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# Crypto art and questions of value: a review of emergent issues

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# Abstract

This discussion paper offers an introductory overview of and reference guide to crypto art, including how it is supported by non-fungible tokens (NFTs). It is intended to inform researchers, those working in cultural institutions in the public, private or non-profit sectors, and artists who wish to better understand what is at stake as blockchain technologies and logics are introduced within arts and cultural contexts. We present a number of key emergent debates about crypto art in relation to [1] its value, [2] business models [3] scarcity, authenticity and ownership, [4] sustainability, [5] collections, storage and archives, and [6] hybridity. Although not wholly new considerations within arts and culture, technological developments and the intensification of crypto art's appeal within the consumer market mean these debates are likely to escalate in the short to medium term. The paper concludes with recommendations for further research, and a full reference list as a resource for anyone wanting to know more.



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# Contents

# 1. Introduction

In September 2022 at London's Newport Street Gallery, artist Damien Hirst began burning works from his collection *The Currency* after selling a corresponding series of NFTs, a practice which drew attention to the increasing interplay between physical artworks and digital counterparts, as well as between the (digital) artworld and the market[1].

In January 2022 Twitter launched its NFT-based profile pictures in the same month as a clip of Paris Hilton and Jimmy Fallon promoting NFTs went viral.[2] NFTs, now a common term heard in relation to digital art and internet culture more broadly, were almost unheard of before the sale of a work by digital artist Beeple (Mike Winkelmann) for an unexpected $69.3 million on 11th March 2021.[3] This sale by auction at Christie's opened 'the door of the fine art auction world to the crypto-community' (Bourron 2021) and catapulted debates about crypto art into the mainstream. It was the first time a major auction house had offered a purely digital artwork for sale with an NFT - in this case one issued by the digital marketplace MakersPlace - as well as the first time it had accepted cryptocurrency as payment[4]. Christie's now hosts its own on-chain auction platform Christie's 3.0 dedicated exclusively to selling NFTs.[5]

Despite broader use of and interest in blockchain technologies, it has been their application within arts and cultural contexts that has really shifted the dial on debates about their value. In this discussion paper we explore why that is the case. We present an introductory reference guide to crypto art, aimed specifically at researchers, cultural professionals and artists, wanting to understand better how it functions, and what is at stake in its increased production and circulation.

We then briefly establish a number of key emergent debates, and present recommendations for further research in this field. Where helpful in our discussions we acknowledge and reflect upon the different challenges and opportunities that crypto art presents for cultural professionals in the public, private or non-profit sectors. For example, the social and public value that publicly-subsidised museums and galleries are expected to deliver.

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[1] See BBC 2022 for more details.
[2] See Casale-Brunet et al. (2022) for more on Twitter NFT profile pictures.
[3] *Everydays – The First 5000 Days*
[4] Beeple: A Visionary Digital Artist at the Forefront of NFTs | Christie's. The Covid-19 pandemic was undoubtedly a crucial factor in auctions going fully online.
[5] https://nft.christies.com/. Although concerns that online auctions slowed down after live auctions resumed might mean that 'traditional art collectors may not fully embrace an online only world' (Bourron, 2021).

Crucially, our approach in this discussion paper balances differing perspectives on crypto art, through a critical exploration which consciously avoids either naivety and hype, or outright rejection of or disdain for these practices. We explore debates about the value proposition of crypto art, and in doing so, offer an analysis of perceived advantages and challenges for artists/creators and for collectors/investors, as well as for cultural institutions engaging in this space.

To support this discussion we have examined the academic and grey literature about crypto art, and about NFTs[6]. As crypto art sits at the intersection of technology, finance and arts, we have collated works from different scholarly disciplines, namely (a) technology, computational science and internet studies (29 percent of articles); (b) finance, business management and marketing (42 percent); (c) regulation, copyright and intellectual property (14 percent); (d) arts, including digital, crypto and generative art (18 percent); museum and heritage studies (9 percent); and (e) ecological sustainability (4 percent). While related, literature on Web3, on Distribution Ledger Technology (DLT), blockchain and cryptocurrencies is referred to as background only when relevant and is not the focus of this paper. Neither are articles referring to the uses of NFTs in other areas, like science, health, academia, or fashion.

In section 2 we introduce and define crypto art and NFTs, before giving a brief historical account of their creation, and subsequent uptake in arts and culture. In section 3 we explore a number of emergent issues that intersect in discussions around crypto art. These are: [1] questions of value, [2] uncertainty about business models, [3] notions of scarcity, authenticity and ownership [4] sustainability concerns, [5] potentials for collections and archives, and [6] hybrid approaches. These are not wholly new considerations, but are increasingly significant given technological developments and the broadening of their application into the consumer market as is demonstrated in the examples above. The discussions recounted in this paper are therefore likely to intensify in the short to medium term.

[6] We conducted a search using the keywords '("non-fungible token*" AND "art*") OR "crypto art"' in WoS, Scopus, ScienceDirect, and J-stor. Duplicates and articles that did not refer directly to these topics were excluded. We also analysed media articles and blog posts to capture the main debates.

# 2. Background And Context

## 2.1 What is crypto art?

Crypto art is an art movement vernacular to the internet and native to the blockchain in particular. It is characterised by an aesthetic that favours 'raw expression and truth to [its] materials - in this case, pixels' (Bailey 2018). Its roots can be traced to generative art in its algorithmic foundation, to pop art in its unashamed embrace of commercialization and marketing, and to conceptual art in its distributive and immaterial logics as well as in its challenging of 'the elitist tendencies of the art world as well as established practices for how art could be bought and sold' (Franceschet et al. 2021: 403):

> *Crypto art is a recent artistic movement in which the artist produces works of art, typically still or animated images, and distributes them via a crypto art gallery or their own digital channel using blockchain technology*
>
> (Franceschet et al. 2021: 402).

As is indicated here, the crypto art movement operates at the intersection of technology, art and (ultimately) the market. Artists produce limited-edition digital works, and in uploading them to the blockchain, create non-fungible tokens (NFTs) associated with them (a process known as minting).[7] The NFT then works as a 'pointer' (Gerard 2021) to the artwork, 'by containing a web address or some other reference that allows the art to be found on the internet.' (MacKenzie and Bērziņa 2021: 2).[8] In most cases, the tokens are stored on blockchains, but the assets they represent (digital files) are stored 'off-chain', 'as it would be prohibitively expensive [to store them on the blockchain] otherwise' (Valeonti et al. 2021: 5).[9]

Once a token is on the blockchain it can then be stored, sold (typically through an auction) or traded in the secondary market despite it having no tangible form, with a record of ownership being maintained on the blockchain as part of a distributed ledger shared across an international network of computers. The code features a smart contract programme that includes the terms of the

[7] We use the term crypto art to move beyond the study of the NFT marketplace to encapsulate a broader range of possibilities that blockchain technologies might offer to artists and cultural organizations. For an example of an NFT-specific glossary, see Ginsburg 2022.
[8] In this paper, we are interested in how NFTs can be used as digital tokens attached to artworks, but they can of course be attached to other kinds of digital and physical assets and stored on the blockchain. An NFT is a digital token with unique properties, meaning it can be issued as a guarantee of authenticity or certificate of ownership and assigned to an object or piece of content, whether that object/content is physical or born-digital.
[9] 'In the case of physical assets, the tangible artefact is usually shipped to the NFT collector, an indicative example of which is the NFT trading cards' (Valeonti et al 2021: 5).

primary and often subsequent transactions. Such a contract programme could, in theory, be determined by the NFT creator, but the most popular are those that are offered on the Ethereum blockchain (mostly, the ERC-721 standard and now the ERC-1155 ). NFTs thus make it technically possible for digital assets to be owned and traded, effectively introducing the concept of scarcity in the digital realm for the first time (O' Dwyer 2018; Valeonti et al. 2021).[10] It follows that economic and cultural value accrue from that scarcity:

> *'While many people might not consider this "owning art", it's clear many collectors do. The implication is NFT artworks are scarce and therefore valuable'*
>
> (Dylan-Ennis 2021, see also Chohan 2021).

Kugler (2021) breaks down what this means for quotidian interactions with an artwork by using Beeple's *Everydays – The First 5,000 Days* as an example:

> *'As a random Internet user, you can view Beeple's "Everydays—The First 5,000 Days" online, but only the person who bought the NFT tied to the art owns it. This dynamic creates a simple, but powerful, change in how digital art works: it makes digital art exclusive. Once minted on the Ethereum blockchain, the NFT is represented on a public ledger that can't be changed. By owning the token, you are proven the owner of the art piece. There is nothing stopping someone online from viewing, copying, and sharing a digital art file, but thanks to NFTs, they cannot fake possession of the art. NFTs make it possible to have exclusive ownership of digital art—something that was previously impossible.'*

What ownership and possession mean in this space is one of the main issues at stake in the debate about NFTs, as we will go on to explore.[11]

Some treat these developments with scepticism, seeing NFTs as a hyped phenomenon or market bubble, whereby it is difficult to know if they represent a 'digital Renaissance' or merely a new 'tulip mania' (Ross et al. 2021, see also Boido and Aliano 2022)[12]. There is also speculation about the type of adoption model NFTs will follow – whether or not, once the hype is over, they will become a niche product with high adopter rates among a small cohort of consumers (Colicev 2022). Areas of concern revolve around financial, regulatory, and environmental concerns as we will go on to explore (Ross et al. 2021; Valeonti et

[10] NFTs are not the first attempt 'to mitigate the reproduction of digital artefacts' (O'Dwyer, 2018, see also Zeilinger, 2018).
[11] For a discussion of different types of ownership in analogue and digital spaces, see Belk et al. (2022).
[12] Tulip Mania is a reference to the 17th century market for Dutch tulip bulbs which is often used as an example of a speculative bubble.

al. 2021, Chalmers et al. 2022), alongside consideration of the reputational risks that might be associated with institutions such as art galleries using NFTs to raise much needed finances (Valeonti et al. 2021).

NFTs are however being adopted within cultural institutions in ways we will demonstrate and discuss in this paper. There is clearly ambition here beyond solely the raising of income. For example, by entering the NFT space, artists and institutions might be able to challenge 'the ownership structure of art', as well as experiment with 'new structures of public and private support and related policy changes' (Whitaker 2019). In-so-doing, they can harness the potential of blockchain technologies and the innovative impetus of more experimental practices in crypto art (Bailey 2018, Ramos 2020, Tugan 2021). That said, it is clearly 'still uncertain what kind of long-term effect the NFT technology will have on the contemporary art scene and the overall perception of crypto artworks' (Cetinik and She 2022).

In summarising and reflecting on current practices and research in this field, we make the case for increased efforts to test a value proposition that more adequately captures the nuances of crypto art and NFTs for cultural institutions.

## 2.2 A brief history of NFTs

Although NFTs are now widely associated with the Ethereum blockchain, the underpinning concept pre-dates that platform by some years (Alexiades 2021). Commentators date NFTs to 2012 when Meni Rosenfeld introduced the idea of 'colored coins' as a way of proving ownership within the Bitcoin blockchain[13]. The first-known NFT *Quantum* was minted in 2014 by digital artist Kevin McCoy (Hamilton 2022). This was the year the Ethereum blockchain was introduced, upon which the majority of NFTs are now built.

Before Ethereum dominated the space of crypto art – and blockchain was seen primarily as a means to commercialize art – digital artists were already experimenting with the blockchain (Catlow. 2017, Suvajdzic et al. 2019). Early crypto art native ecosystems (like Dada and Rare Pepes) blended art and collectibles into a hybrid that responded to the aesthetics and ontology of digital as well as of internet culture and social media in the spirit of 'relational art'. Communities of digital artists were exploring collaborative solutions on the blockchain to the challenges presented by the intangible nature of their artwork and the post-scarcity character of the internet, namely the inability to prove ownership and to profit from their labour. Another early phenomenon of internet culture that welcomed and fully embraced NFTs was memes, whereby the

[13] The technology that enables NFTs predates this (Park et al. 2022). For a history of Crypto Art and its milestones, see Ostachowski (2021).

creators of the original images were able to capitalise on their virality for the first time, as did other historic internet culture moments like the NFT of the first tweet[14]. Cryptopunks was the first NFT project on Ethereum, paving the way for what would become the smart contract ERC-721 standard.

Following the launch of Ethereum there was also increased interest in the issuing of digital collectibles and assets to be traded between players within gaming contexts (Arnedo-Moreno and Garcia-Font 2022), and there has since been speculation about how their use might be expanded across a range of different industries including sport, healthcare and real estate (Valeonti et al. 2021: 5), as well as excitement about how they might be used for branding purposes (Nguyen 2021). There is a wealth of literature on the psychology of collecting and fandom which has been drawn upon to give possible explanations for the popularity of NFTs. That literature can help us to articulate the social and cultural capital derived from owning particular objects or concepts (or indeed, pointers to objects) and the 'bragging rights' that follow, as well as the 'hedonic' value derived from owning a particular NFT (Nguyen 2021).

According to Nadini et al. (2021) the market for NFTs grew rapidly in late 2017 alongside the popularity of trading in the CryptoKitties collection (O'Dwyer 2018, Serada et al. 2021), before stabilising with an average of $60,000 US traded daily, until mid 2020 when the market experienced another period of dramatic growth, with exchanges hitting $10 million US per day by March 2021[15]. We should be careful with such market assessments however, as the NFT market - much like the cryptocurrency market - is high-risk, and likely to remain volatile and speculative. After peaking in January 2022 at $17 billion US, NFT trading volumes plummeted 97 percent by September 2022 (Shukla 2022).

There is likely a bubble of attention around NFTs which, if it were to burst, would threaten their credibility. As we write this piece, recent fluctuations in cryptocurrencies have further convinced critics that NFTs are nothing more than yet another iteration of financial speculation.[16] However Stephensen contends that what is interesting about the technology is what it makes possible, rather than just the pricing of tokens: 'There's unquestionably some speculation and froth around this stuff, but more people are paying attention, and it's changing how artists are thinking about their work and how they get paid' (Stephensen in Nguyen 2021). On the one hand, there is the (yet to be fulfilled) promise of eliminating the middlemen and gatekeepers, allowing artists to take control

[14] There is however some criticism as the 'original' image that creates a viral phenomenon is only one bit of what will constitute a meme - a collaborative process that plays with precisely the lack of scarcity on the internet. Some argue that memes cannot fully be owned or traded by any one person (Kale 2021). Similarly, it is proving difficult to store and collect memes (Rees 2021).

[15] Notably, in the period following the sale of the Beeple artwork at Christie's.

[16] For more on the relationship between NFT pricing and cryptocurrencies, see Dowling 2022.

over their artwork in a new market. On the other, these developments potentially expand the possibilities of what we mean when we speak of an 'artwork' – artists can sell, for example, access to their studios, to their inspiration and creative process as part of what is included in the contract. These opportunities for artists are intrinsically dependent on the multiple, overlapping, and often conflicting, motivations of buyers, as we will go on to explore. For now, we focus on the role of institutions in facilitating and shaping these developments.

## 2.3. Crypto art and cultural institutions

The Covid-19 pandemic and associated lockdowns prompted a wholesale shift to digital practices in the arts and cultural sector. Museums and galleries moved their operations online, mostly free to access, as institutions were unsure about how and under which circumstances to monetize their digital activities (Kidd et al. 2021).[17] As we emerge from the pandemic, a conversation about options for cultural institutions to monetize (some) digital content is needed more than ever (see also AHRC- DCMS 2021). Whether crypto art and NFTs are going to be part of the solution for cultural institutions across the board is yet to be seen, but it is clear that the ability to commercialise digital copies of artworks in their collections is an attractive proposition for the sector (Valeonti et al. 2021). Another potential advantage of entering the NFT space is to increase (and again, monetize) stakeholder engagement (Chalmers et al. 2022).

Notwithstanding these potentials, there is some clear concern about the application of blockchain technologies within cultural institutions:

> *Depending on your perspective, Non-Fungible Token (NFT) artworks are inaugurating an exciting new chapter in the history of art, or a dangerous new chapter in the history of online market bubbles*
>
> (Russell 2022: unpaged)

While it might be hard to grasp the utility of NFTs in the 'real world' for some, responding to these developments will likely become a necessity in the virtual world, in the metaverse for example, particularly in the context of online collections.[18] NFTs offer the possibility for institutions 'to retain a digital asset's value in this system by which a museum could exclusively introduce its exhibits to the virtual world and continue to procure, display and sell' (Hardaker 2022), or

[17] It was also during Covid-19 that crypto art and NFTs became most popular, as both artists and consumers spent most of their time online (Binson 2021).
[18] NFTs can already be displayed on online galleries in virtual worlds such as Decentraland (MacKenzie and Bērziņa, 2021, see also Belk et al. 2022).

perhaps even do so on a time-limited rental basis[19]. The race is now on to be the institution that establishes the foundations of a new market space for the monetisation of digital collections. The British Museum's partnership with French NFT platform LaCollection is one such initiative.

According to the CEO of LaCollection, Jean-Sébastien Beaucamps, selling numbered digital copies of items in the collection is aimed at simulating scarcity. The website offers a collectible structure with different levels of scarcity for different copies. Having the backing of the museum helps to build trust amongst investors and in the marketplace, to the extent that the NFTs might retain or increase their value. The platform fronts the cost and the technology, and the museum lends credibility to the platform, which could in theory work with images from a museum without its support but would be less likely to succeed. The prestige of buying from the British Museum brings in buyers that would not necessarily be attracted to the NFT space - the platform even allows users to buy NFTs with credit cards rather than cryptocurrency.[20] The purpose of LaCollection is, according to its director, to democratise culture in the sense of making it available to a broader public, by offering cheaper NFTs to collectors (relatively speaking because entry NFTs were still £400 when it launched).[21] This partnership is seen by LaCollection as a long-term project 'to showcase artists and institutions with strong historical values' that will, in their view, outlast more hyped designs like Cryptopunks and Bored Apes. It is also hoped that NFTs might function as an entry point for cultural institutions to reach a younger audience with disposable cash, given that promotion on social media is key, particularly on Instagram, Twitter and Discord (Hardaker 2022).[22]

For other institutions, like for the Whitworth Gallery in Manchester, embracing NFTs has been the result of a need to increase revenue, while remaining faithful to their values as an institution that embraces the principles of the 'useful museum', engaged with the local community (Lynch 2020, Harris 2021).

Partnering with Vastari Labs, the project is part of the wider *Economics the Blockbuster* exhibition, and is rooted in their digital strategy of experimentation in the digital space, aiming to combine creative innovation with art as a vehicle for social change.[23] As Whitworth Gallery Director Alistair Hudson noted, the objective is to explore ways to direct new flows of private digitised capital into social capital:

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[19] The reNFT project, for example, proposes a rental protocol that enables NFTs owners to profit from leasing their collections to others in the metaverse (Lee et al. 2021).
[20] This is aimed at increasing user onboarding.
[21] At time of writing (June 2022), there are NFTs at around 150 euros.
[22] Another area of interest for NFTs is their potential for marketing. See, e.g. Chohan and Paschen (2021), Faridani (2021), Treiblmaier (2021).
[23] Since this report was drafted, Vastari Labs has gone into administration and the current status of the project with the Whitworth is unclear

> *The Whitworth decided to embark on this project because it wanted to think about how it could redistribute the wealth of its collections in the most democratic way, and this technology offers the opportunity to open up the collections and the way they work in the world to the broadest possible audience… what this is doing is putting the works of art in our collection into operational use in the world… [allowing] us to liberate their value as social value out there in the world, and in this case for us to deliver projects with the communities around us*
>
> (Hudson in introductory video 2021).

The minting and selling of William Blake's *Ancient of Days*, and the tracking of activity around the NFT over time, will inform an exhibition in the museum in 2023. This is happening as part of a research project and is accompanied by an online research platform, dpe tools, that brings contributors together to explore alternative economies.[24]

Museums, galleries and other cultural institutions entering this space have to make sure that the sale of NFTs fits their institutional mission and values. Even if deciding to embrace NFTs, there are other issues to consider relating to the quality of images, accessibility and user onboarding, interaction within the OpenGLAM movement, reputational concerns, as well as wider ethical concerns around data, inequalities and environmental impact. These matters are beyond the scope of this paper, but merit further research.[25]

As we have already noted, NFTs have attracted strong criticism, including from within the arts and cultural sector. Debates about the value of NFTs are shaped by, but not limited to, technological concerns. While NFTs as a phenomenon have received a chilled response from many scholars and practitioners, blockchain technology more broadly has sparked an interest in relation to its potential to disrupt the future work of cultural institutions. The following section explores these concerns in more detail. Our discussions focus on the possibilities and challenges presented by this socio-technological phenomenon for different stakeholders in the arts and cultural sector, particularly to artists and institutions.[26]

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[24] At the very least, this project seems to provide the museum with a testing ground for the use of NFTs in this space, before jumping too soon into something that could backfire in terms of longer term digital strategy (Bailey, 2021c)

[25] Jung (2022) suggests a 'conceptual model for a common pool of NFT sharing based on the third-party regulation model, the fair use doctrine of copyright, and open access policy among the world's museums that are willing to participate'.

[26] For more on NFT stakeholders, ecosystems and value, see Wilson et al. (2022) and Baytas et al. (2022).

# 3. Emergent Issues

In this section we explore a number of issues that circulate in discussions about crypto art. These are [1] questions of value, [2] uncertainty about business models, [3] the implications of scarcity, [4] sustainability concerns, [5] potentials for collections and archives, and [6] hybrid approaches.

Whilst some of the themes explored here are specific to NFTs, most of them have a pre-history to these developments. For example, the relationship and tension between the aesthetic or even ontological nature of art and its financialization has long been the subject of critique and analysis, and questions about ownership and copyright are well established (Taylor 2011; Khaire 2017, Whitaker 2021). Treating art as a financial asset can be traced back to the 15th Century at least. The themes we explore also relate to broader issues within the crypto space (such as trust, security and transparency) and digital culture more generally (such as inequalities and sustainability).

At the core of many of the debates recounted in this section are a series of tensions. On the one hand, there are critiques of the value attributed to crypto art through processes of financialization, tokenization and assetization,[27] and what might be deemed a technofetishist desire to solve societal problems – in this case for artists and cultural institutions – with code. The combination of both these impulses has been termed 'technoscientific capitalism' (Birch and Muniesa 2020). On the other hand is a radically different interpretation of the NFT phenomenon featuring defenders of blockchain technology excited by what they understand as its commercial and democratic potentials, including for the arts sector. These tensions will be visible, to varying degrees, in all of the following sections.

## 3.1 Valuing crypto art

> *It is this final collapse of aesthetics into economics that dismays the artworld's commentators, although they do not yet articulate their fears coherently*
>
> (Friedman and Hawkes 2021).

While the 2021 Beeple sale was hailed by some as a new chapter for art, a review in *The Washington Post* proposed it 'had absolutely nothing to do with artistic value' (Smee 2021). Instead, the review suggested the sale was 'one more riotous example of high-roller groupthink, market manipulation and the seemingly unstoppable human urge to commodify everything' (ibid.). This

[27] See, for example, Zeilinger (2018), Botz-Bornstein (2021), Joselit (2021).

reaction to NFTs can be seen as a rejection of the pervasiveness of cryptocurrencies and their speculative qualities more broadly, but is evidence too of a specific moral panic arising from NFTs entering the art market in relation to aesthetic and ontological considerations: Are NFTs (or the crypto art that they point to) art?[28]

The discourse around Beeple's NFT was reminiscent of other polemics in the arts from Marcel Duchamps' famous urinal *Fountain* to, more recently, Maurizio Cattelan's overripe banana taped to the wall with duct tape, *Comedian*. Some have argued that crypto art has its origins in conceptual art, sharing 'the immaterial and distributive nature of artworks, the tight blending of artworks with currency and the rejection of conventional art markets and institutions' (Franceschet et al. 2021). If an NFT is a pointer to a work of art, not the work of art itself, the same can be said about much conceptual art in which the idea is what is being traded, not any material object. By purchasing one of the several copies of *Comedian*, for example, collectors bought the concept of the piece that included a certificate of authenticity and instructions to install and preserve the artwork, including replacing the banana whenever necessary.[29]
Crypto art mirrors the value attribution system of the traditional art market, including the social capital afforded by the ownership of a particular artwork. In the case of crypto art, the difference is that the main value exploited by many brands and NFT projects is a sort of digital social capital or social media capital.

Similarly, it might be said that it is through the ritual of the sale that the latent value of a work of crypto art is activated (Thelot 2021). Critics of NFTs note that they unashamedly signify the commodification of arts and culture, and the reification of artworks to a degree (in their view) rarely seen before.[30]
Motivations on the demand side of the market are varied, ranging from the collector's desire to 'own', to the investor's hope to make a quick profit by 'flipping' the NFT – selling it for much more than they paid. While altruism and patronage (i.e. supporting artists and arts organisations) or emotional benefits like aesthetic pleasure are key motivations among art collectors, including digital art collecting, economic factors (return on investment) are reported by buyers as their main reason for investing in NFTs (Hiscox 2022, Ripple 2022).[31]

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[28] The NFT is technically only a medium for artistic expression, rather than the artwork itself (or not even that as we can consider it as just the metadata attached to it).
[29] NFTs are not the first time that an artwork is attached to a non-fungible identifier. By issuing certificates of authentication, Sol LeWitt's Wall Drawing #793B Certificate regulated scarcity by using a system to define uniqueness (Wilson 2022).
[30] This is not news to many artists in this space, many of whom see NFTs as an opportunity to explore the relationship between art and money, such as Hirst's *The Currency*, *Beautiful Thought Coins* by Australian artist Shaun Wilson, or the already mentioned *Economics the Blockbuster* exhibition at the Whitworth gallery.
[31] Some NFT investors and collectors like to identify themselves as Maecenas and patrons of the arts (Chen and Friedmann, 2022).

Some critics are concerned about the speculative nature (rather than just the commodification) of NFTs that can be seen as emphasising investment in what economic geographer Paul Langley terms 'political technology' (Langley 2020, quoted in Juarez 2021).

For many artists however, the value of experimenting with crypto art is precisely the possibility of revolutionising the 'traditional economies or art' (Eng 2021). Dada.art, for example, offers a platform for artists to collaborate in artwork that gets rewarded precisely on the basis of effort and cooperation (Eng 2021), a radically different proposal to more commercial NFT marketplaces like OpenSea or Foundation, which operate like the traditional, profit-based, art market. For some artists, collaborative projects on the blockchain like Dada could provide a solution to the tensions between intrinsic and extrinsic motivations that plague the work of artists in the contemporary market. That said, NFTs also open up the question of what indeed an artist is in this context, further blurring lines with the content creators of the new digital economy (Kraynak 2020). Consequently, the boundaries between 'financially motivated collectibles' and 'artistically motivated fine art' are also becoming increasingly blurred (Belk et al. 2022).

In the following section we explore these issues further by focusing on the value proposition of the main business model currently in operation – NFT marketplaces – while remaining alert to other practices and spaces that offer alternatives to their logics.

## 3.2 The business of crypto art

Crypto art is an artistic practice, but it is also a community. Taking digital art to the blockchain holds a number of potentials for that community: [1] the disintermediation of the market, giving artists a greater degree of autonomy as they become less reliant on the gallery system as an intermediary, controlling access to buyers and charging fees for first and often second sales, [2] a greater degree of control over their cultural production by being able to authenticate works and establish and transfer ownership of them, setting the terms of the rights being transferred, [3] a chance to benefit from primary and secondary sales of their digital labour in the online space, and [4] offering a democratic vision for the artworld, particularly, the art market, by potentially expanding 'spheres of taste and participation' (Lena 2019 referenced in Whitaker 2019, 41)

Many, however, have highlighted a gap between these potentials and the reality. For critics, the dial has moved too far away from the art and artists toward collectors and investors. Recent research, for example, has shown that NFT ownership is very concentrated, arguing that 'diversification does not appear to have happened in the world of NFT-based art' (Ackermann 2022, see also Barbasi 2021, White at al. 2022, and Colavizza 2022). While the same can be

said of the traditional art market, this undermines the particular promise of democratisation noted above, as Helena Ramos of Dada argues; 'today's crypto art market is an investor's market' (2021), which, for the most part, favours consumers – buyers and investors – rather than producers. Anil Dash, creator of non-fungible tokens, has also criticised what he calls the highjacking of the technology by 'tech-world opportunism' (Dash 2021).

Another criticism of the failed promise of democratisation is that the process of minting NFTs and selling crypto art is too technically complex for those not immersed in the crypto world (often referred to in that space as 'normies'). This is particularly relevant in the museums context where user onboarding might prove difficult (see, e.g. Liddell 2021a 2021c). As we have noted elsewhere in relation to immersive practices, large proportions of the public still face significant barriers to entry when it comes to experiencing new technology (Kidd and Nieto McAvoy 2019; Allen 2020). It follows then that third party NFT marketplaces have been quick to appear, acting as intermediaries and, often, gatekeepers.

Despite claims to the contrary, the current state of affairs in the crypto art ecosystem mirrors closely the inequalities and lack of diversity that we find in the artworld more broadly, and in other areas of the creative industries such as the music and authoring industries: few artists are able to live off their work, a handful of artists accumulate most of the sales (Nadini et al. 2021), and members of most NFT communities tend to be male (Laycock 2022) and (crypto)wealthy.[32] Many artists are vetted by curated platforms (like SuperRare), which mirrors gatekeeping systems of curatorship in the physical art world (Bodó et al. 2022). While there are no standards for rating crypto artists and artworks (Franceschet 2021a), most interfaces of open platforms are built on leaderboards, grounded in a very unequal distribution of power, based again on wealth. In that hierarchy, wealthy collectors are prioritised, followed by top selling artists.

The visibility of other collectors and emerging artists is much poorer. It could be argued then that taste is determined by early investors in cryptocurrencies.[33] This was clearly the case with the Beeple sale (Castor 2021), bought by the crypto-based investment firm Metapurse. They later sold B20 tokens that gave buyers

[32] Racial discrimination in collectables and NFT markets is discussed by Nguyen (2022). For a discussion of blockchain imperialism, see Jutel (2021).
[33] Notwithstanding, Franceschet (2020) found a correlation between market success and artworks selected for their quality by art experts and artists. Franceschet and Colavizza (2019) attempt to develop art metrics that can capture the complex social networks and exchanges of reputation in art markets, in particular among artists and collectors (see also Franceschet, 2021b).

ownership of a fraction of the B.20 bundle[34] of a collection of Beeple artwork (but not *Everydays: The First 5000 Days*) alongside other NFTs, such that the investment was 'modelled on the more conventional idea of a unit trust' (MacKenzie and Bērziņa 2021; Castor 2021, Davis 2021).[35]

There are also vetting systems built into the blockchains. NFT creators need to pay money (cryptocurrency) up front in order to mint their tokens. This initial payment might include, for example, 'setting up' fees to join an online gallery or 'gas fees' to compensate miners for recording the transaction on the Ethereum blockchain platform in order to mint the NFT.[36] This again mirrors the situation with cryptocurrencies more broadly; early adopters of blockchain disproportionality benefit, and most of these tend to be behind the super art sales we have seen (Castor 2021).

One of the innovations brought about by artists involved in the crypto art community has been ways to benefit from sales on secondary markets, which have generally higher returns on investment than in the primary markets where a first sale takes place (Whitaker and Kräussl 2020, van Haaften-Schick and Whitaker 2022, Malik et al. 2022).[37] However, monetising from re-sales and royalties in perpetuity as a way for artists to retain fractional equity needs to be written into the smart contract, and, even then, this might not transfer easily between marketplaces which have been slow to respond, despite their claims to be supporting artists.[38]

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[34] B20 refers here to a token, and B.20 refers to the bundle of tokens. Fractionalised ownership refers here to 'multiple owners [that] have a right to benefit financially from increases in the value of the artwork if it is resold' (Belk et al. 2022). Fractionalised can also mean that the distribution of rights between the creator of the NFT, the intermediaries and the buyers.

[35] The B.20 bundle includes a buyout clause in its smart contract that allows anyone that holds at least 5% of the B20 tokens to trigger an auction for the entire B.20 bundle (Davis 2021).

[36] Some platforms like OpenSea have a free minting tools to help with creator onboarding, either by allowing NFTs to be minted on Polygon blockchain technology (a layer-2 blockchain that offers gas-free transactions) rather than Ethereum, or by giving artists the opportunity to use a 'lazy minting' process by which the digital artwork only gets recorded on the blockchain (and transaction fees paid) once the NFT has been sold or transferred. Initial gas fees always need to be paid when first setting up an account (Attalah 2020). The new ERC-1155 Multi Token Standard (created mainly for gaming contexts) is said to help save on transaction costs by being able to transfer multiple token types (fungible and non-fungible) at once. The way transaction fees are calculated depends on the blockchain.; the final price will depend on various factors, including the complexity and speed of a transaction as well as the traffic on the network at the time of minting. Gas fees vary widely during the course of a day and can often be greater than the price the artist had anticipated selling their creation for.

[37] There is a lot of debate about the regulatory implications of resale clauses in smart contracts, which vary by jurisdiction. See discussion on copyright in the next section.

[38] The Ethereoum ERC-721 standard used by OpenSea, for example, did not include royalties when first created. This can now be set with the EIP-2981: NFT Royalty Standard. Currently, Known Origin leads with a 12% of resales fee for artists.

Many of the sale and marketing techniques used by NFT ecosystems to sell their crypto art are similar to other (digital) markets competing in the attention economy. These include advertising and creating a hype around a future 'drop' or sale of new NFTs, allowing pre-sales for those loyal members of the community, unique and scarce merchandising, gamification logics of reward and engagement with other members of the community, and even what some argue are 'gambling-like strategies' to ensure loyalty and growth (Scholten et al. 2019, Zaucha and Agur 2022).

Profit-seeking is an important value proposition of many of the NFT platforms. Potential members of communities are attracted by the possibility of not only being part of an in-group but becoming a venture capitalist. It is, like cryptocurrency and speculative assets more broadly, a market based on predictions of future value. This is so much so that many NFT projects never deliver the product (digital or otherwise) that they promise their early investors, creating what is called a crypto rug pull. The difficulty of participating in a decentralised system that is unregulated outside of the blockchain is that users are left with little recourse to fight these and other scams.

Some argue that the main beneficiaries are the crypto markets and early adopters, as the NFT craze has both raised the price of the currencies and brought in more liquidity allowing them to cash out. However, the relationship between NFTs and cryptocurrencies is not always straightforward (Ante 2021a; Dowling 2022b; 2022a), with some characterizing the NFT markets as 'immature' and 'inefficient' (Ante 2021b).[39] According to Thelot 2021, one of the reasons why NFTs have become so popular is that they lend credibility and functionality to cryptocurrencies as they materialize the 'ideology' of cryptocurrency 'in a culture with its very own aesthetic codes, rules and idiosyncrasies', with the objective of driving adoption (see also Juarez 2021).[40]

Despite these criticisms, there is the potential of blockchain technology to bring about 'entrepreneurial ventures in the arts' (Catlow et al. 2017; O'Dair 2019; Owen and O'Dair 2020; Whitaker and Kräussl 2020, Chandra 2022, Whitaker 2022). Artists could harness, for example, their cultural entrepreneurship as investors in their own practice, including building joint 'investment trusts out of their royalties and shares' that could be facilitated by the blockchain (Whitaker and Grannemann 2019, Whitaker 2022). Cultural organisations, including museums and those in the performing arts, could explore 'cooperative financial arrangements' finding 'new models of supporting the arts itself' (White 2019 23).

[39] For studies on the relationship between cryptocurrencies and NFTs, see e.g. Bao and Roubaud (2021), Boido and Aliano (2022), King and Lin (2021), Pinto-Gutiérrez et al. (2022)
[40] Adoption also varies by regions (Laycock 2022). Europe remains the most conservative in embracing NFTs (Carnahan 2022).

The example of Dada.art is one such space for artists to create but also resist the more exploitative nature of the current NFT market. Their Invisible Economy project aims to separate the art they create from the market in order to empower artists to continue creating art 'for pure joy and solely out of intrinsic motivation' (Ramos and Mam 2020). In London, 'the (de)centre for art and tech' Furtherfield has been exploring the possibilities of blockchain for the arts since their Art/Data/Money programme (2016). They currently run the DAOWO initiative and now the Decentralised Arts Lab DECAL to critically interrogate 'the social impacts of blockchain technologies more widely'.[41]

At the very least, blockchain technology has the potential to open up a space to reflect on the underlying governance, regulatory and economic foundations of the cultural and creative industries. While the NFT craze might pass, some think that 'blockchain may tip the role of the arts toward democratic availability or commodification of cultural assets' (Whitaker 2019 21). NFTs highlight tensions for example between these democratizing impulses and the privatization of artworks or 'between popular audiences and rarified tastemakers' (Whitaker 2019, 41, see also Joselit 2021). The key for those studying this space lies with testing and establishing adequate governance structures (Whitaker 2019, 40).

One of the main issues at stake is the challenge that NFTs and blockchain technology present to ownership structures, including fractionalized or collective ownership of artworks (Whitaker 2019). The next section explores these issues in more detail.

### 3.3 Scarcity, authenticity and ownership

> *Authorship and originality are the strongest drivers of value in art*
>
> (MacKenzie and Bērziņa 2021).

In the case of crypto art, artists are able to endow a particular object (in this case, a digital artwork) with unique properties, therefore mimicking in the digital space the scarcity that exists with physical artworks, particularly of singular artworks like a painting or a sculpture. The process is akin to making a copy of a multiply instantiable artwork - like a photograph or novel - unique by, for example, making it into one of a limited edition or signing copies (Cross 2021; see also Belk et al. 2022). The artists therefore confer on the artwork (whether digital or physical, singular or multiple) some of its value by virtue of authenticating it.

In crypto art circles NFTs are thus significant as they represent a 'transparent, auditable origin and provenance for a piece of digital art' (Franceschet 2021,

[41] https://www.furtherfield.org/about-us/about-us/.

see also Marro and Donno 2021, Liddell 2021a). According to Chalmers et al. (2022) it is the affordances of ownability and verifiability which make them exciting and potentially lucrative for the creative arts. Nadini et al. note that they 'establish the "provenance" of the assigned digital object, offering indisputable answers to such questions as who owns, previously owned, and created the NFT, as well as which of the many copies is the original' (Nadini et al. 2021).[42]

This is intriguing given that an open internet has previously been seen as a positive step away from cultural production and consumption predicated on the notion of scarcity (Nguyen 2021). Indeed, it has been mooted that the internet might have heralded an era of 'post-scarcity' (Hoskins 2011). The re-introduction of scarcity in this context is significant then, as is the notion of 'exclusivity'. On the one hand it seems incompatible with the ethos and practices of an open internet, including OpenGLAM initiatives, 'where galleries, libraries, archives and museums have been openly licensing images of items in their collections for others to use as they will' (Valeonti et al. 2021 2).[43] On the other, it offers an opportunity for those working in the digital arts, should they wish, to make money from their creations. To Stephensen it is precisely the duality of NFTs – the fact that ownership is limited, but access is still freely available to anyone – that might further work toward 'the dream of the open internet, while also ensuring compensation for the producers' (Stephenson quoted in Nguyen 2021).
NFTs are seen by many in the arts and cultural sector then as a solution to long-standing structural challenges for artists and institutions in relation to monetising digital production and collections, and 'value capture' in a landscape where revenues are often funnelled to powerful stakeholders, platforms and intermediaries (Chalmers et al. 2022). The role of NFTs in fulfilling these ambitions needs to be better evidenced however, as it is still being tested.

An issue identified by those studying the regulatory implications of NFTs is that in purchasing a digital certificate of ownership and authenticity 'that might be all you are getting' (MacKenzie and Bērziņa 2021, Moriengiello et al. 2022). With most standard smart contracts, the copyright and other intellectual property (IP) rights are retained by the artist.[44] This situation mirrors what happens in the traditional art market, where the buyer of (e.g.) an oil-painting is purchasing the physical object but not the right to reproduce, communicate to the public or distribute the artwork. In theory, this can be redressed by adding a transfer of

[42] See also Marro and Donno 2021, Franceschet et al. 2021.
[43] For a discussion on the tensions between NFTs and Open Access images in museums, see Liddell (2021b).
[44] Lawyers tend to advise to accompany smart contracts with a natural language contract to comply with transparency standards, which should include 'a clear applicable law and jurisdiction clause', 'given the often cross-border nature of NFT sales and the challenge of determining the "location"' (Rimmer, 2022).

rights in the (smart) contract.[45] Whether this is the case or not, it is still unclear how the terms of the contract might be interpreted by different stakeholders, whether they can be enforced or recognised across jurisdictions (Fisher 2019, Çağlayan Aksoy 2021, Trautman 2021, Belk at al. 2022, Bodó et al. 2022, Chen and Friedmann 2022).46 For example, what constitutes IP infringement in this space? What does it mean then to 'own' an intangible digital artefact in terms of personal property rights distinct from (although bound to) IP (Fairfield 2022)? What compensation can be expected by those who have had tokens stolen from their wallets (Ravenscraft 2022), or have been falsely attributed as the creators of an NFT (Guidi and Michienzi 2022)?[47]

Ultimately, NFTs have brought to the fore discussions about the meaning and value of owning intangible digital objects. For Chohan (2021: 9), the value of ownership can be framed in terms of what he calls the 'leisures of blockchains' – that is, the ascription of value through 'a leisurely exploration of what is possible in terms of digital objects that are treated as unique, non-fungible representations of things that are simply interesting to them'. The values of uniqueness, provenance, authenticity and scarcity need to be agreed upon by artists and collectors then. As Stepehson argues (in Nguyen 2021), the importance of scarcity and uniqueness is not just about what is on offer, but about what is in demand.[48] As a business proposition in NFT ecosystems, the value of each token is dependent on user communities' decision to embrace the NFTs in question (whether in gaming or the world of fine arts), and on token-holders keeping their interest (Kaczynski and Kominers 2021).[49] While a lot of the NFT economy seems to be based on investments, we also find consumptive collecting is a strong motivator where exclusivity, belonging and social capital seem as important as scarcity or authenticity, blurring the boundaries between investors and collectors.[50] This could be said of any art market of course, but

[45] While this applies to copyrighted (digital) artworks, there is a whole set of other (moral) issues associated with minting NFTs from open public domain images, e.g. from institutions with open access/data policies (Liddell, 2021b).

[46] Different jurisdictions are taking different paths in terms of specifically regulating NFT markets. The character of an NFT might determine what regulation might be applicable, for example fractional tokens can be considered security tokens. The recent draft for the European Union's Markets in Crypto Assets (MiCA) seems to affect bundled and fractionalized NFTs (EU 2022). The EU intellectual property office has also published its new approach that includes how to classify virtual goods and NFTs (CMS Law-Now, 2022). In the UK, the Digital, Culture, Media and Sports Committee is launching an inquiry 'into the operation, risks, and benefits of Non-Fungible Tokens (NFTs) and the wider blockchain' (UK Parliament DCMS Committee, 2022).

[47] For a blockchain-based solution to ensure trust and credibility in the NFT ecosystem, see Hasan et al. 2022. For a recent court case relating to the theft of an NFT, see Aufrichtig (2022).

[48] For Vitalik Buterin, legitimacy is the main value that sustains NFTs (2021).

[49] For a study on the impact of NFTs (mainly profile pictures) on social network communities (e.g. Twitter), see Casale-Brunet et al. 2022).

[50] Emotional benefits, such as aesthetic pleasure, social impact and patronage, and educational reasons are also among the motivations of art collectors.

while other markets are regulated, the legal implications of minting, selling and buying NFTs are still being debated.

The legal frameworks in which NFTs operate are crucial for artists. The precarity and insecurity faced by artists has only increased with the Covid-19 pandemic (Walmsley at al 2022), and the predominantly freelance nature of work and the increasing role of digital practices means that solutions to ensuring artists' rights across multiple (re)negotiations of contractual terms are becoming even more important. Applicable to the art market in general and to NFTs and self-executing smart contracts in particular, Amy Whitaker (2022) proposes a framework of what she describes as 'non-zero-sum contractual negotiation in relation to the artistic and financial nature of works of art', arguing that there is an opportunity to rethink the nature of artists' contracts allowing for 'rhetoric and contractual structures of collaboration and friendship' between stakeholders who, for the most part, will 'have shared interests in both sides of a contract'. Whitaker and other scholars and artists in this space are calling for a more ethical approach to crypto art – one that can subvert rather than mimic the shortfalls of the traditional art market.

We find other instances in which blockchain technology is used for 'transgressive co-options' (Brown 2022) that represent challenges to received notions of authenticity (Botz-Bornstein 2021) and ownership. Artists and activists are using NFTs to reclaim 'objects with controversial histories on the blockchain' in what they argue are instances of 'digital repatriation' (Looty NFT 2021). Blockchain technology can also be used to 'disincentivize the sale of looted objects and to manage shared stewardship, ownership, and exhibition of these contested artefacts taken through war or colonialism' (Whitaker et al. 2021). One such digital restitution project is the Nigerian platform Looty, which has launched the first collection of NFTs of the Benin Bronzes. The digital copies are 3D scans which have been taken in the British Museum using LiDAR technology.[51] The first NFT will be returned to what they claim is its original owner – the Edo museum (still under construction) in what was the Kingdom of Benin in southwest Nigeria – while the sale of subsequent reinterpretations of the image will be partially used to support emerging Nigerian artists. According to their website, the objective is:

> *To challenge the museum institutions who refuse to return these looted works to the rightful countries of ownership, we are launching NFTs of looted works and paying out reparations in the form of profits made from the sale of each NFT. Our mission is to empower the future generation of artists from the continent of Africa.*
>
> (Looty NFT 2021)

[51] The British Museum has voiced its support to the Digital Benin project (BBC Sounds, Digital Planet, 17 May 2022).

Another interesting example is the work of The Cercle d'Art des Travailleurs de Plantation Congolaise (CATPC) – a post-plantation artistic community near Lusanga in the south of the Democratic Republic of the Congo. Based on a former Unilever plantation, CATPC has been buying back plantation land, using the proceeds of their art sales. CATPC has also been unsuccessfully trying to loan a Congolese sculpture of a Belgian coloniser (*Balot*) from the Virginia Museum of Fine Arts (VMFA). Bought in the seventies and donated to the VMFA, the *Balot* sculpture had been carved in 1931 by the Pende people during an uprising to protect themselves from their Belgian colonial rulers and fight against forced labour at the Unilever plantations in Congo. CATPC has been in negotiations with the VMFA to host the *Balot* in the recently inaugurated White Cube gallery in Lusanga to raise awareness of the role plantations played in the construction of Western art museums, where these objects are still being exhibited. Unsuccessful so far, CATPC decided to mint a collection of 300 fractionalized NFTs of the *Balot* image in what has been termed an act of 'digital decolonization' (Chen 2022).[52] Profits from the sale of these NFTs in June 2022 will go towards empowering the community, by buying back more land for the post-plantation and to be able to pay its workers fairly (Brown 2022, Chen 2022), which is a very different motivation for buying from investing or collecting. After learning of this sale however, the museum now claims it no longer intends to loan *Balot* to CATPC, a loan which the NFTs were clearly not designed to replace (Brown 2022).

These projects raise interesting questions about 'who gets to keep, exhibit and reap the commercial benefits of ownership' (Looty NFT 2021), the exploration of which presents another motivation for wanting to participate in this space. The project Crypto Connections: Exploring the Personal from National Museums Liverpool, for example, centred the idea of collective ownership as 'shared guardianship', creating value for different stakeholders through the experience of 'connected digital objects' (Liddell 2021a). Frances Liddell (2021a) argues for the importance of blockchain to create digital files that *feel* ownable and meaningful, adding a new layer of (digital) materiality. Similarly, Amy Whitaker has also explored regulatory frameworks for shared ownership of artwork between artists and 'friends' who share a duty of care for the artwork while allowing for future monetisation (2022).

There are exciting and creative potentials here then when it comes to experimentation with notions of authenticity and ownership, even if the legal implications in different jurisdictions are still being determined. There is one issue that is exponentially becoming more problematic - the negative impact of NFTs specifically (and crypto and digital platforms more broadly) on the climate.

[52] For a challenge to this view, see Gregory (2022).

## 3.4 Sustainability

Cultural institutions have in recent years become more mindful of their environmental impacts[53] (Harvey and Perry 2015, Newell et al. 2016, Cameron 2017, Demos et al. 2021, Sloggett and Scott 2022, PEC at al 2022), including how their work in the digital environment might undermine their green ambitions (Cameron 2021).

One of the major ethical issues alluded to in literature about crypto art is the challenge of cryptocurrencies' carbon dioxide emissions and resultant climate impacts (Akten 2020, Marro & Donno 2021). Linking the damage caused by blockchains to climate change and human mortality, Truby et al. propose, for example, that Bitcoin's attributed annual emissions will 'produce emissions responsible for around 19,000 future [CO2-related] deaths' (2022). Regardless of these concerns, and the emergence of some alternatives to energy-intensive proof-of-work blockchain protocols,[54] to date most developers have resisted switching to more sustainable alternatives (Truby et al. 2022), refusing to accept responsibility:

> *To make an NFT, you have to "mint it"- register it on the blockchain. Minting an NFT takes energy, but only abstractly- it gets bundled up into lots of other transactions which take energy to solve as a block, an aggregation scheme which has allowed the NFT market to deny culpability.'*
>
> (Pipkin 2021)

There has been some progress however. A number of networks (notably Ethereum) have changed their protocols in an effort to become more sustainable which, as Truby et al. note, is 'a sign of progress resulting partially from a combination of the social pressure from the environmentally aware NFT art market, the need to lower energy costs and the looming threats of proof-of-work targeted policy intervention' (2022: 2). Policy intervention may well address these practices in future, requiring them to become more sustainable by design. The recently published draft of the EU Markets in Crypto Assets Regulation sets out the need for crypto-asset white papers that give information 'on principal adverse environmental and climate related impact of the consensus mechanism used to issue the crypto-asset' (EU 2022). While the new regulation excludes NFTs (in principle at least), it is indicative of the importance of green digital credentials. It is also indicative of the paths other countries, including the UK, might take in relation to regulating NFTs and their environmental impacts.

[53] See for example the work of Museums for Climate Action https://www.museumsforclimateaction.org/mobilise/toolbox.

[54] Proof of Work refers to the need for mining on the blockchain to be purposefully energy-intensive and difficult such that it can ensure its robustness.

There are a number of ways in which ambitions for greener blockchain practices can be achieved; through carbon reductions, avoidances or removals for example (Gambill 2021).[55] Gambill (2021) offers a helpful account of how a company like Nori can enable carbon removal, and some artists (most notably perhaps Mike Winkelmann, the artist Beeple) have talked about their ambitions to offset or neutralise their art's carbon footprint through, for example, investing in conservation, renewables or green technologies (Calma 2021, see also Allison 2021). Other approaches include Environmentally Smart Contracts that include an environmental tax (Weijers et al. 2021), building an additional second layer on top of the blockchain so that more activity can happen off-chain, or establishing the use of clean air/renewables as sources of power underpinning mining of cryptocurrencies - which are sedimented into these approaches - in the first instance (Calma 2021; Rennie 2021). Lazy minting is one of the most effective strategies – the marketplace allows artists to showcase their artwork off-chain and only mints it once a collector expresses an interest (for more on Green NFTs, see Bailey 2021b).

As awareness about crypto art's emissions increases, artists may opt only to support those marketplaces underpinned by cleaner cryptocurrencies, which could provide the impetus needed to make the sector more sustainable (Calma 2021), or perhaps even underscore a re-setting of the terms of trade in future. The Whitworth Gallery has chosen the Tezos network for its *The Ancient of Days* NFT project as it claims to consume two millions times less energy than other cryptocurrencies like Bitcoin or Ethereum.[56] The reason is that rather than using proof of work, it uses a proof of stake blockchain, which consumes much less energy and is more environmentally friendly Platt et al. 2021). The CleanNFT community uses platforms based on proof of stake cryptocurrencies (see for example the objkt NFT marketplace), but there are those who see such approaches as forms of 'greenwashing' (Juarez 2021). Proof of stake has, however, another set of issues, mainly that it is a less distributed protocol, that it rewards users who already have a large amount of cryptocurrency (which they need to act as validators), and is less secure than 'proof of work' (Castor 2022). The inequalities built into a system that 'rewards early adopters and those with existing wealth' are also a climate problem – 'climate justice *is* social justice' (Pipkin 2021). As it is still used by fewer cryptocurrencies (there are technical issues but also a pushback from miners behind the slow adoption by other blockchain platforms), scalability also remains an issue that will surely affect its perceived 'green' credentials.

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[55] '...Not all offsets are the same. Reductions are projects that *produce fewer future* emissions and Avoidances are projects that entirely avoid *future* emissions. Removals, however, are projects that actually pull CO2 back out of the atmosphere and sequester it safely in the earth' (Gambill 2021).

[56] Ethereum switched to a proof of stake mechanism in September 2022.

These concerns can be seen within the broader context of energy consumption of the internet, including data centres and servers. Not only are transactions taxing to the environment, but so is the storage of NFTs (or the files that they point to). In the next section we reflect on some of the main issues in relation to the preservation of crypto art, as well as on the opportunities and challenges that NFTs present for cultural collections and archives.

### 3.5 Collections, storage and archives

One of the main claims of NFTs is that they represent an immutable proof of ownership and provenance. But while the code on the blockchain might be permanent, there are concerns that the same cannot be said of the tokenized content that the NFT points to. The digital file is often stored elsewhere on a local or cloud-based server that is accessed via the hyperlink included in the NFT.

Critics warn that there is the risk of 'link rot' - that is, that the url will no longer point 'to its target because it is no longer available through the corresponding hosting service' (Kastrenakes 2021; Idelberger and Mezei 2022). The relative instability of digital formats can ultimately affect the preservation of crypto art, even when stored and shared on decentralised and distributed networks like the peer-to-peer InterPlanetary File Storage system (IPFS).[57] As noted in making a case for archiving online media more broadly, the fact that the files are on the internet does not mean that they will not eventually disappear (Rees 2020). A case in point is, for example, the loss of all music uploaded to Myspace between 2003 and 2015 due to its files being corrupted during a server migration (Porter 2019, Rees 2020).

While in most cases, this 'link rot' will be an unintended outcome, it has also been argued that it could be the result of criminal activity which contrasts with the value proposition of NFTs as mechanisms of crime prevention in the crypto art space (MacKenzie and Bērziņa 2021). There are many instances reported of multiple tokens being minted for the same artwork claiming to be proof of the original, of trademarked images being illegally minted and sold, and of artists surprised to find NFTs of their creations on crypto art marketplaces. Even the marketplace OpenSea announced that more than 80% of their free minted NFTs were 'plagiarised works, phoney collections, and spam' (@OpenSea tweet cited in Singh 2022). In their study on the 'criminal lives' of NFTs, MacKenzie and Bērziņa (2021) argue that a 'less corruptible link between the token, the artist and the original artwork would be required to fulfil [the] promise' of crime prevention in the crypto art market.

[57] In order for the file to be stored on the IPFS, someone has to pay for it. If the marketplace goes bust, the file will disappear (Bailey 2021d).

Another issue that arises is whether the permanent and immutable character of the entries in the blockchain (and, arguably, the digital files they point to) is as positive as NFT (and cryptocurrency, DeFi and DAO) proponents claim.[58] There might be legitimate reasons why certain images need to be taken down, from harmful and illegal content to violations of copyright law (Guadamuz 2021). The process of 'burning' NFTs is a partial response to these concerns. The term refers to different methods of reversing the validity of an NFT, whether by invalidating any future transaction on the blockchain, by for example moving the NFT to a 'rubbish address' that's void and leaves the NFT un-transferable, or by changing or deleting the digital file that the hyperlink points to so that the token is still valid but not the artwork. Again, these processes can be used for both 'legitimate' purposes or otherwise. The fact that creators can limit or change the rights allocated to the NFT buyer via changes to the smart contract is also a case in point of the ambivalence of the technology and its uses.[59]

In the GLAM context (galleries, libraries, archives, and museums), there are advantages to using blockchain technology in relation to storing, preserving and managing metadata. Aside from improving 'attribution for digitised or born-digital objects', as a 'publicly accessible repository of data, the blockchain is a form of metadata preservation' that means that if the 'institution's record is destroyed, there are multiple trusted copies in the blockchain network that can be accessed to restore the institution's copy' – although 'long-term uncertainty' about the technology is still an important consideration (Quirion 2021: 11). There is also the potential for blockchain projects to be tools for building trust, facilitating, for example, 'collaboration between marginalized communities and archival institutions' (Quirion 2021: 12). Liddell's work with National Museum Liverpool (NML) explores the distinct and alternative forms of value that arise when using NFTs to forge 'relations and connections between people, objects, and the museum' (2021a: 231).

Opportunities arising from the financialization possibilities associated with NFTs include the option to use the sale of 3D models of museums' collections in order to subsidise the expensive process of digitising collections (Bolton and Cora 2021). Similarly, NFTs are being used to preserve cultural heritage (Vacchio et al. 2022). Through a blockchain-based cultural property protection system called Heirloom, foundations can receive funding to protect cultural assets, which are digitised in turn, allowing supporters to earn their share of protection and maintenance rights (Ertürk et al. 2021).

The possibilities seem endless, but it is less clear at this stage which of these many futures is probable.[60] Practitioners in the sector suggest museums and galleries

[58] Another issue is whether this immutability is technically correct (Zeilinger, 2018).
[59] Whether these could be legally enforced and how, it is another matter.
[60] For uses of blockchain in the curatorial process, see Veiga (2021).

consider whether NFTs might offer (or not) opportunities to institutions and their stakeholders (Liddell 2021b, Summerfield 2022). Some of the challenges include the lack of capacity or expertise in this field among museum professionals (Mittendorf and Sean Stein Smit 2021), or the need to ensure that using NFTs responds to institutional values and missions (Merritt 2022, Summerfield 2022), as museums are often regulated by public policy (Jung 2022).

In any case, as Quirion rightly argues (2021: 12), despite all the uncertainty and challenges posed by NFTs and blockchain technology, it is important for those working in the GLAM sector and in LIS (library and information science) to participate in ensuing debates, not least of all to help set standards and plan for the need to archive the blockchain itself. As Quirion notes:

> *With the volume of born-digital objects created each second, LIS professionals can use blockchain as a storytelling opportunity, capturing the intent of the object at the time of creation, and locking that in place*.
>
> (Quirion 2021: 12)

This they will need to do whilst negotiating possible vested interests and, in many cases, a poor understanding of the technology. The possibilities of the technology go beyond digital-born objects however, and the interplay between the materialities of digital and physical objects is the focus of the next section.

### 3.6 Hybridity

During the Covid-19 pandemic there was a notable rise of interest in the notion of hybridity, and how it could inform the practices of cultural institutions around the globe (Galani and Kidd 2020, Noehrer et al. 2021, Kidd and Nieto McAvoy 2022). Hybridity was a particularly seductive notion in the context of the blurring of physical and digital experiences which we encountered at that time, and the fluidity and in-betweenness which characterised many of our everyday interactions. Going forward, there is interest in exploring further what the 'diverse material implications of digital engagement might be' (Galani and Kidd 2020) for both professional practice and research enquiry.

Crypto art and the NFTs that support its circulation and storage, might be understood as digital assets, yet they have material realities and implications that speak to their hybridity also.[61] This is most readily and starkly exemplified in the discussion about environmental concerns in section 3.4, which highlights well the physicality of crypto art's impacts. But there are other ways in which these

[61] Chandra (2022) suggests that NFTs offer four main types of affordances: virtual assets; hybrid assets; as a physical/virtual interface; and as a metaverse asset.

material realities are being explored, often very playfully. Autoglyphs, for example, have explored the blurred boundary between physicality and digitality in relation to NFTs. Autoglyphs are generative artworks designed specifically within the storage limitations of the blockchain and shaped by its logics; the code generating them is 'small and efficient', and the actual output only uses a small amount of data making them easier to generate and store on the blockchain. They live entirely on the blockchain, being created, distributed and owned therein. Notwithstanding that, the artists Matt Hall and John Watkinson have used a pen plotter to re-create some of the works physically in an echo of the generative art produced in the 1960s and 70s (Bailey 2019). Creative interactions between physical and digital outputs have become a hallmark of this space, as we observed in relation to Damien Hirst's *The Currency*.[62]

Another example, the Seattle NFT Museum, is 'designed to bring together artists, creators, collectors, and the broader blockchain community'. In the museum, art which is stored on the blockchain is displayed on loan, and there is a series of in-person programmes and activities visitors can take part in. Each installation is displayed with a link to its metadata, and many are featured on high fidelity screens reminiscent of traditional gallery hanging within the white cube. In this context the hybridity of crypto art is simultaneously understated and underscored. Such a setup is likely to be productive as a means for onboarding potential audiences for crypto art, and for normalising its presence within debates about art also.[63]
There is potential here then for experimentation beyond crypto art's current 'relatively traditional' manifestations, as Franceschet et al. (2021: 404) point out:

> *The artist Sergio Scalet of the artistic duo Hackatao highlights how crypto art allows them to move across physical and digital spaces with a speed and freedom of experimentation previously unknown. The space for exploration remains quite wide if we consider that, until now, crypto artists have been focusing on the relatively traditional format of rectangular images and GIFs… Crypto art might be, in this respect, just the beginning of a whole new way to create, exchange and experience art in the digital space.*

[62] In an NFT Museum hosted on Steam owners of crypto art can load a copy of their NFT into a virtual museum which is designed in the model of a traditional display space, and suggestive of its physicality. It would seem that at least some collectors of crypto art yearn for the embodied and emplaced experience of exhibition, even if through a digital surrogate.
[63] *Proof of Art: A Short History of NFTs from the Beginning of Digital Art to the Metaverse* claims to be the world's first museum exhibition on the history of NFTs and digital art, with both an offline display (and catalogue) and an online space on Cryptovoxels, a blockchain-based virtual world (Weidinger, 2021).

The interaction between digital and physical things or practices in the orbit of crypto art is worthy of further attention and analysis, and will provide fertile ground for experimentation and creativity in the short to medium term.

Beyond their use for crypto art, NFTs can of course be issued for physical things which is another expression of their hybridity. Some critics have doubts about the viability and usefulness of this however, unless it is used to clarify ownership of items that are too large to be sent to their owners (Kaczynski and Kominers 2021). In some infamous cases, the minting and selling of the NFT of a physical artwork has been framed as an act of transfer of value from the material object to the code on the blockchain, as happened with BurntBanksy when the original piece was burnt after the NFT was sold for four times its valuation. It is in fact the destruction of the artwork that gives the NFT its increased financial value (Friedman and Hawkes 2021, see also debates about Hirst's *The Currency*): 'By physically destroying the Banksy print, the purchasers of the NFT attacked the Benjaminian "aura" that dwelt within the original work of art' (Friedman and Hawkes 2021).[64] We have already explored other examples of conflicted relationships between the physical object and its NFT, like the digital decolonization projects of Looty and CATPC. Not limited to the blockchain, these all sit alongside other initiatives to rethink, challenge and reform the art market and institutions.

[64] For other explorations of NFTs through Walter Benjamin's essay 'The Work of Art in the Age of Mechanical Reproduction' (1935), see Beller (2021) and Whyman (2021).

# Conclusions

In this paper we have explored a series of emergent debates and tensions around the more expansive uptake and circulation of crypto art within and adjacent to cultural institutions. We have demonstrated that the use of NFTs to enable this practice is motivated by a number of things, which very often have little or nothing to do with the arts, and that some of the panic surrounding NFTs predates blockchain technology, mirroring and connecting with existing, analogue and historic modes of artistic creation, distribution and consumption. But we have also demonstrated that crypto art has other potentials once debates about it are taken beyond talk about speculative financial bubbles and the world of brands and collectables, and into a more experimental and research-oriented space. These potentials are perhaps best demonstrated in the Looty and Whitworth Gallery projects described above. Here we see NFTs being used to challenge and open up questions about ownership in the digital age, centring debates about institutional purpose, rights and social justice. Finances are important of course, and compensation for artistic work is clearly legitimate, but there are other ways to embrace these technologies that can support creatives and institutions.

Looking forward, it is clear that further research is needed into crypto art and allied issues, such as AI (Semeler et al. 2021, Suvajdzic et al. 2021) To borrow from and extend a suite of potential research questions presented by Hofstetter et al. (2022) and Vasan et al. (2022), we propose that further investigation should include asking:

1. How does owning a purely digital product or a digital companion to a physical product influence how audiences think and talk about ownership, uniqueness, and value?
2. How does this differ where multiple crypto-assets are assigned to an edition of an artwork?
3. How important is the product itself, the originator, and the history of ownership?
4. How does the decentralised nature of crypto art impact major cultural brands and perceptions of their value?
5. What factors drive perceived value of and willingness to pay for crypto art?
6. How might the introduction of royalties from resales change creators' incentives and behaviours?
7. What are the implications for artists and other stakeholders of using economically motivated IP regulations?
8. How do the community of collectors interact, and how will artists' careers be shaped as a result?
9. How could communities of collectors interact in ways that might benefit them and the artists they support individually and collectively?

10. What motivations compel the demand side of the market – are people investing, collecting, sponsoring, experimenting, or consuming (or a mixture of all of these)?
11. What role can NFTs play in constructing digital or physical selves or brands?
12. What further insights or interventions can NFTs support in debates about repatriation, decolonisation and digital/data extractivism?
13. How will debates about responsibility, inclusivity, sustainability and uses of data impact uptake of crypto approaches by artists, audiences and institutions?
14. How does the socially, politically and culturally situated nature of blockchains, and of specific platforms, shape their uses and debates about them?

There is an opportunity here for cultural institutions to impact decisions being made about what these systems look like going forward, and to imagine other futures for them also. Regardless of individual and professional positions on these developments, they are likely here to stay, or at least, represent a first step towards new ways of thinking about ownership, value, purpose and permanence in the future.

## Disclaimer

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