Keywords: NFTs; Prints; Sculpture; Contemporary Art; Blockchain; Cryptocurrency; American Art; Printmaking; Digital Art; Frank Stella

1. Introduction

> ". . .the scale on which the structure is operational in contemporary technoscience and artistic experimentation is no longer a human one".
>
> Jean François Lyotard (1985)[1]

> "No matter how digitized the work gets in the process, it always ends up a physical reality".
>
> Frank Stella (2022)[2]

In 1985, the French philosopher Jean-François Lyotard and Thierry Chaput organized the revolutionary exhibition, *Les Immatériaux*, on the fifth floor of the Centre Pompidou in Paris. Since heralded as a paradigm-shifting show, the works on display spanned across disciplines—from biosciences to plastic arts—and ranged from Dan Flavin's neon works to synthetic skin to video games. At its core, *Les Immatériaux* sought to negotiate how the materialization of new media resulting from encroaching globalization simultaneously dematerialized the notion of the subject. For Lyotard and Chaput, the intangible scale of technological progress was seen to disrupt the Cartesian model of the visitor experience of objects. Instead, they asserted, "new technology pursues and perhaps accomplishes the modern project of becoming master and possessor. But in so doing it forces this project to reflect on itself; it disturbs and destabilizes it" (Lyotard and Blistène 1985, pp. 32–39; Hudek 2009).[3]

Les Immatériaux's collective anxiety over the porosity of material experience remains prescient today, particularly in the widespread adoption of blockchain technology in cultural production. This essay considers a project by the venerable American artist Frank Stella (b. 1936), who launched a series of twenty-two digital artworks minted as Non-Fungible Tokens (NFTs) in collaboration with the Artist Rights Society (ARS) on 8 September 2022. Titled *Geometries* (Figure 1), the project combined Stella's sustained attention to

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copyright infringement and intellectual property protection for artists with his interest in expanding the material limits of reproduction. In fact, each NFT "package" included the token itself, the corresponding geometric model designed by Stella in JPG (image), MP4 (video), SLS (3D printing, Figure 2), GLB (virtual reality and model manipulation), and USDZ (augmented reality), and the "smart contract" (or blockchain-based code) governing how ownership can be transferred.[4] This range of digital formats alludes to two of Stella's innovations in this space: the license to remix and manipulate his models, and the ability to 3D print *Geometries* at any color, scale, and material (Figure 3). Taking Stella's foray into the NFT space as a starting point, my article focuses on an emergent trend by artists engaging with Web3: the conceptual and material efforts to bridge the physical and the digital.

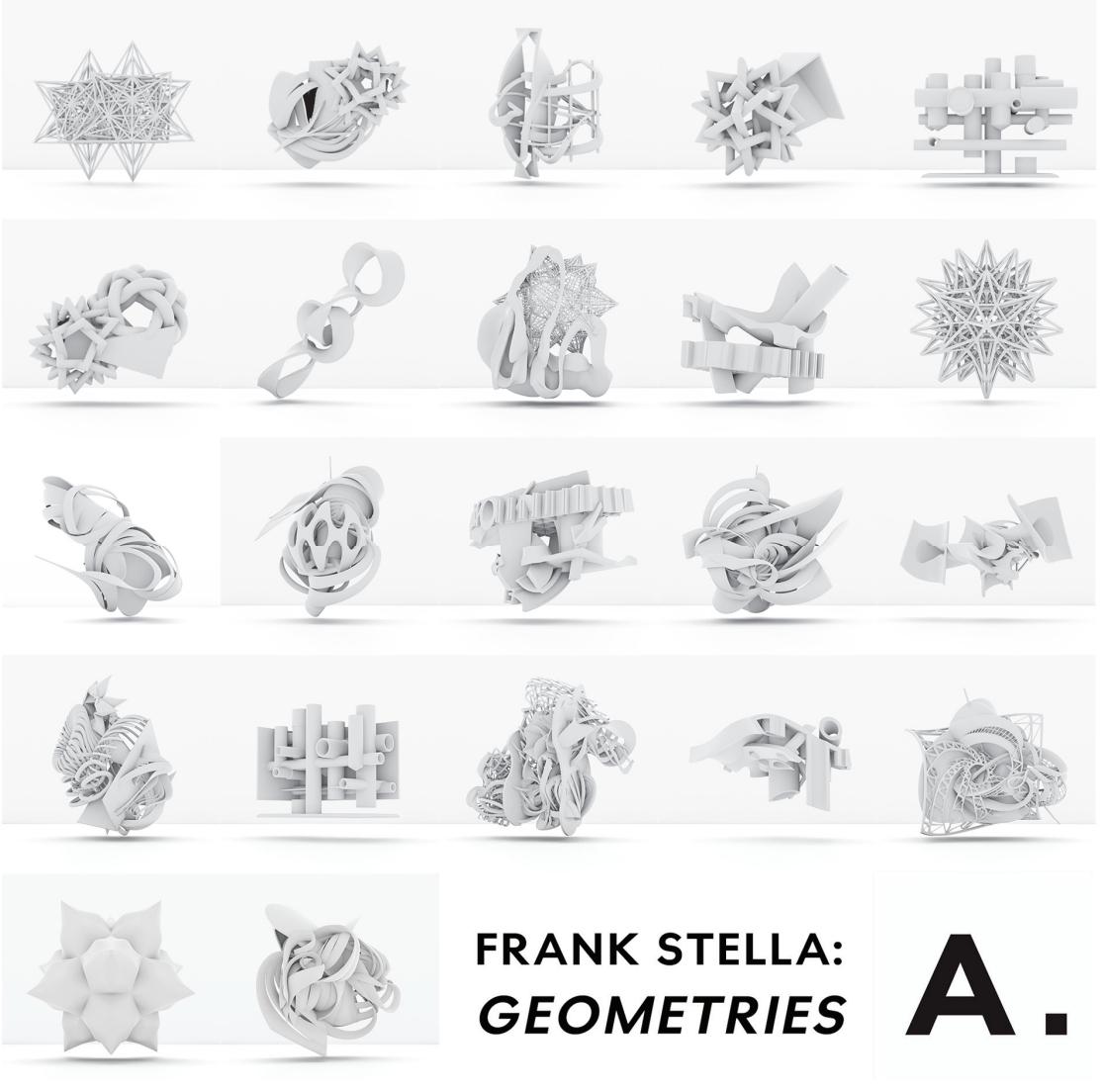

Figure 1. Frank Stella, *Geometries*, 2022. Photo courtesy of ARSNL. © 2022 Frank Stella.

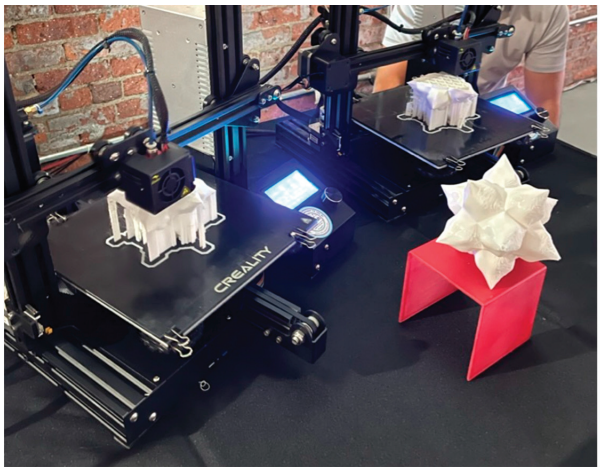

Figure 2. Creality's 3D printing of Frank Stella's *Geometries*. Photo by the author, 8 September 2022.

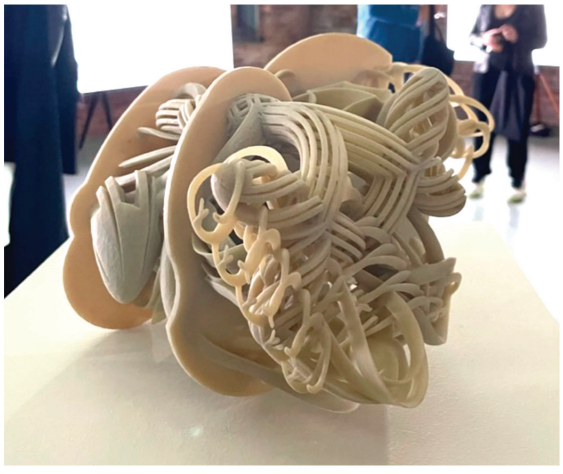

Figure 3. A 3D printed model of Frank Stella's *Geometry XVIII*. Photo by the author, 8 September 2022.

Stella's works are a particularly rich case study in the dilemma of a "phygital" work (a portmanteau that combines a physical object and digital manifestation.[5] The term was in use by the mid-2000s in relation to retail experiences and was widely adopted in 2020 with regards to Web3-driven curatorial practices.[6] My article specifically focuses on four concurrent themes that emerge from Stella's project. I first begin by tracing a brief history of the invention of NFTs and how Stella's interest in the technology is intrinsic to and preceded by the very intention behind its creation. I then outline Stella's project in relation to his own artistic production, particularly the *Geometries's* formal relationship to printmaking, and how Stella's approach diverges from contemporary works that also engage with the value of phygital works, such as Damien Hirst's *The Currency* (2021–2022). Thirdly, I consider the concept of digital materiality in terms of how NFTs have been publicly exhibited. Here, I consider works by artists such as Jennifer and Kevin McCoy and LoVid as they leveraged aspects of blockchain technology to recenter agency and reorder material values with regards to conditions of their institutional displays. Finally, I argue that debates central to the NFT space find historic and already articulated parallels in institutional documentation of performance and time-based works. Ultimately, at its core, I argue that Stella's project

demonstrates the porous boundaries of the materiality of new media, and unpacking NFTs' recourse to historical tangible forms outlines conceptual and theoretical debates crucial to future institutional exhibition, installation, and presentation of fine art NFTs.

2. "To Create Indelible Provenance": A Background on NFTs

In a conversation in September 2022 with the digital artist Andres Reisinger, Frank Stella defined what he saw as three advantages of NFTs, stating, "they are a way to address ownership and reproducibility of digital art. They can also have built-in resale rights".[7] From the onset, NFTs were created with these very themes as their central mandate. At its very base, a "Non-Fungible Token", is a type of publishing technique that creates ("mints") unique, limited, or open editions of tradable digital assets. The art market journalist Tim Schneider has succinctly unpacked the importance of the two-part term writing, "The 'non-fungible' aspect comes from the fact that each NFT has a value independent of all others, including different editions of the same work, kind of like fine-art photographs or prints. 'Token,' meanwhile, is a term of art for a unique alphanumeric code recorded on the blockchain. Like an inventory number or tracking code, the token locates the actual asset within a larger system".[8] The resulting product is a secure combination of blockchain technology and digital media files that permanently encodes authenticity, provenance, and sales history through a smart contract on a blockchain. A smart contract is a program that runs on a specific blockchain, the latter is a largescale database composed of a cooperating network of computers.[9] Having this data "on-chain" not only endows each version of the work with its unique value but also initiates the possibility of guaranteeing artist rights in an unprecedented way.

The inaugural marriage between a visual work with the permanence of the blockchain occurred in 2014 at a yearly hackathon organized by Rhizome, titled "Seven on Seven" (7×7), which paired artists with technologists for a day.[10] There, the artist Kevin McCoy (one half of the artist duo Jennifer and Kevin McCoy) was paired with the technologist and writer Anil Dash. Driven by McCoy's desire to "use blockchain technology to create indelible provenance and ownership of digital images", the duo minted the first NFT, *Quantum* (Figure 4, 2014–2021) which essentially was a combination of two things: a digital file and a registration on a blockchain (Jennifer and Kevin McCoy 2014). The digital file was a visually generative work by McCoy that featured a psychedelic mirage of pulsating concentric shapes inspired by cycles of life and movement. The registration of *Quantum* on a blockchain (specifically, the Namecoin blockchain) was a determined rejoinder to the problems inherent in the digital dissemination of works. Instead of allowing works to be shared without proper attribution or remuneration to the maker, NFTs permanently connected a digital file to the maker by creating a scarcity framework around an otherwise infinitely replicable digital asset, and in so doing, impose the same kind of conceptual and market dynamics on digital works that preexist for physical works.

While NFTs were thus invented in 2014, market and institutional attention to this new technology paralleled the art world's interest in cryptocurrency, reaching highs from 2020 to 2022 driven by speculative investment. The former is best exemplified by the founding of the Sotheby's "Metaverse" department in September 2021, and the latter by the active minting of works from their permanent collections by museums such as the British Museum, the Galleria degli Uffizi, and the Hermitage Museum.[11] These different classes of entities collecting and trading NFTs allude to an extended gap in artists' rights that should have been guaranteed by the smart contracts: at Sotheby's, secondary market sales of traditional artworks do not benefit artists directly, and at museums, the sales wholly benefit the institution as works are often minted after long-deceased artists without estates to manage their interests in the present day. In this gap, the Artist Rights Society (founded in 1987) launched its own in-house platform on August 2022.[12] This new platform, Arsnl, defined its mission as bridging "the fine art world and digital art space through collaboration and intellectual property protection".[13] For them, launching their digital platform with a series of works by Frank Stella combined two aspects: Stella's sculptural practice which in

themselves formally embraced digital tools, and the artist's long-time campaign to codify resale royalties for artists. Indeed, there is a ten percent resale royalty embedded in the smart contract of each edition of *Geometries*.[14] However, analysis of *Geometries* to date has treated the series as an unindividuated whole. Through close consideration of the forms selected for the series, I assert that they are deeply indebted to and formally oriented toward reproductive technologies.

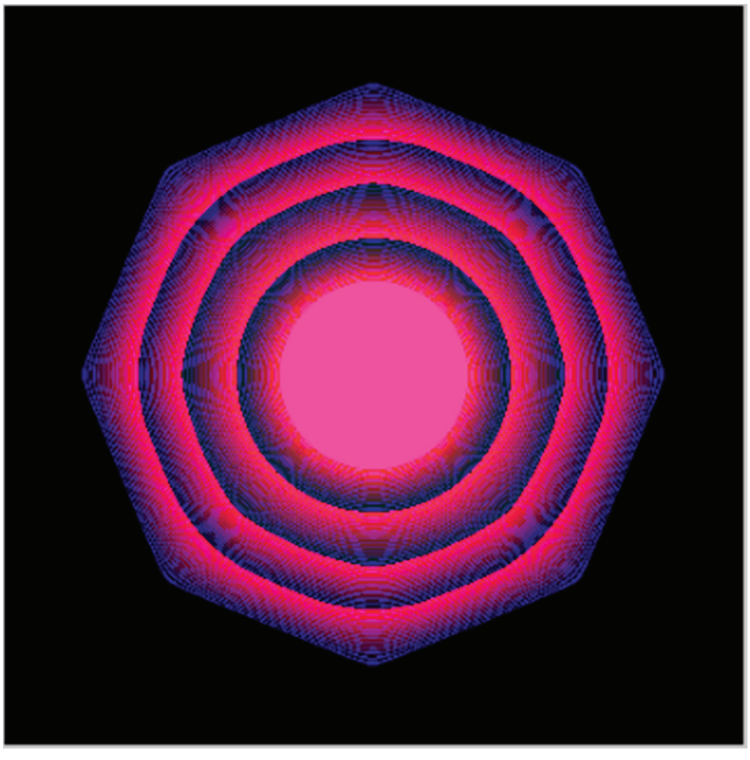

Figure 4. Kevin McCoy, *Quantum*, 2014. NFT (Screenshot of a GIF). Photo courtesy of Postmasters Gallery and the artist.

3. The Geometry of Frank Stella's *Geometries*

Geometries (Figure 1) is composed of twenty-two asymmetric interwoven cylinders and polyhedrons whose open trusses are sometimes perforated by rogue vectors. Each of the twenty-two forms were issued in editions of one hundred. One-third of them highlight the star motif that has been central to Stella's work since the 1960s and is as much a part of his visual signature as his study of smoke rings.[15] As previously noted, the structures are natural extensions of Stella's artistic practice. Iconographically, they fall within the lineage of Stella's sculptures and paintings made with CAD/CAM software, such as the following series of works: *Italian Folktales*, (1988–1989), *Imaginary Places* (1994–1999), *Bali* (2002–2009), and *Scarlatti K* (Figure 5; 2006-present).[16] These polychrome calligraphic reliefs defy categorization as 2D or 3D objects to instead revel in what Frank Stella called "frozen gestures", that in turn activate a visual and a virtual mode of seeing.[17] It is thus impossible to determine whether Stella's interest in these forms or the technology to realize them came first; Jason Bailey noted in his essay for the launch of *Geometries* that it was serendipitous that "Stella's march toward increasingly complex geometries coincided perfectly with rapid advances in computer-aided drafting (CAD), digital fabrication, and 3D printing".[18]

However, *Geometries* and their extended visual and structural concerns are extensions of his earlier work in theorizing and engineering the relationship between space and surface.

Figure 5. Installation shot of "WG. 62: Frank Stella, Recent Work", 4 June–5 July 2013, Wetterling Gallery, Stockholm, Sweden. Photo: Jean-Baptiste Béranger. Courtesy of Wetterling Gallery, Stockholm. © 2023 Frank Stella.

By virtue of their multiple digital formats, *Geometries* is simultaneously in motion (MP4) and in flattened 2D space (as a JPG). The fluidity of the forms across linear and dimensional spaces is primarily rooted in Stella's own approach to "pictorial space", which he historically situated "in-between" 2D and 3D.[19] This fluctuating space is the culmination of a sort to Stella's inexorable drive toward creating "a sense of motion and action within a static medium" (Stella and Clearwater 2000, p. 86). This attention to space may even be conceptually traced back to Stella's *Irregular Polygons* (1965–1966), a series of eleven individual compositions with four color variants (totaling forty-four paintings) featuring variations of interlocking and abutting asymmetric shapes. Considered a radical shift from his previous striped paintings, *Irregular Polygons* were innovative forms that addressed space and vision, even occupying a central role in Michael Fried's influential essay, *Shape as Form* (1966).[20] For Stella, interrogations of space remained central to his work thereafter, best exemplified by his "Working Space", a series of six Charles Eliot Norton Lectures delivered at Harvard University from 1983–1984 where he expounded on the relationship between the state of abstraction vis-à-vis venerable Old Masters such as Caravaggio, Michelangelo, Titian, Peter Paul Rubens, Diego Velazquez, and Leonardo da Vinci. There, Stella asserted that "the aim of art is to create space—space that is not compromised by decoration or illustration, space in which the subjects of painting can live", a view that seems ever pertinent in his exploration of digital and virtual space.[21] For Stella, paintings and sculptures oscillated in the same multidimensional space, a perspective that echoed the contemporaneous attention to the fluidity of the sculptural medium itself. Rosalind Krauss has notably stated in her influential essay, "Sculpture in the Expanded Field", that "for, within the situation of postmodernism, practice is not defined in relation to a given medium-sculpture-but rather in relation to the logical operations on a set of cultural terms", arguing

for an "organization of work that is not dictated by the conditions of a particular medium" (Krauss 1979, pp. 42–43). In fact, with regards to his *Scarlatti K*-series—to which *Geometries* have been most extensively compared—Stella saw his wall-mounted relief configurations as "multidirectional paintings", as they "function in a pictorial way".[22]

Beyond his conceptualization of pictorial space, the specific geometries of *Geometries* stage a meta-argument into new spatial materiality as they are Euclidean solids staged in non-Euclidean space. On the one hand, Stella has always demonstrated an interest in new materials throughout his career by incorporating fiberglass, carbon fiber, and plastics made through prototyping technology and synthetic resins into his works.[23] On the other hand, his formal inspirations have a historic basis in early modern explorations of perspectival geometry and their (in)ability to be translated into different materials. We might compare Stella's colliding and exploding forms to sixteenth-century goldsmith Wenzel Jamnitzer's exploration of Platonic solids (Figure 6) that were then subsequently realized in new materials such as lathe-turned ivory or innovations in metalworking. Stella has additionally noted that his works are not only about "computing the faces of polygons" but also speak to the symbiotic relationship between material and form, asserting in 2012 that his adoption of improved plastic material has lent themselves to the creation of new complicated shapes for the *Scarlatti K*-series (Stella et al. 2017, p. 16; 2012, p. 24). The emphasis on Platonic solids central to *Geometries* preemptively positions the forms toward reproductions either as 3D printed forms in physical space or as digitally encoded materials suspended in virtual space.

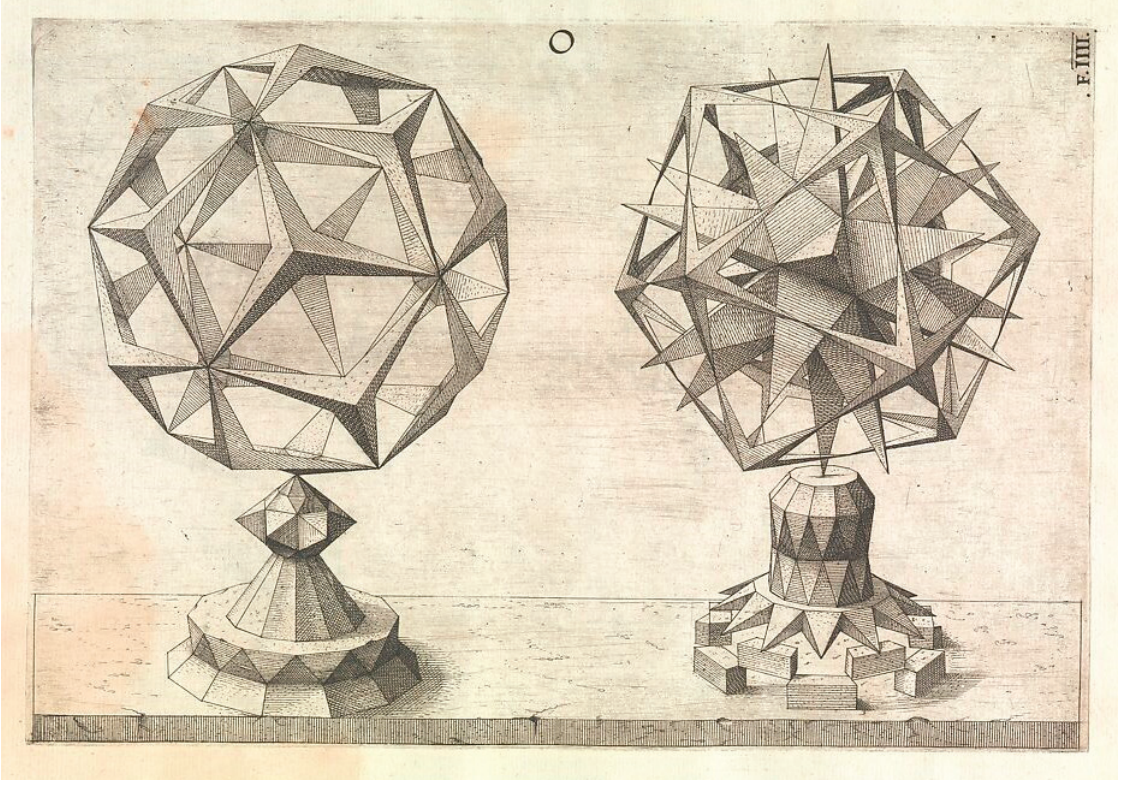

Figure 6. Jost Amman after Wenzel Jamnitzer, *Perspectiva Corporum Regularium*, Plate O, F.IIII, 1568. Etching on Paper. 35.0 × 25.5 × 1.0 cm. Inv. no. 24.45.1. Harris Brisbane Dick Fund, 1924. The Metropolitan Museum of Art, NY. Image in the Public Domain.

This link between form and material is further compounded by Stella's resuscitation of earlier shapes in *Geometries*. Some were previously licensed for merchandising. For example, *Geometry XII* (third row down and second column from the left in Figure 1) reprises the same model as a gold ring Stella made in 2008 with the Dutch designer Ernest Mourmans (Figure 7), the first "wearable art" the artist has produced. Additionally, his open-weave stars are similar, if not identical, to the holiday ornaments Stella designed for the Whitney Museum of American Art's shop in 2014. Practically, these tried-and-tested models would have been ideal additions to *Geometries*, given that they had been once stably realized in the corporeal form. The resuscitation of these compositions into digital files inherently orients *Geometries* as a series intended for reproduction by dually co-opting Stella's formal exploration of new materials and to a certain extent, referencing early modern artistic experimentations in Platonic solids.

Figure 7. Frank Stella, *Ring*, 2008. 19 kt yellow gold ring, 4.4 × 8.9 × 5.1 cm. Edition of 10. Signed and numbered. Photo: Deniz Guzel, Courtesy of Elisabetta Cipriani.

4. Stella[r] Prints

The individual forms of *Geometries* are tied to Stella's interest in reproduction, particularly printmaking. To a degree, the open-endedness of the shapes is preceded by Stella's earlier works, as he has always been interested in expanding the framework of formats through repetition and seriality.[24] For Stella, however, printmaking has a long material history. He famously claimed to have "absorbed printing—a printmaking way of thinking—into the pattern of [his] normal thought process" (Stella and Clearwater 2000, pp. 84–85). Given this, the 3D printed models after Stella and his tokenization of the series on the blockchain may be seen as types of prints. In fact, many adopters of blockchain technology have made similar comparisons: Hannes Koch (one of the co-founders of interdisciplinary

art studio Random International) has discussed the merger between NFTs and immersive installations as akin to publishing a print. For their installation *Living Room* (2022), Random International converted a visitor's spatial journey inside the work into digital line drawings that could then be minted as NFTs, with Koch saying that for artists "whose work is code and cameras and displays, this is the appropriate format to add to the canon of lithographs and editioned prints".[25] This comparison to printmaking is particularly persuasive in the context of Stella's œuvre as printmaking was strongly linked to his exploration of technology and new media (Stella and Clearwater 2000, pp. 81–91; Stella et al. 2017, p. 22).

Here, I return to the star motif in *Geometries*, which remains recognizable in seven of the twenty-two forms or elsewhere deconstructed into vectors. From the onset, the star motif served as Stella's geometric self-portrait, as recorded in a drawing from 1960–1961 in which he translated his peers into abstracted shapes.[26] As a shape, the star was central to Stella's interest in printmaking as it formed the basis of the first series of prints he ever published: a series of lithographs made in collaboration with the master printer Kenneth Tyler for Gemini G.E.L in 1967 (Stella et al. 2020, pp. 16–17). The *Stars of Persia* series was later described by Stella in 1995 as the "perfect example of an artist's frustrating introduction to a new medium", as he lamented the inability of the paper to match the complex spatial intermediality of his paintings and reliefs (Stella and Clearwater 2000, p. 87). In the same lecture, Stella even speculated on the future possibility of a "built" print, imagining "a more malleable type of paper that could stretch itself in more than one direction, a paper with the properties of spandex", while at the same time stressing that he sought to explore a type of printmaking that would not exist *after* a painting but rather prints that "could be made concurrently, simultaneously" (Stella and Clearwater 2000, pp. 82, 89). The digital capabilities of Stella's NFT project thus allow his models to exist simultaneously across media. As such, the resonance of the star shapes in *Geometries* underscores Stella's long-time interest in the possibilities of reproduction and positions his approach to NFTs as a type of printmaking.

This concept raises a vital question: are the printed models akin to editioned prints whereby the value of the work equivocates between the printing matrix and their imprints? Legally, Arsnl and Stella are quick to identify a major difference between this cross-media afterlife of Stella's *Geometries*. According to the official "Collector's Rights Agreement", the owner of *Geometries* is given four main rights: to create derivatives using the geometry as source material; to 3D-print the form at any scale, material, or color; to use and display the NFT and the models in physical and virtual spaces (i.e., the metaverse); and finally, to resell the NFT on any platform or marketplace that recognizes its digitally embedded resale royalty provision in the smart contract. In the case of the last, the previous owner is allowed to retain any models or derivatives they created during the time they owned the work. Yet, one of the more ambiguous aspects of *Geometries* is that the fine print states that the models (such as Figures 2 and 3) are not considered to be an artwork by Frank Stella, and authorized only for "personal, non-commercial use and may not be gifted, sold, or transferred or otherwise used or exploited" (Arsnl and Open Sea 2022). How might we reconcile these seemingly divergent approaches to agency, phygital materiality, and their corresponding artistic values? In this section, then, I will address this dilemma by turning to other works that overtly test the digital and physical in tokenized works. A productive comparison may be made between Stella's devaluing of a printed model of *Geometries* and Damien Hirst's *The Currency* (2021–2022), an infamous contemporaneous project that staged a diametrically opposed argument to Stella's. This debut NFT project by Hirst questioned the materiality of value itself. In 2021, Hirst minted digital reproductions of 10,000 unique works on paper he had hand-painted in 2016, essentially giving each NFT a physical counterpart (HENI and Damien Hirst 2021–2022). Taking the conceit a step further, Hirst mandated that the owner of each NFT had a grace period of a year to sell and exchange the token *ad infinitum*, but at the end of the year, the owner at the time would have to choose between either the tokenized digital work or the physical work. For those that opted for the digital, the corresponding work-on-paper was to be destroyed, a process that

Hirst claimed was "bringing the works to life", a curious inversion of Theodor Adorno's argument on the synchronicity of museum as a mausoleum (Adorno 1983). Indeed, the unclaimed physical works were burned by the artist himself on 27 July 2022 (Figure 8) (Rea 2022; Morton 2022).

Figure 8. Damien Hirst, The artist at Newport Street Gallery for the grand finale of *The Currency*. Photo: Courtesy of Naomi Rea, 27 July 2022, Published in *Artnet News*, 12 October 2022.

The title of Hirst's work, *The Currency*, not only addresses the outsized attention to the market in the NFT space but also alludes to longstanding concerns regarding digital materiality, a term that encapsulates inquiries into how digital processes, forms, and intentionalities intersected with their material counterparts (See also Pink et al. 2016; Geismar and Knox 2021). Recent approaches to the concept have advocated not for a dichotomy between the material and the digital, but for an acknowledgment of multiple levels of concurrent operations. For instance, Heather Horst and Daniel Miller noted in 2012 that digital materiality is comprised of attention to "digital infrastructure and technology. . . of digital content. . . and digital context" (Horst and Miller 2012, p. 25). In terms of traditional plastic arts, companies such as Factum Foundation have sponsored academic publications on how their projects in the cultural heritage preservations sector intersect with historical models for early modern arts and architecture (Lowe 2020). Hirst's combination of hand-made paintings on paper and NFTs can be considered alongside an assertion Jacques Derrida made in the exhibition catalogue of *Les Immatériaux*. Derrida emphasized the exchange function inherent in the term, "material" asserting that it "resonates like a currency, a currency of exchange with the history of its concept, paying homage to the 'tradition of modernity.'"[27] While new materiality as a type of currency is at the core of Hirst's experimentation, in practice, 51.5 percent of the token holders (5149) opted for the physical referent over the digital, a number that does not include Hirst's personal purchase of 1000 of his own NFTs to keep them in their digital form (Rea 2022). The end result of Hirst's experiment was that when faced with a direct one-to-one value proposition, the physical artwork was preferred over the digital. Conversely, Stella's *Geometries* does not equate the physical form (i.e., the model) with the digital file, in turn allowing for the work to remain

digital and negate any Hirst-like debates over value. Instead, Stella's project fuses the perceived "authority", of the work with the conditions enumerated in the blockchain. In other words, instead of dematerializing artistic authorship through intangible multimedia, it rematerializes a type of digital materiality inherent to the character of the blockchain.

5. Private Star/Public Star

This tenuous relationship between the visual, physical, and structural character between the conditions of an NFT, its digital work, and its physical counterpart is made even more tenuous once NFTs enter institutions, and thus become subject to circumstances of display not necessarily compatible with the work's internal demands. In this section, I consider Stella's *Geometries* alongside two NFT projects in the collection of the Whitney Museum of American Art: NFTs by LoVid (an artist duo composed of Tali Hinkis and Kyle Lapidus), and by Jennifer and Kevin McCoy. Their projects offer differing approaches to the integration of NFT into their practice that in turn illuminate the future potential of the medium.

Stella's project as discussed above, does not only eschew physical materiality by denying their reproductions as authored artworks, but also seemingly denies a physical form to the digital files by refusing to specify which equipment should be adopted for in-gallery presentation. Compare this to the approach of LoVid. Two versions of their eighteen video series *Hugs on Tape* (*Beals*, 2021 and *David/Tanya*, 2021) were some of the earliest NFTs acquired by the Whitney.[28] The works themselves (Figure 9) feature two layers of video: a loop of an analog video of a spontaneous hug that is then digitally overlaid with colorful patchwork designs. According to Hinkis, these fabric-like patterns were originally generated with analog synthesizers, circling back to what Sadie Plant referred to as the inevitable alignment between fibers and filaments, as cables essential to the technological operation of digital networks were seen as akin to the production of textiles (Plant 1997). Just as Stella's Platonic forms were embroiled in the history of material reproductions, the visual patterns in LoVid's works are generated from the materiality inherent in the technological media itself.

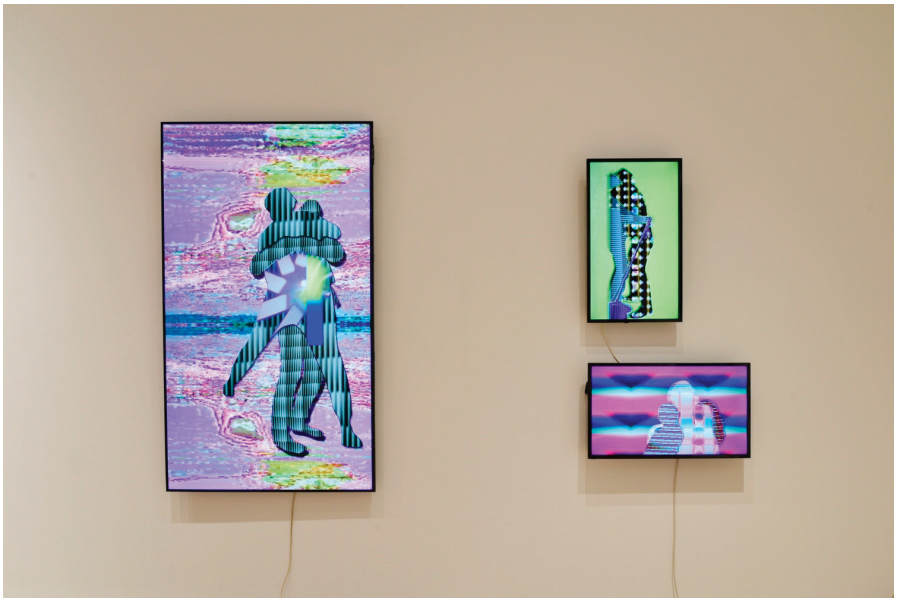

Figure 9. LoVid, Installation view of "Hold On" (19 March–23 April 2022). Courtesy of Postmasters Gallery and the artists.

Hugs on Tape remains a particularly interesting case in terms of the musealization of NFTs. In a conversation on June 2023, Hinkis noted the physicality of digital art—actualized through her specification that the work at the Whitney be presented on a screen—by describing *Hugs on Tape* as a type of painting that operates at the "scale of the body".[29] LoVid emphasized the apparatus of the display, with Hinkis asserting that the work was "not so much about the mechanism of the NFT" but rather a reaction to the "recognition of the historical moment", meaning a response to the speed and indiscriminate influx of works at the height of the NFT market boom in 2021 (Ibid). True to form, earlier showing of the work at the Postmasters Gallery in 2022 (Figure 9) displayed their work on screens of varying sizes, privileging physical format of the files instead of, for example, having a centralized device that would enable visitors to click through multiple files. Madga Sawon, the co-founder of Postmasters (who has worked with both LoVid and Jennifer and Kevin McCoy) outlined three important factors in displaying NFTs: the ratio of the NFT, preference by the artists, and what is possible given the resources.[30] Sawon additionally outlined that there exists a "whole hardware industry producing NFT screens", that will "soon be obsolete like much of technological march", alluding to the concerted attention toward devices that give physical form to the digital (Ibid). As such, in the case of LoVid's work, an institutional recognition of the work as an NFT recorded on the blockchain is essential not to the work's inherent visual, physical, and material operation but instead to its cultural context.

Conversely, consider the McCoys' project *Public Key/Private Key* (2019) that recentered the issue of value in the contractual potential of the NFT as a medium in relation to institutional presence. The work infused capabilities afforded by the blockchain into the Situationist strategy of *detournement*: a reworking of public symbols and images with subversive social meanings and historical memories. This project was launched online on 5 March 2019, at the Whitney Museum of American Art's official website. The work was comprised of two components: first, a unique 16 mm film shot in Lake Oscawana in New York and housed in a metal canister, and second, fifty of what were then called "blockchain certificates" (NFTs before the term became commonplace) awarded to fifty individuals deemed to have submitted the most compelling essays in response to an open call asking why they should become one of the donors of the work (Jennifer and Kevin McCoy 2019; See also Jennifer and Kevin McCoy 2018). The work is a contemporary update to institutional critique that sought to deconstruct institutional authority notably exemplified by works such as Hans Haacke's *MoMA Poll* (1970) and Krzysztof Wodiczko's *Hirshhorn Museum, Washington D.C.* (1988) that overtly intervened into the historical dialectics of conceptual art. Just as these works sought to expose the hidden underpinnings of institutional space and governing structures, the McCoys' work sought to address the role of donors vis-à-vis ownership of art in museums.

The work confronts the false neutrality of works within museum spaces and interrogates the power dynamics between art institutions and their donors by altering the private and public aspects of ownership. The title of the McCoys' work is a play on the conception of public-key cryptography, which generates separate public and private "keys" (essentially, passwords) offering different levels of access to encrypted data that can then be communicated confidentially, such as in the use of digital signatures.[31] It is for this reason that public-key cryptography is also sometimes called asymmetric cryptography. Similarly, the work operated on two levels. On the public side, the fifty selected winners' names were all recorded "on-chain", as a list of donors was to be included in every future display of the 16 mm film. (The film itself also includes a depiction of a blockchain key that, upon the film's showing at the Whitney, would earn the first viewer to transmit it to the artists a fifty-first donor NFT.) On the private side, each of the fifty original participants were also permitted to transfer, gift, or sell their blockchain certificate at their discretion. As the certified donors of the work changed through swaps and sales of the NFTs, however, the public key—that is the ledger at the Whitney—stopped being updated six months after the project's initiation, locking the public donor list in place regardless of its members'

subsequent trading activity.[32] In other words, while the actual composition of the donor cohort might change ad infinitum after the artist-imposed deadline, new names would not be memorialized in the museum record. This wrinkle profoundly questions the worth of the NFT transactions, resulting in a work that Tim Schneider has argued "distill[s] its value proposition to the visible credit for its donation" (Schneider 2019). Here, the physical 16 mm work has no intrinsic value—its function hinges on the dual recordkeeping uniquely enabled through the work as an NFT.

Similarly, Stella's work at its base also offers a reconsideration of the potential of blockchain as a medium by elevating the ability of the technology over the plastic arts. While *Geometries* seemingly decentralizes its materiality through co-creation with, and participation by, its owners, in actuality the series centralizes authority with Stella by negating the value of any reproduction and subjugating its operational and financial value to the blockchain conditions, in turn safeguarding the artist's rights. The copyright law professor, legal historian, and artist Brian Frye distinguished between NFT works "for which the token is the medium" and "NFTs consist[ing] of a URL. In other words, they represent ownership of a work of art" (Frye 2023). By focusing on how and where material values manifest in NFT works, whether it be the visual form, the apparatus of presentation, or its internal conditions of circulation, the works of Stella and his peers in this space demonstrates the collision that occurs between the digital token and its will to physicality.

6. Documenting the Non-Fungible

The unifying force between the works explored is their ambivalent relationship to their physical manifestations. In my view, this attention to materializing the intangible operations of NFTs can be productively framed in earlier cases where non-plastic arts were faced with the very plastic demands of a collection, such as the case of performance art. Time-based performances are by nature ephemeral events that, in the view of some artists and conservators, can never be repeated. For example, Peggy Phelan has stated that "performance's only life is in the present. Performance cannot be saved, recorded, documented, or otherwise participate in the representations of representations: once it does so, it becomes something other than performance" (Phelan 2006, pp. 146–48). At the same time, the primacy of exhibition remains central with Peter Osborne asserting in 2013 that "the art market may still be trading in individual works, but it is the exhibition that is the unit of artistic significance, and the object of constructive intent" (Osborne 2013, pp. 167–68).[33] Given this tension between NFTs and the apparatus of its display, I offer a thought experiment: might the interwoven hierarchies of material values of NFT projects be institutionally staged as a type of a performance?

Often, institutional display of performance art relies on satellite ephemera to represent the original work. One of the more recent instances I witnessed of this long-standing paradigm was at a monographic exhibition on the Chilean dancer and performance artist Sylvia Palacios Whitman (active in New York in the 1970s and 80s) staged at the Americas Society, NY (7 June–22 July 2023) The exhibition represented Palacios Whitman's performance pieces through a wide variety of media (Figure 10) including audio and video recordings, photographs, props, artist's statements, and drawings. It should be noted that not all performances can reliably turn to documentation; for example, Tino Sehgal famously does not allow records of any kind to be made of his performances. Even when video and photographic documentation is allowed, it is often not considered to have an indexical relationship to the work. At times, it becomes a new work altogether. For instance, Babette Mangolte, a prolific photographer of the downtown performance scene whose recordings of Palacios Whitman are featured in the Americas Society exhibition, has argued that visual documentation of performance art can "mislead" its audience, stating, that one has to, at times, "fight the documentation in order to rethink the performance".[34] Despite Mangolte's reluctance to have recordings replace it, documentation, i.e., physical reproduction of the event, is essential to the future analysis and historicization of a performance piece—similar to the inclination toward physical counterparts of many NFT works, including *Geometries*.

Figure 10. Installation view, "Sylvia Palacios Whitman: To Draw a Line with the Body", (7 June–22 July 2023), America Society, New York, NY. Photo by the author.

To return to Stella, he noted in 2022 with respect to *Geometries* that "no matter how digitized [*Geometries*] gets in the process, it always ends up a physical reality".[35] In fact, the "Collector's Rights Agreement" is careful to enumerate that reproductions can be shown in non-profit spaces, including museums.

This emphasis on the "physical reality" despite its lack of resale value ultimately gestures at the dual level of ideological demands levied at a new media artwork: a dual desire for concrete physicality by the institution showing it and the public consuming it. This expectation imposed on reproductions of *Geometries* versus the actual condition of the work can thus be compared to what Philip Auslander has outlined in his study of the performativity of performance art documentation. Auslander asserts, "the crucial relationship is not the one between the document and the performance but the one between the document and its audience. Perhaps the authenticity of the performance document resides in its relationship to its beholder rather than to an ostensibly originary event" (Auslander 2006, p. 9).

Just as the various modes of physically archiving performances presage their eventual institutional displays, analyzing the materiality of NFTs in each iteration of their multi-media formats is essentially an exercise in viewership and how it aligns with the decisive transparency granted through the blockchain. Unpacking new media's return to historical forms demonstrates how it is only through historical forms that the new media can assert its material innovations.

7. Conclusions

This article has sought to use Frank Stella's *Geometries* as a prism through which to view the complex relationship between the visual, physical, and structural aspects of NFTs, with an eye toward the following questions: What precipitated Stella's turn toward this new medium? How do the works' formal elements relate to their digital processes? And how does this series navigate contemporary institutional demands? To that mandate, I first contextualized the development of NFTs alongside Stella's long-standing interest in artist's resale royalties. Having established *Geometries* as a conceptual extension of his overall artistic practice, I next explored how individual geometries in the series connect to historical, artistic, and material aspects of Stella's engagement with reproducible media, most notably printmaking. Third, I turned to contemporary digital artists' unease with "phygital" art in our contemporary moment. This anxiety unfolds at the levels of both value and presentation. With regards to the former, a productive foil to Stella's reproducible geometries is Hirst's *The Currency*, which inherently argued for a one-to-one relationship between physical and digital. With respect to the exhibition, I compared *Geometries* to NFT projects by LoVid as well as Jennifer and Kevin McCoy, both of which reside in the collection of the Whitney Museum of American Art. These projects highlight the evolving dialectic of NFTs in institutional contexts by offering distinct examples of how artists negotiated the complex and ambivalent relationship between the digital and the material, the virtual and the spatial. Finally, I offered a thought experiment comparing the multiple layers of Stella's *Geometries* and its corresponding hierarchies of value to the fraught dynamics of exhibiting performance art. Ultimately, the material innovations of new media can best be understood when examined in relation to historical forms, emphasizing the interplay between their creative operations and their material orientation toward their presumed audiences.

Stella's work exemplifies a thoughtful intersection between art and digital technology. While the multiple formats of the *Geometries* appear to dematerialize artistic authorship, Stella's project rematerializes digital materiality through the nature of the blockchain. At a broader level, this article hopes to continue the conversation concerning the conceptual and material stakes in this nascent wave of artistic and institutional inquiry, with the promises and shortcomings of NFTs manifesting through their conditions, their mediation of the digital and the physical, and the interplay between the technique of one and the format of the other.

To conclude then, I return to *Les Immatériaux*, and Christine Buci-Glucksmann's assertion in the catalog that "matter is no longer what it was. . .due to the impact of science and technology it has shed its classic criteria of identity".[36] As noted throughout this essay, Lyotard, along with Buci-Glucksmann, imagined a rather apocalyptic erasure of the author with the onset of new materiality, with the former asserting that the scale of contemporary technoscience "is no longer a human one".[37] At least in the case of NFTs, however, there seems to be an affirmation of the author that is thoroughly detached from material conditions—an affirmation that emerges through an insistent attachment to the plastic arts. Stella once asserted that "virtual space has no ground. . .it's about destroying the ground so you can explore all the dimensions and viewpoints".[38] Through NFTs, the "dimensions and viewpoints" extend not only to Cartesian coordinates but also to chipping away at the fourth wall of the market, creating a collision between the artist and the collector, as mediated layers of phygital materiality ultimately operate at a profoundly human scale.

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Conflicts of Interest: The Author declares no conflict of interest.

Notes

1 Jean François Lyotard, "Les Immatériaux (1985)", in (Greenberg et al. 1996, p. 164).

2 Quoted from Frank Stella's conversation with Andres Reisinger, see (Droitcour 2022).

3 Lyotard, "Les Immatériaux (1985)", in (Greenberg et al. 1996, p. 165).

4 Debuted on the platform, Arsnl as "Frank Stella: Geometries," in (Arsnl 2022b).

5 Chris Weil at the Australian-based firm Momentum Worldwide has been often cited as the inventor of the term, "phygital". However, the term appears to have been in use as early as 2004 according to Google Trends data. See also (Morel and Bier 2023, p. v); See "Chapter 11: Phygital customer experience. Definition, characteristics, types, and key success factors", in (Batat 2019).

6 For instance, the exhibition, "Seeing the Invisible", was sponsored by the Outset Contemporary Art Fund and hosted at the Jerusalem Botanical Gardens, sought to "create a new 'phygital' model". See (Artnet News staff 2021); seeingtheinvisible.art/about/. See also (Kinsella 2022; Harris 2021).

7 See Stella's conversation with Reisinger, in (Droitcour 2022).

8 For an introduction to NFTs, see (Schneider 2021).

9 Ibid; Tim Schneider in conversation with the author, 5 September 2023; (Smith 2023).

10 For more, see (Rhizome 2014).

11 For some instances of museums minting works on the blockchain, see (Khomami 2021; Dafoe 2021; Nayeri 2022).

12 According to Katarina Feder, the Founder and CEO of Arsnl, the launch of *Geometries* was originally scheduled for June 2021 but was delayed due to market conditions. See (Schneider 2022b).

13 For the full press release, see (Arsnl 2022a).

14 For further details on the royalties system, see (Arsnl and Open Sea 2022).

15 For more on the star motif in Stella's artistic production, see (Stella et al. 2020).

16 To a certain extent, they also harken back to Stella's occasional use of maquettes for paintings. See (Stella et al. 2011b, pp. 58–67); (Droitcour 2022).

17 In an interview with Andrianna Campbell, Stella asserted, "I don't do computer work. I draw and this gets translated into AutoCad or some other digital-imaging program. It's merely a tool. . . I only think about the imagery, then I have to arrange it in space, when it gets to be physical". Andrianna Campbell *and* Frank Stella, "*Interview*: *Andrianna Campbell* in *conversation* with *Frank Stella*", in (Stella et al. 2017, p. 11); Robert Hobbs, "Connecting Past and Present", in *Frank Stella: Connections* (Stella et al. 2011b, pp. 17, 29); Frank Stella, "Melrose Avenue", in (Stella and Clearwater 2000, p. 86).

18 See Jason Bailey's exhibition statement for "Frank Stella: Geometries," (Bailey 2022; Arsnl 2022b).

19 Frank Stella quoted in (Stella et al. 1988, p. 31).

20 Stella in conversation with Claudia Bodin in 2012 referred to the *Irregular Polygons* as "his most interesting art". See Claudia Bodin and Frank Stella, "Order within Chaos: Claudia Bodin in Conversation with Frank Stella", in (Stella et al. 2012, p. 21; Stella and Kennedy 2010; Fried 1966, pp. 18–27).

21 Stella's lecture was fully published as (Stella 1986, see also p. 5).

22 Michael Auping, "The Phenomenology of Frank: 'Materiality and Gesture Make Space", in (Stella et al. 2015, pp. 36–37); Stella and Kennedy, *Frank Stella: Irregular Polygons, 1965–66*, p. 5.

23 For Stella's use of materials and technology, see (Stella et al. 2011a, pp. 21–24).

24 Stella's tendency to favor repetition is seen to be influenced by Samuel Beckett. See Stella and Kennedy, *Frank Stella: Irregular Polygons, 1965–66*, p. 81; (De Antonio and Tuchman 1984, pp. 141–42).

25 Koch's interview can be found in (Schneider 2022a).

26 Frank Stella, *Untitled (List of Copper Paintings, 1960–1961, and Purple Paintings)*, 1961. Reproduced in Stella, Smith-Stewart, and Klein, *Frank Stella's Stars*, p. 14.

27 Jacques Derrida, "Matériau", in (Lyotard and Chaput 1985, p. 124), translated by Philippa Hurd in 2015, cited in (Lange-Berndt 2015, p. 208).

28 Both works by LoVid were transferred to the Whitney's institutional wallet on 19 September 2023.

29 Author's conversation with Tali Hinkis in New York, 7 June 2023.

30 Author's correspondence with Magda Sawon. Conducted over email, June 2023.

[31] Author in conversation with Tim Schneider, 10 June 2023; (Buchmann et al. 2013; George 2023).

[32] For the "Donors of Record", list see whitney.org/exhibitions/public-key-private-key#exhibition-tertiary (accessed by the Author on 18 September 2023).

[33] Osborne's assertion echoes the claim in *Thinking about Exhibitions* (1996), which described exhibitions as "the medium through which most art becomes known". See (Greenberg et al. 1996, p. 2).

[34] Babette Mangolte, "Balancing Act between Instinct and Reason or How to Organize Volumes on a Flat Surface in Shooting Photographs, Films and Videos of Performance", in (Clausen 2007, p. 45). This views directly overturn Kathy O'Dell's assertion that "performance art is the virtual equivalent of its representations". (O'Dell 1997, p. 77; Auslander 2006, p. 5).

[35] Stella's quote taken from conversation with Reisinger, see (Droitcour 2022).

[36] Marshall McLuhan has further noted that electronic media conflates space and time. Christine Buci-Glucksmann, "Dématérialisation", in *Les Immatériaux, Epreuves d'écriture*, eds., Lyotard and Chaput, p. 42, translated by Ian Farr in 2015, cited in Lange-Berndt, *Materiality*, p. 207.

[37] Lyotard, "Les Immatériaux (1985)", reproduced in (Greenberg et al. 1996, p. 164).

[38] Frank Stella quoted in Auping, "The Phenomenology of Frank: 'Materiality and Gesture Make Space", p. 36.

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Review

Integrating NFTs into Feminist Art Practices: Actualizing the Disruptive Potential of Decentralized Technology

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Abstract: The integration of NFT technology into the art market utilizes a two-pronged approach of decentralization and increased accessibility as an equalizing answer to rectify gender discrepancies in the contemporary art world. This is not the first time that technology as an art medium has been used as a feminist tool to disrupt the previously established status quo. Through the exploration of the 1990's Cyberfeminist Net Art Movement, this article will discuss how female-identifying artists employ technological characteristics such as anonymity and online gender masquerading to answer the exclusionary issues affecting their art practices. Furthermore, it will examine how NFTs work to build upon the previously established revolutionary movement of the 1990s to evolve the contemporary art practices of feminist artists. Additionally, this article will address the impacts of this new digital landscape, where anonymity is preferred and algorithmic ordering is non-existent, as a more pragmatic way of creating, selling, and buying art. Finally, this article will examine how the integration of blockchain technology—entirely machine-operated and free from human manipulation—aims to eliminate the human biases of identifying factors such as gender that can be concealed or fabricated when operating in an online sphere.

Keywords: NFTs; cyberfeminism; Net Art; crypto technology; gender discrepancies; feminist art practices; art markets; gender

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1. Introduction

The integration of non-fungible tokens (NFTs) as both a new technology and a new art form has facilitated discussions over the disruptive potential that the new technology poses amongst curators, artists, and academics alike. While NFTs have encouraged first-time artists to begin creating—with many notable names such as Madonna and Grimes bridging the gap from music to art—they also provide a new medium for established artists such as Banksy and John Gerrard to create new works (Kinsella 2021). This budding technology has already been adopted by auction houses, with both Christie and Sotheby auctioning off record-high NFTs and creating secondary NFT marketplaces in an attempt to collect blue-chip digital works (Whiddington 2023). Furthermore, the British Museum adopted NFTs and used them to sell over 200 works by Hokusai, and the Museum of Modern Art in New York has released its own collection of NFTs in partnership with artist Refik Anadol (Cuseum 2022). The proliferation of NFTs into these traditional art spaces demonstrates a marked technological shift in the world of art. So, what are the factors that account for the technology's rapid rise in popularity amongst artists?

The power and appeal of these NFTs, especially for female-identifying artists, come from the decentralized system of operation that they use. In the vast expanse of the NFT market, which exists in cyberspace, where anonymity is preferred and algorithmic ordering is non-existent, it appears that this newfound system will provide a more pragmatic way of creating, selling, and buying art. Additionally, the blockchain NFT system, free from human manipulation and entirely machine operated, aims to eliminate human biases on the grounds of identifying factors such as race and gender that can be concealed or fabricated

when operating in an online sphere. For women artists, this promise of a decentralized and equalizing alternative to the traditional art world, where gender bias and discrimination are exacerbated by gallerists, auction houses, museums, and art dealers, is an assuring solution[1].

This article will highlight several established methods of biases throughout the art world before examining the attempted responses to rectify these discrepancies, starting with the 1990's Cyberfeminist Net Art Movement. Additionally, this paper will attempt to analyze NFTs as a logical progression of the Cyberfeminist Net Art Movement as it adapts the previous movement's key elements of online anonymity and gender masquerading to the modern technological age to circumvent exclusionary art practices. Through the examination of contemporary feminist-art practices, this paper aims to explore the disruptive potential of NFTs for women artists and whether or not the technology's implementation as an art medium is effective in mitigating the current gendered discrepancies.

2. Gender Bias in the "Traditional" Art World

In order to examine the purported benefits of NFTs and their disruptive potential for female-identifying artists, it is important to delineate the systemic biases and barriers that contemporary women artists are faced with. In exposing these faults, a comparative evaluation of NFTs as an intended answer to the status quo and an analysis of their effectiveness is elucidated.

2.1. Women Artists in the Traditional Art World

One of the primary issues affecting contemporary women artists in the traditional art world is gender discrimination on the basis of artist names. One conducted study found that when participants were asked to pick artworks based on their personal preference, there was no clear predilection for artists with traditionally male names. However, when participants were asked to guess artworks that were more pedigreed or more expensive, participants were more likely to choose artworks by male artists (Hoffmann and Coate 2022). The results of the study indicate that a gendered bias is placed on artwork when discussing the monetary value of works, when participants were asked to indicate more renowned artworks, and when they were asked to indicate which paintings they thought would be preferred by others (Hoffmann and Coate 2022). This means that when art is viewed through the lens of fame, popularity, and marketability, a clear preference for artworks by male artists is shown. The results from this study can be extrapolated when examining the market-driven side of the art world. With these innate gender biases present, collectors, buyers, and gallerists looking to make a profit through the sale of art equivocate fame, higher monetary value, and prestige to male artists, or, artists with traditionally male-sounding names. Micol Hebron, gallery owner, curator, and artist, stated, "You are more likely to make money selling or reselling art by a man than a woman. And it's not because women make work that's less good. It's because we've made capitalism a patriarchal system" (Boroff 2015). Therefore, those looking to sell or resell works can be, and are, influenced by something as minuscule as a male artist's name attached to the artwork.

Name-bias studies are not the only notable evidence of discrimination that women artists face in the traditional art world. A 2024 Artsy study, "The Women Artists Market Report", found that only 25% of all inquiries on for-sale artwork were for works by female-identifying artists, while in 2023, women artists' works accounted for a mere 9% of the auction market (Lesser 2024). Furthermore, WorldMetrics, a data site dedicated to aggregating statistics, states that, as of 17 June 2024, female artists only account for 30% of all represented London gallery artists (Lindner 2024). Additionally, 88.3% of works in the top 18 United States' museums' collections are by male artists, and only 13.7% of living artists represented by galleries in Europe and North America are women of non-white backgrounds (Lindner 2024). Therefore, evidence of gender bias in the traditional contemporary art world is still pervasive, while progress towards equality remains stinted. Female-identifying artists continue to remain underrepresented in museum spaces, gallery

spaces, and auction spaces, while the proclivity for male artists continues to persist. This effectively excludes female-identifying artists from entering gallery spaces and prevents them from gaining representation, exposure, and adequate financial compensation in comparison to their male counterparts.

The statistics for women artists in the contemporary art world remain disheartening. Despite the emergence of several proposed solutions from the opening of female-only galleries to museums hiring more female-identifying individuals to their boards and similar positions of power, the statistics indicate that women continue to comprise a small percentage of the current art world (Halperin and Burns 2019). As women artists attempt to combat the bias that their works are of a lesser caliber, worth less, and viewed as less preferred by others, their limited gallery representation and inability to break into the auction world reflect the harms these assumed biases continue to have. In an attempt to address these issues of bias and exclusion, NFTs and crypto platforms emerged as a solution for contemporary women artists looking to further establish themselves within the world of art.

2.2. NFTs as a Method of Decentralizing Equality

NFT technology proposes a two-pronged approach of increasing accessibility and decentralization to rectify gender discrepancies in the contemporary art world. These two tenets work in tandem in an attempt to provide an equalizing solution to the aforementioned exclusionary issues affecting women artists.

There is very little required to upload an artwork to an NFT marketplace, and due to the newness of the technology, there are minimal regulations regarding the types of NFT uploads that are allowed. Provided that an individual has access to the internet and a crypto wallet, as well as having a base knowledge of crypto platforms, they are able to upload and sell their artwork (Abrol 2023). Additionally, there are no stipulations about what type of artwork a marketplace will accept. NFT marketplaces are free-for-all forums that only require an email address and an online profile from a user before granting them access to millions of NFT artworks that are up for sale. In this new world of crypto, first-time artists can showcase their creations alongside Bansky and Beeple on the same platform (Hirshhorn 2021). In fact, budding 3D artist Jo-Anie Charland began creating her digital architectural works in 2019 and frequently found herself in marketplace listings alongside Beeple, who created the world's highest-selling work of NFT art, The First 5000 Days, at a Christie's auction and whose NFT artworks average over USD 100,000 a piece (Cascone 2022). In fact, it is not uncommon to see women NFT artists in lists of top-selling works. No longer are they excluded to their own category of "Top Selling Women Artists" but are instead making it onto the top-selling lists overall, with Monica Rizzolli, a previously small ecological NFT artist, now on the same lists as Beeple and Pak (Bein 2024). With the elimination of algorithmic ordering to determine intrigue, value, and marketability, buyers are forced to rely on their artistic eye and personal tastes, which are generally less discriminatory towards women artists (Hoffmann and Coate 2022). The need to be a well-established or well-connected artist also dissipates under a crypto market. American artist, collector, and curator of contemporary art Kenny Schachter argues that this fact alone indicates a huge advancement for women and other marginalized artists as the need for a traditional, exclusionary gallery space is eliminated (School of Visual Arts 2021). Due to the fact that NFT marketplaces are not looking for a particular type of art, make no discernment based on profit or auction trends, and have no preference for a certain type of medium or subject matter, the traditional exclusionary gallery-showing tactics and art-dealer tactics are rendered obsolete. Furthermore, NFT marketplaces are structured by showcasing and categorizing artwork uploaded to the platform by the most recently minted NFT. The user of the marketplace then has the ability to sort by "trending NFTs" or "top-selling NFT collections" if they wish. However, since there is no default algorithm pushing a particular NFT artist or artwork to the top of the marketplace homepage by default, crypto platforms eliminate an innate bias or preference towards "traditional western aesthetic influences"

in the art historical sphere. If the first forms of art that the viewer is met with on the marketplace are the most recently uploaded forms of art, then female-identifying artists are just as likely to find themselves at the top of a marketplace page as their male counterparts, once again eliminating the exclusionary gallery-viewership tactics.

Additionally, the nature of an NFT marketplace provides an extra layer of anonymity that artists are able to opt into, which has the potential to work in female-presenting artists' favor. As previously established, once a user provides an email address to their desired NFT marketplace, they are then able to create an online persona that has the potential to be divorced from their actual identity (Schneps 2022). An artist's NFT marketplace profile could be under any name and any profile picture that the artist desires, and they are still able to buy and sell artwork. The creation of an anonymous identity is an advantage to artists who want to be separated from their gender identity or who wish to operate under a pseudonym to eliminate the biases associated with being a female-presenting artist. Now, women artists no longer have to contend with the biases associated with a more traditional-sounding female name. If they wish to combat the optics of marketability, profitability, and canonical success, the option to create an online persona under a different name or even a quirky catchphrase is now a possibility. NFT forums provide the potential for the elimination of name bias as the crypto market forces buyers, preliminarily, to grapple with personal tastes and objective preferences first, without the influence of gendered indicators.

Another key proponent of the NFT solution to equalize the art world is crypto technology's ability to create a decentralized online space. Decentralization works primarily between the buyers of crypto art and the sellers. Instead of working through the gallery spaces or auction houses of the traditional art world, artists now have the ability to work directly with their cohorts in a generally unregulated market to establish their own terms of sale (Whitaker and Abrams 2023). Furthermore, proponents of NFTs discredit the need for gallery spaces, auction houses, and art dealers under crypto technology's decentralizing platform. As the NFT marketplace currently operates, artists upload their art to the market and set the stipulations for terms of sale and price themselves. These terms may be negotiated with potential buyers if either party sees fit, but they are not controlled by a centralized source of power such as art market trends determining the prices of each work. The NFT platforms also eliminate the need for an artist to be represented by a gallery in order to gain access to the art market (Whitaker and Abrams 2023). The innate biases of gallery owners and art dealers are undermined through crypto technology's ability to circumvent additional human contact (O'Dwyer 2018). Additionally, artists no longer have to rely on their connections to the art world or firmly establish themselves in the contemporary art sphere to showcase and sell their art. The more traditional exclusionary tactics of the contemporary art world are dismantled by eliminating the concentrated sources of power and authority that auction houses, gallerists, and dealers have when they determine which artworks to sign, display, and sell. Instead of keeping the power to determine representation limited to a few organizations and corporations throughout the world, the power is now less concentrated and more widely distributed to individual users regardless of their status or standing in the art world. These aspects of decentralization serve to benefit female-identifying artists in particular as they now have the ability to represent themselves and determine the price of their works directly. NFTs also have the potential to solve, in a direct manner, the lack of representation in gallery spaces and the exclusion from capital that women artists face when working within auction houses.

On the surface, this two-pronged approach appears to offer fast-acting and direct solutions to issues that women artists encounter within the status quo. Accessibility barriers found in needing gallery representation or an art dealer are eliminated with a platform that allows anyone with an email address to upload and sell their art. Inherent gender biases are combatted using online anonymity to help promote marketability and artist sales. Unregulated crypto platforms remain algorithmically free, making no discernment for art market trends, popularity, or aesthetic preferences, thus equalizing the buying and selling field for art mediums and closing the inherent bias gap that is still prevalent in the

traditional art world. Furthermore, women artists no longer have to work with galleries and auction houses on setting adequate prices and reserves for their works, nor do they have to fight the bleak representation statistics that galleries are still contending with. The decentralized nature of NFT marketplaces allows female-identifying artists to become their own agents, dealers, and gallerists whilst simultaneously providing them equal, non-discriminatory access to the same selling platforms available to their male counterparts. These proposed solutions to gender issues in the status quo largely account for the rise in NFT popularity amongst women artists (Thaddeus-Johns 2022). The crypto world has promised a more feminist alternative to the status quo and touted the strides that NFTs have made to equalize the art world for women artists. Additionally, these purported benefits of combatting the sexism found in traditional art spaces continue to act as a beacon of hope and a viable alternative for many practicing artists.

3. Exploring the Origins of NFT Proposed Solutions

This two-pronged approach of accessibility and decentralization is not novel in its solution to solving gender discrepancies in the art world. In the late 1990s, with the introduction of a widely accessible internet-space, feminist artists began using the early emergence of the internet to help explore and deconstruct the gendered biases found in their profession. Known as the Cyberfeminist Net Art Movement, feminist artists quickly explored cyberspace's potential for gender anonymity and, in some cases, gender masquerading via online personas in a decentralized digital landscape (Kolko et al. 2000).

3.1. The History of Cyberfeminism in the Net Art Movement

Emerging from the introduction of the world wide web, the field of cyberfeminism came to fruition around the same time as the internet in August 1991 (Scott 2016). Prior to the increased accessibility to the internet, computer technology of the 1980s was largely seen as a male-dominated area. Computer technology was a tool made by men, for men to utilize until the early 1990s. Following its introduction into mainstream usage, cyberfeminists began postulating whether technology was the key to patriarchal upheaval, while exploring the idea of being able to escape gender through an online platform.

The roots of cyberfeminism go back slightly earlier to the early 1980s with works like Donna Haraway's A Cyborg Manifesto (1983) creating the foundation for a blend of a part-human–part-machine cyborg that was capable of eradicating solely human-ingrained racial and patriarchal biases. Haraway states, "The cyborg is a kind of disassembled and reassembled, postmodern collective and personal self. This is the self feminists must code" (Haraway 2017). The cyberfeminists used this as a rallying cry, writing their own homage to Haraway for the new cyber-age titled, Cyberfeminist Manifesto for the 21st Century (1991). Female artists, coders, and gamers began working in unison to reconfigure gender in a digital age, exploring the ways in which anonymity, gender masquerading, and an untapped technological landscape could help them shed the ingrained biases in their respective practices, envisioning the digital future as a non-gendered utopia (Wilding 1998).

3.2. A Cyberfeminist Approach to Gender Bias

Cyberfeminist Net Art artists of the late 1990s and early 2000s served as the precursors to NFTs' promise and ability to obfuscate gender online if one chooses. The idea of inventing your own person online, untethered to one's "real" existence, for the benefit of subverting gender biases was the subject of several artworks created by cyberfeminist artists.

Yael Kanarek's (2000) Net Art piece, World of Awe, follows a genderless, anonymous traveler through a desolate digital landscape. Known simply as "The Traveler", Kanarek takes the user on a parallel-world journey to discover unmapped territory through the lens of an old computer that The Traveler has built out of spare electronic scrap parts for the sake of exploring personhood and narratives through a new art medium. Created in the form of a computer-programed game walkthrough, Kanarek explores the internet as a metaphorical space to construct new identities alongside new worlds in a setting detached

from gender (Kanarek 2000). The desert, acting as a stand-in for the new and vast digital landscape that has now become so accessible to the masses, serves as the backdrop for exploring gender obfuscation and identity within The Traveler, as well as within the users of the program, who are now, regardless of their gender identity, acting as a genderless person. In turn, Kanarek uses technology to play with gender and identity roles in her art, showcasing and highlighting the fact that The Traveler is allowed to be genderless and nameless in the vast world of the digital landscape and, furthermore, so is the user.

Another example of a cyberfeminist artist working to subvert gender can be found in artist Shu Lea Cheang's 1998 work, *Brandon*. Cheang's work takes on the identity of a transgender man named Brandon, as viewers navigate his life through a series of chat rooms, internet pop-ups, and video live-stream conferences (Jones 1998). Through depictions of the graphic moving images of the disembodied human form and colorful chat textboxes, Cheang utilizes the ever-evolving "skin" of the internet to break down gender assumptions using a technological medium. The technological environment allows the users of Cheang's artwork to assume different identities, gender roles, and characters that may not coincide with their gender or identity outside of the technological space as they play as different characters from Brandon's life, including Brandon himself. Once again, this work explores a central theme of the Cyberfeminist Net Art Movement of employing technology to obfuscate or hide gendered identifiers or, in some cases, masquerade as a different gender entirely.

Both artworks explore an individual's ability to investigate and alter different gender roles and identities from their own within a digital landscape. Supporters and practitioners of cyberfeminism like Nouraie-Simone, an Iranian activist and historian, speak to internet technology's subversiveness in a way that mimics the language surrounding the current NFT technology. Simone equated liberation from gender oppression to the anonymity of the internet by stating, "The absence of the physical body in electronic space and the anonymity this offers have a liberating effect on repressed social identity, as 'electronic technology' becomes a tool for the design of freely chosen identities", (Nouraie-Simone 2014). The cyberfeminist movement of the late 1990s and early 2000s served as a catalyst for using budding technological advancements to subvert the societal expectations of gender presentation and identity. These ideas and art practices continue today, as technology continues to evolve after the COVID-19 pandemic with the post-Cyberfeminist art movement. The "Dgtl fmnsm Hot Mess" program took place online in March 2020 for cyberfeminist artists to display their extensive digital performance and display art, "A Traversal Network of Feminist Servers (ATNOFS)", a post-cyberfeminist artist radio broadcast took place in six separate events from March–October of 2020, and "TransHackFeminist Convergence 2022: Feminist Infrastructure" took place in Barcelona in August 2022 (Dusan 2024). Artists interested in using evolving technology as a tool for equalizing liberation continue to utilize previous cyberfeminist art practices to advance their goals.

However, the cyberfeminist movement was short-lived, and the post-cyberfeminist movement is lacking in popularity as a feminist art practice. For all the aims of gender subversion and decentralization that the Cyberfeminist Net Art Movement sought from a new technological landscape, the digital sphere quickly came to reflect the same gendered social conditions of the "real world" due to the lack of distinction between the cybersphere and the world that exists outside of the internet space. Just as race and gender play pivotal roles in an individual's "real-world identity", the shaped knowledge, experiences, and values that race and gender precipitate bleed into the cybersphere and cannot be forgotten upon the switch to a digital platform (Kolko et al. 2000). The sharp delineation between "online" and "offline" experiences makes it so that they do not exist independently of one another; however, the delineation is not fully actualized, leaving the lingering traces of one's "real world identity" to shape the previously uncharted digital landscape. Wilding claims the internet "is already socially inscribed with regard to bodies, sex, age, economics, social class, and race" (Wilding 1998). This realization effectively ended the cyberfeminists' vision of liberation through a technological medium as the internet proved not to be

the genderless, equalizing utopia that the cyberfeminists had once hoped it would be. While the post-cyberfeminists attempted to revive the movement by updating the issues that cyberfeminism initially tackled for the modern age of feminine representation in cyberspace, Helen Hester, gender, technology, and cultural politics professor, stated that, in the wake of a new digital age, cyberfeminism is not able to address the surmounting gender discrepancies. Technological advancement was happening too rapidly for the movement to adjust in time (Hester 2017). In lieu of this, post-cyberfeminist artist Cornelia Sollfrank stated, "Now we know more about the downsides of networked technologies; we had to learn how they are being abused by corporate and governmental interests in order to surveil and control users and citizens; This situation continuously needs to be confronted with feminist methodologies" (Elbaor 2017).

4. NFTs as the Next Logical Progression

While the Cyberfeminist Net Art Movement has lost its initial momentum, the movement's methodologies continue to resound in line with Sollfrank's call as technology rapidly advances. With the introduction of NFTs to the mainstream population, questions of gender subversion, accessibility, and decentralization arise for female-identifying artists once more. How can this new, unmarked digital landscape work to subvert the status quo? Will the promise of a decentralized market to display and showcase artists' works without the need for middleman representation lend itself towards machine-like pragmatism free from human manipulation and built-in biases? Is a genderless utopia, at least in the new age of buying, selling, and creating NFTs, possible? Additionally, if so, how will the ever-evolving art world shift?

4.1. A Feminist Take-Over of NFTs

One artist attempting to answer these questions through her work is Barbara Finck-Beccafico. A self-described "Eco-Feminist-Queer-Nft Artist", Finck-Beccafico's art predominantly focuses on humankind's relationship with the surrounding environment (Finck-Beccafico 2022). Her latest non-NFT work from 2016, Conscience, blends topics such as ecology, feminism, consumption, and interconnected relationships. In this audio-visual space, four projected screens were placed on the four walls of a room, playing a story told in six chapters on a loop. Each chapter described an alternate near-distant future in which the effects of climate change were reversed due to human intervention. These alternate imaginings explore the effect that saving the planet has on catalyzing a feminist and gender-equal utopia that is "beautiful" and "peaceful" (Finck-Beccafico 2023a).

Following the introduction of NFTs into the art world, Finck-Beccafico began working on translating these themes into the world of crypto art. With the creation of a collective art project known as DNA NFT Art, Finck-Beccafico joins art, science, and esoterism through NFT works created solely by women and gender non-conforming artists (Finck-Beccafico 2023b). In this project, Finck-Beccafico constructed audio-visual portraits by reading a subject's energy, aura, and chakras to map the body's consciousness. Then, using the information from the reading, Finck-Beccafico composed a soundtrack set to an application she created to generate visual material based on the DNA data reports of subjects who took a DNA test. The result is a unique, personalized self-portrait that combines both audio and visual media, as well as esotericism and biotechnology to produce an artwork similar to a music video (Finck-Beccafico 2023b). Throughout this process, Finck-Beccafico aims to highlight that while a scientifically strict DNA mapping of a subject provides a partial and objective view of data, it is not a holistic view of an individual. Furthermore, Finck-Beccafico stated that "the individual cannot be reduced to a scientific and factual definition of his or her body" in the hopes that her work will call into question the reductive vision of the status quo as influenced by the patriarchal society (as the idea that science dominates the natural world and imposes order stemming from patriarchal concepts). These personalized portraits based on an individual's genetics were then minted as NFTs in the form of a fifteen-second video on the blockchain and launched on NFT

marketplaces during the second quarter of 2022. Using NFTs as a medium to actively imagine the possibility of a gender-liberated world through environmental liberation, Finck-Beccafico uses technology to challenge the status quo and to encourage conversations on the revolutionary aspects that the new crypto technology inspires.

Finck-Beccafico is aware of the criticisms that NFTs pose to her environmental feminist art practices as well. Previously, the majority of NFTs were created on the Ethereum blockchain, which utilized a consensus mechanism called proof-of-work (PoW) that is compute-intensive and thus harmful to the environment (Tabuchi 2021). This consensus mechanism is a program that is implemented in a network system that replaces the need for human verification and auditors for each transaction and creation of NFT art. The PoW mechanism works by solving long cryptographic puzzles over a myriad of computers that generate numbers in a frenzied trial-and-error attempt to make a unique and irreplicable strand of code. This code is then stored on the blockchain and contains a record of data structures, time stamps, and transactions that are unable to be altered (Murtazashvili et al. 2022). However, while the PoW mechanism saves time, eliminates error, and allows for incorruptible data storage, the computational power required to run the mechanism is extensive. There have been several scientific peer-reviewed studies that conservatively estimate the carbon footprint of minting an NFT to be anywhere between 33.4 kg CO_2 and 40.8 kg CO_2 (Qui 2021). For reference, this carbon footprint is more than 14 times higher than mailing an art print, which is estimated to produce 2.3 kg of CO_2 on average (Qui 2021). It is important to note that these carbon emissions are produced each time an NFT is minted or sold. Some scientists have estimated that after averaging the number of times a singular NFT has been bought and resold after minting, the carbon emission can be as high as 200 kg CO_2 or the equivalent of driving roughly 500 miles in an average American gasoline-powered car (Tabuchi 2021).

However, this does not mean that there are not viable alternatives to the energy expending PoW mechanisms. In response to environmentally conscious critic's refusals to engage with NFTs, several crypto platforms began working on a more sustainable alternative to the proof-of-work system known as proof-of-stake. This mechanism is less onerous than the complex crypto-solving computer system of proof-of-work, as it requires fewer computers and cuts carbon emissions almost in half (Bruner 2021). Furthermore, StarkWare, a company co-founded by engineers Eli Ben-Sasson and Uri Kolodny, is working on packing more information per transaction into the blockchain to offset the environmental impacts (Lindrea 2022). As of 2022, Ethereum has switched to a proof-of-stake mechanism, significantly reducing the environmental damage that the prior PoW system caused (Wackerow 2024).

In order to offset the energy expenditure of NFTs, Finck-Beccafico mints and sells her works on platforms that utilize proof-of-stake systems and marketplaces. Furthermore, more carbon-neutral NFT marketplaces are emerging that are available to environmentally concerned artists while other marketplaces are making the switch to PoS systems (e.g., Avalanche, OpenSea, Bubblehouse, and Binance). The constant development of the new technology allows crypto marketplaces and systems to adapt to better fit the needs of artists for the benefit of the general population. In doing so, Finck-Beccafico is able to ethically sustain her ecofeminist art practices while shifting to a new platform that permits her anonymity, decentralization, and a more equitable market.

Another female artist making strides in the world of crypto art and technology is Afro-Caribbean creator Itzel Yard, better known as IX Shells. In 2021, Yard became the top-selling female NFT artist with her work *Dreaming at Dusk* selling for two million dollars, or 500 ETH (Shrivastava 2021). While Yard first began selling her NFT works at 0.5 ETH (USD 800), she now sells each work at a minimum price of 3 ETH (USD 8000), which is a price increase of 900% in just a few years. Since making her foray into NFT art, Yard has had her works offered and sold at auction houses including Sotheby's, as well as being featured in gallery shows such as "Somewhere Ethereal", the first physical NFT exhibition at Fotografiska in Stockholm (Mutual Art 2022). Yard's art focuses on a blend

of the digital world with the physical one by translating architectural patterns, computer glitches, and soundwaves of her voice reading poetry into complex abstract works of art. In addition to this, Yard's work is steeped with her own emotions, stemming from relationship cycles, difficult life experiences such as her move from Panama to Toronto, Canada, that left her with nothing, and socio-political views of being Afro-Caribbean and living in a non-inclusive world (Maidan 2022).

In the world of crypto art and technology, Yard has managed to carve out a place for herself amongst the top-selling NFT artists of her time. Assuming the genderless username of IX Shells that the crypto platform allows her, Yard is able to successfully create and generate artworks that depict female emotion and feminist concepts such as intersectionality and sell them alongside her male counterparts with no gendered distinction. This freedom of the cryptoverse opened up new avenues of creation for Yard to explore her stories artistically and afforded her the anonymity of a gender-neutral artist profile to help facilitate the distribution of her works.

For women artists, and more specifically feminist artists, participation in the creation and distribution of NFTs has opened new avenues to distribute their artworks and afforded them more autonomy over their own creations. Neither Finck-Beccafico nor Yard has gallerist or dealer representation as artists. Their works are uploaded to the NFT marketplace of their choice with prices they can set themselves under names they can pick for themselves. These two specific examples highlight what is happening on a much larger scale. NFT artist collective groups such as World of Women, Baddie Babes NFTs, and Encyrptas by CyberCHK, have formed to empower women artists through NFTs and to carve out a place for female-identifying artists in the crypto space. Many of these collective groups further their feminist practices by donating a portion of all their sales to organizations like Girl Up, The Malala Fund, and Female Strong in the hopes of encouraging the next generation of female leaders and scholars (Crypto Altruism 2024). Much like the Net Art Movement of the 1990s, women artists are seeing the potential that this new unmapped digital landscape offers and are attempting to use it to bridge the gender divides in not only art but the world at large, too.

4.2. COVID-19 as a Catalyst

Wide-spread access to NFT technology for female-identifying artists largely took place after the COVID-19 global pandemic. Previously, access to NFT technology, and even cryptocurrency, had been confined to those in technology industries with the knowledge of and access to crypto platforms. According to the updated NFT statistics, NFT usage dropped in 2017 from 0.12 users (in millions) to 0.08 users (in millions) by 2018 (Statista 2024). The transition from a hyper-connected world to a quarantined, isolated one in the wake of COVID-19 forced the art world to adapt to a new era of digital normalcy. Artists and galleries alike began to utilize new technological advancements to continue their practices in a socially distanced, lockdown friendly manner. In 2020, New York Frieze took their fair completely virtual and converted their show into a virtual viewing room (Khemsurov 2020). This was then followed by Frieze LA going virtual. Then, in 2021, the LA Art Show was anchored by NFT-backed digital art with its theme: Tech. This art show predominately featured NFT art made in the height of the pandemic, making sure to keep the show diverse and featuring women NFT artists such as Claudia Hart, Luna Ikuta, Blake Kathryn, Ana Marcos, IX Shells, and Nicole Ruggiero (Riefe 2021). In the wake of COVID-19, NFT usage increased exponentially, going from 0.08 users (in millions) in 2018 to 0.41 users (in millions) by the end of 2019. By the end of 2020, NFT usage rose to 0.79 users (in millions), and, by the end of 2021, the number of NFT users burgeoned to 5.39 (in millions) (Statista 2024).

The digitization of the world during and post-pandemic allowed for a more diverse user base in the world of crypto art and technology. In the wake of COVID-19, the online digital landscape shifted once more, effectively allowing an influx of artists and creatives to utilize the new technology to their benefit. In the case of practicing feminist artists, the new technology provided an unmapped digital landscape that they could confront and shape

with feminist methodologies as previous cyberfeminist practitioners had done before them. In 2021, women NFT participation accounted for 16% of the digital market (Barratt 2022). This number has since risen to 28% in 2024 based on current NFT marketplace statistics (Elad 2024). Post-pandemic interest in NFTs has skyrocketed, and, while the initial NFT boom has since leveled-out, there is still a steady increase in NFT users each year (Statista 2024). This increase in accessibility brought on by COVID-19 allowed women artists to express their artistic ideologies in new formats on a global scale. With auction houses, Frieze shows, and galleries forced to adapt to a digital platform during the pandemic, NFT feminist artists exploring subversive art tactics such as gender masquerading and decentralization were allowed to take center stage in the art world in a way that was unprecedented pre-pandemic.

5. The Shortcomings of Decentralized Technology

Based on the previous examples, it is clear that the equalizing groundwork and potential for NFTs to disrupt the art world has been laid. While female-identifying artists are attempting to utilize NFT technology for their feminist practices, new artistic and creative outlets beget the same intended hopes and desires of the preceding cyberfeminist movement. However, much like the prior 1990s Net Art Movement, the full disruptive potential of NFTs has yet to be actualized.

5.1. Persistent Inequality in the Crypto Age

One is likely to assume that a machine-like crypto sphere, designed to be pragmatic and free from human manipulation, would also be free from the innate human biases that are reflected in the traditional art world. Unfortunately, as NFT technology continues to integrate itself into the mainstream world of contemporary art, statistics are showing that this is not the case. As of March 2022, NFT works created by female-identifying artists make up 5–15% of the NFT market's multi-billion-dollar industry (Shaw 2022). This means that NFT works that are being bought and sold are predominantly created by male artists. Zillah Eisenstein, a feminist activist and professor at Ithaca College in New York, believes that NFT art and technology are concentrated in the hands of male power and stated that, "If you're encouraging excessive wealth, you're also encouraging excessive inequality" (Naraharisetty 2022). This exacerbation of inequality, as Eisenstein states, appears to be true when looking at the statistics of the more traditional mediums of the art world. Women comprise just 28% of the NFT art market, a marked decline from the 48% of women who are visual artists, according to a new Diversity in Arts report by the WorldMetrics database (Lindner 2024). Furthermore, with newer forms of media, such as video and performance art, women make up 40% and 41% of these sectors, respectively. Additionally, female-identifying artists make up 29% of digital artists in the art world (Shaw 2022). The correlation between the gender and choice of medium is interesting to note, with most women working within newer forms of art mediums. This is perhaps due to the fact that newer art mediums are more pervasive and provide room for experimentation in their novelty, thus making them more accessible (Leuzzi 2023). With NFT technology being one of the newest art forms, the low statistics of female representation appear disheartening, exclusionary, and call into question what about the new technology lends itself to male domination.

Claudia Hart, a professor in film, video, new media, and animation at the School of the Art Institute in Chicago and a digital artist herself, provides one answer to this question. In a term coined as "bro culture", Hart explicates that the NFT tie to currency, and specifically cryptocurrency, confines the buyers and investors to a male-dominated demographic (Hirshhorn 2021). As NFTs require the attainment of cryptocurrency and at least a basic knowledge of complex minting and mining systems, Hart argues that the buyer audience is limited to the tech market and financial technology (FinTech) industry giants that have created and regularly work with cryptocurrency (Hart 2021).

It is no secret that NFTs were first a product of the technological and finance sectors at conception before their introduction into the art world. Blockchain technology, first developed in Silicon Valley, has long been obscured by the complex computer-science-oriented processes of minting and mining cryptocurrency, crypto wallets, and computational power. In its early days, NFT technology was only able to be used by those within the tech industry who had played a role in creating it (Whitaker 2019). With the development of an NFT art marketplace, which operates strictly within the crypto sphere, the Silicon Valley tech giants and hedge fund managers who had previously been less active in the traditional art world now found themselves in a unique position to dominate a new crypto art market (O'Dwyer 2018). As an example, statistics from the sale of digital artist Beeple's NFT work titled, The First 5000 Days, indicated that 80% of interested buyers were first-time art buyers, largely from FinTech sectors (Hirshhorn 2021). These two sectors continue to remain largely dominated by white men. A report conducted by the Equal Employment Opportunity Commission found that men make up 83.3% of tech executives and that 80% of all tech executives are men (Daileda 2021). Furthermore, men make up over 70% of all FinTech industries and only 10% of women are involved in FinTech leadership positions (FinTech Global 2024). This means that those who worked on constructing NFT technology, and those that had preliminary access to the crypto metaverse, crypto art, and their benefits, were predominately white men. Hart adamantly maintains that while these disparaging statistics remain unchanged, the world of NFT art cannot reach its full potential for increasing accessibility (Hirshhorn 2021).

Senior art critic for New York Magazine and 2018 Pulitzer Prize winner Jerry Saltz raises concerns along the same line. Saltz takes Claudia Harts' argument one step further and supposes that the artworks that sell and garner high prices are works that lack artistic diversity and are traditionally created by men because the buyer demographic is confined to white, male, tech industry giants (Catlin 2021). One only has to look at the top-selling NFTs created by artists such as Beeple, Kevin Abosch, and Steve Aoki to see the common pattern: They are all men. This has led to an aesthetic decline of art in Saltz's opinion as he described the male-dominated NFT art that sells as "conventional" and "computer screensaver art" (Hirshhorn 2021). Saltz argues that while the NFT platform has the potential to diversify the art world even further, careful examination of the buyers and the artists of the works purchased have proven that the world of crypto art is still highly dominated by men. As men in the finance and tech industries continue to hold the crypto purchasing power, then it is male artists who find the most success selling their works on NFT platforms. From the mining of cryptocurrency to the NFT markets, those with the technological knowledge and know-how stand to influence the type of NFT art that is bought and sold. While both Hart and Saltz agree that the disruptive potential for NFT art and technology is there, it appears that the newfound accessibility of NFTs has only encouraged an influx of male tech giants and venture capitalists to inflame gender disparities and a decline of aesthetics in a new digital art market.

5.2. An NFT Digital Plundering and Colonial Takeover

While NFTs hold the promise of greater accessibility for practicing women artists, it is important to look further into the geographical makeup of NFT usage to determine, on a non-westernized scale, the reach of this accessibility advantage and the underlying colonialist nature of the world of crypto.

NFTs are already dominating the digital space with a hyper-masculine, westernized nature that threatens to circumvent feminist art practices. The creation of the metaverse introduced a new space, one conducted entirely online, where individuals could coalesce and interact just as they would in the "real" world. The metaverse allows individuals to purchase digital clothes for digital renderings of themselves, digital food to keep their digital pantries stocked, and ultimately allows for the digitization of reality, thus creating an alternate, entirely virtual world (Lastowka and Hunter 2004). NFT technology exists as a facet of this virtual world where music, videos, GIFs, art, and other art forms can be

created, bought, and sold for profit with virtual (crypto) currency. In turn, this creates a digital landscape that can now be mined for profit, with NFT art acting as digital resources. With the digitization and creation of the metaverse mirroring present reality, it is not hard to imagine that soon every aspect of digital existence will be commodified and mined for profit with digital resources being abused and plundered in the same way natural resources are. These NFT artworks now create a new space to store value and allow for the tokenization of the digital commons, as an individual can stake ownership in a portion of the crypto sphere by purchasing an NFT work. The creation of NFTs and blockchain technology now encloses a previously free virtual space, just as land, water, and soil were enclosed before it (Naraharisetty 2022). It appears that NFT technology has only further encouraged colonialist ideas of ownership and privatization for individual wealth as it turns the previously free and open digital landscape into an unmarked territory that can belong to an individual and be mined for digital resources and profit.

In her work, A Cyborg Manifesto, Donna Haraway discusses and analyses this blend of human life and technology in order to calculate the social impact and potential abuse of technological innovation. Haraway claims that there is no neutrality in tech and that there will never be neutrality in tech as long as there is a "continued intense sexual and racial division of labor" in the industry. Furthermore, Haraway calls for the development of technology that breaks down barriers and encourages openness and the dissolution of boundaries rather than technology that clearly delineates boundaries and builds up barriers even further. She argues that there will always be a gendered divide in tech as long as patriarchal ideals of domination and oppression are favored over community and connectivity (Haraway 2017). As it currently stands, NFT technology and NFTs as an art medium seem to only further the gender divide as they encourage privatization and ownership over community and connectivity. While it is true that NFTs provide an alternate market and medium for marginalized groups that may have been exploited or "starved out" of more traditional markets, the economic models behind blockchain technology and the unequal labor sectors that the technology was founded in only reinforce colonialist practices and structures rather than dissolve them (Ali 2016). In fact, recent data show that the countries that benefit at large from NFTs are still predominately westernized ones. The top five countries seeing the most revenue from NFT sales since 2018 are the United States, Germany, the United Kingdom, Canada, and Japan (Statista 2024). This is despite countries such as China, Singapore, and Nigeria showing the most consumer interest in NFT technology (Statista 2024). As NFTs present digital space and digital art as something to be owned and commodified, and as they integrate themselves as a new resource promising wealth in a new digital landscape, ideas of digital scarcity, digital territorialization (claiming an object in a digital space), and ownership drive the appeal of NFTs. As westernized NFT and FinTech industries tokenize and colonize the internet space, they leave women and marginalized artists, lured by the idea of a decentralized and equalizing new-age art space, to deal with the remnants of their plundered empire.

In their most neutral state, it appears that the consequences of NFTs have led to a crypto market that mirrors the problems of female exclusion and underrepresentation found in the traditional system of galleries, auction houses, and art dealers, instead of correcting them. The power and profit remain concentrated in the hands of male artists and buyers. Additionally, the western domination of the crypto sphere continues to mirror the harmful colonial practices of commodification and plundering, which are detrimental to feminist practices. With westernized countries and artists reaping all the benefits and profits that the crypto sphere promised, non-westernized artists continue to struggle accessing the same benefits and representation.

6. Conclusions

With these findings in mind, it is necessary to touch on what the future of feminist art practices could look like alongside NFT technology. For better or worse, NFTs have integrated themselves thoroughly into the art world. As of December 2021, NFTs consti-

tuted nearly 16% of the global art market, and, in 2022, though not growing at the rapid rate of the previous year, NFT transactions continued to surpass previous records than that of the year before (Gaskin 2022). NFT art galleries and museums have now been cropping up in multitudes in both the digital and physical realms in NFT-curated exhibitions with the intent of giving NFT artists more exposure (e.g., Superchief, Seattle NFT Museum, Frankfurt B.20 Gallery, and KnownOrigin Gallery). Additionally, museums and galleries such as the British Museum and the Uffizi Gallery have taken to minting their own NFTs in conjunction with the world's largest auction houses (Cuseum 2022).

In lieu of this development, it is a wonder if NFT art will further exacerbate the gender discrepancies that the technology aims to solve. NFTs pose a real disruptive potential to the current status quo for the better. Carbon-neutral marketplaces and energy-efficient alternatives to proof-of-work systems are already being developed to be more environmentally conscious in congruence with eco-feminist practices. Anonymity and gender masquerading are tools that artists are utilizing to their advantage. Real work would need to be done in order to address the current gender imbalance in the tech and business labor industries, and a dismantling of the current Silicon-Valley-backed systems would be necessary to actualize NFTs' full accessibility and decentralizing potential. However, this does not mean that the benefits of NFT technology, as previously discussed, cannot be fully realized on a large scale with restructuring. Some feminist artists such as Finck-Beccafico are still choosing to work within the world of crypto art, finding that NFTs' accessibility, free from algorithmic ordering, outweighs the gender discrepancies in the crypto art market. In doing so, Finck-Beccafico adds her name to a list of women artists pushing back against the male-dominated space of crypto art and, furthermore, supports the development of energy-efficient NFT alternatives by selling her artwork on these environmentally conscious NFT platforms.

At present, corrective responses to the NFTs' exacerbation of feminist issues continue to remain reactive rather than proactive, but these issues can be remedied, especially in the early stages of NFT integration in the art world. Instead of repeating the short-lived goals of the 1990s Cyberfeminist Net Art Movement, NFT technology has the capacity to build upon the movement's foundational principles and pose disruption to the status quo. As more women and artist collectives crop up to support the female-identifying artists joining the world of crypto, the NFT markets can adapt to be better suited to feminist art practices and issues. Already, feminist artists are integrating NFT technology into their art practices to widen their audience, skirt representation bias, and equalize their professional playing field. On an individual level, the disruptive potential that NFT technology poses to the status quo is tangible. However, when extended to a larger scale, this equalizing, equitable, and decentralizing answer is not yet fully actualized. Instead of using these statistics as a discouraging call to abandon the technological advancements or to write NFTs off as a repeat of the past, artists and art-world professionals can build upon this newfound potential and look towards the cryptotechnological advancements as a tool to be utilized in eliminating gender bias in their professions.

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Notes

[1] Here, the traditional art world is defined as the systems, institutions, and individuals that have historically been dedicated to maintaining a network for creating, buying, selling, displaying, and interpreting art.

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Post-Merge Carbon Footprint Analysis and Sustainability in the NFT Art Market

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Abstract: The market for non-fungible token (NFT) art is expected to reach USD 44.2 billion in 2021 and increase by 67.57 percent in 2022, revolutionizing the relationship between artists, collectors, and investors. Despite this, concerns regarding the environmental impact of blockchain technology's high energy consumption persist. NFT art transactions will continue to generate significant carbon emissions after Ethereum's "Merge" to a Proof-of-Stake (PoS) system in September 2022, rendering many low-carbon solutions obsolete and necessitating further research into post-Merge alternatives. This study identifies solutions in the NFT art market, such as carbon neutrality, lazy minting, alternative consensus mechanisms, Layer 2 solutions and policy interventions. Carbon neutrality is achieved through investments in renewable energy or carbon credits to mitigate emissions generated by NFT art transactions. Lazy minting reduces energy consumption by postponing the creation of NFT art until a buyer is secured. In the NFT art ecosystem, alternative consensus mechanisms such as Proof of Authority (PoA) and Proof of Spacetime (PoST) reduce energy consumption. By offloading transactions from the primary blockchain, Layer 2 solutions enhance scalability and reduce energy consumption. Carbon taxes and energy consumption levies are examples of policy interventions that promote cleaner energy sources in the NFT art market. This study will explore the role of artists, collectors, galleries, and other significant players in encouraging environmentally sustainable practices in the NFT art market. In addition, it will investigate the effect of prominent NFT art sales on carbon emissions and the adoption of eco-friendly alternatives. By integrating and optimizing current carbon reduction strategies, the NFT art market can continue to flourish while reducing its environmental impact. The study emphasizes the significance of implementing a comprehensive strategy that incorporates multiple solutions that are tailored to the specific challenges of the NFT art market.

Keywords: non-fungible tokens; NFT art market; Ethereum Merge; carbon neutrality; sustainable development

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1. Non-Fungible Tokens (NFTs) and the NFT Art Market

1.1. Non-Fungible Tokens (NFTs)

The non-fungible token (NFT) represents a distinct category within the realm of digital assets, and its surge in prominence has propelled discussions on its sustainable development. NFTs are the digital ownership and authenticity certificates for digital or physical objects. When an NFT is minted, a unique entry is created in the blockchain ledger to identify it, and when it is sold, its transfer is likewise recorded to keep the ownership public. NFTs can be used in various areas of life and for almost everything that can be stored (Kumar 2022). NFT art distinguishes itself from other cryptocurrencies not only due to its intrinsic non-substitutable nature (Dowling 2021), but also because it serves as a verifiable proof of provenance and a novel sales mechanism in the art domain.

The NFT market encompasses various sectors such as art, collectibles, games, and the metaverse. However, the diversity is not just in these sectors but in how NFTs are utilized within them. For instance, a single NFT can serve as a valuable art collectible, perhaps auctionable on esteemed platforms like Sotheby's, while also offering "utility" features

such as special access to events or as a digital certificate of provenance. The layered utility of NFTs not only exemplifies their dynamism but also lends them a multifaceted role in the worlds of art, gaming, and beyond. An item of NFT art is a unique cryptocurrency token that may take the shape of virtually anything digital, including artwork, GIFs, and even the first tweet by Twitter CEO Jack Dorsey. Even though NFT art accounts for only 10% of the entire NFT market, it often becomes the center of discussions due to its transformative implications for the conventional art world (Nadini et al. 2021). The discourse distinguishing art from collectibles is pivotal, as it can mold market perceptions and valuations. The NFT art market, a significant subset of the broader NFT market, centers on the creation, trade, and collection of digital artworks that are authenticated via blockchain technology.

Most of the art-related NFTs operate on the Ethereum blockchain. Platforms like OpenSea, an aggregator, lets consumers trade NFTs from multiple marketplaces. However, Nifty Gateway is known for its exclusive artist collaborations and drops (Chang 2023). SuperRare is a curated portal for premium digital art. Each platform has a different user experience, accessibility, and collection of artworks, demonstrating the diversity and versatility of Ethereum-based NFT art. Ethereum's share of NFTs declined from 95% in 2021 to 80% in 2022 (Canny 2022). Through its smart contracts and decentralized applications, the second-largest blockchain supports a large developer and user community (Dapps). Multiple ecosystems for NFTs have emerged on the Ethereum blockchain (Bhalla 2022). In September 2022, Ethereum made notable alterations to its protocols, reducing its greenhouse gas emissions. Nevertheless, Ethereum, along with various other leading cryptocurrencies, still employs energy-intensive processes, which continue to produce substantial greenhouse gas emissions. This underscores the ongoing environmental concerns associated with blockchain technology.

1.2. The NFT Art Market

The NFT art market, while a recent phenomenon, has experienced dramatic and substantial growth, especially in the years between 2017 (Deloitte 2017) to 2022. The early years from 2017–2020 marked the foundational phase of the NFT art market. The Whitney Museum's groundbreaking cooperation with Kevin and Jennifer McCoy was one such event. In 2019, their avant-garde project "Public Key/Private Key" critically examined museum art ownership paradigms and donor–museum relationships. By intertwining it with blockchain technology, they extended its market life and allowed contributors to participate in an ongoing art ownership tapestry (Whitney Museum 2019).

According to the NFT Art Report 2018–2019, the NFT art segment witnessed a massive growth of over 114%, with the total traded volume escalating from USD 260,290 in 2018 to USD 559,403 in 2019. The number of artworks traded increased from 2146 in 2018 to 32,084 in 2019 (NonFungible Report 2018–2019 2019). In 2020, the NFT art segment made significant strides. The dollar value traded reached an impressive USD 20,156,934, showcasing the resilience and adaptability of the market (NonFungible Report 2020 2020). In the face of the epidemic and lockdowns, many artists turned to NFTs for revenue and artistic expression.

Fast-forwarding to 2021–2022, the market saw a significant uptick in both attention and valuation. A study by Chainalysis (2022) indicated that the NFT art market number of transactions increased rapidly, with the average transaction value topping USD 20,000. The value of transactions involving digital collectibles and other forms of NFTs reached USD 44.2 billion in 2021 (NonFungible Report 2022 2022). In terms of the total number of transactions, the number of NFT purchases reached 101 million in 2022, representing a rise of 67.57% from the previous year's total (DappRadar 2023).

In 2022, the NFT art market generated an organic trading volume of around USD 24.7 billion across blockchain platforms and marketplaces, a modest decrease from the USD 25.1 billion in 2021, when the NFT art market activity peaked (Hayward 2023). Notably, the market saw dramatic fluctuations throughout the year. NFT sales peaked at USD 12.6 billion in January 2022 but experienced a staggering drop, totaling just over USD 1 billion by June 2022, a clear indication of the market's volatility (Milmo 2022). By October 2022, sales had plummeted by over 90% in almost every category, from volume to price, compared to the previous year's metrics (Parisi 2022). Despite these hurdles, the market showed signs of a post-crash recovery. Despite diversifying across platforms and blockchains in 2023, the NFT market has continued to grow (Gherghelas 2023).

The market's rise was driven by HNW collectors. They invested heavily in digital art, particularly NFTs. HNW collectors spent USD 46,000 on art-related NFTs in 2022, with 12% spending above USD 1 million (Art Basel 2022). This continuous rise and high-net-worth collectors' popularity is suggestive of the NFT art market's future.

In essence, the foundation of the NFT art market was created between 2017 and 2020, and it grew rapidly from 2021 to 2022. However, artists were among the first to worry about Proof-of-work NFTs' environmental impact. Their proactive actions show how art transforms this ecology. Evident are the market's dynamism, adaptability, and growth potential. However, as we explore the complexities of this topic, the fundamental environmental concerns, especially the increased carbon emissions caused by mining and transactions, remain of the uttermost importance. As the market for NFTs continues to expand and diversify, a comprehensive comprehension of its environmental impact becomes essential; this will be the focus of the following chapter.

2. The Carbon Footprint of NFTs

The NFT art market's expansion has increased carbon emissions from mining and transactions, contributing to climate change and environmental degradation. The Ethereum merged on 15 September 2022, planned to switch from Proof-of-Work mining to a Proof-of-Stake system. However, NFT carbon emissions remain a concern. Therefore, carbon profiles of non-financial transactions must be studied and monitored to reduce their environmental impact.

In the vast NFT market, the art section shows intriguing sales value changes over time. From April 2021 to July 2023, NFT art sales had highs and lows. On 15 April 2021, a 30-day sales review revealed a figure of USD 78 million. This sum reached about USD 881 million by 15 September 2021. However, sales tapered off, reaching USD 14 million on 15 July 2023, which encompassed the 30-day period (Statista 2023).

Given that art NFTs represent 10% of the entire market, as established earlier (Nadini et al. 2021), it is crucial to take this figure into account when assessing the carbon footprint of NFT art. To offer a well-rounded perspective on its environmental impact, I will incorporate this proportion while examining the broader NFT ecosystem.

The carbon footprint is a measure of the exclusive total amount of carbon dioxide emission that is directly and indirectly caused by an activity or that is accumulated over the life stages of a product (Wiedmann and Minx 2007). The greenhouse gas emissions caused by the energy used in the production, transfer, and blockchain storage of NFTs are included in their carbon impact. This includes the equipment used to access and store NFTs as well as the energy consumption of NFT mining.

The NFT art market's rising popularity increases its environmental impact, even though bitcoin trading and games also contribute to global carbon emissions. Due to its rapid growth and rising social prominence, this industry offers a unique chance to examine its environmental impacts. Thus, studying the NFT art market's carbon footprint is both a scientific and sociocultural approach to promote sustainability. This chapter will examine NFT carbon emissions under both Proof-of-Work and Proof-of-Stake techniques to analyze this emergent digital art form's ecological footprint.

2.1. Carbon Emission of NFTs in a Proof-of-Work Mechanism

2.1.1. Ethereum and Its PoW Consensus

Ethereum previously employed Proof-of-Work (PoW) consensus processes. The creation of an NFT, known as "mining", requires computing power to solve complex mathematical problems, which requires a significant amount of energy. PoW is like a problem-solving contest where the winner gets a block as a reward. The greater the number of problem-solving attempts, the greater the likelihood of success. After each newly created block, the procedure is repeated endlessly. Before "The Merge", on 15 September 2022, Ethereum used a Proof-of-Work (PoW) consensus algorithm, which required 900 billion calculations per second for transaction validation (*Ethereum Is Ditching Miners and Merging to a Proof-of-Stake System: Here's Why | CBC News* n.d.). This PoW process required powerful mining equipment and was energy-intensive. With "The Merge", the Ethereum mainnet merged with the Beacon Chain, a proof-of-stake blockchain, eliminating the need for energy-intensive mining (*The Merge | ethereum.org* 2023).

As the landscape of blockchain technology evolves, the PoW mechanism has undeniably become a focal point of environmental discourse. Before Ethereum's notable transition to the Proof-of-Stake (PoS) model in August 2022, it was estimated that each NFT transaction under the PoW mechanism contributed a significant 48 kg of CO_2 emissions (Akten 2022). In 2022, 101 million NFTs were sold (DappRadar 2023), resulting in 4848 million kilograms of CO_2 emissions. This quantity is about 0.004848 gigatonnes of CO_2 in the widely recognized measure. To understand the environmental impact of this, imagine a green canopy of 150–220 million trees, depending on their carbon sequestration[1] capacity (Encon 2023). While Ethereum's switch to PoS reduces its carbon footprint, blockchain technology's environmental issues are significant, especially for systems that rely on PoW.

2.1.2. Bitcoin and Ordinals: The New Wave of NFTs

On the contrary, even as Ethereum transitioned toward the more environmentally-conscious Proof-of-Stake (PoS) mechanism. The use of ordinal NFTs, introduced to the Bitcoin mainnet by developer Casey Rodarmor on 20 January 2023, is a revolutionary method to NFTs (Chainlink 2023). These gained popularity quickly, setting daily registration records in April 2023 (Chainlink 2023). Ordinals encode all their data onto the Bitcoin blockchain, eliminating the requirement for external data sources (Larson 2023). Additionally, where most NFTs embed creator royalties, Ordinals deviate from this standard practice (Larson 2023).

However, Bitcoin's breakthrough adoption of Ordinals is still based on the PoW process, which has severe environmental costs. As the world's leading blockchain, Bitcoin's energy usage is massive, frequently equal to that of whole nations. In August 2022, Bitcoin's energy consumption was estimated as 60–77% of the global cryptocurrency-related electricity demand (Larson 2023).

Finally, NFTs' importance as revolutionary digital assets necessitates a rigorous assessment of their environmental impact. Given the substantial environmental dangers involved with their creation and transaction, especially within the PoW consensus framework, the sector must move to more sustainable alternatives. Technology is supposed to bring greener methods to the NFT industry, allowing it to thrive without harming the environment.

2.2. Carbon Emission of NFT Art in a Proof-of-Stake Mechanism

Ethereum's shift from a PoW to a PoS system emerged from the strategic foresight to amplify energy efficiency and curtail carbon emissions. While NFT art's ecological concerns were not the sole catalyst, they undeniably expedited this transition. With "The Merge", Ethereum veered away from exhaustive mining, using staked ETH to bolster its network. The PoS system does not incentivize block generation with computational power, and which machines construct the next block of the blockchain depends on their wealth. PoS leverages game theory to reach consensus, incentivizing users to stake a percentage of their native currency to validate NFT art transactions. The system uses a combination of

factors such as staking age, randomization, and node wealth to determine the next block's validator (Binance Academy 2018). The staking technique simply needs a device with sufficient storage and an internet connection, not computational capability. As a result of this modification, there is no longer a network of energy-intensive mining machines competing to produce the next block for the underlying blockchain, which greatly reduces carbon emissions; by at least 99.84% (Digiconomist 2023).

As illustrated in Figure 1, Ethereum's shift to a PoS system in September 2022 led to a marked reduction in carbon emissions. The annualized carbon footprints for Ethereum using PoS diminished to 0.01 TWh and 0.01 Mt CO_2, showcasing its progressive approach to sustainability within the realm of blockchain technologies.

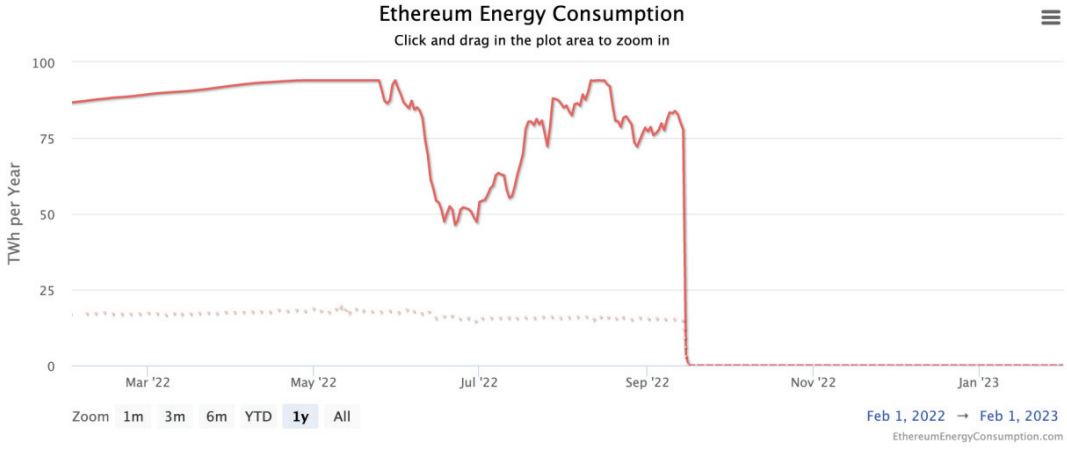

Figure 1. Ethereum energy consumption from 1 February 2022–1 February 2023. ***Note.*** The data is from (Digiconomist 2023). *Ethereum Energy Consumption Index*. Retrieved 1 February 2023, from https://digiconomist.net/ethereum-energy-consumption/. Copyright 2023 Digiconomist.

The data of energy consumption of Mastercard transactions are from *MasterCard USA | A Global Payment Technology Solutions Company*. (MasterCard USA 2019). Retrieved 9 February 2023, from https://www.mastercard.us/content/dam/mccom/global/aboutus/Sustainability/mastercard-sustainability-report-2017.pdf. Copyright 2019 by Mastercard.

The underlying blockchain technology replicates data and operations across thousands of machines, thereby increasing data redundancy and the energy expenses associated with maintaining multiple copies (De Vries 2023). Therefore, the Ethereum network may continue to be comparatively less energy-efficient than centralized alternatives. Figure 2 illustrates that a single Ethereum transaction incurs an energy footprint of 0.04 kWh and emits 0.02 kg CO_2. On the other hand, the Mastercard digital transaction system, emblematic of global digital payment infrastructures, consumes just 0.0007 kWh per transaction (MasterCard USA 2019). MasterCard transactions equal 57 Ethereum transaction footprints. Even though Ethereum has shifted to a PoS model, it is essential that policies and actions limit carbon emissions in order to ensure the sustainable development of the NFT art market.

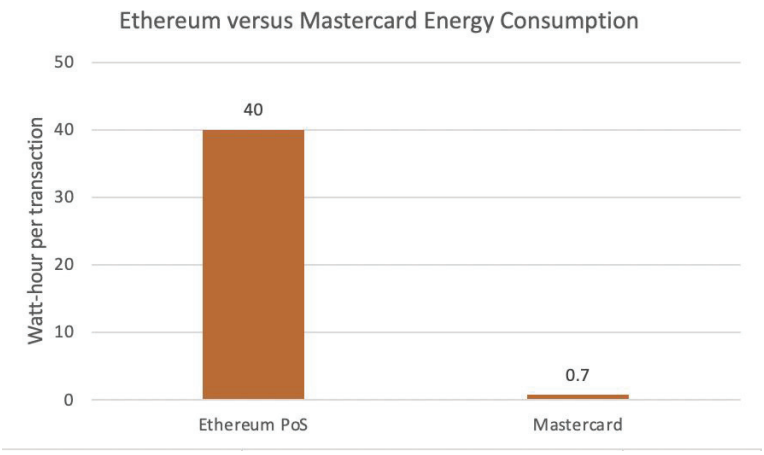

Figure 2. Energy consumption per transaction of PoS Ethereum and Mastercard. ***Note.*** The data on the Ethereum PoS mechanism is from Digiconomist (2023). *Ethereum Energy Consumption Index*. Retrieved 1 February 2023, from https://digiconomist.net/ethereum-energy-consumption/. Copyright 2023 by Digiconomist.

3. Solutions to Reduce NFT Art Carbon Emissions after the Merge

The increase in carbon emissions from NFT art transactions, which is predominantly attributable to the energy-intensive mining process in blockchain technology, is becoming a major cause for concern. Despite Ethereum's transition to a Proof-of-Stake (PoS) system, this concern persists, necessitating the study of additional strategies to reduce the carbon footprint of NFT art transactions. This occurs for three main reasons:

Primarily, the NFT art sector, despite its fluctuating market demand, presents environmental challenges. Due to its blockchain technology foundation, it has environmental implications. Beyond its revolutionary digital presence and commercial possibilities, NFT art represents the digitalization and democratization of art ownership. NFT art is transformative, even with variable demand, thus it is important to be proactive about its environmental impact. Establishing a durable foundation for a creative medium that can change cultural narratives is more important than business dynamics.

Secondly, even though Ethereum's transition to PoS reduced carbon emissions, it may be less energy-efficient than centralized alternatives. A single Ethereum transaction, often required for the purchase or sale of NFT art, is still quite energy-consuming. Consequently, the carbon emissions from NFT art transactions are still substantial and cannot be disregarded.

Thirdly, the NFT art realm demands environmental mitigation strategies that are as avant-garde as the art it represents. With the NFT art market being an ever-evolving entity, previous assessments might lack relevance in today's context. There is a need for innovative NFT art environmental mitigation strategies across consensus mechanisms. After all, art has always been a reflection of society, and in an age defined by environmental concerns, NFT art must mirror these values. Therefore, it is necessary to explore a variety of strategies to reduce the environmental impact of NFT art on the ecosystem.

3.1. Carbon Neutrality to Offset Carbon Emissions

Carbon neutrality might reduce NFT art's carbon footprint, benefiting creators, buyers, and platforms. Being carbon neutral is reducing emissions or buying carbon credits to offset them (*What's the Difference between Carbon Negative and Carbon Neutral?* 2020). It is expected to have no overall impact on the amount of greenhouse gases over the long term. Carbon neutrality is being achieved within the NFT art ecosystem through the use of

renewable energy or carbon-sequestering tokens and the mitigation of carbon emissions through carbon offsets.

3.1.1. Carbon Offsetting

Carbon offsetting involves either the removal of CO_2 from the atmosphere through the use of forestry or wind fields or the reduction in CO_2 emissions by other businesses or individuals (Hyams and Fawcett 2013). Regrettably, this approach may not be viable due to its considerable expense, which can ultimately negate the offset's advantages. For example, consider the renowned NFT marketplace, SuperRare. This has been proactive in addressing the environmental concerns associated with NFTs. It purchased offsets to counteract its carbon footprint. In addition to the works that artists have created, some NFT art organizations, such as ArtStation, have swiftly canceled the launch of their NFT art platform (ArtStation Magazine 2021). Critics cited the substantial energy consumption and carbon emissions associated with NFT blockchain transactions, prompting ArtStation to recognize the environmental implications and delay its plans. (Hayward 2021). Significantly, NFT platforms like KodaDot (*KodaDot About* n.d.) and Voice (Fish 2021), claim to be carbon-neutral. Therefore, although carbon offsetting provides a potential solution to the environmental impact of NFT art, it is not the only method being investigated. The industry is continually innovating and exploring new strategies. Certain blockchain-based tokens have been introduced.

3.1.2. Blending Art and Ecology: Carbon-Offset Innovations in NFTs

Building upon the framework of the carbon-offsetting mechanisms discussed in Section 3.1.1, it is imperative to explore innovations specifically engineered for NFT art. While the overall carbon neutrality strategies provide valuable insights, the emergence of art-specific solutions such as Carbon Collectible NFTs (CCNFTs) is adding a new dimension to how the art industry can address its ecological impact.

Moving beyond the conventional use of renewable energy for carbon mitigation, there has been an innovative foray into the deployment of specialized tokens, such as Carbon Collectible NFTs (CCNFTs), which leverage carbon credits to offset the ecological impact of NFT art transactions. CCNFTs are new NFTs that offset carbon emissions from minting and trading by providing digital rights to one hectare of mature forest land and carbon sequestration based on satellite pictures (Kumar 2022). The buyer can purchase a CCNFT for a period of 1 to 10 years (Kumar 2022) and will receive a numerical representation of the carbon sequestration that can be achieved by owning one hectare of forest, similar to an environmental certificate. CCNFTs can motivate the public to protect forests and encourage replanting by compensating forest landowners for the carbon sequestration that occurs in their forests. The concept underlying CCNFTs may be applicable to NFT art. NFT artists might offset art transaction carbon emissions by minting digital artworks with a similar carbon-offsetting scheme. However, CCNFTs use inaccurate forest carbon sequestration values. To be effective, CCNFTs must correctly measure these data.

Another intriguing initiative is MOSS's MCO_2 token, which is an environmental token that combines the concept of carbon credits and blockchain. Moss created the MCO_2 coin in March 2020, the first blockchain-supported global green digital asset (Earth 2022). Companies and individuals can offset carbon emissions by buying MCO_2 digital certificates (MCO_2 n.d.). MOSS bought Amazon jungle land, divided it into virtual currency shares, and distributed them to investors. A specific number of shares control this land, allowing the corporation to raise funds to buy or develop green spaces to attract investors.

Sven Eberwein is a pioneer in NFTs, combining art, sustainability, and technology. Collaboratively, Eberwein and Offsetra have crafted a path toward sustainable digital artistry. Eberwein's "M Carbon Dioxide" is particularly illustrative of this synergy, and this work is the first carbon-neutral NFT. Representing 1000 tonnes of CO_2 offset, this artwork visualizes a world bereft of land, adorned with a million black particles, each denoting 1kg of CO_2 (Eberwein 2020). These emissions were retired as Verified Credit Units

(VCUs) on the Verra registry. To elucidate further, the carbon offset by this singular NFT parallels the emissions produced by an average individual from an industrialized nation over four decades, or equivalently, 500 round-trip transatlantic flights between New York City and London (Offsetra 2020; Kentidas 2022). The NFT, priced at 15 ETH, matches the cost that Eberwein bore to purchase the VCUs, rendering the art as a medium to catalyze climate action (Eberwein 2020). With Offsetra's efforts underpinning this endeavor, such ventures amplify the potential of NFTs to intersect environmental conscientiousness with artistic innovation.

In essence, initiatives like CCNFTs and MCO_2, coupled with the contributions of artists like Eberwein, offer a diverse range of possibilities. These innovative approaches to integrating carbon credits and blockchain technology provide individuals and businesses with a unique investment opportunity. This not only satisfies the investors' desire for sustainable and environmentally beneficial investments, but also demonstrates their dedication to combating climate change. The difficulty lies in modifying these strategies effectively and precisely for NFT art, ensuring that they not only contribute to reducing carbon emissions but also preserve the integrity and appeal of the art form.

3.1.3. Limitations of Carbon Neutrality

As explored in Sections 3.1.1 and 3.1.2, the concept of carbon neutrality has been embraced by many in the NFT art world as a step toward sustainability. Nevertheless, while carbon-neutral NFT art projects signify a paradigm shift in addressing environmental repercussions, there remain pertinent limitations to be addressed:

First, the current data used to calculate carbon offsets is inaccurate, and multiple agencies lack mutual oversight. Nifty Gateway wants to become "carbon negative" by buying twice its CO_2 emissions in carbon offsets. Nevertheless, the intricacies surrounding the methodology employed to ascertain its carbon footprint raise significant questions. The platform uses Kyle McDonald's open-source calculator to account for data discrepancies that could double or halve its emissions (Di Liscia 2021). These ambiguities highlight the limitations of carbon offsetting in NFTs and the need for thorough data analysis.

Secondly, it does not result in a significant reduction in carbon emissions because it does not fundamentally change the carbon-related behaviors of individuals. This is because the crux of the problem lies not just in offsetting emissions but in the overall behavioral patterns associated with carbon production. Art Basel Miami Beach illustrates the limits of carbon offsetting in the art sector. The fair organizers vowed to reduce their carbon footprint (Rea 2019). This does not necessarily reduce carbon emissions. Critics argue that emissions should be totally eliminated rather than maintained at existing levels. (Rea 2019). This issue applies to NFT art, where carbon neutrality may encourage careless trading without meaningful carbon emission reduction efforts. Notably, carbon offsetting is not a panacea; tackling carbon-producing habits is.

Lastly, there is no guarantee that initiatives to reduce carbon emissions will be effective in the long term. Offsetting carbon emissions may take time, or the carbon conserved may be released back into the atmosphere, negating any long-term advantages. The famous band Coldplay has long been carbon neutral. The band promised various eco-friendly steps for its 2022 global tour, including lowering CO_2 emissions by 50% and using renewable energy. Innovative methods included a "kinetic floor" to harness fan energy, planting a tree for each ticket sold and solar panels at venues (Beaumont-Thomas 2021). Although commendable, these approaches emphasize that this is a long-term commitment that will take years to pay off. While commendable, these efforts do not guarantee that the carbon avoided now will not be released into the climate in the future. Therefore, we must keep seeking better, more sustainable alternatives.

To overcome these constraints, carbon-offset requirements need tougher and more independent audit methods, such as third-party verification and continuous program audits. Recognized carbon standards like the Verified Carbon Standard (*Verified Carbon Standard Methodologies* n.d.) should be used. While some mechanisms such as third-party

verification and continuous program audits aim to ensure robustness in carbon-offset measurements, the efficacy of such standards is subject to ongoing scrutiny and debate, as evidenced by recent controversies questioning the reliability of dominant standards in the voluntary offsets market. Recent incidents have questioned the Verra carbon standard, which dominates the USD 2 billion voluntary offsets market. The Guardian, Die Zeit, and SourceMaterial found that more than 90% of their rainforest offset certificates are likely "phantom credits", and they do not reduce carbon emissions (Guardian News and Media 2023).

This suggests that well-known worldwide firms, some of whom call their products "carbon neutral", may increase global warming by buying credits. Addressing data inaccuracy requires more stringent and independent audit procedures for carbon-offset standards, such as third-party verification and continuous audits of carbon-offset efforts.

Carbon-neutral NFT art is an innovative way to address the environmental impact of the NFT art ecosystem, but it is important to acknowledge and address its limits. By improving carbon-offset standards' transparency, precision, and oversight, the NFT art market can gain credibility and promote environmental responsibility. As the sector evolves, solutions must prioritize carbon neutrality and a more comprehensive and sustainable approach to environmental preservation.

3.2. Lazy Minting

Creators can use lazy minting to reduce the environmental impact of NFT art, and as the technology evolves, the platform can push it as its primary minting method. After an asset is created and documented in a smart contract for trading, minting adds data to the blockchain's main network (Chandra 2022). The carbon footprint of this process includes computing, storage, and transaction costs. It is pertinent to note that unsold NFT artworks, once minted, continue to occupy valuable storage capacity in the blockchain and contribute to environmental degradation through the energy utilized in their minting process.

Lazy minting involves the buyer paying the minting charge after the sale (Alchemy 2022). By avoiding the minting and energy use of unsold NFT artworks, this technique reduces creator costs and increases environmental sustainability. This architecture requires the seller to presign a smart contract with a wallet, token ID, and pricing information. The NFT is minted and transferred to the buyer's wallet to complete the transaction (NFT School 2021). Lazy minting reduces unsold NFTs, making it more eco-friendly.

Platforms renowned in the NFT art realm, like OpenSea and Rarible, have utilized lazy minting as an option (Atallah 2022; Rarible 2021). Lazy minting allows developers to generate NFTs for free, but it is currently only an optional method that many creators may not choose. Lazy-minting technology has the disadvantage that sellers potentially lose control over their work and there is the risk of fraud (Phemex 2022). The smart contract may mint NFT art immediately once it is sold and sent to the buyer, ensuring that the author receives a part of future sales. This would keep using the more ecologically friendly lazy minting process while giving creators some control over their products. Blockchain technology can manage and monitor NFT ownership and transfers, reducing fraud and ensuring that authors have a record of all interactions with their works.

Lazy minting is a more eco-friendly way to make NFT art, despite its challenges. As this technology evolves, new protocols and systems will improve its efficacy and security, making the NFT art market more resilient.

3.3. Alternatives Using Eco-Friendly Blockchain Systems

3.3.1. Alternative Solutions on the Blockchain Main Chain

In response to NFT carbon emissions issues, methods like Proof of Authority (PoA), Proof of Spacetime, and Proof of Good have emerged. Some of these methods have been implemented and produced results, while others are still being conceptualized. NFT art buyers can trade on these platforms, which is pushing them to be more environmentally responsible.

Proof of Authority (PoA)

Back in 2019, the Congressional Research Service recommended PoS and Proof of Authority (PoA) as more sustainable alternatives to PoW for consensus mechanisms (Clark and Greenley 2019). PoA is a consensus mechanism that relies on a set of pre-selected nodes or validators to validate transactions and to create new blocks in a blockchain network (Shardeum Content Team 2022). The PoA system, like that of the PoS, has validators that aid in network agreement. However, in PoA, validators stake their reputation. To enter the chain as a validator, a master of ceremonies must possess a valid United States notary public license and be able to add additional verifiers through the dapp's[2] built-in voting procedure governance (POA n.d.). The PoA system establishes trust and ensures consensus via a combination of identity verification tests and validation by participants who have already been verified.

Due to the performance gains from fewer message exchanges, PoA, a consensus algorithm for permissioned blockchains, has grown in favor (De Angelis et al. 2018). It re-quires less computing power, fewer nodes, and no communication between nodes in order to achieve consensus. Existing nodes are trusted and publicly verified, so the network can still operate with fewer nodes (Curran 2018). In addition, the PoA system has quicker block times and a significantly higher transaction throughput than the PoS system (Majer 2022), uses less energy, and emits less carbon dioxide.

However, the PoA consensus algorithm may limit decentralization and scalability. PoA risks centralization if a few validators conspire or are compromised, since they depend on a collection of validators. The fixed number of validators may also slow transaction processing as the network grows. A potential blockchain network carbon emission substitute is PoA's effective consensus technique, despite its scalability and decentralization limitations. To encourage more NFT artwork transactions based on PoA platforms (such as xDai and POA networks), interoperability must be guaranteed between existing NFT platforms and PoA-based platforms to preserve NFTs' distinctive qualities and value.

Proof of Spacetime (PoST)

The Chia blockchain platform created Proof of Spacetime (PoST), a distributed ledger technology agreement technique based on timestamping data segments to solve energy industry issues while ensuring network security (Chia 2023). PoST might considerably lower NFT art platforms' carbon impact.

PoST validators must stake cryptocurrency to participate in a consensus. They are more likely to be validators and receive incentives if they keep their stake. Because this method encourages validators to keep their coins longer, trading is less frequent, transaction fees are lower, and energy-intensive mining is less necessary. PoST employs hard drives and storage instead of power-hungry, single-use computing hardware that does not need validators' processing power. The Chia network utilizes 0.3% of Bitcoin's annual energy consumption, compared with PoW (*Intro | Chiapower* 2023; Digiconomist 2023). PoST's reduction in energy consumption could lead to a significant decrease in the carbon emissions associated with the minting and trading of NFT artworks. This makes it a more sustainable alternative to traditional, energy-intensive methods.

PoST reduces environmental impact; however, hard drive energy usage is crucial. PoST may increase hard drive usage and electronic waste. After forty days of Chia mining, a 512GB SSD's storage capacity would be gone, according to Fast Technology (Xian 2021).

In conclusion, PoST-based NFT platforms can reduce carbon emissions by utilizing a more energy-efficient consensus mechanism, thereby reducing the total energy consumption associated with the NFT artwork traded on this platform. Notably, the effects of energy supply and the increasing demand for hard disk devices must also be addressed.

3.3.2. Layer 2 Protocols

As an alternative to the mechanisms described above that operate on the main chain, additional mechanisms can be used to reduce NFT art emissions and preserve the decentralized nature of the network (Calma 2021). Adding another "layer" to the current blockchain, which already operates in tandem with Ethereum, is one possible solution. Layer 2 protocols add scalability frameworks to Layer 1 blockchains like Bitcoin and Ethereum. These additional mechanisms, such as sidechains and rollups, aim to lower NFT emissions while preserving the network's decentralized nature (Ginsburg 2022).

Rollups aggregate numerous transactions into one before submitting it to Ethereum for verification, minimizing computing overhead and energy use. NFT art creation and transactions are more carbon-friendly. Arbitrum and Optimism, two popular Ethereum rollup solutions, have 95% lower swap fees than Ethereum's base network (*L2fees.info* 2023). NFT artists and collectors can mint and trade NFTs on Immutable X and Polygon using Layer 2 solutions. These platforms allow NFTs to be transferred to Layer 2-based networks, saving energy.

Layer 2 presents a number of challenges in addition to its many strengths. Layer 2 networks confine interactions to a protocol (RAILGUN Project 2021), limiting communication with Layer 1 (Adede 2023). For instance, rollups may limit Ethereum's compatibility. This may fracture the NFT art ecosystem, forcing developers and traders to adapt to many marketplaces and platforms, which may slow asset transfers between networks, complicate monitoring, and increase complexity (Murphy 2022). End users may also find Layer 2 solutions more complicated as they learn new platforms and technologies. This learning curve may deter users and result in slow adoption.

Despite these challenges, Layer 2 scaling solutions like rollups may reduce NFT art's carbon footprint without affecting efficacy or security as the blockchain industry grows. Therefore, opting for Layer 2 platforms may be a beneficial choice for reducing one's carbon footprint. They need continuous study and development to provide a more sustainable and user-friendly environment for NFT art creation and exchange.

3.4. Calculating the Carbon Emissions of NFT Art

Numerous businesses and individuals, including Digiconomist, NonFungible, DappRadar, and Kyle McDonald, actively track daily NFT transactions and carbon emissions on the blockchain. Their data can be extrapolated to inform and influence the NFT art sector in particular. This real-time monitoring and reporting serve as a valuable tools for those in the NFT art community to comprehend the environmental implications of their actions.

In addition, specialized groups like the Crypto Carbon Ratings Institute (CCRI) have developed methods to determine the carbon emissions of particular NFT transactions for consumers (CCRI-Crypto Carbon Ratings Institute 2022). This encourages more sustainable investments in the NFT art market by enabling consumers to make informed choices about the environmental impact of their purchases. While applicable to the entire continuum of NFTs, the CCRI's approach can be utilized to comprehend the environmental impact of NFT art transactions, thereby empowering consumers to make more sustainable decisions.

Joanie Lemercier, a French climate activist artist, illustrates this need for transparency. Despite his efforts to reduce his carbon impact, NFT art presented unforeseen problems. After successfully selling his artwork as NFTs, he wanted to evaluate his carbon footprint. To his disappointment, Lemercier had trouble obtaining accurate and transparent data from his sales on Nifty Gateway. Joanie Lemercier consulted Offsetra, a carbon-offsetting expert, to analyze the environmental impact of his digital artworks. He learned that his NFTs equated to 80 kg of CO_2, undermining many of his carbon footprint reduction efforts (Mattei 2021). These occurrences demonstrate the importance of open and clear communication about NFT art's potential carbon emissions.

Another NFT community, NFT Club, offers a convenient tool to help NFT creators and collectors become more aware of their environmental effect by allowing users to calculate their carbon footprint by entering the quantity of NFTs issued and traded (NFT

Club n.d.). The Gallery Climate Coalition (GCC) concentrates on the physical art world by monitoring carbon emissions from art shipments (Gallery Climate Coalition 2023). This effort is crucial for highlighting the need for sustainable practices in the traditional art market and for increasing awareness of carbon reduction among art trading parties, galleries, and institutions.

The monitoring and calculation of carbon emissions are essential for effectively addressing and reducing the environmental impact of NFT art. By utilizing these tools, the NFT art community will be able to resolve environmental concerns in a more proactive manner, potentially resulting in a shift toward NFT artworks with smaller carbon footprints. As a result, this rising awareness, in turn, will foster the adoption of environmentally friendly blockchain systems and procedures in the NFT art industry.

3.5. Policy Interventions

Post the Merge in September 2022, Ethereum transitioned from a PoW to a PoS mechanism, significantly diminishing its energy consumption and consequential environmental impact. The reverberations of this transition were felt across various domains, including the NFT art sector. The NFT art market, intrinsically linked with blockchain technology, is directly influenced by such transitions in the digital currency space. It is essential to comprehend and anticipate how policy adjustments affecting the broader blockchain ecosystem may inadvertently affect the NFT art market.

Before the Merge, a plethora of policy propositions were in the limelight to instigate a deviation from the energy-intensive PoW mechanism. These included endorsing alternative consensus mechanisms and proposing regulations that mandate environmental assessments for PoW. Additional fiscal measures, such as fluctuating transaction sales taxes or energy-driven income tax rates, were put forth to stimulate the adoption of eco-friendly consensus processes.

These measures, while not tailor-made for NFT art, hold significant referential significance as they showcase how fiscal incentives and disincentives can shape industry behavior toward sustainability. In essence, by analyzing these policies and understanding their impact on related sectors, stakeholders in the NFT art space can glean valuable insights and be better prepared for potential shifts in the regulatory environment, ensuring the sustainable growth of the sector.

3.5.1. Regulations Prohibiting the Trading or Mining of Virtual Currencies

Various jurisdictions have adopted diverse industry-focused policy interventions in an effort to reduce the carbon emissions associated with blockchain activities, including the creation and trading of NFT art. As seen in China, the United States, and Iran, one such strategy is the implementation of prohibitive regulations on miners and financial institutions. Since 2018, the number of countries with cryptocurrency bans has increased substantially. In 2018, there were eight jurisdictions with absolute bans and fifteen with implicit bans.[3] By November 2021, the number of jurisdictions with absolute bans increased to 9 and the number of jurisdictions with implicit bans increased to 42 (Regulation of Cryptocurrency Around the World: November 2021 Update 2021).

China is an example of a country that has restricted not only mining operations but also the ability of financial institutions to conduct digital currency transactions. China enacted a rule in May 2021 that prohibited a variety of activities involving virtual currencies. This rule bans the use of cryptocurrencies like Bitcoin, Ethereum, and Tether as legal tender, exchange services, information intermediaries, token issuance, and derivative trading. The policy also penalizes people and organizations for virtual currency activity (*Notice on Further Preventing and Resolving the Risks of Virtual Currency Trading and Speculation Act* 2021). This also has significant implications for the NFT art industry, as it restricts transactions and exchanges involving NFT art.

According to the Cambridge University data, Bitcoin mining's carbon footprint has decreased substantially as a result of China's crypto crackdown, which forced more than half of the global hash rate[4] offline, as shown in Figure 3. This implies less operational mining hardware and reduced energy consumption, which indirectly impacts the environmental footprint of NFT art creation and trading, given that Ethereum and Bitcoin employ comparable consensus mechanisms.

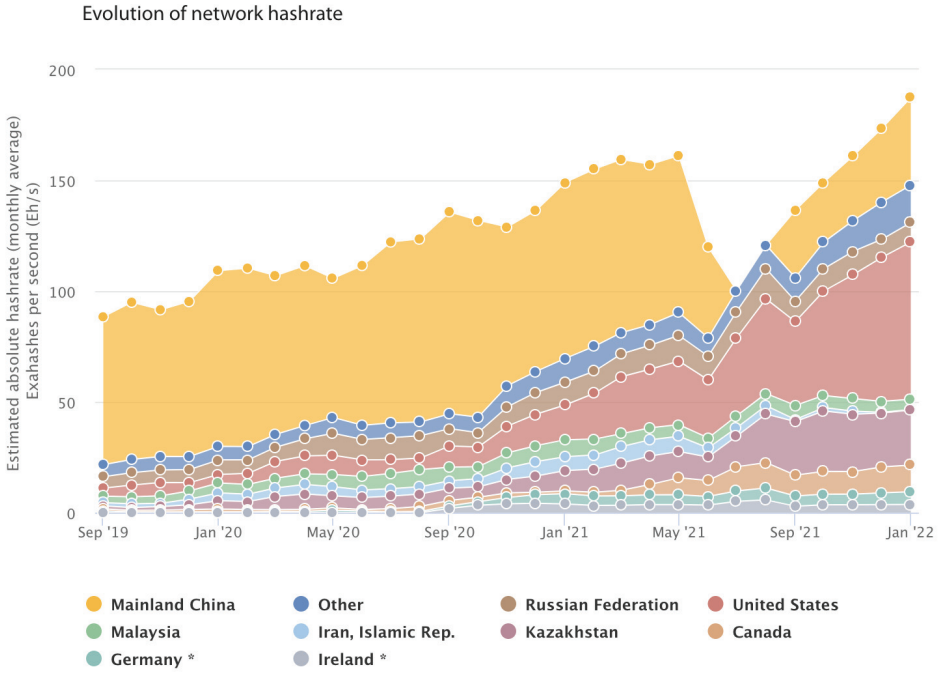

Figure 3. Evolution of the global Bitcoin network hashrate map as of January 2022. * ***Note.*** The data is from (Cambridge Centre for Alternative Finance n.d.) *Bitcoin Hash Rate*. The Cambridge Bitcoin Electricity Consumption Index (CBECI). Retrieved 18 March 2023, from https://www.blockchain.com/charts/hash-rate. Copyright 2023 by Cambridge Centre for Alternative Finance.

Despite the fact that China's policy is a step toward reducing the carbon footprint of NFTs and the blockchain industry, it has distinct limitations that must be acknowledged. Firstly, the policy only restricts mining operations within China's borders, so miners can simply move their operations to countries with reduced electricity costs, such as Kazakhstan, Russia, and Iran, and continue to contribute to high carbon emissions. Numerous Chinese Bitcoin miners have relocated to nations with lower and more renewable energy sources, such as the United States, which is now home to 37.84% of the world's Bitcoin miners (Kavanagh 2022). Secondly, while the policy encourages the use of renewable energy, it does not inherently require it, so mints may continue to rely on fossil fuels to power their operations. Thirdly, the policy focuses primarily on reducing carbon emissions from mining while ignoring other aspects of NFT art creation and trading and the blockchain industry that contribute to environmental degradation, such as the energy consumption required for transactions and storage. Fourthly, there may be difficulties in enforcing the policy, specifically in identifying and penalizing individuals and organizations that continue to engage in NFT art-related activities with a high carbon footprint. This could hinder the policy's ability to reduce the environmental impact of NFTs. China's policy is a positive step toward reducing the environmental impact of the NFT art industry, but it is not a

comprehensive solution and must be accompanied by additional efforts to address the limitations and assure the industry's sustainable future.

3.5.2. Imposing Fees for Energy Consumption

An effective policy approach to reducing the carbon footprint of NFT art could involve internalizing the environmental costs associated with energy consumption during the minting process. Internalizing the environmental costs of energy consumption by instituting surcharges or fees on the energy used in the minting process is an effective policy strategy for reducing carbon emissions associated with the production of NFTs (Truby et al. 2022). This approach, inspired by the increased fees imposed on miners in New York, adheres to the "polluter pays" principle, according to which those who profit from energy consumption should cover the costs of environmental damage caused by their energy use (PSC Approves New Cryptocurrency Electricity Rates for Upstate Utility 2018).

Implementing these costs may encourage energy users to reduce their energy consumption or transition to greener, more sustainable energy sources. Furthermore, this policy could be devised to target high-energy consumption activities associated with NFT art minting, such as PoW algorithms, by imposing a tiered fee structure that levies higher rates for more energy-intensive processes. Revenue from these surcharges could also fund clean energy infrastructure or renewable energy projects, accelerating the shift to a low-carbon economy. International cooperation and planning can prevent carbon leakage and tax competition, achieving the policy's environmental aims without compromising the NFT art market's global competitiveness.

3.5.3. Fiscal Measures to Reduce Carbon Emissions from Cryptocurrency and Blockchain Mining

A variety of measures have been proposed to mitigate the environmental impact of blockchain technology and the creation and trading of NFT art in light of escalating environmental concerns. Environmentalists and policymakers are concerned about the rising carbon emissions caused by NFTs and blockchain mining. In response, various tax measures to mitigate the environmental impact of these technologies have been proposed, including carbon tariffs on blockchain mining, tax breaks or incentives for energy-efficient technologies, implementation of a cap-and-trade framework, taxes on electricity consumed by NFT art and blockchain mining operations, and a tax on NFT art transactions that differs based on the carbon footprint of the underlying blockchain technology. These measures are predicated on the evolution of a carbon tax, which substantially reduces the use of fossil fuels and their environmental impact.

A carbon tax is a fee established by the government whereby emitters must pay per tonne of greenhouse gases emitted. (Center for Climate and Energy Solutions 2021) Sweden's carbon tax, for instance, was implemented in 1991 and is one of the world's earliest and most extensive carbon taxes. It taxes fossil resources like coal, oil, and natural gas according to their carbon dioxide emissions (*Sweden's Carbon Tax* n.d.). The tax has been instrumental in reducing greenhouse gas emissions in Sweden and advocating the use of clean energy. Following is a discussion of several tax policy strategies that could reduce the carbon emissions of NFT art.

Carbon Tariffs on Blockchain Mining

Envisage an art gallery powered predominantly by non-renewable energy; the carbon tariffs on blockchain mining would motivate NFT art creators to pivot toward greener alternatives. By instituting a tax on energy usage and carbon emissions resulting from various consensus protocols, policymakers have the potential to incentivize miners to adopt greener energy sources and to invest in energy-efficient technology. The tax structure could be designed with a gradient approach, in which less efficient equipment would be subject to higher taxes and more efficient equipment with diminished environmental impacts would be subject to lower taxes.

Tax Breaks or Incentives for Energy-Efficient Technologies

Art has always been an avenue for innovation, and with fiscal incentives, NFT artists and platforms could be at the forefront of technological advancements. Governments could provide tax breaks or incentives to NFT artists and platforms who invest in energy-efficient technologies or use renewable energy sources. This policy could stimulate industry innovation and increase the demand for green technologies by providing financial support for environmentally favorable practices in the NFT art sector. For instance, federal tax credits for solar energy systems in the United States illustrate the potential influence of such incentives on industry behavior (*Homeowner's Guide to the Federal Tax Credit for Solar Photovoltaics* 2023). The federal tax credits are an excellent example of how incentives can influence industry behavior.

Cap-and-Trade Framework

The implementation of a cap-and-trade framework is an alternative method for reducing carbon emissions in the NFT art sector and other blockchain mining industries. This market-based mechanism establishes a cap on total allowable emissions while distributing or auctioning permits to mining companies. NFT art creators are then incentivized to reduce their emissions in order to trade excess permits or avoid the need to obtain additional ones. The European Union Emissions Trading System (EU ETS) is an example of a successful cap-and-trade program that has effectively reduced emissions across multiple sectors; installations subject to the ETS have experienced a reduction in emissions of approximately 35% between 2005 and 2021 (European Comission Climate Action 2023). By employing a similar cap-and-trade system, the NFT art industry could potentially achieve comparable environmental mitigation results.

Taxes on Electricity Consumption

In addition to the aforementioned strategies, a tax on the electricity consumed by NFT art could encourage the adoption of energy-efficient equipment and practices. Governments can indirectly target carbon emissions associated with energy consumption through the imposition of taxes on energy consumption. The Climate Change Levy (CCL) of the United Kingdom, which taxes the energy consumption of enterprises, is one policy that promotes energy efficiency and the use of renewable energy sources (*What Is the Climate Change Levy (CCL)?* n.d.). By imposing taxes on electricity consumption, much like the UK's Climate Change Levy, NFT artists would be nudged toward more energy-efficient modes of creation and exhibition.

NFT Art Transaction Taxes Based on Carbon Footprint

Lastly, a tax on NFT art transactions that varies based on the carbon footprint of the underlying blockchain technology could encourage users to adopt platforms with minimal emissions. There is a need for tax regulations that fluctuate based on the carbon footprint of the blockchain technology underlying NFT art transactions. Currently, while certain NFT transactions, such as purchasing an NFT with fiat currency, are not taxable, the taxation rate can vary significantly depending on whether you are an investor or a creator (Brooks 2023). To effectively combat the environmental impact of NFT transactions, fiscal measures that incentivize users to gravitate toward platforms with minimal emissions should be implemented. Not only would such a policy internalize environmental costs, but it would also ensure that the art market remains acutely aware of the environmental consequences of its choices (Coinbase n.d.).

A combination of tax policy strategies could effectively reduce carbon emissions related to NFT art. By encouraging the adoption of cleaner energy sources, energy-efficient technologies, and more sustainable practices within the industry, these measures have the potential to significantly mitigate the environmental impact of this swiftly expanding sector. In essence, by integrating these tax policy strategies into the NFT art realm, there is an

avenue to sculpt a future where art not only reflects our culture but also our commitment to the planet.

4. Conclusions

In recent years, the NFT art market has witnessed remarkable growth, with transactions totaling billions of dollars. NFT art that operated primarily on Ethereum and utilized the PoW mechanism was energy-intensive and generated significant carbon emissions. The adoption of a PoS system by Ethereum reduces carbon emissions. Despite the fact that this is a positive development, the underlying blockchain technology incurs energy costs for sustaining multiple instances, which must be addressed.

This paper compares and analyzes the options proposed by experts and the NFT art platforms prior to the Merge to determine the carbon reduction strategies that are still useful. Carbon neutrality is a possible remedy. CCNFTs and MCO_2 offset the carbon footprint of NFTs with carbon credits. However, their high cost and the imprecision of carbon-offset data calculations limit their efficiency. Although lazy minting is a viable solution, it results in creators losing control over their own works. Alternative solutions on the blockchain, including PoST and PoA on the mainnet and Layer 2 systems, have been implemented. Notwithstanding, new issues have emerged, including, among others, decreased dispersion, increased demand for hard drives, decreased connectivity, and emerging information security concerns. There is no single solution that combines the advantages of all stakeholders; all existing alternatives have glaring disadvantages. These methods, despite their limitations, can significantly reduce the carbon footprint of NFT art.

Numerous policy interventions have been discussed, including regulations prohibiting the trading or mining of virtual currencies, the imposition of fees for energy consumption, and fiscal measures to reduce carbon emissions from cryptocurrency and blockchain mining. While Ethereum's successful transition to a PoS system has deemed many of these policy interventions irrelevant to the Ethereum network, they may still be applicable to other blockchain platforms utilizing PoW consensus methods. These interventions could promote the industry's adoption of healthier energy sources, energy-efficient technologies, and more sustainable practices.

In conclusion, sustainability and environmental impact mitigation must be prioritized as the NFT art market expands. Combining tax policy strategies, such as carbon taxes on NFT art minting, energy efficiency tax credits, tradable emissions permits, energy consumption taxes, and NFT art transaction taxes, with technical solutions such as carbon offsets, lazy minting, and alternative consensus mechanisms can assist in addressing the environmental challenges posed by NFT art. These measures have the potential to substantially mitigate the environmental impact of this rapidly expanding sector by encouraging the adoption of cleaner energy sources, energy-efficient technologies, and more sustainable practices within the industry.

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1. Ethereum Energy Consumption: The quantifiable metrics pertinent to Ethereum's energy utilization, inclusive of those associated with Ethereum's Proof of Stake (PoS) mechanism, were acquired from Digiconomist's (2023) Ethereum Energy Consumption Index. This repository is accessible to the general public and can be retrieved from the following URL: https://digiconomist.net/ethereum-energy-consumption/. The dataset is copyrighted by Digiconomist, thereby requiring acknowledgment for its reproduction or dissemination.
2. Ethereum PoS Mechanism: Data delineating the energy implications of Ethereum's Proof of Stake (PoS) mechanism have also been sourced from Digiconomist's "Ethereum Energy Consumption Index," accessible as of 1 February 2023. This is the same database as the aforementioned Ethereum energy consumption data, and it is copyrighted by Digiconomist.

This repository is accessible to the general public and can be retrieved from the following URL: https://digiconomist.net/ethereum-energy-consumption/.

3. Mastercard Energy Consumption: The analytical data germane to Mastercard's energy consumption has been culled from a copyrighted 2019 sustainability report released by MasterCard USA. Due to intellectual property rights, direct sharing of this dataset is inhibited. However, interested scholars can procure the data from the following URL: https://www.mastercard.us/content/dam/mccom/global/aboutus/Sustainability/mastercard-sustainability-report-2017.pdf.
4. Bitcoin Hash Rate: For assessments related to Bitcoin's energy consumption, data was procured from the Cambridge Centre for Alternative Finance's Bitcoin Electricity Consumption Index (CBECI). This dataset is also publicly accessible and can be found at the following URL: Cambridge Bitcoin Electricity Consumption Index (CBECI). Copyright permissions apply as dictated by the Cambridge Centre for Alternative Finance.

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Notes

1 The method of capturing and storing carbon dioxide in the atmosphere is called carbon sequestration (Clear Center 2019).

2 A decentralized application (dapp) is an application that combines a smart contract and a frontend user interface and is created on a decentralized network. Source from *Introduction to dapps* (Introduction to Dapps. ethereum.org n.d.).

3 In the report of the (Regulation of Cryptocurrency Around the World: November 2021 Update 2021), the term "absolute ban" is defined as a country that prohibits the use or operation of cryptocurrencies through legislation or official statements issued by government or financial regulators. Clearly, cryptocurrencies are prohibited under this prohibition.The term "implicit ban" refers to restrictions that make it difficult or impossible to use or operate cryptocurrencies in a country without explicitly prohibiting them. Bans on banks, banking entities, and cryptocurrency exchanges are implicit bans. These steps restrict cryptocurrency use and adoption in the jurisdiction without outlawing them.

4 Hash rate is a measure of a cryptocurrency network's computing power that functions as a key security indicator. It indicates the number of approximations made per second to solve complex mathematical puzzles using transaction data. A high hash rate indicates that many processors are validating transactions (Kavanagh 2022).

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A Brave New World: Maneuvering the Post-Digital Art Market

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Abstract: The digital revolution has launched myriad new technologies in the field of art and cultural heritage law, including digital art, NFTs (non-fungible tokens), artificial intelligence (AI)-generated art, virtual reality and reality augmentation, online viewing rooms and auctions, holograms, immersive experiences, and more. As a $67.8 billion industry, the art market is a global driver of innovation, international collaboration, and national economies, given its cross-border transactions. However, given the extremely rapid development of these new technologies, regulators have struggled to keep pace and implement legal measures that are fit for purpose in this field. Limited oversight has resulted in several claims that have the potential to change the legal landscape. For instance, claims over the theft/misappropriation of NFTs and the related fraud and money laundering that may ensue, as well as a recent class action copyright infringement suit against the creators of a popular AI algorithm and infringement claims over immersive installation and light technologies, demonstrate how new ways of thinking are required to assess cases involving digital property (distinguished from other types of non-tangible property). Moreover, the US Supreme Court has issued a landmark ruling on fair use within the copyright context, which will be relied upon in the future to determine whether (and to what extent) the appropriation of existing copyrighted material is permitted. This includes both the digital use of physical artworks and the use of born-digital works. Although jurisprudential decisions are made on a case-by-case basis, factual patterns involving online media, digital art, and related technologies could serve as guidance for legislators and other decision-makers when considering what limits should be imposed on Web 3.0. This article will focus on recent US-based claims and regulations and dovetail with existing art market regulations in this jurisdiction (e.g., anti-money-laundering statutes) to determine their impact on new technologies, whether directly or indirectly. Finally, the article highlights ongoing trends and preoccupations to provide an overview of the shifting legal landscape.

Keywords: art market; digital art; new technologies; artificial intelligence; copyright law

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1. Introduction

Both the art market and technological developments have undergone rapid changes over the past few years. In an increasingly globalized and technologically advanced world, it is now possible to engage in almost instantaneous transactions and communications with people thousands of miles away. This includes the sale of physical and digital art, where purchasers can view, buy, and receive their goods online without in-person interactions or inspections. However, with billions of dollars funneled through the art market annually and the popularity of new forms of art that intersect with technology (e.g., NFTs and artificial intelligence/AI), it is necessary to examine how such goods—and, by extension, consumers and market participants—are protected. The global art market is currently valued at $67.8 billion, representing a strong increase from both post- and pre-pandemic levels. In particular, the US has demonstrated "one of the most robust recoveries of all the major markets", having experienced continued growth since 2021 to reach $30.2 billion, its highest level to date (McAndrew 2023, p. 17). The US has maintained its top spot in the art market by relying on industry self-regulation and the fair use copyright doctrine to incentivize creators. But these protections do not necessarily have a seamless application

in the digital realm, as artists are left vulnerable to infringement through unauthorized copying, false endorsement, fraud, and third-party derivative works. Regulators have also begun to pay attention to the ways in which digital art, particularly non-fungible tokens (NFTs), can be used as vehicles for fraudulent activity such as insider trading and money laundering. The present article examines the interactions between the art market and technology in the US to ascertain whether current legislation and regulations are fit for purpose in the burgeoning post-digital world.

Previously, the art market existed in its own rarified sphere, where industry insiders—art collectors, galleries, and dealers—operated discreetly, away from the public eye. Now, the art market has become a fixture in the social consciousness after receiving mainstream attention. The names and work of blockbuster artists such as Banksy are relatively commonplace and receive media coverage by outlets like CNN and The New York Times. This indicates that there is an increased public awareness of the art market and its interactions with everyday life.[1] It is not far-fetched to attribute this change to new technologies, particularly the Internet, as information can be shared "virally". But, as the art market and digital mechanisms have proliferated in tandem, it has become apparent that new forms of legislation and regulation are needed to ensure that transactions are carried out responsibly and both artists and consumers remain protected.

The present article discusses art-market-related regulatory attempts in the US while considering recent case law on copyright fair use and artificial intelligence (AI), which are poised to become the main contenders for legal claims in this sphere. This article is one of the first to analyze these developments within a wider art market framework. Legislation and regulation must both take into account the peculiarities of the art market and how it has traditionally operated in the physical space when imposing controls on artwork traversing the digital space. Furthermore, the concept of transformativeness in copyright doctrine, which is unique to the US, was recently analyzed in a hallmark case before the highest court in the land (the Supreme Court of the United States). This is one of the factors courts use to determine fair use of original material, and there is a wealth of jurisprudential analysis that could be applied—and even extended—to proliferating forms of digital art. However, AI art has its own challenges, as a settled body of law based on opinions from the Copyright Office and federal courts indicate that works do not qualify for copyright protection unless there is a substantial amount of human input. Given that digital art and technologies intersecting with the art market continue to develop at a rapid pace, and with limited case law that addresses the rights and responsibilities in this area, it is crucial to examine how existing measures can be adapted to the current state of affairs and how effective new provisions can be developed.

The following section examines the interactions between technology and the art market, focusing on the development of Web 3.0 and its potential to revolutionize the way in which art is conceived of and valued.

2. Web 3.0 and the Art Market

As argued in a previous article (Quiñones Vilá 2021), global society is currently inhabiting a post-digital world where Internet usage and reliance on online tools in daily life are not only prevalent, but also expected. This has resulted in considerable changes to the ways in which tangible and intangible property rights are conceived. New technologies and their offshoots (e.g., social media and apps) ushered in the nascent Web 3.0 age, where "[a]dvances in technology and shifts in culture have the ability to create an environment that is different rather than merely a faster and better-rendered version of what has gone before" (Garon 2022, p. 167). In lay terms, this means that there are greater overlaps between the physical and the digital than ever before, and ownership of digital assets is seen as equally valid to ownership of physical assets (described in more detail below). The current "centralized, algorithmically mediated new media marketplace" derives from the Web 2.0 model, where global conglomerates (e.g., Amazon, Facebook, and Google) dominate the "digital industrial age" through advertising revenue and the "corporate management of

public content". Web 3.0 will theoretically turn users from "passive consumers to active creators", democratizing the access to and use of information through decentralization and the participation by diverse contributors (Garon 2022, pp. 165–67, 176–78).

The metaverse is a key example of this trend. According to McKinsey, the metaverse is "the emerging 3-D-enabled digital space that uses virtual reality, augmented reality, and other advanced internet and semiconductor technology to allow people to have lifelike personal and business experiences online". This means that the metaverse is essentially a viable alternative to in-person interactions and transactions. So far, investors have poured over $120 billion into metaverse technologies, with the potential to reach $5 trillion by 2030. Given the lucrative opportunities to develop digital technologies and extend their reach, the metaverse is poised to gain an even greater foothold in everyday life. While the basic tenets of the metaverse—a sense of immersion, interaction in real time, and user agency—can already be observed, its true apotheosis—platforms and devices that work seamlessly with each other—has yet to arrive, mainly due to a lack of sufficiently advanced technology. Nonetheless, today's metaverse serves to illustrate how users can act as stakeholders in this community, developing content and experiences through platforms and apps, as well as interacting with other users through tools that manage digital identity and affect the economy (e.g., cryptocurrency and online payment alternatives such as PayPal and Venmo). Experts agree that the metaverse is not a passing fad, but rather a permanent addition to the digital realm (McKinsey & Company 2022).

At first glance, the metaverse and the art market do not appear to have much in common. Although the art market has become a global powerhouse characterized by blockbuster sales and international collectors, the impression it leaves in the mind of outside observers is likely that of traditional handshake deals and physical luxury, rather than technological innovation. Nonetheless, the art market has become increasingly enmeshed with the financial sector over the past few decades, with commercialization as the dominant force driving the multi-billion-dollar industry (Quiñones Vilá 2021, p. 4). As a result, it is susceptible to trends and influence-based marketing, much like generic online consumers. Moreover, in recent years, the art market has begun to fully embrace the digital sphere. While this process was already underway before the COVID-19 pandemic occurred in 2020, extensive lockdowns, staff redundancies, and dwindling funds forced cultural institutions and art businesses to shift and adopt long-distance solutions through the use of technology. Although the art market is famously face-to-face and consumer-oriented, with networking at art fairs (e.g., TEFAF and Frieze) and other social events seen as essential for developing relationships between dealers and collectors, this approach required re-evaluation once such contact posed a deadly risk.

In fact, it seems that the pandemic forcibly propelled the art market into the digital realm, with online sales reaching "an historic peak of $12.4 billion in 2020, doubling in size year-on-year as the pandemic restricted offline channels and events. Growth continued in 2021 with sales reaching $13.3 billion, an increase of 7%. . . Most businesses maintained digital sales and programs alongside their gradual return to live sales and exhibitions" (McAndrew 2023, p. 30). Successful initiatives included online viewing rooms (OVRs), which allow prospective buyers to engage with the objects (e.g., through superzoom) and obtain expert information on their aesthetic and economic qualities, granting users more transparency on the availability and costs (Indrisek 2019; Schneider 2020). Although online sales fell to $11 billion in 2022 as live events and sales once again became the norm, this still represents an 85% increase from 2019's pre-pandemic levels (McAndrew 2023, p. 30). Technology and digital art were also crucial for the art and culture sector's post-pandemic recovery. Social media campaigns and a greater online presence allowed cultural institutions to develop visual content and capitalize on public interest, which then translated to real-world gains (Quiñones Vilá 2020, p. 187). According to a report by the International Council of Museums (ICOM), most museums enhanced their digital activities and increased their social media participation throughout the pandemic, resulting in a "lasting impact on the way cultural institutions communicate with their audiences" (ICOM

2020, pp. 2, 10). Although the art world was historically slow to adapt to new technology, it is now "being forced to reckon with the metaverse" in the wake of COVID-19 (Noh et al. 2022, pp. 315–16).

There are several recent examples of art market/technology overlaps. In May 2023, Sotheby's auction house announced that it was entering the second phase of its Metaverse project, originally launched in autumn 2021 as part of its "aggressive courtship" of collectors seeking blue-chip digital works. Shortly after its inception, the site hosted its first auction of digital art and NFTs (non-fungible tokens), netting $18.6 million in sales. Other sales of individual NFT collections have followed. Now, the platform will operate entirely on-chain, allowing direct peer-to-peer primary and secondary market transactions. Primary market transactions consist of direct sales between artists and purchasers, while secondary market transactions consist of subsequent sales. Unlike other NFT marketplaces, Sotheby's will only list works from specific artists to guarantee quality and enforce artist royalties. It is reported that, to date, Sotheby's has generated over $100 million in NFT sales through its ventures, and the auction house remains "fully committed" to continuing with Web 3.0 (Escalante-De Mattei 2023b; Whiddington 2023a). Furthermore, the purchasing power of younger generations and their interest in digital art cannot be overlooked. In June 2023, an auction of 37 NFTs once belonging to a crypto hedge fund, announced as the "largest ever live sale of digital art" and expected to reach over $5 million, netted $11 million. Sotheby's employees commented that it was the youngest audience ever seen in the salesroom, with many first-time bidders attending (Small 2023). An earlier sale of the "Grails" NFT collection exceeded estimates and netted $6 million, demonstrating collectors' continued appetite for generative art (Whiddington 2023b). Christie's auction house has also dabbled in the technoverse. In 2022, it deployed hologram technology to display one of Edgar Degas's bronze ballerina sculptures in previews at overseas locations. This was viewed as a viable alternative to potentially risky and expensive international shipping costs. Technology company Proto provided the software and display cases, which produce lifelike, three-dimensional displays that allow viewers to examine the work in detail. The units can be transported easily, and holographic reproductions can be viewed anywhere in the world as long as the Proto device is present. This could significantly impact how art is viewed and displayed in the future, particularly at art fairs and auctions (Dafoe 2022; Cassady 2022). It further demonstrates how digital reproductions of artwork are increasingly viewed as legitimate alternatives to physical works, not merely as lifelike stand-ins until the "real" version can be obtained.

Artists have also used new technologies to create innovative artworks. In March 2020, popular contemporary artist KAWS launched Expanded Holiday, which exhibited one of his Companion sculptures in 12 locations around the world simultaneously. Using an augmented reality (AR) smartphone app, users could view the work and share it simultaneously on social media. AR allowed the artwork to be placed in front of or behind objects while appearing fully three-dimensional and grounded in space. KAWS followed this experiment with an exhibition titled NEW FICTION at the Serpentine Gallery in London, which was a hybrid show. In addition to physical sculptures, an app produced digital works that appeared on empty plinths in the gallery as AR sculptures, including one above the entrance to the building. The app further allowed users to place the works in public spaces nearby or in their own homes, effectively bringing the artwork along with them. They could even lease or purchase AR Companions (Palumbo 2020). KAWS stated: "I'm interested in all these outlets because I love the idea of interacting with people in these different ways, in very candid ways… It doesn't need to be a big painting on the wall. It could be any form. That's very inclusive, and I honestly think it's better for the work" (Christie's 2022). Immersive art installations showcasing works by deceased artists, such as Claude Monet, Vincent Van Gogh, and Frida Kahlo, have also become extremely popular amongst audiences. These installations use multimedia tools, digital art, and physical props to engage visitors and immerse them in the artwork as part of a sensory experience, including sights, smells, and sounds.[2] Both types of exhibitions blur the line between the

physical and digital and allow visitors to continue experiencing the artwork after they exit the space (notably through social media interactions).

Not all art market participants are so keen to embrace the digital, however. An Artnet correspondent visiting the Frieze New York Art Fair in May 2023 noted: "Selling new-media art is a daring proposition in the best of times, of course—but the near invisibility of references to present-day tech at this event may be seen as art playing it safe in the face of economic jitters, or stressing its most tried-and-true, embodied pleasures against the specter of all-destroying A.I." (B. Davis 2023). The tension between welcoming (and exploiting) cutting-edge technology and concern over the unknown ramifications of the same are at the heart of ongoing developments in the US. Legal and regulatory issues, particularly in the field of copyright, are discussed further below.

Having established the relevant context for this article, the following section examines US copyright law and recent copyright developments applicable to the art market.

3. US Copyright Law and the Limits of Fair Use

According to the Art Basel and UBS 2023 Art Market Report, the US's share of sales by value increased by 2% year-on-year, reaching 45% in 2022. The US art market also experienced "one of the most robust recoveries of all major markets" to reach $30.2 billion, its highest level to date. Given that nearly half of global art market sales take place in the US (McAndrew 2023, p. 17), and New York recently accounted for 15% of the national caseload in copyright filings (U.S. Courts 2020), the importance of case law from this jurisdiction cannot be overstated. Copyright claims are governed exclusively by federal law (under the Constitution and 1976 Copyright Act)[3] interpreted by federal courts, as well as determinations issued by the US Copyright Office, a federal government agency. While artists' moral rights in the US are limited to works of visual art created since 1990,[4] copyright protection has been a mainstay of the US legal system since the Constitution was drafted in the late 18th century. As a mercantile society that became independent from the most powerful commercial nation in the world at the time, the government felt that it was crucial to stimulate the progress of science and the arts by incentivizing authors to create and protecting their work.[5] This is the core purpose of copyright, which grants authors the exclusive right to exploit their works through reproduction, derivative works, sale, loan, performance, and other forms of economic benefit.[6] Copyright protection subsists in "original works of authorship fixed in any tangible medium of expression. . . from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device". This includes literary, musical, dramatic, pictorial, graphic, audiovisual, architectural, and choreographic works. Copyright protection arises from the moment a work is created, but, in order to qualify, it must be an original work of creative expression, fixed in a tangible medium, with more than a transitory duration.[7]

However, copyright protection is not absolute. There are exceptions, known as fair use, which serve as a defense to copyright infringement. Such exceptions include criticism, comment, news reporting, educational use (e.g., teaching), scholarship, or research. The Copyright Act establishes the following factors to be used by courts when determining fair use: (1) the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes; (2) the nature of the copyrighted work; (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and (4) the effect of the use upon the potential market for or value of the copyrighted work.[8] An additional concept, "transformativeness", has been developed under the first factor and is often seen as definitive in the fair use analysis. In order to qualify as transformative, a secondary work must "ad[d] something new, with a further purpose or different character" to the original.[9] Likewise, if the works are substantially similar, the possibility of fair use decreases.

Fair use is a cornerstone of copyright enforcement in the US. The Copyright Office has even created a Fair Use Index, compiling judicial decisions with the aim of "mak[ing] the principles and application of fair use more accessible and understandable to the public".[10]

Various fair use cases have impacted the art market. For instance, in *Cariou v. Prince*,[11] the Court of Appeals for the Second Circuit held that appropriation artist Richard Prince's modification of Rastafarian photographs by Patrick Cariou was fair use because they would be considered transformative by a reasonable observer, given their new aesthetic. Prince had modified the original photographs by enlarging, blurring, or sharpening them, adding elements and compositing multiple photographs with other works. Notably, the Second Circuit reversed the previous ruling by the district court, which had found that Prince's work was not transformative because he failed to comment upon the original works. As a result, artists adding new expression, character, or aesthetics to an existing work became shielded from copyright infringement by the fair use defense without the need to prove commentary on the original. While transformativeness is determined on a case-by-case basis, for the past decade, *Cariou v. Prince* was seen as the gold standard for fair use cases.

However, a case directly impacting the US's fair use legal landscape (Legal Information Institute (2022), *Andy Warhol Foundation for the Visual Arts, Inc. v. Goldsmith et al*.[12]) was just resolved in 2023. For the past six years, attorneys and art market participants eagerly awaited a final decision over whether a work by renowned pop artist Andy Warhol infringed copyright in a photograph taken by Lynn Goldsmith. In brief, the facts are as follows: In 1981, Goldsmith, a professional photographer, took a photograph of up-and-coming musician Prince. Years later, when the singer's popularity had taken off, magazine Vanity Fair approached Goldsmith to license her photograph with the intention of commissioning a work based on it. Goldsmith agreed, and received both payment and credit for her work. Notably, the license's terms stipulated that the use of the photograph would be for "one time" only. Vanity Fair then commissioned an illustration from Warhol using the photograph as an "artist reference". This work was published in the November 1984 issue of the magazine. Unbeknownst to Goldsmith, Warhol created 15 additional works based on her photograph ("Prince Series"). One of these works ("Orange Prince") was licensed by Condé Nast, Vanity Fair's parent company, for a retrospective issue featuring Prince after his death in 2016. The license was issued by the Andy Warhol Foundation ("Foundation"), which received the intellectual property rights in Warhol's work after his death in 1987, in exchange for $10,000. Goldsmith was not notified, paid, or credited at this time. When Goldsmith saw Orange Prince on the cover of the 2016 issue, she notified the Foundation of her belief that this was copyright infringement. The Foundation filed a claim before the District Court in New York seeking a declaratory judgment of noninfringement or, in the alternative, that this qualified as fair use (Escalante-De Mattei and Solomon 2022).[13]

The District Court sided with the Foundation, holding that the Prince Series was transformative because "they have a different character, give Goldsmith's photograph a new expression, and employ new aesthetics with creative and communicative results distinct from Goldsmith". It found that the works were "immediately recognizable as a 'Warhol'" rather than as a photograph of Prince, changing the subject's regard from vulnerability to an iconic presentation and removing "nearly all . . . protectible elements", concluding that the market value for Goldsmith's work would not be affected.[14] The Second Circuit reversed and remanded, favoring Goldsmith. In particular, it stated that adding a new aesthetic or expression is not necessarily transformative; the relevant inquiry is "whether the secondary work's use of its source material is in service of a fundamentally different and new artistic purpose or character". Under this analysis, simply imposing a different style on the work is insufficient to qualify for fair use.[15] The Second Circuit further noted that the Foundation had "encroached on Goldsmith's protected market to license her photograph 'to publications for editorial purposes and to other artists to create derivative works'".[16] The overlap in purpose was significant. Finally, the court rejected the notion of a "celebrity-plagiarist privilege", whereby more famous artists with distinctive styles would be able to freely appropriate works from lesser-known authors.[17]

On 18 May 2023, the US Supreme Court ("SCOTUS") issued its ruling in the case, sending shockwaves across the art world. Despite high-level art market participants arguing that limiting the scope of fair use would have a negative effect on artists and

hinder creativity overall, such as The Robert Rauschenberg Foundation, Roy Liechtenstein Foundation, and the Brooklyn Museum,[18] the court ruled in favor of Goldsmith. In a 7–2 majority opinion delivered by Justice Sotomayor, it was held that the Foundation's licensing of Orange Prince to Condé Nast did not constitute fair use because the work had the same essential purpose as the original, which was to illustrate magazine stories about Prince. The use was also commercial in nature, which generally weighs against a finding of fair use.[19] It is important to note that this ruling has not eliminated fair use altogether, but rather set a higher threshold for artists and other third parties who use or appropriate pre-existing copyright-protected works, contrasting with earlier opinions heavily weighted towards transformativeness as standalone evidence of fair use.[20] The existing factors under the Copyright Act will continue to be used by courts to determine whether fair use applies, taking into account all the facts and circumstances of each case. SCOTUS even used other works by Warhol, such as his depictions of soup cans, as examples of transformative fair use. Nonetheless, allegations of transformativeness cannot be used as *carte blanche* to dispense with copyright protection; there must be some change with "critical bearing" on the original. Otherwise, greater weight will be given to the other factors, particularly commercial use.[21]

There are several points that should be considered here. First, SCOTUS specifically exempted the rest of Warhol's body of work from its analysis, focusing instead on a narrow instance: the Foundation's failure to pay Goldsmith a licensing fee for the use of *Orange Prince* licensed to Condé Nast for its 2016 retrospective issue.[22] The court knowingly declined to extend the scope of its decision, as this would open a Pandora's box of infringement claims, particularly for contemporary and digital artists. Even so, there is concern that this decision will "significantly limit the amount of borrowing and building on previous works that artists will engage in" (Miranda 2023). Second, the fact that Goldsmith had licensed her photograph for a single purpose, and that the original Warhol illustration was created pursuant to that license, appears to have played an important role for SCOTUS. This can be compared to another instance of appropriation by Warhol, where he used a photograph of hibiscus blossoms licensed to a magazine by Patricia Caulfield to create his *Flowers* series. Notably, the *Flowers* series were not intended to circulate in the same manner as the original Caulfield photograph, reaching a different market altogether (publishing versus visual art). Although this could have supported a finding of fair use, Warhol ultimately settled with Caufield, awarding her $6000 and royalties on future sales. As a result, there is no applicable case law governing the matter. It must be stressed that this case was filed in 1964, before the Copyright Act and its provisions on fair use were enacted. If it had been brought after 1976, but before this ruling, it is likely that the result would have favored Warhol and that his series would have been considered fair use (López 2022; Daley 2019). The Foundation's licensing of Orange Prince, which had a commercial purpose, was thus a key component of the court's analysis. Third, neither transformative use nor commercial purpose is dispositive for a finding of infringement on its own; both must be considered against each other, the circumstances of the case, and the remaining statutory factors. SCOTUS appears to have given greater weight to the commercial purpose of the Prince Series when compared to its transformativeness, although the dissenting opinion in the case criticizes the majority's "commercialism-trumps-creativity analysis".[23] Fourth, "fair use is an objective inquiry into what a user does with an original work, not an inquiry into the subjective intent of the user, or into the meaning or impression that an art critic or judge draws from a work".[24] This means that judges should not impose their own criteria on the aesthetic value of a work, limiting their analysis to the elements that have been altered. Finally, SCOTUS focused on the first statutory factor, leaving other issues unaddressed (Ewing 2023).

As the final determination in *Goldsmith* is so new, it has not yet been fully applied to artwork-related copyright claims before the courts. However, other lawsuits involving new technologies illustrate approaches and outcomes that could be applied to the art market. In November 2022, two open-source programmers filed a lawsuit against OpenAI, GitHub

Inc., and Microsoft Corp. over their AI coding tool Copilot, arguing that it was trained on their code without the proper license information or attribution.[25] Open AI is also behind the DALL-E 2 program, another machine-learning model, which allows users to create complex visual images from text prompts (Poritz 2022). A copyright-related ruling against OpenAI in the Copilot case would give artists ammunition to prevent their work from being used to train DALL-E without their consent; here, they would merely need to cite the relevant decision in a cease-and-desist letter rather than proceeding to file a claim in court—unless the fair use doctrine applies. For example, in *Authors Guild, Inc. v. Google, Inc.*, the Second Circuit affirmed the District Court's ruling that Google's manual scanning of millions of copyrighted books without a license in order to create its book search project constituted fair use because the purpose of the copying was "highly transformative, the public display of text is limited, and the revelations do not provide a significant market substitute for the protected aspects of the originals. Google's commercial nature and profit motivation do not justify denial of fair use". Notably, this court's analysis also relied on *Campbell v. Acuff-Rose*, as did SCOTUS in *Warhol v. Goldsmith*.[26] Here, the determining factor was not commercial use but market substitution. Based on this ruling, an artist could succeed on an infringement claim against works created by AI if they can prove that there is an overlap in the market between the original work and the secondary work. This could potentially apply to digital artworks created by human artists based on existing physical originals by other artists as well. Subsequently, in *Google LLC v. Oracle America, Inc.*,[27] SCOTUS ruled that Google's use of third-party code was fair use because Google only copied what was needed, it was destined for use in a different platform (smartphones rather than desktop and laptop computers), and the use was "distinct and different" from the original.[28] While copyright is more complex in the software context, which depends on open-source material and interoperability, these cases are nonetheless instructive. Courts will generally favor outcomes that "serv[e] copyright's goal of enriching public knowledge" and avoid those that "shrin[k] the protected market opportunities of the copyrighted work".[29]

In December 2022, SCOTUS asked the US Solicitor General to file a brief in a separate case that accuses Google of illegally scraping lyrics from the Genius song transcription website and posting them in its search results pages (*ML Genius Holdings LLC v. Google LLC*).[30] Genius alleges that Google's actions divert Internet traffic away from the Genius website, resulting in tens of millions of dollars in lost advertising revenue. However, since neither Genius nor Google own the copyright in the lyrics, the Second Circuit found that the Copyright Act pre-empted the suit.[31] It appears that SCOTUS may take a different view of the matter. If a decision is rendered in favor of Genius, it could open the door for third-party websites that use copyrighted material fairly (e.g., DeviantArt, an online art gallery where community members post their work) to enforce the rights of users, even though they are not the copyright holders or owners of the material.

Finally, the US Court of Appeals for the Ninth Circuit, based in San Francisco, established a legal standard known as the "server test",[32] which states that a website displaying a copyrighted work without authorization cannot be held liable for infringement if the work is digitally stored elsewhere (i.e., on a different server). For example, a blog containing an embedded post with a copyrighted photograph would not be liable because the photograph is not stored on the blog's servers, but rather on the server of the website where it was originally posted. In 2021, two photographers brought a class action suit against social media platform Instagram, challenging the use of its embed tool. Plaintiffs claim that this tool allows other websites to display posts without a license, thus enabling widespread copyright infringement.[33] The case was dismissed in the Northern District of California due to the Ninth Circuit's server test, but a New York judge rejected this precedent in a ruling over Instagram embeds in a news magazine article.[34] US case law can be either binding or persuasive. It is binding when precedent is established by upper courts; for example, federal District Courts must follow precedent established by Circuit Courts. The same

principle applies at the state level. Within any jurisdiction, the decision of one trial court is not binding on other trial courts, and decisions in one jurisdiction are not binding on courts in another jurisdiction. A precedent may be adopted by a court if no previous decisions on the issue exist within the jurisdiction (i.e., persuasive authority rather than binding authority). Here, the New York court was free to reject the California court precedent, because it was persuasive in nature.[35] Although the parties ultimately settled and the case did not go to trial, this initial decision could impact cases involving digital art shared across digital platforms and publications without crediting the author in the near future. The lack of uniform case law on these topics means that there is a possibility of widely varying results, unless SCOTUS or the courts of appeal issue a firm ruling. Given the wide online dissemination of digital art, the outcomes of copyright infringement cases involving tech companies, digital publications, and social media platforms will be significant for the art market.

The following section discusses issues particular to specific types of digital art, and how their legal treatment has evolved.

4. NFTs, AI, and the Digital Revolution

For the purposes of this article, the term "digital art" is used broadly to refer to works that are either born digital or have been transposed to a digital format. Although there are myriad forms of digital art, this article will focus on those that are most pertinent for the purposes of this article: works that are created or modified using artificial intelligence (AI), non-fungible tokens (NFTs), and immersive art installations (briefly). All these types of digital works touch upon copyright issues. Under US law, so long as a work is a fixed, original work of human creativity, it will obtain copyright protection from the moment of its creation. A work is considered fixed "when its embodiment is sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration".[36] A work can have a temporary nature of a few seconds and still meet this requirement.[37] However, the US Copyright Office follows the principle that only works by human authors qualify for copyright protection and may be registered.[38] This specifically excludes "works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author",[39] such as converting a work from analog to digital format; for example, transferring a film from VHS to DVD (U.S. Copyright Office 2021, §313.2). It is generally understood that NFTs qualify for copyright protection, but protections for AI art may vary.

NFTs have been the subject of much speculation and alarm, depending on whether the affected party is a seller, buyer, artist, or regular consumer. NFTs are unique digital assets created by recording ("minting") files on a blockchain. Each token is unique (non-fungible), and ownership is tracked on the blockchain according to smart contracts embedded in the programming code. Smart contracts are pieces of code that make up the computer program running the operation of an NFT. They use blockchain technology to verify and record the existence and ownership of digital assets: "The smart contract creates a registry entry on the blockchain that is understood in the NFT industry and crypto community to represent proof of ownership of the asset linked to the NFT, whether that be artwork, a piece of real estate, or other asset" (Murray 2023, p. 29). NFTs are not a type of cryptocurrency, although they are often purchased with this type of coin. NFTs can consist of images, videos, music, memes, tweets, highlights, and GIFs—generally, any type of collectible, including sports clips. NFTs raise interesting questions as to the nature of property ownership in the post-digital age: "The conceptualization of NFTs empowers artists, but also the investors with a powerful instrument to enforce their property rights about a digital good which makes them attractive to financial investors", and "represent a relevant class of assets of their own" (Horky et al. 2022, p. 1). As intangible assets, the very nature of NFTs "makes them flexible and adaptable to multiple uses" and they are not susceptible to the limitations placed on physical goods with respect to their transportability, fungibility, scalability, costs, reproduction, and enjoyment (Moro Visconti 2021, pp. 13–14). In other words, NFTs can

be created, disseminated, and viewed by millions of users simultaneously in real time, whereas physical works would require considerably more effort.

The distinction between tangible and intangible property is nonetheless important when considering NFTs. Unless expressly agreed upon, ownership of an NFT does not entitle the holder to retain or exploit the physical or digital asset the NFT is based on (e.g., artwork); it merely grants the purchaser ownership over the NFT itself: "An NFT is not the digital asset itself. If you buy the NFT for a piece of digital art, the NFT is not the image file. It is only the record of ownership or authenticity that's stored on the blockchain. The image file will be hosted elsewhere" (Goforth 2022, p. 779). Because blockchains operate on a decentralized model, the likelihood of hacking or theft is extremely low, as is the ability of third parties to modify information recorded on the blockchain. (However, it is not impossible; the information contained in the ledger is only as accurate as the information provided or the website storing the NFT could become defunct.) (Sharp 2022, pp. 644–46) In theory, this provides holders with transparent, immutable proof of ownership and provenance (i.e., the chain of ownership for the asset) over the NFT. Smart contracts can also be used to ensure artist royalties, giving them a percentage of future sales (usually ranging from 2.5–10%). For example, since the code in smart contracts is embedded in the NFT, if the code includes a royalty provision, the artist will receive a percentage of each subsequent sale each time the NFT is traded: "Whenever the NFT is resold on the secondary market, the smart contract automatically calculates the royalty fee based on the percentage set by the creator. It transfers the payment to the creator's wallet address [automatically]. The creator can earn ongoing income every time their NFT is resold, even if they only received payment for the initial sale". Since artists often struggle to properly monetize their work, this provision has been heralded as a "game-changer" that incentivizes artists to continue producing high-quality content and ensures that the value of the NFT is maintained over time (Umashankar 2023). In late 2022, the leading NFT marketplace OpenSea implemented a royalty enforcement tool applicable to new collections, which will be blacklisted from resale on marketplaces that do not honor artist royalties (Tan 2022).

The craze for NFTs is best understood as an extension of real-world consumer behavior, where scarcity (either real or manufactured), collectability, and authenticity drive buyer demand. Conversely, blockchain technology ensures a steady supply (Sharp 2022, pp. 654–55). The art world first took notice when an NFT of digital artist Beeple's work Everydays: The First 5000 Days was sold for $69 million at Christie's auction house in March 2021.[40] This sale spurred a frenzy of collector interest and million-dollar sales akin to an NFT "gold rush" (Trautman 2022, p. 365). The Crypto Punks collection has amounted to $2.4 billion in sales since its creation in 2017 and Pak's "Clock" was the second highest NFT sale ever recorded at $53.7 million in 2022, while art-based NFTs increased from 2% to 24% of sales between 2019 and 2020, reaching 65% in 2021 (Santillana Linares 2023). But NFTs remain susceptible to the vagaries of the market. Despite sales reaching a peak of $17 billion in January 2022, by September 2022, trading volumes had fallen 97% to $466 million as the result of a wider crypto crash and market saturation (Shukla 2022; McAndrew 2023, pp. 33–34). Overall sales of art-related NFTs reached $1.5 billion in 2022, which represents a 49% decline from 2021 but still counts as a significant increase from 2020 levels ($20 million). The "high liquidity, ease of access, and instant tradability of NFTs" that attracted speculative buyers has now cooled somewhat, although interest has not faded entirely. As the art trade "steadily adopt[s] some of the more important and long-term implications of Web3 and blockchain for their businesses", NFTs will continue to gain visibility (McAndrew 2023, pp. 34, 40). It has been noted that "NFTs appear to be establishing themselves as new alternative financial assets in the blockchain cosmos", with the potential to play a decisive role in shaping the art market (Horky et al. 2022, p. 7).

Creating an NFT based on a pre-existing work may violate the copyright in the underlying work as an unauthorized reproduction, display, or derivative work. Artists have reported unauthorized creations and sales of NFTs featuring their work (Beckett 2022), but enforcement of copyright in this context can prove challenging due to the overwhelm-

ing number of visual assets across the NFT landscape online. Moreover, the terms and conditions used by platforms and smart contracts do not always address intellectual property issues satisfactorily. The very nature of the Internet facilitates anonymity, allowing NFT owners to remain untraceable and appear in various marketplaces, exacerbating the situation (Noh et al. 2022, pp. 324–25). Other jurisdictions have made inroads into the thorny world of NFT regulation: a UK court has ruled that NFTs are legal property subject to interventions, such as injunctions,[41] and a Chinese court recently determined that online marketplaces are liable for copyright infringement involving NFTs traded on their platforms (Bridegan et al. 2022). The Hangzhou Internet Court ruled that purchasing and offering an NFT for sale is the copyright owner's right, ordering the platform to pay damages and "burn" the NFT (Kumar et al. 2022). However, no such precedent is available yet in the US, as most cases have either been settled or remain pending. A recent example is the dispute between director Quentin Tarantino and producer Miramax over the rights to create NFTs based on the film *Pulp Fiction*, which settled in September 2022. Had this case proceeded to trial, it could have established a model for future NFT copyright infringement lawsuits.[42] In theory, US copyright infringement disputes involving NFTs will follow established case law and principles, including limitations on fair use.

Trademark cases have proven more effective as a means of enforcement. In *Hermès International and Hermès of Paris, Inc. v. Mason Rothschild*, [43] the defendant Rothschild created faux-fur versions of the iconic Birkin bag (labelled "MetaBirkins") and sold them as a collection of 100 NFTs. Although Rothschild disclaimed any affiliation with Hermès, the luxury brand filed suit for trademark infringement and dilution, as well as cybersquatting. The court found Rothschild liable despite his freedom of expression claims, holding that there was a likelihood of consumer confusion (Greenberger 2023c; Robertson 2023; Thompson 2023). In April 2023, Yuga Labs, a company that hosts the popular Bored Ape Yacht Club NFT collection, prevailed against artists that released a copycat collection. Although the artists claimed that their work was satirical in nature, the court held that this constituted trademark infringement.[44] In both cases, copyright law was not considered.

Moral rights and public rights may also be involved, depending on the jurisdiction. For instance, in 2021, the Uffizi Gallery minted and sold an NFT of Michelangelo's *Doni Tondo* for €140,000 and announced plans for further NFTs based on works in its collection—before the Italian government put a stop to this activity, citing the unknown risks of such technology. As a public institution, the Uffizi was bound by this pronouncement (Escalante-De Mattei 2022b). A businessman is currently under investigation by the Mexican government after seemingly destroying an original Frida Kahlo drawing (by lighting it on fire in a martini glass) to promote its permanent transition to an NFT and immortality in the metaverse. Kahlo's entire body of work is protected as artistic monuments under Mexican law, meaning that this destruction could be considered a crime (Feldman 2022). Other publicity stunts have prompted backlash, including the livestreamed burning of an original work by Banksy to "cynically" promote an NFT sale (for £274,000) (Criddle 2021) and the attempted sale of an NFT collection based on paintings from famous institutions by a collective named Global Art Museum (GAM). This was widely criticized as an "art heist", whereby GAM took advantage of the museums' open data policies. GAM ultimately walked back the sale and claimed it was part of a "social experiment" (Cascone 2021).

NFTs thus provide an illustration of how art market principles can be applied to, and thrive in, a Web3 environment. The use of artificial intelligence to create art has also become widespread, having experienced a recent boom in the marketplace. In 2018, Christie's auctioned a computer-generated artwork by art collective Obvious titled Edmond de Bellamy.[45] The painting was the result of self-taught algorithms fed with thousands of images of portraits. The final sale price of $432,500 shattered records as well as pre-sale estimates of $8000–11,000, although later sales of AI work failed to reach these heights (Quiñones Vilá 2019). This seems poised to change. Over the past year, AI art generators have proliferated to such an extent that they have become nearly ubiquitous, with mesmerizing yet uncanny renderings populating social media feeds. In particular, selfie portraits created

using the Lensa app's "magic avatar" feature made the rounds in 2022, with over 5 million downloads worldwide (Ulea 2022). The seemingly unstoppable rise of AI art, and the money to be made from it, require firm standards to ensure that original creators are fairly compensated and acknowledged for their work.

First, it is important to understand how AI machine models operate: "Systems that use machine learning commonly train themselves on existing works and generate outputs based on previous learnings. In the case of AI-Generated Art [sic], the expert system analyses countless works of art based on artistic style and produces a similar output" (Dee 2018, p. 32). AI models typically use artificial neural networks to perform tasks according to an algorithm. Generative adversarial networks (GANs) use two simultaneously trained networks tasked with outperforming each other to "teach" the machine how to distinguish images generated by the first network and real images. Whereas older networks required thousands or even millions of images to train, GANs can use 100–300 real images (Gillotte 2020, pp. 2660–65). This is the type of network used to create Edmond de Bellamy. AI programs can learn by receiving feedback from either supervised or unsupervised learning. Supervised learning consists of labeled training data fed into the AI, which are then tasked with constructing an algorithm that accurately maps the input to the output, for example, the word "flower" (input) into images of flowers (output). In unsupervised learning, the AI independently observes patterns in the input data and refines its algorithm by comparing its performances over time (Gillotte 2020, pp. 2660–65). Projects like Google's Deep Dream and The Next Rembrandt serve as examples of generative AI art (Guadamuz 2020, pp. 3–5).

In March 2023, the Copyright Office issued guidance to "clarify its practices for examining and registering works containing material generated by the use of [AI] technology", due to the ongoing popularity of such works. The guidance reaffirms the human authorship requirement, but also recognizes that there are works utilizing AI which may be the result of an author's "own original mental conception, to which [they] gave visible form", which qualify for copyright protection. This is a case-by-case inquiry. The guidance further distinguishes between a generative AI receiving a prompt from a human and producing complex works in response, where the "'traditional elements of authorship' are determined and executed by the technology" (in this case, the AI technology is what determines the expressive elements of its output, not the putative human author) (see U.S. Copyright Office 2023), and a human modifying, selecting, or arranging AI-generated material in a creative way. The former work will not be protected by copyright or subject to registration, while the latter will be protected with respect to "the human-authored aspects of the work, which are 'independent of' and do 'not affect' the copyright status of the AI-generated material itself". Applicants are required to disclose the inclusion of AI-generated content and to provide a summary of their contributions to the work when filing for registration (see U.S. Copyright Office 2023).

This rationale was recently illustrated in practice. Previously, in 2018, Steven Thaler attempted to register a visual artwork titled A Recent Entrance to Paradise, which was described as "autonomously created by a computer algorithm running on a machine". The Copyright Office denied the application on the grounds that there was no human authorship, which is required to meet the originality threshold. Following several administrative appeals, the Office's Review Board issued a final determination in 2023 affirming the decision because the work was made "without any creative contribution from a human actor" (U.S. Copyright Office, Copyright Review Board 2022, p. 2; see also Moghadam 2022; Recker 2022). The Copyright Office declined to overturn longstanding precedent in this field, stemming from an 1884 SCOTUS case which requires a minimum amount of creativity to grant copyright protection.[46] Notably, Thaler's stated aim in seeking registration was not to protect the work from infringement, but rather to prove that machine-created works were eligible for copyright protection (Robertson 2022b).

In 2022, Thaler filed a lawsuit before the District Court in Washington DC to compel the Copyright Office to register his work.[47] The Copyright Office's determination could only be overturned if Thaler proved that the decision was made in an arbitrary or capricious

manner, as an abuse of discretion, or otherwise not in accordance with the law. Thaler relied on SCOTUS precedent stating that "technological changes must be considered when interpreting the Copyright Act", arguing that AI-generated works meet the purpose of copyright law in progressing the arts and sciences (Kinsella 2023a; Homen 2023). Because the Copyright Office's decision was made in keeping with earlier precedent requiring human authorship, and this is a long-standing principle of copyright law, it was unlikely that Thaler would succeed on the merits. It is also worth noting that Thaler allegedly modified his original claim that he had no involvement with the creation of the work, now stating that he provided instructions and directions to the AI, directly controls the AI, and that the AI only operates at Thaler's direction. This seems to indicate a tacit acknowledgement of the human authorship requirement and an attempt to downplay the machine's independence (Growcoot 2023; Chen 2023). In August 2023, the court ruled in favor of the Copyright Office and held that Thaler's work was not copyrightable. While the judge recognized that humanity is "approaching new frontiers in copyright" that pose challenging questions on authorship, a "guiding human hand" was required for copyright (W. Davis 2023). It is worth noting that Thaler advanced legal theories under which the copyright in the AI work would transfer to him as the computer's owner under the work-for-hire doctrine.[48] Thaler might have succeeded on these grounds in the UK, where a work produced by or with the assistance of a computer can be afforded copyright protection and the copyright will be owned by the person who enabled the generation or creation of the work.[49] Thaler plans to appeal the ruling but, as it stands, without legislative changes, the human authorship requirement remains a pivotal component of copyright protection and registration in AI cases before US courts (Estoesta 2022).

Earlier this year, a graphic novel titled *Zarya of the Dawn* by Kris Kashtanova which included AI-generated images as well as human-authored text was also submitted for registration. In February 2023, the Copyright Office determined that the work as a whole was copyrightable and could be registered, but that the individual images were not protected.[50] In doing so, it retracted an earlier decision granting copyright protection to the images, citing "incomplete information" in the original registration as justification, since Kashtanova had not disclosed that the images were AI-generated (Chen 2023; Edwards 2023; Escalante-De Mattei 2023c; Lawler 2023). This decision is seen as a partial victory for artists that use generative AI models, such as MidJourney, to create works (Brittain 2023b). In essence, if the Copyright Office determines that the author used AI as a tool and there was limited distance between the user's input and the finished product (output), then the work will be protected. This can be contrasted with the field of photography, where an external tool (camera) is used to generate an output. Photographs are generally eligible for protection because there is a modicum of creative decision making that the photographer engages in, such as choosing the subject, focus, angle, etc. (Analla 2023). Kashtanova has the option to request reconsideration from the Copyright Office. After two denials, the matter may then progress to federal court. However, this would likely be time-consuming and expensive. However, given the adjudication of Thaler's case, it is doubtful the claim would succeed unless Kashtanova was able demonstrate a higher degree of human decision making than Thaler.

Additional copyright disputes involving AI tools are currently ongoing. The most recent controversy involving AI-generated artwork revolves around the practice of "scraping", whereby data (including images) are pulled from across the Internet and used to train image-generating AI models (e.g., Stable Diffusion) (Maiberg 2023). This practice "frequently exploits legal loopholes in existing IP frameworks" (Zeilinger 2021, p. 54), and there are limited ways for creators to prevent their work from being used for such purposes. For instance, artists can remove their artwork from websites or only upload low-resolution images, but this negatively impacts their ability to obtain new commissions and make a living.

In the meantime, artists can use other tools to protect their work. A team of computer scientists at the University of Chicago have developed a software tool called "Glaze",

which cloaks images so that AI models are unable to scrape a work's defining features, thus preventing them from appropriating an artist's unique style. One of the scientists commented: "Artists really need this tool; the emotional impact and financial impact of this technology on them is quite real. . . We talked to teachers who were seeing students drop out of their class because they thought that there was no hope of the industry, and professional artists who are seeing their style ripped off left and right". Previously, the same research group developed Fawkes, an algorithm to cloak personal photographs to prevent their use in face recognition models. However, this proved insufficient when applied to artwork, as an artist's style is defined by a larger number of characteristics (brushstroke, color palette, shadowing, texture, etc.) (Mitchum 2023).

Interestingly, Glaze "us[es] AI against itself" to interrupt style transfer algorithms, identifying specific features and perturbing them "just enough to fool art-mimicking AI models, while leaving the original art almost unchanged to the naked eye". Generative AI systems interacting with Glaze produce "much less successful forgeries", even when trained on a combination of both cloaked and uncloaked images. Since scraping is a continuous process, Glaze will effectively poison the well and leave such tools unable to appropriate new data. The team is working on a downloadable version of Glaze that artists will be able to use at home before posting their work online (Mitchum 2023). This is a unique proposition where AI can be weaponized against copyright infringement. AI itself is neither good or bad, and, since it is clear that AI will not disappear anytime soon, artists should take advantage of this technology to protect their work while members of the art market and legal community advocate for greater regulatory controls.

Since this is an emerging area of law, there is often no firm precedent on the legality of such actions—but, where the data used as source material are created by humans, it will be copyright-protected and subject to enforcement, as discussed above (Vincent 2022). Legal challenges have already arisen in this context. In January 2023, a class action lawsuit was filed in San Francisco by three artists on behalf of the visual arts community, alleging that AI generators (including MidJourney) violate artist rights by scraping the web for images and using copyrighted works without crediting or compensating creators, and threatening their livelihoods (Vincent 2023a).[51] The complaint states: "The harm to artists is not hypothetical—works generated by A.I. Image Products 'in the style' of a particular artist are already sold on the internet, siphoning commissions from the artists themselves . . . [plaintiffs] seek to end this blatant and enormous infringement of their rights before their professions are eliminated by a computer program powered entirely by their hard work".[52] A representative for defendant Stability AI claims that scraping is fair use and that holding otherwise is a misunderstanding of the applicable technology and law, while the CEO of MidJourney commented: "To the extent that A.I.s are learning like people, it's sort of the same thing and if the images come out differently then it seems like it's fine" (Feldman 2023). This comment evidences a lack of understanding of how copyright law works and a dangerous conflation of human rights and machine rights. The defendants have asked the court to dismiss the claim (Brittain 2023a), but it is clear that a new "protocol of consent" needs to be developed in this context, as well as a wider discussion on the purpose of such tools and their wider use (Ulea 2022).

Although an argument supporting fair use in this context might have succeeded prior to the SCOTUS *Goldsmith* decision, it now seems unlikely that courts will view such appropriation in a favorable light, particularly since these companies are making a profit and any transformative use will be minimal, as it is produced/determined by the AI tool itself rather than humans. There is also a very real concern about human creativity being stifled, thus disincentivizing members of the artistic profession as a whole and undermining copyright law and constitutional protections. This even extends into other fields where human authors are being curtailed by companies' reliance on AI (e.g., ChatGPT), as evidenced by the current Writers' Guild strike (Shah 2023). Furthermore, and most importantly, AI is not a human being—it is a machine and, therefore, a tool, not a substitute for human ingenuity. The same parameters for fair use and transformativeness

do not apply. When weighing a work that was made by human creativity versus one that was produced mechanically using the former work as a guide, the Copyright Office (and, presumably, courts) will side with the human author, upholding decades of copyright law interpretation. Here, it is important to distinguish training systems versus generating content, as the latter will more likely be considered infringement due to its purpose (commercial rather than educational) (Vincent 2022).

In the meantime, the photograph licensing company Getty Images filed a separate lawsuit against Stability AI, alleging that the company copied 12 million images without authorization, "to benefit [its] commercial interests and to the detriment of content creators"(Vincent 2023b).[53] Prisma Labs, the creator of the Lensa app, is facing a lawsuit on the grounds of illegal collection of biometric data.[54] Other claims are sure to follow, as "[w]e are still in the Wild West days of this type of AI" (Sheng 2023). Until legislation is fit for purpose, and amidst companies' disregard for the wider legal implications of their technology, it is crucial for regulators to step in and maintain order.

5. Current US Regulatory Framework

Regulatory measures in the US have mainly focused on NFTs rather than other types of digital art, particularly due to their heightened risks of fraud, money laundering, consumer confusion, and links to cryptocurrency, which is undergoing increased scrutiny. It is worth noting that the art market's habitual lack of transparency has already been singled out by US legislators. A bipartisan Senate report published in July 2020 exposed the vulnerabilities of the art market to illicit activity, including the evasion of sanctions by Russian oligarchs, aided by high-profile auction houses. It is common practice for consigners to use intermediaries (agents or shell companies) in order to preserve their anonymity and for dealers to respect confidentiality. While this is not illegal in and of itself, it can lead to deficiencies in due diligence and AML reporting procedures. In the report, the art market was described as "the largest unregulated market" in the US (Grossman et al. 2021), leading to the enactment of a new anti-money laundering law which extends reporting obligations to antiquities dealers.[55]

In April 2023, the US Department of the Treasury ("Treasury") published a risk assessment on decentralized finance ("DeFi"), services exploring how these are being exploited by illicit actors to engage in criminal activity. The government is chiefly concerned with the potential of DeFi service providers to launder money through ransomware, theft, fraud, scams, and proliferation finance (Edgar et al. 2023). This follows an earlier report from February 2022 by the Treasury's Financial Crimes Enforcement Network ("FinCEN") discussing art-market-based financial risks. NFTs were identified as vehicles for potential money laundering due to the inherent ease in transferring digital assets nearly instantaneously; the lack of recorded transactions on a public ledger; the lack of uniformity in structure, ownership, and operation of platforms; and incentives to sell repeatedly during a short period of time; in addition to a lack of technical understanding amongst consumers and art market participants (U.S. Department of the Treasury 2022, pp. 26–27). Thus, regulators are aware of the risks these assets pose and their vulnerability to illicit activity.

NFTs may also qualify as commodities or securities depending on the circumstances, falling within the purview of the Commodity Futures Trading Commission (CFTC) and Securities Exchange Commission (SEC), respectively. Commodities consist of goods with contracts for future delivery. In December 2014, the Chairman of the CFTC opined that cryptocurrencies were commodities, and the agency has issued guidance on its regulation of virtual currencies. As assets with value that can be sold and converted into cryptocurrency, it is possible that NFTs fall within the scope of the CFTC's authority. Since it is not yet clear whether NFTs will be treated as fungible cryptoassets or distinct assets by the courts, this is a gray legislative and regulatory area (Goforth 2022, pp. 792–94). In order to qualify as securities, the NFTs in question must be marketed as an asset that will give a return on investment due to the efforts made by third parties (an investment contract). If the price appreciation for the NFT can be attributed solely to market factors, such as inflation,

then it will not be considered a security. This is known as the *Howey* test, established by SCOTUS in *SEC v. W.J. Howey Co.*, 328 U.S. 293 (1946). An interest will be classified as an investment contract under *Howey* if it satisfies the following elements: (1) There is an investment of money or something else of value; (2) in a common enterprise; (3) where the purchaser expects to receive profits; and (4) the expectation of profits is from the essential entrepreneurial efforts of others (See Goforth 2022, p. 784). The main criterion is whether a buyer reasonably expects a profit from the funds they have invested in a common enterprise. The SEC has stated that cryptoassets are considered securities under *Howey* and released an accompanying framework. NFTs may meet the elements of the *Howey* test, depending on the circumstances, for instance, where multiple purchasers acquire non-exclusive licenses and limited rights in the underlying asset motivated by the hope that their NFTs will increase in value. A practical effect of this application is that platforms facilitating the sale and secondary trade of NFTs will need to register with the SEC; otherwise, they risk breaking the law (Goforth 2022, pp. 783–90; Cointelegraph n.d.). Moreover, the Internal Revenue Service (IRS) has taken an interest in NFTs, which may be subject to taxation. While no formal guidance has yet been issued, the general consensus is that NFTs should be treated as collectibles, making them liable to capital gains tax and, potentially, sales tax (Rottermund et al. 2022, p. 5).

Authorities have already begun to crack down on NFT transactions involving fraudulent activity. In March 2022, two defendants (Ethan Nguyen and Andre Llacuna) were charged with conspiracy to commit wire fraud and money laundering in connection with a million-dollar scheme to defraud purchasers of NFTs advertised as "Frosties".[56] The defendants engaged in a "rug pull" scam, offering purchasers certain benefits alongside the NFTs, then shutting down the relevant website and transferring the cryptocurrency proceeds to various digital wallets under their control once the sales had been made. Investors were left with "empty pockets and no legitimate investment". Prior to their arrest, the defendants were planning to launch a second set of NFTs advertised as "Embers", which were expected to generate approximately $1.5 million (U.S. Attorney's Office for the Southern District of New York 2022b).

Shortly afterwards, in June 2022, a former employee of NFT marketplace OpenSea was charged in the first ever digital asset insider trading scheme.[57] Here, the defendant (Nathaniel Chastain) used confidential information to purchase dozens of NFTs in advance, knowing that they would be featured on the OpenSea homepage (and, therefore, increase in price). Chastain then sold the NFTs for 200–500% of the original price, concealing the fraud by conducting the transactions through anonymous OpenSea accounts and anonymous digital currency wallets (U.S. Attorney's Office for the Southern District of New York 2022a). In both cases, the maximum penalty is 20 years' imprisonment. In early May 2023, Chastain was found guilty despite his lawyers' attempts to distinguish his conduct from insider trading on the grounds that NFTs are not considered securities. However, the judge noted that insider trading applies to any misconduct involving the use of non-public information about an asset, and using that information to trade the asset or help another person do so (Escalante-De Mattei 2023a; Gatto 2022).

Finally, a group of collectors filed a lawsuit against Sotheby's over the auction house's alleged "misleading promotion" of Bored Ape Yacht Club (BAYC) NFTs as part of a larger scheme to defraud investors. The lawsuit also names Yuga Labs, the creator of the NFTs, as a main defendant.[58] With respect to Sotheby's, it sold 101 BAYC NFTs in an online auction in 2021, at the peak of the market, netting $24 million total. The pre-sale estimates were set at $12–18 million. The plaintiffs claim that Sotheby's artificially inflated the value of the NFTs and that its endorsement helped legitimize these assets for inexperienced collectors, making them more attractive to purchasers. In particular, although the undisclosed buyer of the NFTs was identified as a "traditional collector", it may have actually been FTX, the now-defunct cryptocurrency exchange (Porterfield 2023). This further demonstrates the entanglement between technology and the art market, and how established participants play a key role in issuing a "stamp of approval" for potentially risky ventures (Villa 2023).

The aforementioned NFT cases exemplify the application of existing (i.e., traditional) laws to new types of digital assets. Regardless of their recent popularity and emergence on the market, at their core, NFTs are still a type of property asset and may be regulated accordingly. However, the burden of protecting consumers and artists against illicit NFT activity has fallen largely on individuals themselves, as regulators have not yet caught up to the multiple scams that have arisen in this context, including sites imitating legitimate NFT platforms, fraudulent or counterfeit NFTs, impersonation of brands on social media, and fake giveaways (Goforth 2022, p. 776). It is also telling that OpenSea did not have clear policies in place prohibiting employees from trading in featured NFT artists or using confidential information in their trading until Chastain's misconduct was discovered. Platforms' *laissez faire* attitude towards criminal activity may be partly to blame for the Wild West of NFTs; after all, it is much easier to restrict behavior beforehand than attempt to rein it in once such patterns have become embedded in the system. Now that NFT cases are more high-profile, crackdowns on illicit activity seem imminent.

Regarding AI art, the legal landscape is much less settled, including data privacy concerns (Israel 2021). Aside from limited copyright protection, a David and Goliath battle is being fought between creators and users of AI tools. It is apparent that GAN AI models are threatening to displace artists and require clear regulatory and legislative boundaries to prevent copyright infringement. There are additional ethical concerns, as works are being used without authors' knowledge or consent, while technology companies remain unapologetic. Is it fair for the burden to be placed on creators to defend their work rather than for others to provide a justification for appropriating it? For example, an image-scraping tool called img2dataset attempts to scrape images from any existing website unless site owners actively opt out by placing tags on the site address. But website owners may not even be aware that these types of tools exist, and their images may be taken and used without permission before they realize what has happened. The creator of img2dataset has suggested that those who do not want their images to be used should shut down their websites altogether, but this is not feasible. Website owners who were targeted by img2dataset have had to purchase additional security measures to compensate for the "sustained attack" (Maiberg 2023).

In April 2023, a German photographer won the Creative category of the Sony World Photography award for an AI-generated image. The artist rejected the award and stated that his aim in submitting the work was to facilitate dialogue around artificially generated images, distinguishing them from photography as "different entities" that should not compete against each other (Kolirin 2023). The World Photography Organization was not impressed with this stunt and claimed to have been deliberately misled (Greenberger 2023b). A similar controversy occurred in August 2022, when a man who won first place at the Colorado State Fair's art competition (Jason Allen) revealed that the work had been created using text-to-image generator MidJourney. Allen suggested that the fair might include an AI subcategory for the digital art prize in the future but was otherwise not troubled by the results of the competition. He claimed that he wanted to "make a statement using artificial intelligence artwork" and stake a claim for artists, who he regards as complacent in the face of "the disruptive technology of open AI" (Escalante-De Mattei 2022a). However, in September 2022, the US Copyright Review Board issued a decision rejecting the work's registration due to Allen's extensive use of MidJourney (Greenberger 2023a). It appears that courts and the Copyright Office, rather than regulators, are defining the scope of intellectual property rights in this field.

To date, the US has lagged on digital regulation, and legislation has struggled to keep pace with the constant evolution of new technology. For instance, ChatGPT was estimated to have reached 100 million users just 2 months after launch according to a UBS study, making it the fastest-growing consumer application in history (Hu 2023). At the same time, the art market has also been relatively unregulated, with more stringent AML reporting measures only now being implemented. The overlap between these two areas has produced a shifting landscape, which leaves creators vulnerable to the unauthorized exploitation

of their work as third parties make significant profits. Existing laws can address certain challenges, rather than a complete overhaul of the legal framework, but enforcement is key. For newer forms of digital art, such as NFTs, additional oversight is required. Challenges related to the widespread use of NFTs include "the absence of industry-wide safety guidelines for agreements, ambiguity concerning intellectual property rights, scam factors linked with artist imitation, an openness that jeopardises consumer safety as well as confidentiality" (Sahni 2022, p. 657). Government agencies and judicial courts have a key role to play here, as they are equipped to render decisions that directly shape the landscape. In the case of illicit activity, heavy fines or other penalties can help dissuade potential criminal actors from similar offenses, while case law can provide guidance for lower courts, as well as recourse for artists. However, since solutions have not yet been applied uniformly, both new and existing problems will continue to arise as the market expands, "causing havoc", unless effective measures are implemented to curtail illicit activity (Sahni 2022, p. 657).

Other countries can serve as models to follow in this field. For instance, Spain has issued an official ruling that sales of NFTs qualify for Value Added Tax (VAT) as "electronically supplied services"—NFTs are, thus, taxed at a higher rate (21%) than artwork (10%) (Moscoso del Prado and Panizo 2022)—while the EU is currently developing the first comprehensive AI regulation (the AI Act). In particular, generative AI would be subject to transparency requirements, such as disclosing that the content was generated by AI, designing models to prevent them from generating illegal content, and publishing summaries of copyrighted data used to train models.[59] It remains to be seen whether the US will adopt similar standards, but ongoing trends indicate that a greater push for transparency in both the use of technological tools and art market transactions is desirable.

6. Conclusions

The expansion of the digital art market boom has revolutionized the way in which traditional property rights and concepts of ownership over tangible and intangible things are viewed, as well as what qualifies as human authorship and fair use in the copyright context. However, the lack of harmonization among existing laws, regulations, and judicial precedent have undermined their effectiveness in this context. The art market itself is a nearly $70 billion global industry, meaning that participants have a vested interest in maintaining its upward trajectory. Artists and creators operate at various ends of the spectrum, depending on whether they are able to harness new technologies for their benefit. NFTs and AI art pose both an opportunity and a threat in this context. On the one hand, the decentralized nature of blockchains and the accessibility of software tools can help artists expand their creativity and receive royalties through smart contracts. On the other hand, copyright infringement is rampant and extremely difficult to prevent; as the saying goes, "the internet is forever". The practice of "scraping" by AI tools is also a moral and legal gray area. While legal remedies are available, more robust enforcement is required. Regulators should devote greater amounts of time and resources to study emerging technologies and their impact on the art market beyond mere economic and financial considerations.

So far, AI artwork has not been scrutinized by US regulators to the same extent as NFTs. However, with the use of AI tools such as ChatGPT gaining prominence in everyday life, it is likely that attention will be given to this area sooner rather than later. US case law and agency decisions on copyright and fair use have made headway in this field, by stressing human authorship requirements and declining to lower standards for the appropriation of original works. As the next generation of infringement cases makes its way to the courts, it remains to be seen whether companies will be halted in their quest for technological dominance, or whether human artists will prevail. Nonetheless, it is clear that digital art, including NFTs and AI-generated works, are now part of the mainstream art world. These constantly evolving technologies require robust oversight to protect artists, users, consumers, purchasers, and platforms/marketplaces from digital predation. Oversight will also ensure fairness in how digital assets are transferred and utilized in the post-digital

world of Web3. Ultimately, the law should operate to stem the tide of infringement while incentivizing creators and ensuring the progress of arts and science, taking into account the increasingly digital environment in which we live.

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Notes

1 For a more in-depth analysis of media representations of the art market in recent years, see Quiñones Vilá (2020).
2 See Claude Monet: The Immersive Experience (https://monetexpo.com/, accessed on 20 May 2023); Van Gogh Exhibit: The Immersive Experience (https://vangoghexpo.com/, accessed on 20 May 2023); Immersive Frida Kahlo (https://www.immersive-frida.com/, accessed on 20 May 2023).
3 Pub. L. No. 94-553, 90 Stat. 2541, 19 October 1976, as amended. Cited as 17 U.S.C. §101 et seq.
4 Visual Artists Rights Act (VARA), Pub. L. 101–650, 17 U.S.C. §106A, 5 June 1990.
5 US Constitution Art. 1, Section 8, Clause 8.
6 Copyright Act, 17 U.S.C. §106.
7 Copyright Act, 17 U.S.C. §102(a).
8 Copyright Act, 17 U.S.C. §107.
9 *Campbell v. Acuff-Rose Music, Inc.*, 510 U.S. 569 (1994) p. 579.
10 https://www.copyright.gov/fair-use/, accessed on 20 May 2023.
11 714 F.3d 694 (2d Cir. 2013).
12 Case No. 21-869, 598 U.S. (18 May 2023) ("SCOTUS Decision").
13 See SCOTUS Decision at 1–2.
14 *Andy Warhol Foundation v. Goldsmith*, 382 F.Supp.3d 312 (SDNY 1 July 2019) ("District Court Decision") at 325–326 & 331.
15 *Andy Warhol Foundation v. Goldsmith*, 11 F.4th 26 (2d Cir. 26 March 2021) ("Second Circuit Decision") at 36–39 and 42.
16 SCOTUS Decision at 11, citing Second Circuit Decision at 48–51.
17 Second Circuit Decision at 43.
18 See Brief for The Robert Rauschenberg Foundation, Roy Liechtenstein Foundation, and Brooklyn Museum as *Amici Curiae* Supporting Petitioner.
19 See SCOTUS Decision at 13–20.
20 SCOTUS Decision at 3.
21 SCOTUS Decision at 3, citing *Campbell v. Acuff-Rose Music, Inc.*, 510 U.S. 569 (1994) at 580.
22 SCOTUS Decision at 21.
23 SCOTUS Decision, dissenting opinion at 19.
24 SCOTUS Decision at 5.
25 *John Does v. GitHub, Microsoft Corporation, OpenAI, Inc. et al.*, Case No. 3:22-cv-06823 (N.D. Cal. 2022).
26 721 F.3d 132 (2d Cir. 2015), 804 F.3d 202 (2d Cir. 2015); Slip Opinion at 46.
27 593 U.S. (2021), 141 S. Ct. 1183.
28 SCOTUS Decision at footnote 8, p. 20.
29 *Authors Guild v. Google* at 214.
30 Case No. 22-121 (SCOTUS 9 December 2022).
31 Case No. 20-3113 (2d Cir. 10 March 2022).
32 *Perfect 10 v. Amazon.com, Inc.*, 508 F.3d 1146 (9th Cir. 2007).
33 *Hunley v. Instagram LLC*, Case No. 21-cv-03778-CRB (N.D. Cal. 1 February 2022). See also (Brittain 2021).
34 *McGucken v. Newsweek LLC*, Case No. 19-cv-09617 (SDNY 21 March 2022). See also (Brittain 2022).
35 See https://www.law.cornell.edu/wex/case_law, accessed on 20 May 2023.
36 17 U.S.C. §101.
37 For instance, in the case of immersive art installations. A lawsuit brought by a Japanese art collective against a Los Angeles museum for copyright infringement has highlighted the fine line between imitation and appropriation: *Teamlab, Inc. v. Museum of*

Dream Space, LLC, Case No. 19-cv-06906 (C.D. Cal. 8 August 2019). Available online: https://www.courtlistener.com/docket/16035318/teamlab-inc-v-museum-of-dream-space-llc/, accessed on 20 May 2023. See also (Kinsella 2023b).

38 "The U.S. Copyright Office will register an original work of authorship, provided that the work was created by a human being. The copyright law only protects the 'fruits of intellectual labor' that 'are founded in the creative powers of the mind'. . . the Office will refuse to register a claim if it determines that a human being did not create the work". (U.S. Copyright Office 2021, §306), The Human Authorship Element.

39 *See* U.S. Copyright Office (2021) at §313.2, Works That Lack Human Authorship: "The crucial question is 'whether the 'work' is basically one of human authorship, with the computer [or other device] merely being an assisting instrument, or whether the traditional elements of authorship in the work . . . were actually conceived and executed not by man or by machine".

40 Christie's lot information available online: https://onlineonly.christies.com/s/beeple-first-5000-days/beeple-b-1981-1/112924, accessed on 20 May 2023.

41 *Osbourne v. Persons Unknown*, [2022] EWHC 1021 (Comm).

42 *Miramax, LLC v. Quentin Tarantino*, Case No. 21-cv-08979 (C.D. Cal. 8 September 2022). See also (Robertson 2022a).

43 Case No. 22-cv-384 (SDNY 2 February 2023).

44 *Yuga Labs, Inc. v. Ripps et al.*, Case No. 23-00010 (D. Nev. 14 February 2023). See also (Akers 2023).

45 Christie's lot information available online: https://www.christies.com/en/lot/lot-6166184, accessed on 20 May 2023.

46 *Burrow-Giles Lithographic Company v. Sarony*, 111 U.S. 53 (1884); see also *Feist Publications, Inc. v. Rural Telephone Service Co., Inc.*, 499 U.S. 340 (1991).

47 *Thaler v. Perlmutter*, Case No. 1:22-cv-01564-BAH (D. D. C. 10 January 2023) [Motion for Summary Judgment].

48 *Google LLC v. Oracle Am., Inc.*, 141 S. Ct. 1183, 1197 (2021), cited in *Thaler* Motion for Summary Judgment at 9–10.

49 Copyright, Designs and Patents Act 1988, Sec. 9(3).

50 U.S. Copyright Office, *Determination on Registration of Zarya of the Dawn*.

51 *Andersen v. Stability AI Ltd.*, Case No. 23-00201 (N.D. Cal. 13 January 2023) [Complaint]. See also (Feldman 2023).

52 *Andersen* Complaint, ¶8 & 9.

53 *Getty Images, Inc. v. Stability AI, Inc.*, Case No. 23-cv-00135 (D. Del. 3 February 2023).

54 *Flora* et al. *v. Prisma Labs*, Case No. 23-cv-00680 (N.D. Cal. 15 February 2023) [Complaint]. See also (Dafoe 2023).

55 The Anti-Money Laundering Act of 2020; see also Grossman et al. (2021).

56 *US v. Ethan Nguyen and Andre Llacuna*, Case No. 22-mag-2478 (SDNY 15 March 2022) [Complaint].

57 *US v. Nathaniel Chastain*, Case No. 22-crim-305 (SDNY 31 May 2022) [Indictment].

58 Sotheby's was added to the existing class-action lawsuit *Real and Titcher v. Yuga Labs, Inc. et al.*, Case No. 2:22-cv-08909 (C.D. Cal. 8 December 2022) [Complaint].

59 https://www.europarl.europa.eu/news/en/headlines/society/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence, accessed on 20 May 2023.

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Article

Non-Fungible Tokens and Select Art Law Considerations

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Abstract: Since 2021, non-fungible tokens (NFTs) have been a popular topic which has kindled the interest of art and technology enthusiasts and professionals. Some had very high expectations for the potential of NFTs, and in some cases, made an assessment for NFTs that go beyond the existing limits of NFTs. There have also been others who approached NFTs suspiciously and in some cases, described them as a hoax. The purpose of this study is to examine the important effects of NFTs on the art world and art law, and to consider NFTs' current and potential impacts. In this context, this article first provides an introduction to NFTs and why the author finds it interesting to think about legal issues surrounding NFTs. After providing definitions of non-fungible tokens and highlighting technical aspects of NFTs, the article then discusses select legal issues surrounding NFTs, such as the importance of legal terms and conditions of an NFT purchase, legal qualifications of NFTs, artwork ownership, artwork authenticity, artwork provenance and intermediary liability for NFT sales. One of the aims of this study is to put forward clearly what should be expected of non-fungible tokens and their potential. Another objective is to underline the fact that the unique dynamics of the art world necessitate having a unique perspective for legal matters relating to them, which is satisfied with art law and its professionals. Ultimately, this paper aims to contribute to having a more comprehensive understanding of non-fungible tokens and their impact on the art world and surrounding legal questions.

Keywords: art law; crypto assets; non-fungible tokens; blockchain; contracts law; property; securities; artwork ownership; artwork authenticity; artwork provenance

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1. Introduction

Non-fungible tokens ("NFTs") have emerged as a phenomenon with striking popularity since 2021 (Lee 2023; Lerner et al. 2022). Although the first NFT was minted in 2014[1], surprisingly almost a decade ago, the year 2021 kindled the interest for NFTs. Wide press coverage of the sales of the works of artists like Beeple's Everydays: the First 5000 Days for high prices contributed to this growing interest (Lerner et al. 2022; Von Appen 2021). Thus, NFTs, which stood as an interesting phenomenon at the intersection of art and technology[2], and the reason for the enormous interest in them, began to be discussed by all people and not just a small group of tech-savvies or narrow-scale art circles traditionally referred to as conservative and closed (Lee 2023; Beckman 2021).

Non-fungible tokens are a product of blockchain technology (Beckman 2021). It is therefore necessary to know (at least an adequate part of) their technical infrastructure to understand the results of concepts such as token IDs, ERC standards on the Ethereum blockchain, fungibility, on-chain and off-chain NFTs, and static and dynamic NFTs.[3] The use of technical terms (usually much referred to but not adequately explained) led to confusion, avoidance of discussion about this phenomenon, and overly fantasist predictions about NFTs. Had NFTs existed in Seneca's time, perhaps he would have coined the famous maxim attributed to him as "*Pompa NFTs magis terret, quam NFTs ipsa*"—it is the accompaniments of NFTs that are frightful rather than NFTs themselves.[4]

Not only people who read blogs and articles about this phenomenon outside the NFT market, but also important actors operating within the NFT market itself (i.e., artists who

develop NFT projects, intermediaries that enable these artists to advertise and sell their works, buyers, and those who want to add NFTs to their pre-existing or newly created collections.) have been confused. Answers to the questions such as what it means to own an NFT, what are the consequences of an NFT transaction for persons who buy, sell, intermediate a transaction, or for persons who are neither the party or the intermediary of that transaction but the creators or rights owners of an underlying asset of an NFT, have not been put forward in a clear and proper way.

However, NFT transactions have been ongoing, and legal disputes and discussions have quickly begun to arise. The first legal fields which evoked many questions regarding NFTs involved intellectual property law, criminal law, and property law. This is because NFTs, as a type of token, involves underlying works of art and therefore opening the way to many intellectual property and ownership related questions. In addition, the transactions take place in a rather unorthodox manner, using blockchain, crypto currencies, and crypto wallets often involving pseudonymous buyers and sellers (Wilson [2019] 2022; Lalla et al. 2023). Therefore, the transactions were considered to be prone to illegal activities such as fraud, manipulation, plagiarism schemes, insider trading schemes, phishing scams, and money laundering suspicions (Cyca 2022; Biggs 2022; Hoppe 2022; Schneider 2021; Tidy 2021). The number of questions to be discussed was large, and the legal basis of these disputes would be become a matter of curiosity.

A variety of evaluations have been made for NFTs, which made a rapid entry into the art world, about their positive and negative sides and their potential. Some displayed serious criticism and disbelief about NFTs (Morris 2021; Low 2023). Beckman envisioned a more optimistic and revolutionary situation and future for NFTs (Beckman 2021). Lee stated that the potential of NFTs is actually very high, so much that they can empower people to take more control of their lives (Lee 2023). Chuvaieva argued that NFTs are not so revolutionary after all, that many of the revolutionary results attributed to it are not from NFTs themselves, but as an extension of the disruptiveness of blockchain technology (Chuvaieva 2023). Some authors state that NFTs are operating highly satisfactory in some issues (such as transfers), but do not bring any revolutionary solutions to other issues (such as ownership), and that they were even dysfunctional (Chuvaieva 2023; Steiner 2021; Low 2023).

This author believes that the current state of NFTs does not bring a new revolution to our lives in 2023. But, with the development of use cases and the increase in regulations on the subject, NFTs have the potential to cause a paradigm shift in the long term, especially in issues such as artwork provenance, artwork ownership, and intellectual property management. In our opinion, if NFT use cases of 100 years later are NFT *sapiens* in terms of security, legal certainty, technological infrastructure capacities, the current ones are not yet at this level. Their development and ability to reach their latest evolutionary state in the interim remains to be seen. Inevitably, this is in direct proportion to the development of their adaptation and modification abilities.

Often, the point where we want technology to exist does not always show the current stage (Chuvaieva 2023; Tegmark 2017). And not knowing the present limits and actual working principles of a certain technology can lead to the result of not being able to correctly determine the legal problems that arise or that may arise. This results in the incapacity to solve the problems that require answers and regulations. Therefore, it is important to have (at least) basic knowledge in relevant branches in order to be able to examine issues affecting more than one branch of law.

The art market is a sensitive market with its own characteristics (Kaye and Speigler 2022; Wilson [2019] 2022) and it involves many actors from collectors to investors, auctioneers, curators, and taxpayers (Weil 1981). Furthermore, this market paves the way for many questions affecting many fields, including but not limited to, intellectual property law, contracts law, commercial law, international trade law, public law, public international law, private international law, human rights law, and tax law (Lerner and Bresler 2013; Gerstenblith 2012). In fact, this intertwining is not only limited to the fields of law, but also covers

art history, economics, history, anthropology, architecture, and increasingly omnipresent information technology-related disciplines and many others (Gerstenblith 2012).

In that context, art law emerges as a multi-interdisciplinary field that applies various legal rules to the sale, purchase, and many other transactions of (usually visual) art works, whether they take place as a private sale, in an auction, in a gallery, or another platform, while taking into account the unique dynamics of the sensitive art market (Lerner and Bresler 2013; Gerstenblith 2012). Art lawyers have been accustomed to keeping in mind an interdisciplinary cluster of legal and ethical questions (Weil 1981). Considering that technology is constantly advancing, and artists are exponentially benefiting from the opportunities provided by technology, it is clear that basic technology-related information must be included in this cluster of questions. Indeed, Sterpi states that the art lawyers of the future also need to be technology lawyers (Sterpi 2022). We agree with this view, and think it already holds true.

For these reasons, the title of this work refers to art law considerations. One reason for this preference is the belief that art lawyers are the most convenient professionals to holistically combine current market information, know-how, and legal knowledge for a healthy discussion about non-fungible tokens. Another reason is the belief that it is important to think about the concepts discussed in this work, such as terms and conditions of an NFT sale, art ownership, artwork authenticity, artwork provenance, filtered from the wholistic perspective of art law. We believe that this way, any considerations for NFTs, which is a concept located at the intersection of technology and art, will have a more substantial basis.

In this context, this article first aims to provide some definitions and important features relating to NFTs, in an attempt to clarify some of the above-mentioned misunderstandings and lack of information. Then, select issues surrounding NFTs which have important legal ramifications will be mentioned along with various legal resources and case law.

2. Definition of NFTs and Notion of Fungibility

The three-letter abbreviation, NFT, widely mentioned since 2021, stands for non-fungible tokens (Steiner 2021). It was mentioned so much in 2021 that the abbreviation was selected as the Collins Word of the Year 2021, beating the words "*crypto*" and "*cheugy*" (Guy 2021).[5]

A number of definitions have been made for non-fungible tokens. Collins itself defines them as "*abbreviation for non-fungible token: a unique digital certificate, registered in a blockchain, that is used to record ownership of an asset, such as an artwork or a collectible*" by highlighting their function of recording ownership.[6] Another definition is that they are "*unique and secure ownership certificates that utilize smart contracts and are protected by blockchain technology*" (Çağlayan Aksoy and Özkan Üner 2021; Majocha 2021). Some authors highlight the uniqueness and function of NFTs in their definition, that they are unique blockchain records that can be used to identify another thing, such as digital content (Güçlütürk 2022; Koonce and Carron 2021; Mastropietro 2022). Similarly, Lee summarizes the non-fungible tokens by their function, by stating that "*NFTs are computer programs with unique identifiers called token IDs, recorded on blockchain to identify or represent things, such as artworks or just about anything*." (Lee 2023); and Steiner provides the simple explanation that "*NFTs are digital ledger entries that identify or point to things, usually digital images or videos*" (Steiner 2021).

Some sources emphasize NFTs' feature of being distinguishable as tokens in their definition for NFTs. Sterpi defines NFTs as "*digital tokens that have a very specific characterisation and are not replaceable.*" (Sterpi 2022). Sharma explains that "*Non-fungible tokens are assets that have been tokenized via a blockchain. They are assigned unique identification codes and metadata that distinguish them from other tokens*" (Sharma 2022). This feature of being distinguishable and not being able to be replaced by other non-fungible tokens explains the notion of non-fungibility.[7] The adjective "*fungible*" roots back to the Latin verb *fungi*, which means "*to perform*" and shares the same root with the noun "*function*".[8] A thing is fungible if it can be replaced by something which is exactly the same kind: fiat money bills or cryp-

tocurrencies are considered to be fungible because they all can be exchanged for the same counterpart without any practical differences (Koonce and Carron 2021; Beckman 2021; Sullivan 2021). However, the same is not true for the non-fungible tokens as their exchange with one another causes practical differences (Beckman 2021). Therefore, they are called non-fungible tokens.

We find that an often-cited quotation which is said (but not conclusively) to be of George Bernard Shaw is illuminating for grasping the notion of fungibility: "*If you have an apple and I have an apple and we exchange apples, then you and I will still each have one apple. But if you have an idea and I have an idea, and we swap them, we will each have two ideas*".[9] Apples are the fungible items in this comparison because trading one apple for another makes no difference. In the end, both people hold only one apple, without any practical difference. In the case of non-fungible tokens, if two people exchange them, both people will again have one NFT each, but they will be unique tokens, containing different encrypted data. Moreover, NFTs held by each person will have the unchangeable record of ownership of these two people, of which the order will be different for each person. This is because non-fungible tokens serve as a digital proof of these people's holding[10] of these NFTs (regardless of whatever rights are attached to this holding) and establish that this information is maintained on the blockchain (Okonkwo 2021; Drylewski and Levi 2022; Beckman 2021). Hence, an exchange of NFTs causes meaningful practical difference.

This article does not intend to provide a highly detailed technical background of the working mechanisms of NFTs or blockchain technology. However, an important difference we would like to put forward is the difference between on-chain and off-chain tokens. The word "chain" refers to blockchain in both terms. The fact that the data are distributed on small blocks on the blockchain creates storage problems and augmentation of costs[11] (Güçlütürk 2022; Guadamuz 2021b; Çağlayan Aksoy and Özkan Üner 2021). Writing directly on the blockchain is referred to as on-chain (Guadamuz 2021b; Güçlütürk 2022; Çağlayan Aksoy and Özkan Üner 2021). This method can be used for small sized content, considering the mentioned limitations (Güçlütürk 2022; Von Appen 2021).[12] Guadamuz refers to on-chain NFTs as truly native blockchain works which act more like true ownership of the work (Guadamuz 2021b). However, for lower costs and for storing bigger data, there are other methods which include not storing the content directly onto the blockchain, and the NFTs created with these methods are called off-chain NFTs (Güçlütürk 2022; Guadamuz 2021b; Çağlayan Aksoy and Özkan Üner 2021; Filorinalı 2022).[13] This distinction is worth mentioning as it has security and capacity implications for NFT transfers.

No matter what method is used, it is very important to understand that in most cases, an NFT by itself is not the aimed asset or digital content; it is an indicator or a connector taking us to that asset or digital content (Sullivan 2021; Huertas and Hikl 2022; Guadamuz 2022). Even internalizing this fact is an important step to answer the most commonly asked question about NFTs: what it *really* means to have a non-fungible token (Beckman 2021; Guadamuz 2021c, 2022; Sullivan 2021; Wilson [2019] 2022).

3. Select Legal Issues and Discussions

With the emergence of NFTs, many questions have arisen in numerous particular fields, such as contracts law, criminal law, property law, intellectual property law, international private law, securities law, and tax law. In addition, discussions relating to tokens (which are the closest supergroup of NFTs) and crypto assets (a larger supergroup) have accelerated, along with regulatory attempts from states and international organs. UNIDROIT Principles on Digital Assets and Private Law, adopted on 10 May 2023 at the 102nd Session of the Governing Council, which provides legislative guidance and best practices for digital asset transactions and guides on private international law, procedural law including enforcement and insolvency, is one example of these efforts.[14]

The fact that NFTs cause all these brainstorms makes it unfortunately impossible for one article to cover all legal aspects. Nevertheless, in the following sections, we will briefly cover some of the most interesting legal points in our opinion. It is especially avoided to

enter detailed discussions in the field of intellectual property at length, both because there are many satisfactory works on the intellectual property law implications of NFTs, and because the scope of these discussions is very large.[15]

3.1. Legal Terms and Conditions of an NFT Transaction

The question that came up at the end of the second chapter, namely, what it means to have an NFT, is one of the most fundamental legal questions relating to NFTs. Answering this question requires a good understanding of contracts and intellectual property law. More specifically, understanding the scope of licences relating to the underlying content acquired with the purchase of the NFT is crucial. At the most basic level, purchasing an NFT provides the purchaser the capacity to prove that one owns it, benefit from any particular advantages offered by the seller (such as being admitted to an event), transfer the NFT to other accounts, and to burn[16] it (Steiner 2021).

If an NFT is linked to an underlying content which is a work of art (such as a physical painting or a digital art piece), the author of that artwork maintains their exclusive rights to reproduce, control the adaptations of, publish, display, and perform in public that artwork, unless those rights are transferred or licensed (Lerner and Bresler 2013). Thus, the purchase of an NFT does not necessarily provide the purchaser all rights of the underlying artwork completely (Lalla et al. 2023; Guadamuz 2021a, 2021b; Steiner 2021; Çağlayan Aksoy and Özkan Üner 2021; Sullivan 2021; Hambraeus 2021). Therefore, carefully reading the terms and conditions[17] for the sale of an NFT and understanding their scope is of utmost importance, reminding the buyers the olden principle *caveat emptor*[18] (Lerner et al. 2022).

This diligence must be shown not only by the purchasers. Similarly, one must be very careful about any past licences or transfers of other rights of an artwork. If one had licensed some rights of an artwork years ago, the licensor or the transferee can now attempt to mint NFTs based on that artwork. The question of who holds the rights for minting and selling NFTs using the video footages of the famous film *Pulp Fiction* was at the heart of the dispute between Quentin Tarantino and Miramax, which was later settled.[19] In that dispute, there were a series of agreements concluded between Quentin Tarantino and Miramax which contained clauses for the scope of licences and transfers of the rights related to the movie *Pulp Fiction*. However, these agreements were dated 1993, much before today's technological advancements. During the course of the dispute, both parties were trying to interpret to their benefit whether the wording "*publications*" included NFTs or not.[20] Therefore, it is wise for all persons and establishments to beware of their existing licence and transfer agreements, and provide extra attention to the wording of their agreements while drafting those agreements.

There are several marketplaces for non-fungible tokens, which advertise, promote, and intermediate NFT transactions (Beckman 2021). Also, major galleries and auction houses such as Christie's, Phillips, and Sotheby's engage in NFT sales. Although in the past, some NFT creators such as Larva Labs, creator of Cryptopunks did not provide written licence terms, currently many of these marketplaces publish the terms and conditions for the purchase of the NFTs (Steiner 2021; Sullivan 2021). Carefully analysing these terms and conditions is essential for being diligent in an NFT purchase.

Apart from the importance of analysing these terms and conditions thoroughly, it is also a matter of debate whether these terms and conditions are legally correct. As Steiner explains, some of the wordings in these terms and conditions do not adequately reflect the unique characterization of NFTs and are written in a way that is commonly used for other art works or digital artworks. This paints a problematic picture of what rights are granted to the purchasers of the NFT (Steiner 2021). In addition, in most jurisdictions, transfer of copyright ownership requires a written and signed contract, and it may be questionable whether the terms and conditions present in a website or the metadata of the NFT itself meet the written and signed contract requirement, although electronic signatures have begun to satisfy some courts and governmental agencies to legally bind the copyright owner (Steiner 2021).

If there is no express licence granted with a contract, there might be an implied licence granted to the owner of the NFT to use the underlying artwork, which allows the purchaser to use the NFT for non-commercial, personal purposes (Steiner 2021). Although this question has not been answered by any courts yet, Steiner expected that any implied licence to be recognized by courts for NFT purchasers might include right to display the underlying artwork for non-commercial purposes (Steiner 2021).

Thus, if a written express licence provides very few rights to the NFT buyer, or if the law recognizes an implied licence for NFT purchasers, which turns out to be limited, then owning an NFT can mean as little as only having that NFT in a crypto wallet. While this might seem odd, authors explain that what one actually pays for when one purchases an NFT is "*bragging rights*" for the owner (Okonkwo 2021; Chen and Friedmann 2022). Beckman explains this phenomenon as "*you buy the fact that you have bought the NFT*" (Beckman 2021; Steiner 2021). Steiner qualifies these bragging rights as "*Veblenesque bragging rights*" (Steiner 2021). This is an analogy that explain very well that, even if they do not gain much in the legal sense, NFT purchasers may prefer to purchase NFTs, because they see a value.

3.2. Legal Qualifications of Non-Fungible Tokens

While working on any concept, legal professionals as a reflex first attempt to lay out the definition and function of the concept, and then to determine what legal classification that concept belongs to. For NFTs, we briefly covered various definitions and their function in Section 2. However, answering the question of how NFTs are legally qualified is not easy, although it has important consequences (Salmon and von Gerlach 2021).

Indeed, legal qualification is important. For example, if, in the sense of property law, NFTs (and other crypto assets) are defined as personal property, then they benefit from the rights of specific personal property (Bilgili and Cengil 2022). For example, in many jurisdictions, in order for the crime of theft to occur, there should be *actus reus* of taking of a property belonging to someone else.[21] If the item in question is not defined as property, then the crime of theft will not occur. A similar chain of cause and effect is linked to the debate over whether NFTs classify as securities, which is a long-discussed question, particularly in the United States. If they are considered as security, they will be subject to serious and complex financial regulations, and cases involving NFTs will be shaped according to this definition (Lee 2023; Vander Woude and Tan 2022; Chittum 2022).

A good example illustrating the importance of legal classification of concepts was the Open Sea incident involving Nathaniel Chastain, where it was discussed that the acts of Chastain (namely, choosing certain NFTs to be displayed on Open Sea's front page which was kept secret from others until the publication of the website, using this secret information to purchase NFTs beforehand that would increase in value after the featuring of NFTs on the front page, and reselling those NFTs at huge profits) would qualify as *actus reus* for the crime of insider trading (U.S. Attorney's Office, Southern District of New York 2022). Under United States law, the offense of insider trading occurs when the *actus reus* involve securities. Therefore, the case progressed with the offense of wire fraud, which did not require an *actus reus* involving securities.[22]

For these reasons, it is important to have a definition, despite how difficult the process is. That definition will shed light on how to solve complex questions relating to the ownership, possession, transfer, theft, and securitization of non-fungible tokens (Çağlayan Aksoy 2023). Surely, this is not an easy task, as understanding rapidly developing technological concepts and providing precise definitions is not always easy. Because it takes time to understand the technological concept, the market and the behaviour of the actors, and legal regulations may sometimes lag in this (Low 2023; Beckman 2021). Some regulators have even verbalized that regulation efforts in the face of such developments are particularly slow (Gofort 2018). Nevertheless, discussions and academic work relating to these questions will facilitate resolving this question and having a better foundation for other legal issues.

In this section, we briefly mention conceptual problems about the definitions of NFTs and their classification as property and securities.

3.2.1. Non-Fungible Tokens and Their Property Status

The analysis of the notion property is a complex and multi-layered matter, and different legal systems adopt diverse approaches and definitions (Çağlayan Aksoy 2023; Low and Hara 2022). The distinction between common law and civil law systems emerges both in terms of regulation style and welcoming new concepts in relation to the notion of property (Low and Hara 2022). Civil law jurisdictions tend to have clear and distinct vocabulary for the concept of property, whereas common law jurisdictions usually do not have specific vocabulary defined in a code, but rather leave the qualification issues to court decisions (Lee 2023; Low and Hara 2022). The basic principles of property law for both legal systems date back to many years and are based on a deep-rooted legal history. Therefore, those basic principles were not actually designed in a way to comprehend today's technological products with one hundred percent compatibility (Çağlayan Aksoy 2023).

Therefore, thinking on the concept of property, an already complicated issue, becomes even more complex when it comes to adding crypto assets to this exercise (Çağlayan Aksoy 2023). One of the main reasons for this is that crypto assets, as assets in the digital realm, do not have tangibility, or physical presence, which is a criterion for defining a thing as property in most jurisdictions[23] (Çağlayan Aksoy 2023; Von Appen 2021). While these kinds of non-compatibility come as a serious hurdle in some civil countries such as Germany (Von Appen 2021); common law jurisdictions have been more welcoming to accept crypto assets as a type of property for some time, even though they are intangible (Low and Hara 2022; Beckman 2021).[24]

However, the analytical problems do not practically resolve with deciding to have a welcoming approach. Being welcoming to accept crypto assets as a type of property is one thing, but the real question is to decide on how to accept crypto assets as a type of property. For instance, the consultation paper of the Law Commission of England Wales relating to digital assets proposed to add a third category to existing sub-categories *chose in action* and *chose in possession* to solve this fitting problem.[25] This dual property sub-categorization was present in English law for a long time, with Lord Justice Joseph Fry's reasoning in *Colonial Bank v. Whinney*, which concludes that "*All personal things are either in possession or action. The law knows no tertium quid between the two*".

We think that the assessment of the Law Commission for changing this long-used categorization is a positive and proactive effort. Despite the difficulty and the amount of academic work required for resolving all questions, this approach can serve to make a better definition which can be a more ideal fit of the true nature of crypto assets. However, Low for instance, finds that finding a *tertium quid* is not necessary and particularly useful, since crypto assets can also be considered under the already existing sub-category, *chose in action* (Low 2023). He explains that when the technical aspects of crypto assets and the historical, legal, and circumstantial reasons for the absence of a t*ertium quid* are thoroughly understood, it will be clear that adding a *tertium quid* is not necessary (Low 2023).

Another practical approach came from UNIDROIT Principles on Digital Assets and Private Law adopted in 10 May 2023. These principles accepted that digital assets are "*susceptible to being the subject of proprietary rights*", *without addressing whether they are considered "property" under the law of a State*".[26] This approach reflects the need for practical solutions without spending too much time on the convoluted property classes discussions. However, this approach does not solve the issue once and for all, leaving the national jurisdictions to take care of the practical matters separately.

The real success of a legislator is not to constantly add to existing rules, rather, to make good use of the existing rules.[27] Therefore, having a legal framework that allows to interpret new technologies within the existing rules, but not avoiding producing new definitions when harmonization cannot be achieved comes across as an advantageous

approach. Achieving this depends on the speed of adaptation and the intensity of the academic work in this area.

Although accepting NFTs as a type of property has not become the rule, in the last three years, there have been several injunction decisions for cases involving non-fungible tokens in various jurisdictions. In some of these decisions, courts have analysed the existing property definitions in their jurisdiction and usually came to a *prima facie* conclusion that non-fungible tokens can be classified as property.[28] It will be exciting to see how these definitions fit and settle in each jurisdiction over time.

3.2.2. The Securities Polemic: Are NFTs Securities?

Another definitional problem is whether NFTs qualify as securities or commodities (Chuvaieva 2023; Beckman 2021; Çağlayan Aksoy and Özkan Üner 2021; Von Appen 2021; Barbagallo 2022). This is a heavily debated discussion which is not yet settled but introduces new proposals and discussions constantly (Von Appen 2021; Henderson and Raskin 2018).

The methods of classifying assets as securities also vary among jurisdictions. Some regulations such as the European Union approach applies a formalistic approach, which analyses the fit of an asset to criteria of transferability, tradability on capital markets, standardization as established in Markets in Financial Instruments Directive II and material comparability with a typical security class (Von Appen 2021). The United States utilizes the *Howey* test, which searches for the investment of money in a common enterprise where profits are expected to derive from the efforts of the promoter or another third party (Drylewski and Levi 2022; Lee 2023; Von Appen 2021).[29]

The first stimulating point in this discussion is that while commodities generally are fungible, NFTs are not (Beckman 2021). Therefore, if it is accepted that fungibility is a core characteristic of a financial services products (such as stocks or bonds), then NFTs would remain outside this scope. For instance, the United Kingdom His Majesty's Treasury concluded in its consultation that fungibility is a core characteristic of a range of regulated financial services products and is more likely to raise consumer protection concerns.[30] The paper then concluded that non-fungible tokens are "*more akin to a digital collector item than financial services products*" as their sale "*depends on the utility or unique value it gives the holder*". Considering the functions of non-fungible tokens, some authors agree with the idea that non-fungible tokens are unique ownership indicators of some tangible or digital items, and therefore should not be considered as securities (Von Appen 2021; Beckman 2021). However, some authors also underline that in cases where the NFTs are used with an investment aim, then there is a utilization that is more akin to securities[31] (Von Appen 2021; Barbagallo 2022; Wilson [2019] 2022; McAndrew 2010; Gatto and Walter 2022; Schickler and Handagama 2023). Some examples provided for these uses by these authors are: where the purchasers focus on the investment value and the future gains instead of the ownership of a unique item; where there are fractionalized[32] NFTs involved or where several items are pooled into a single NFT.

As explained above, classification of NFTs as securities is not quite straightforward, because there is no one-use-fits-it-all use case of the NFTs. Therefore, we agree with the authors who state that the courts will be most likely to solve this question by a case-by-case analysis (Beckman 2021; Castle 2022; Drylewski and Levi 2022). A final regulatory approach would be after the accumulation of these case-by-case analyses, with the creation of NFT sub-categories according to their function and differentiation of to what sub-categories securities rules will apply.

3.3. NFTs and Their Effect to Highlighted Art Law Concepts

As much as there are debates relating to NFTs, it is indeed true that some aspects of the NFTs influence the current state of the art market and will result in changes. In this section, we will mention NFT's select effects on important issues relating to the popular issues and important actors in art law. While we support the idea that while it is not purely

NFTs which are the source reason of many of these changes (rather, it is the features and capacities of the blockchain technology) (Chuvaieva 2023), there is no reason to deny that NFTs currently are the embodiment and the indicator of these changes.[33] This is ironically parallel with their function of indicating another item.

3.3.1. Artwork Ownership and NFTs

Ownership of an artwork is a complicated issue which involves questions of good title, and any potential theft, the situation of the good faith buyer in private art transactions (Lee 2023; Wilson [2019] 2022). In addition, from an international perspective, it is also in the centre of the debated cultural property and cultural heritage items (Wilson [2019] 2022; Roehrenbeck 2010; Merryman 1986). The presence of ownership in legal terms both in civil law and common law jurisdictions is usually confirmed by two criteria: control and exclusion (Lee 2023; Low 2023; Von Appen 2021). The technology behind NFTs allows the NFTs to satisfy both criteria (Von Schlenhenried 2022; Çağlayan Aksoy and Özkan Üner 2021).

Since the emergence of the high interest for the NFTs, it was stated that NFTs will change the concept of art ownership (Beckman 2021; Von Appen 2021; Harfoush 2021). This hype is linked to the nature of digital art especially, since an indicator of ownership and a secured transfer method for digital artworks did not exist before, to the detriment of digital artists (Kasdan 2022; Kugler 2021). Moreover, if the records relating to the change in ownership for an artwork is non-existent or not reliable, it can be difficult to demonstrate the ownership of a work (Okonkwo 2021). However, with NFTS, especially for on-chain NFTs where the digital artwork in its entirety is stored on the blockchain, stating that one owns that NFT is easier than traditional digital art works (Guadamuz 2021b).

In addition to their capacity of proving ownership thanks to their technical features, NFTs also make room for different perspectives for ownership. This is because NFT communities have particular dynamics within themselves. These dynamics open the door for innovative practices. One example is the popularization of NFTs for proving fractionalized art ownership, where one NFT can be partly owned by several people (McAndrew 2022). This practice provides a contrast to traditional art ownership and demonstrates that the concept of ownership is not only changing technically, but also from within the users' point of view. Hence, the legal rules around the issue of ownership might adapt to these innovative practices. For instance, Lee remarks that the exclusion criterion sought for determining the concept of ownership will now change to "inclusion" in NFT communities (Lee 2023). It is to be seen in the future how these innovative practices will be settled and reflected in legal regulation.

3.3.2. Artwork Authenticity and NFTs

A quality that directly determines the value of artwork is the authenticity of the artwork (Holmes 2021; Von Habsburg et al. 2010; Goodman 1996). A work is deemed to be authentic if it reflects where, how, when, and by whom it was created.[34] Benjamin states that the authenticity of a work is a whole concept including both the original physical changes that the work has undergone over time that no copy thereof will have undergone, and the changes in the ownership of the work, which constitutes the traditional background of the work (Benjamin 2008). In this sense, authenticity of the work emerges as a situational concept (Wilson [2019] 2022). The more original connection an artwork has with its original creator, the more valuable is the work (Holmes 2021; Von Habsburg et al. 2010; Goodman 1996).

Artwork authenticity is proved through technical and physical examinations, analysis of aesthetic styles, and various documentation (Wilson [2019] 2022; Lerner and Bresler 2013). If an artwork is deemed to be authentic, this is verified by documents called "authenticity certificates". These certificates are created by the author himself, an expert on the subject or another relevant authority (Wilson [2019] 2022). Receiving and keeping these certificates is strongly recommended for art buyers (Von Habsburg et al. 2010). However sometimes, even with the best authenticity certificate, the risk of an artwork being counterfeit cannot

be ruled out (Beckman 2021). This is a serious concern in today's art markets (Beckman 2021; Von Appen 2021). Because fake art works can be created by methods such as the continuation of a work started by the original author by someone who can imitate the style, the existence of people who can imitate a work at a very good level like the original author, and the convincing use of an artist's signature style, manner, and expression (Lerner and Bresler 2013). Naturally, fakes and counterfeits are damaging for the buyers. Especially digital art is said to pose many challenges to authenticity, due to their dissipative nature, where one can easily copy and benefit from the original work of a digital artist (Kasdan 2022; Von Appen 2021; Von Habsburg et al. 2010).

Among these challenges, the potential of blockchain technology, that is, the ability of blockchain to keep the immutable records of authenticity and provenance of an artwork, has created a stir in the art world (Wilson [2019] 2022). In particular, it has been stated that digital artworks which can be easily copied will benefit greatly from blockchain technology (Wilson [2019] 2022). These questions have gained a new dimension with the emergence of NFTs. The potential of NFTs in this regard has been highlighted as one of the strengths of NFTs (Beckman 2021).

For example, if a digital artist initially reveals her work in connection with an NFT, then doubts about the original creator of the artwork will be minimized (Kasdan 2022; Beckman 2021). Similarly, artists who create physical artwork will be able to mint an NFT associated with their work and add information about that artwork to that NFT's metadata. Thus, in both cases, NFTs will actually act as a kind of authenticity certificate and can be used to further transfer the artwork. In this way, the possibility of fake artworks will be prevented relatively more successfully (Beckman 2021). Of course, these will not apply in cases where the person minting an NFT is not the original creator of the work (Okonkwo 2021; Lerner et al. 2022). In addition, one must always pay utmost attention for scams, hacking, and forgeries, at least for the current state of the NFT market (Lerner et al. 2022; Von Appen 2021). However, as the use of NFTs as certificates of authenticity by the author themselves become established practice, authenticity concerns will be kept to a minimum, at least in newer works, thanks to NFTs.

3.3.3. Artwork Provenance and NFTs

Another factor that contributes to the attractiveness, therefore the value, of an artwork is the provenance of the artwork (Wilson [2019] 2022; Von Habsburg et al. 2010). While the term provenance may refer both to the origins of an artwork[35] and the history of ownership of an artwork, generally it is commonly understood as the chain of ownership of an artwork (Wilson [2019] 2022; Beckman 2021). Starting from the 17th century, various information gathered from artwork sale records, be it private sales or auction sales, were recorded in the form of physical provenance records, which demonstrate the chain of ownership of an artwork, and by the 20th century, the practice became common (Jaffé 1996; Tompkins 2020; Goodman 1996).

Although provenance records are similar to certificates of authenticity, as they are also made by experts and are important for the transaction of the artwork, they are actually more comprehensive than certificates of authenticity (Tompkins 2020). This is because while authenticity records only reveal the relationship of the work with its creator, provenance records ideally reveal a picture of who has owned the work from the moment it left the hands of the creator (Wilson [2019] 2022; Goodman 1996). In this way, information about who had purchased that work under what conditions and how it had been transferred are also obtained (Amineddoleh 2020). This not only creates a legal basis for various disputes that may arise, such as the repatriation of works of art, but can also increase the value of the artwork (Wilson [2019] 2022; Amineddoleh 2020). The fact that something had been owned before, especially by an important person, can increase the value of the work in some instances[36] (Von Habsburg et al. 2010).

No matter how carefully they are kept, provenance records also do not always have perfect credibility (Tompkins 2020; Jaffé 1996). Sometimes, there are gaps that do not close

between the records. In addition, there are also forged provenance records which mislead parties (Wilson [2019] 2022; Tompkins 2020; Jaffé 1996). Although provenance researching is a serious researching field with many experts and institutions involved, lack of information or reliability are not always quickly solved (Amineddoleh 2020; Wilson [2019] 2022; Tompkins 2020).

This is where the excitement about the way new technologies can change the notion of provenance makes sense (Nayeri 2023; Wilson [2019] 2022; Beckman 2021). NFTs reveal the importance of provenance as well as change the meaning of art ownership. Those who are familiar with blockchain technology and provenance records are able to understand why NFTs have received a lot of excitement. This is because, thanks to NFTs, provenance records for artworks will be able to be kept immutable and secure on the blockchain without any gaps (Wilson [2019] 2022; Beckman 2021). Once one purchases an NFT, in a way, one purchases the opportunity to be added on the chain of ownership of that NFT, which becomes a part of the sale (Beckman 2021).

Thus, thanks to the nature of blockchain, NFTs have the potential to solve problems commonly faced with provenance records, such as the inevitability of fabricated or undocumented provenance information (Wilson [2019] 2022; Beckman 2021; Tompkins 2020; Jaffé 1996). This potential of course is valid where there are no hacking or security problems inherent to the NFTs and exclude the instances where the minter of an NFT is not the rights holder for an underlying (digital or physical) artwork. If a framework exists where only the creator of an artwork (or another authorized party) mints an NFT linked to that artwork, then the said NFT acts as a truly immutable and a gap-free provenance certificate.

3.3.4. Intermediary Liability for NFT Sales

NFT transactions take place in specific marketplaces or platforms of established galleries or auction houses (Beckman 2021). The importance of the terms and conditions for an NFT transaction was mentioned in Section 3.1. These terms are important not only for governing the relationship between the purchaser and the seller, but also for understanding the scope of liability of the intermediary of that transaction.

Determining the scope of the liability of the intermediary for an NFT transaction works in various ways: the purchaser and the seller will want to protect themselves and resort to the intermediary in case of an inadequacy thereof, the intermediary will want to protect itself, and in case there is a violation committed for a third party (such as an artist whose artwork was unauthorizedly used for minting and selling an NFT and whose intellectual property rights are thus infringed), the third party whose rights were violated will want to invoke the liability of all parties concerned, including the intermediary (Okonkwo 2021). In this respect, it is necessary to make various contract law (with emphasis on issues such as breach of duty of care and misrepresentation) and intellectual property law determinations for all parties concerned (Okonkwo 2021).

In the art market, intermediaries such as galleries or auction houses draft provisions in terms and conditions to specifically protect themselves against other parties of that transaction (Wilson [2019] 2022; Okonkwo 2021). However, considering the basic principles of consumer law, which aims to protect the consumer, it should be taken into account that not all of these provisions may be unconditionally valid. Indeed, if such provisions are found to be "overprotective" for intermediaries contrary to fundamental legal principles, it may result in such provisions being void or voidable (Okonkwo 2021). Moreover, in many jurisdictions, if the loss arises from the negligence of the intermediary, then neither disclaimers nor limitation of liability clauses will provide relief from liability (Wilson [2019] 2022; Okonkwo 2021).

There have been two interesting disputes where the liability of an intermediary came to the fore. For the relationship between the parties of an NFT transaction, a case where the liability of an auction house concerned the first NFT ever minted, Quantum by Kevin McCoy, in *Free Holdings Inc. v. Kevin MCoy, Sotheby's Inc., Nameless Corporation and Alex Amsel* raised interesting questions.[37] (Escalante-de Mattei 2023). In this complicated case, the NFT

in question was sold in Sotheby's auction on 10 June 2021.[38] The claimant Free Holdings qualified the description provided by Sotheby's as false and misleading and objected to the condition report provided on Sotheby's website.[39] This incident made the authors rethink the condition reports provided by intermediaries. The auction houses generally sell the lots "as is" as they do not want to assume liability for the condition of the artwork, generally they provide a note called "condition report" describing the current condition of the artwork (Wilson [2019] 2022). This condition report naturally tends to have many clauses pertaining to exclude liability of the intermediary (Wilson [2019] 2022). Although the plaintiff's claims were dismissed by United States Magistrate Judge James L. Cott on 17 March 2023,[40] and the judge did not make any further comments on the potential liability that would arise from Sotheby's contested condition report, this case was an interesting beginning to think about the liability of intermediaries through condition reports.

Another case analysed the liability of an intermediary for infringement of the rights of a third party, outside the parties of the NFT transaction. In the Chinese case *Shenzhen Qice Diechu Cultural Creativity Co., Ltd. v Hangzhou Yuanyuzhou Technology Co., Ltd.*, a Chinese court found that an NFT platform is liable for the copyright infringement as it contributorily violated the copyright holder's rights of the illustration series "*I am Not a Fat Tiger*" from which an NFT was minted and sold.[41] The court found that the platform on which the NFT was sold had subjective culpability, because it breached its duties of inspection and attention as a trading service provider for NFT purchases (Gang 2022).

Although some intermediaries have a more sensitive approach, many NFT platforms do not have an automatic audit system where each NFT on the platform is checked whether they involve in an intellectual property infringement (Okonkwo 2021). Such situations are problematic for rights holders. For now, two solutions seem to have been found in the NFT markets: the first one is the platforms publishing a Code of Conduct for users, which involve various limitations of liability clauses therein for themselves.[42] However, as mentioned above, the validity and the functionality of those clauses are debatable (Wilson [2019] 2022). Especially, they might not be sufficient to protect the NFT marketplaces from liability, as evidenced by the *Shenzen Qice* case. The second solution is the platforms acting cooperatively by removing infringing NFTs from their platforms in accordance with the notice and take down rule that exists in many jurisdictions (Yash 2022; Okonkwo 2021). Nevertheless, this approach is also controversial. There are thousands of NFTs in many platforms, and an anonymous, right-infringing NFT minter may put an unauthorized NFT on a market, sell it, take the financial gain, and vanish, until a notification is executed.[43]

Intermediary liability for NFT platforms is an interesting aspect to think about, as it involves thinking about fundamental rules of consumer law, commercial law, and contracts law in the context of art law. As other disputes and court decisions come, it will be better understood which actions invoke intermediary liability and to what extent.

4. Conclusions

Non-fungible tokens, albeit disputable as to whether they are as disruptive as they were imagined to be, require a rethinking of established concepts and frameworks. While their future (if not present) is uncertain, it is critical to discern the potential bubble burst and the long-term possibilities of the underlying technology. NFT's purview extends beyond art to a wide range of disciplines. We agree with the opinion that, even if the interest in highly priced digital art NFT fades, their larger applications promise long-term importance (Resch 2022; McAndrew 2023)[44]. We evaluate that NFTs are an inventive tool with widespread implications, capable of shaping various industries. Their future shape and lifespan however will depend on technological improvements (especially in cybersecurity and data storage areas) and legal adaptation.

To comprehend the trajectory of the NFTs, one must go beyond the present and evaluate the long-term potential and repercussions. This is a difficult task, as it necessitates avoiding having "*technological myopia*"[45] on one hand and being realistic on the other. However, especially in the legal sector, lawyers who have a good understanding of the law and

can apply established principles coupled with an adequate understanding of the technicalities surrounding the topic will leave their marks on this rather pristine area (Hambraeus 2021). What a decade it is indeed, to be an art lawyer (Valentin and Yapova 2022).

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Notes

1 See Chuvaieva (2023) for the historical background of Kevin McCoy's Quantum, the first-ever minted non-fungible token on the Namecoin blockchain.

2 See Sterpi (2022), who explains that the concepts of art and technology, which both were expressed once with the old Greek word "téchne", result from creative acts at the origin. He explains that these two concepts, which have been historically separated are returning to a more unitary state in our age due to the increasing use of technology in artistic creation.

3 See Çağlayan Aksoy (2023) for further concise explanations regarding these terms.

4 The Latin maxim "*Pompa mortis magis terret, quam mors ipsa*" attributed to Seneca which translates as "It is the accompaniments of death that are frightful rather than death itself". See Bacon, Francis. Essays, Civil and Moral. Vol. III, Part 1, 2 of Death, The Harvard Classics. New York: P.F. Collier & Son, 1909–14; Bartleby.com, 2001. www.bartleby.com/3/1/, accessed on 25 August 2023.

5 Collins' lexicographers stated that the reason for choosing NFTs as the "Word of the Year" was that NFT "*demonstrated a unique technicolour collision of art, technology and commerce*" which had "*broken through the Covid noise*" to become ubiquitous. The Word of the Year of 2020 was Lockdown. See Flood (2021) and Guy (2021).

6 Collins Dictionary, https://www.collinsdictionary.com/woty, accessed on 30 August 2023; Collins Dictionary, https://www.collinsdictionary.com/dictionary/english/nft, accessed on 30 August 2023.

7 The fungibility of a token depends on the standard that is used by the smart contract on the blockchain of the NFT. See Çağlayan Aksoy and Özkan Üner (2021); Guadamuz (2021b).

8 Online Etymology Dictionary, "Fungible", https://www.etymonline.com/word/fungible, accessed on 5 June 2023.

9 While commonly attributed to George Bernard Shaw, the true authorship of the quote is not definitively established. For further information on its origins and analysis, you can refer to the following link: [https://quoteinvestigator.com/2011/12/13/swap-ideas/], accessed on 30 August 2023.

10 We use the term "*holding*" here deliberately to avoid the commonly used expressions, which state readily that NFTs serve as a "*proof of ownership*" of the underlying work of art on the blockchain or may infer that buying an NFT by itself provides the buyer all rights relating to that NFTs. Both expressions may not always be true. Very briefly, because the minter of an NFT is not always the person who is the author or the rights holder of the underlying item (be it a physical object or a digital artwork), and that it is not always very clear what rights the buyers obtain when they purchase an NFT. See (Lee 2023; Steiner 2021; Steiner 2022; Chuvaieva 2023).

11 Andres Guadamuz cites and summarizes Gavin Wood's Ethereum: A Secure Decentralised Generalised Transaction Ledger EIP Revision, which can be accessed at [http://gavwood.com/paper.pdf], accessed on 30 August 2023. Accordingly, uploading one kilobyte of data on the Ethereum blockchain costs 640 k gas, which is around USD 13.61 per kilobyte. The cost grows exponentially as the volume of data to be uploaded grows. For example, adding one megabyte to the Ethereum blockchain would cost around USD 475. See Guadamuz (2021c).

12 For instance, some Cryptopunk images were stored on chain as they did not require too much space or cost, being 24 × 24 pixels images. See On-chain Cryptopunks. *Larvalabs*. Available online: https://www.larvalabs.com/blog/2021-8-18-18-0/on-chaincryptopunks, accessed on 30 August 2023. See also Steiner (2022).

13 See Güçlütürk (2022) for detailed explanations relating to different methods which include the NFTs saving a hash of a content and NFTs using decentralized storing tools such as IPFS (Interplanetary File System).

14 See https://www.unidroit.org/unidroit-principles-on-digital-assets-and-private-law-adopted-at-the-102nd-session-of-the-governing-council/, accessed on 30 August 2023.

15 For interesting discussions relating to NFTs and intellectual property law, see Steiner (2022); Guadamuz (2021a, 2021b, 2021c, 2022); Çağlayan Aksoy and Özkan Üner (2021); Steiner (2021); Beckman (2021).

16 The NFTs are recorded on the blockchain, and blockchain records are immutable. Therefore, it is not possible to change or remove the non-fungible tokens on the blockchain once it is minted. Burning refers to the process of restricting the access to the particular non fungible token, by sending it to a digital wallet address that is not owned or utilized by another. See NFTExplained.info, "*What is Burning an NFT? A Complete Guide and Explanation"* https://nftexplained.info/what-is-burning-an-nft-a-complete-guide-and-explanation; Çağlayan Aksoy and Özkan Üner (2021).

17 The first episode titled "*Joan is Awful*" of Season 6 of the Netflix series Black Mirror depicts perfectly why the terms and conditions must indeed be read very carefully, for all transactions in general.

18 *Caveat emptor*, which means "*Let the buyer beware*" in Latin, is a condensed form of the phrase "*Caveat emptor, quia ignorare non debuit quod jus alienum emit*" which means *"Let a buyer beware, for he should not be ignorant of the nature of the property he is purchasing from another party*". Within common law nations, this principle had been commonly employed in contract law. This principle, however, is no longer primarily relied upon since consumer legislation has developed and attempts have been taken to protect customers from the detrimental effects of knowledge asymmetry. *Caveat venditor* is the counterpart for sellers. More information may be found in Julia Kagan's essay "Caveat Emptor (Buyer Beware): What It Is, and What Replaced It" (https://www.investopedia.com/terms/c/caveatemptor.asp), which was accessed on 1 September 2022.

19 Miramax deposited their notice of settlement on 8 September 2022. See Justia, Dockets & Filings, https://dockets.justia.com/docket/california/cacdce/2:2021cv08979/836944 for the filing history, accessed on 30 August 2023.

20 For being informed about the procedural history of the case, see *Miramax LLC v. Quentin Tarantino; Visiona Romantica* Complaint at https://deadline.com/wp-content/uploads/2021/11/TARANTINO-LAWSUIT.pdf, accessed on 30 August 2023.

21 Some jurisdictions prefer the concept of ownership to define theft. For instance, the French penal code defines theft as "*the fraudulent appropriation of a thing belonging to another person". Whereas some jurisdictions use the concept of "property*". For instance, the UK Theft Act 1968 defines theft as "*dishonestly appropriating property belonging to another with the intention of permanently depriving the other of it*".

22 For further explanations from the US Department of Justice, see U.S. Attorney's Office, Southern District of New York (2022).

23 For instance, in the Swiss and Turkish jurisdictions, there is no definite definition of a property. Rather, criteria which are commonly cited in the doctrine (with some discussions) are materiality (*Körperlichkeit*), specificity (*Abgegrenztheit*), eligibility for dominance (*Beherrschbarkeit*) and impersonality (*Unpersönlichkeit*) are used as indicia. As for the UK, the indicia are stated in the case *National Provincial Bank Ltd. v. Ainsworth* as being identifiable by third parties, being capable of assumption by third parties and a degree of permanence and stability.

24 See the UK cases *AA v Persons Unknown, Director of Public Prosecutions v Briedis & Anor, and Fetch.ai Ltd*. and *Another v Persons Unknown Category A and Others;* New Zealand High Court decision *David Ian Ruscoe And Malcolm Russell Moore v Cryptopia Limited* and the recent 2023 Hong Kong decision *Re Gatecoin Limited* where courts accepted cryptocurrencies as a type of property.

25 Law Commission, https://www.lawcom.gov.uk/project/digital-assets/, accessed on 30 August 2023; Law Commission, "*Digital Assets: Summary of consultation paper*", https://s3-eu-west-2.amazonaws.com/lawcomprod-storage-11jsxou24uy7q/uploads/2022/07/Digital-Assets-Summary-Paper-Law-Commission-1.pdf, accessed on 30 August 2023.

26 This principle takes place on UNIDROIT Principles, Introduction, IV Core Concepts, 14.

27 "*Corruptissima re publica plurimae leges*" ("*The most corrupt state is the one with the most laws*") is a maxim of the Roman senator and lawyer Tacitus, which underlines that the high increase in the number of laws, proving to be inadequate and useless in their mere existence, risks losing focus on the most fundamental rules, and therefore becomes a threat to state order. See Tacitus, Cornelius, Annales ab excessu divi Augusti, Edited by Charles Dennis Fisher. Available online: https://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0077%3Abook%3D3%3Achapter%3D27, accessed on 30 August 2023.

28 2022 UK High Court decision *Lavina Deborah Osbourne v (1) Persons Unknown (2) Ozone* and 2022 Singapore High Court decision *Janesh s/o Rajkumar v Unknown Persons (CHEFPIERRE)* are among the decisions where there were *prima facie* conclusions that NFTs can be classified as property.

29 The *Howey* test was first used with the United States Supreme Court case *Securities and Exchange Commission v. W.J. Howey Co. et al.* in 1946, where the court held that offer of a land sales and service contract was indeed an investment contract within the relevant securities legislation. The court held: "*For purposes of the Securities Act, an investment contract (undefined by the Act) means a contract, transaction, or scheme whereby* ***a person invests his money in a common enterprise and is led to expect profits solely from the efforts of the promoter or a third party****, it being immaterial whether the shares in the enterprise are evidenced by formal certificates or by nominal interests in the physical assets employed in the enterprise*". See See *SEC v. W.J. Howey Co*., 328 U.S. 293 (1946), available at https://supreme.justia.com/cases/federal/us/328/293/, accessed on 30 August 2023. (Emphasis added.)

30 United Kingdom His Majesty's Treasury, Cryptoasset promotions: Consultation response at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1047232/Cryptoasset_Financial_Promotions_Response.pdf, accessed on 30 August 2023.

31 One of the most influential case laws relating to the NFTs (although having intellectual property rights in the centre as the main debate), *Hermès International and Hermès of Paris, Inc. v. Mason Rothschild* decision, also highlighted that "*NFTs can be easily sold and resold with a transaction history securely stored on the blockchain, NFTs can function as investments that can store value and increase value over time*".

32 Fractionalized NFT refers to an NFT that represents a certain portion of interest of an asset or revenue stream.

33 Kevin McCoy, the creator of Quantum (the first NFT ever minted in 2014) wrote as early as 2013 in his blog mccoyspace "I *am interested in developing a method or system where a* ***contractual ownership token*** *or message* ***can be embedded within a blockchain transaction****. This way,* ***artists working digitally can present their work in its native form*** *on the internet. At the same*

time, they would have a mechanism for selling it to a collector who would have a ***verifiable and secure way of showing ownership and transferring ownership*** *to another party*". See mccoyspace, Comment to Using the Blockchain as a Method for Assigning Ownership of DigitalArtworks?, BITCOIN TALK(Oct. 24, 2013, 4:20 AM), https://perma.cc/5MJJ-EAXF, accessed on 16 June 2023 (Emphasis added).

34 Encyclopedia, Authenticity in Art: https://www.encyclopedia.com/humanities/encyclopediasalmanacs-transcripts-and-maps/art-authenticity, accessed on 16 June 2023.

35 The word provenance derives from the French word *provenir*, which means "to come from, to be result of." See Collins Dictionary, "Provenir", https://www.collinsdictionary.com/dictionary/frenchenglish/provenir, accessed on 15 May 2023. The denotation of "coming from" refers to the origins of the work.

36 See, for instance, McDowell (2020) to see the astronomic prices paid for items that were once owned by famous people.

37 Quantum was minted by Kevin McCoy on 3 May 2014 on Namecoin blockchain. The NFT was later minted on Ethereum blockchain on 28 May 2021 and sold in Sotheby's auction on 10 June 2021. The original blockchain Namecoin, is a key/value pair registration and transfer system based on the Bitcoin technology, with certain differences to make it function as domain names. It requires renewal of domain names for regular intervals. However, after the creation of Quantum, Kevin McCoy had not renew his registration. In principle, if the renewal is not performed, somebody else can claim the Namecoins. This manual renewal feature of Namecoin is stated to be in contrast with the concept that is the uniqueness of non-fungible tokens and the immutability of blockchain. In this case, no one, including McCoy, had claimed the name created by McCoy for several years. In 2021, where interest over non-fungible tokens spiked everywhere, and Quantum's name began being highlighted as being one of the earliest specimens of the new technology, a third party with the twitter alias @EarlyNFT registered the name on Namecoin on 5 April. After this registration, @Early NFT tried to contact McCoy several times through Twitter, to which McCoy never responded. Sotheby's then began the advertisement of the auction Natively Digital: A Curated NFT Sale around May 2021 and the sale occurred on 10 June 2021 Sotheby's explained that the NFT was "*[o]riginally minted on 3 May 2014 on Namecoin blockchain, and preserved on a token minted on 28 May 2021, by the artist*". In addition, Sotheby's provided a condition report prepared by Nameless, which reads *inter alia*: *"The hash and all the information about the artwork are stored on the Ethereum blockchain, and therefore cannot be modified.* ***This token was minted May 2021, but the referenced pieces were originally made public in 2014, with a link to the image hosted on the Namecoin network.*** *[. . .] To avoid domain squatting, Namecoin was designed to include removal of pointers after 36,000 blocks.* ***Accordingly, this specific Namecoin entry was removed from the system after not being renewed and was effectively burned from the chain.***" @EarlyNFT, represented by the Canadian company Free Holdings, started the lawsuit for title slander, deceptive and unlawful trade practice and commercial disparagement against Kevin McCoy, Sotheby's, and the NFT startup Nameless, who prepared the condition report published in Sotheby's website, and Alex Amsel, the buyer (who was later dismissed from the case on 8 March 2022). The statement of Sotheby's for describing the NFT sold at the auction is qualified as "*false and misleading*" by Free Holdings, because "*Quantum is still extant on the Namecoin blockchain and requires no "preservation*" and also objects to the condition report on Sotheby's website, which was prepared by Nameless, because "*a Namecoin blockchain record cannot be "removed", and the blockchain record for Quantum has not been "removed" or "burned". Rather [it] remains active and under the control of Free Holdings*". The defendants on the other hand declare that when Quantum was minted as an Ethereum-based non-fungible token, all related rights and ownership of Quantum was transferred to that NFT which was minted in 2021.It had been stated that, the original text of Quantum's value read "*I assert title to the file at the URL http://static.mccoyspace.com/gifs/quantum.gif*" and "*Title transfers to whoever controls this blockchain entry.*" However alternative resource indicates that this expression was inserted around 30 April 2021, which is after the registration of @EarlyNFT. See Free Holdings Inc.v. Kevin McCoy, Sotheby's Inc., Nameless Corporation and Alex Amsel, 1:2022cv00881, Complaint, 5,7,39,40,44,50,60,61,62,63,64,70,77,78,79,81,82,89,90,91,92. The court then dismissed the case, stating that "*Free Holdings has demonstrated nothing more than an attempt to exploit open questions of ownership in the still-developing NFT field to lay claim to the profits of a legitimate artist*".

38 *Free Holdings Inc.v. Kevin McCoy, Sotheby's Inc., Nameless Corporation and Alex Amsel*, 1:2022cv00881, Complaint, 33, 49.

39 *Free Holdings Inc.v. Kevin McCoy, Sotheby's Inc., Nameless Corporation and Alex Amsel*, 1:2022cv00881, Complaint, 5,7,39,40,44,50,60, 61,62,63,64,70,77,78,79,81,82,89,90,91,92.

40 *Free Holdings Inc.v. Kevin McCoy, Sotheby's Inc., Nameless Corporation and Alex Amsel*, 1:2022cv00881, Opinion and Order Re Motion to Dismiss the Amended Complaint Pursuant to Federal Rules of Civil Procedure.

41 For an English translation of the case, see https://www.taylorwessing.com/-/media/taylor-wessing/files/germany/2022/06/mv-nl_04-2022_first-nft-decision-in-china_urteil{-}{-}internet-court-hangzhou_final_neu_pdfa.pdf, accessed on 3 June 2023.

42 For instance, Article 9 of Rarible's Terms of Service provides for the permitted and prohibited conducts. Accordingly, the use of Rarible's services in a manner to violate any local, state, national or international law or knowingly selling, transferring or using the NFTs in a manner that does or may infringe any copyright, trademark, patent, trade secret or other intellectual property or other proprietary rights is prohibited. See Rarible Terms of Service at https://static.rarible.com/terms.pdf, accessed on 30 August 2023. In addition, Rarible Community Guidelines has do's and don'ts lists for both creators and collectors, which summarizes as "*Treat people well. Be cool, kind and helpful. And never to anything illegal, unethical, or hateful*". Also, these guidelines also have a reminder as not to "*mint anyone else's work as NFTs (unless you've got permission).*" See Rarible Community Guidelines at https://rarible.com/community-guidelines, accessed on 30 August 2023.

[43] The number of NFTs available in the market should not be underestimated. A tweet dated 2022 of Alex Atallah, co-founder of and the current Chief Technology Officer of OpenSea stated: "*There are now more NFTs on OpenSea than there were websites on the internet in 2010. Very soon, NFTs will outnumber websites, maybe even webpages. This growth has major implications for how we should index NFTs*. . ." See Alex Atallah's tweet at https://twitter.com/xanderatallah/status/1501619723338924039, accessed on 30 August 2023.

[44] This view is also in line with Beeple's thoughts relating to NFTs provided in one of his interviews: "*I actually believe it is a bubble, to be quite honest. I think you're going to see a mad rush of people come to this space. And a lot of the stuff that people are making into NFTs is junk. And that stuff will not hold its value. When the bubble bursts, it's not going to wipe out this technology. It's just going to wipe out the junk*." at NPR, The USD 69 Million JPEG, https://www.npr.org/transcripts/976513031, accessed on 30 August 2023.

[45] The term "technological myopia" is used by Richard Susskind, who defines it as an inability to anticipate how substantially superior future systems would be in comparison with existing ones. He claims that the term includes an incapacity to comprehend the likely ramifications of nearly certain technical developments. It also entails thinking about the future based on the constraints of current systems. See Susskind (2021).

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