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The many complexities of video games: A narrative review

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Abstract: Complexity has been discussed in video game studies across a diverse range of disciplines and perspectives. This narrative review examines how different entanglements of video games and complexity have been analysed in the academic literature, focusing on works connected to narrative, game rules, game design structures, and the simulation and representation of societal issues. By synthesizing existing research, the review identifies themes, methodological approaches, and theoretical frameworks that have shaped academic discourses on video games and complexity. Drawing on these findings, I also highlight gaps in the literature and suggest directions for future research.

Keywords: video games; complexity; narrative review; interactive digital narratives

1 Introduction

In the relatively short life of video game studies as an academic field, the notion of complexity has appeared several times. In one way or another, complexity and video games have found several entanglements, spanning from the algorithmic and combinatorial complexity of game rules to their ability to represent complex societal issues.

Being such a ubiquitous and dense concept, complexity takes various forms and meanings depending on the specific discipline and perspective from which one is looking at it. At the same time, video games, too, lend themselves well to many different analytical angles, therefore allowing manifold notions like complexity to be often intertwined in their study. To delineate the main ways in which video games and complexity have been mutually illuminating, this article presents a narrative review of the various entanglements of the polysemantic concept of complexity with the videoludic medium from a video game studies perspective. Rather than pursuing

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exhaustive coverage, this narrative review focuses on works that have significantly contributed to theoretical frameworks, introduced key concepts, or represented important or innovative disciplinary perspectives on how complexity and video games mutually illuminate one another.

The reasons for choosing the methodology of the narrative must be seen in the unsystematic nature of the topic to be surveyed. On the one hand, as the concept of complexity presents exceptionally high semantic variability and carries considerably different meanings in the various disciplines touched, the systematisation required by a systematic literature review would result in a loss of essential nuances and therefore in a flattening of an otherwise variegated landscape. On the other hand, the concept of complexity clearly appears only in a handful of cases, and it is otherwise hinted at, assumed, or presupposed in several others, sometimes even indirectly. For instance, the concept of emergence is closely related to the notion of complex system, but it is often mentioned in isolation and without reference to complexity itself, and a systematic approach to literature scoping could easily miss these transversal studies. Furthermore, as relevant scholarship appears in various fields of academic inquiry including (but not limited to) video game studies, narratology, computer science, systems theory, mathematics, sociology, epidemiology, semiotics, and philosophy, a systematic literature review would stumble upon its own limitations due to the number of publications that would need to be analysed: expectably in the order of the thousands, and spanning extremely diverse research fields. Unlike systematic literature reviews, narrative reviews provide a more flexible and interpretive approach to surveying a research topic, and assume as a starting point the knowledge and expertise of the author (Baumeister and Leary 1997; Ferrari 2015). The current narrative review can also be seen as the basis from which more systematic reviews could be conducted.

The findings of this narrative review are organized thematically to highlight conceptual clusters and trace how different notions of complexity have been applied to the videoludic medium. This approach allows for a critical examination of complexity as both an analytical lens and an object of study within various strands of scholarship. The article discusses, in order: game complexity, the simulation of complexity and its representation through video games; videoludic narrative complexity, the complexity of the collaboration between games and players in sensemaking; the complex ethical dimension of video games and the emergence (as a feature of complex systems) in video games. Towards the end of the article, I will also provide thoughts on less systematic but still notable investigations of video games and complexity, highlighting underexplored entanglements of the two.

2 Game complexity

Game complexity refers to the variable difficulty of a game expressed in the number of allowed combinations, and can be roughly equated to the number of game positions reachable by following the game rules or, inversely, to the number of possible scenarios the rules can generate. It is customary to consider the game of *Go* the most complex tabletop game, as within the space of 19×19 available squares it is possible to reach up to 10^{178} unique situations (Tromp and Farnebäck 2007). A game of *Chess*, by contrast, presents between 10^{43} and 10^{120} unique legal combinations (Shannon 1950), therefore being immensely less complex under these terms.

Within video games studies, the notion of game complexity as a purely combinatorial index has found scarce interest so far. The very nature of many video games impedes or prevents obtaining such a measurement. If one considers a generic video game with an explorable 3D world, it is very difficult if not impossible to calculate exactly the number of available positions the "pawns" can take. While it would be possible to argue that not all variables matter in such a calculation, and thus the actual number of positions would be much lower than the ones available in actuality, the exercise of defining positions of value to find a reasonable game complexity index remains a logical and mathematical enterprise that is quite hermeneutically unproductive. Moreover, temporal mechanics (the ability to pause, save, reload, and replay) add heterodiegetic layers of strategic and performative complexity (Hanson 2018) that further complicate the calculation. Nonetheless, for specific genres of video games (e.g., card-based video games) and for certain aspects of others (e.g., the power-ups available in a *roguelite* video game) the notion of game complexity could provide insightful data, and even be a predictor of players' appreciation and therefore of the game's success. No such analysis has been systematically conducted to date, but games like the recent *Balatro* (LocalThunk 2024) could lend well to such an inquiry.

Connected to game complexity is also the notion of algorithmic complexity, which concerns the computational resources required to effectively play a game, and which has been described as a mainly mathematical problem (Lafond 2018). In video games, the algorithmic perspective has proven particularly relevant for the design of artificial intelligences that can effectively operate under real-time constraints and limited computational budgets (Yannakakis and Togelius 2018). However, the broader implications of algorithmic complexity for game design remain underexplored in video game studies. Empirical studies of algorithmic complexity and players' mental engagement could provide valuable insight into cognitive aspects of game enjoyment.

3 Simulated complexity

Simulated complexity refers to the computational representation of intricate, interconnected physical, social, or cultural systems that approximate the dynamics of real or imagined worlds. Simulating complexity therefore describes an axiomatic approximation to the nearest possible similarity (Ciccoricco and Large 2019; Perkis et al. 2023; Wardaszko 2018). The simulation of complexity has traditionally been one of the main intents of video games: ever since the very birth of the medium, one of the most felt needs of game designers has very often been to provide the most accurate simulation possible. This is immediately evident in video games dedicated to various sports (car racing, soccer, basketball, etc.), where the complexity of interest is that of the real world, but it is not less visible in other genres of games (e.g., open-world, adventure games, like *Red Dead Redemption II* (Rockstar Studios 2018)).

The academic discourse on the simulation of complex real-life scenarios has evolved together with the exponential increase in the computing power available to video games, and with the technological advancements introduced in the medium over the years. The resulting innovations are visible not only in the photorealism achieved in newer games, but also in the complex physics engines that allow extreme verisimilitude. The simulation of complex physics has found its employment (and has been greatly appreciated by players) not only in realism-seeking games, but also in non-realistic videoludic worlds like *The Legend of Zelda: Tears of the Kingdom* (Nintendo EPD 2023). This shows that the *nearest possible similarity* of simulating complexity does not need to refer to all aspects of reality, as a simulation is not a model *of*, but rather a model *for* (Klabbers 2006): in our case, for a similar enough representation of a videoludic world.

The simulation models developed for video games, and more specifically the techniques for their development, have found a number of alternative employments. For instance, *Space Fortress*, a game simulating various complex world scenarios, was famously utilized already in the 1980s to study learning from a cognitive psychological point of view (Donchin 1995). Another famous case of video games as a research tool through the simulation of complex scenarios is the online puzzle game *Foldit*, through which biochemists were able to discover folding patterns for proteins, significantly advancing biochemical research in medicine and other related disciplines (Cooper et al. 2010).

The videoludic simulations of complexity have found applications also in the form of serious games, i.e., games created for education, teaching, advocacy, or any other non-entertainment purpose (Papagiannakis 2024). In these cases, of particular importance has been the procedurality of video games, that is, their ability to execute a series of rules (Murray 2017 [1997]). What has been famously defined as the

procedural rhetoric of video games (Bogost 2007) is arguably the affordance that allows them to be so apt and effective simulations of complexity. Notorious examples like *The McDonalds' Video Game* (Molleindustria 2019 [2005]) or *September 12*th (Frasca 2003) artfully make use of this procedurality to make strong claims about the many-fronts flaws of fast-food chains,[1] or the US Global War on Terror post 9/11,[2] respectively.

The academic discourse on simulated complexity has had a new boost after the recent release of new generation generative artificial intelligence tools that made possible previously unrealisable endeavours like the seamless simulation of complex societal systems (Park et al. 2023). These recent advancements certainly forebode a new approach for the simulation of complexity, the results of which will be thrilling to witness.

As video games are considered particularly apt in simulating complexity, these very same affordances could find (mis-)applications for propagandistic purposes or for spreading disinformation. For instance, a video game like *Papers, Please* (3909 LLC 2013), that simulates the complex situation of a border control police member, could quite easily be manipulated to foster racism and nationalism, and to drive the players towards a specific political ideology. These same concerns can apply to a wide range of other videoludic products, and researchers have indeed detected unethical uses of the procedural rhetoric of video games for quite a long time now (e.g., Robinson 2012). As a countermeasure, some ethical frameworks for game design have been proposed (Fisher and Schoemann 2018; Sicart 2009; Sukhov 2019), and preventing as much as possible the biased use of the affordances of the medium is a growing concern in the field. I will return to the ethical complexity of video games in the upcoming pages.

4 Represented complexity

A slightly different perspective, not unconnected to that of the simulation of complexity, is the *representation* of complexity.[3] I intend here "representation" in the semiotic sense, as the process of linking "'things', concepts and signs" (Hall 1997: 19). Representing complexity therefore concerns the semiotic challenge of making visible the interconnected factors, competing perspectives, and multiple interpretations

1 By exposing the profit-oriented ideology disregarding consumers' safety, environmental protection, and animals' wellbeing.

2 By showing the twisted logic of treating civilians' death as collateral damage.

3 A simulation is a representation, but a representation is not necessarily a simulation. While simulation models system dynamics computationally, representation focuses on meaningful accessibility: making complexity understandable rather than merely operational.

that constitute complex phenomena (sometimes also referred to as "wicked problems"), with the ultimate goal of conveying interconnectedness and multifaceted understanding and rendering cognitively graspable what is otherwise overwhelming in its multiplicity. In this case, the complexity in question refers not only to various macro-scale complex systems (social, economic, climatic, etc.) in general, but also to the interconnectedness of factors that shape or play a role in much more micro-scale phenomena, like a specific pirate attack off the Somali coasts,[4] or the meaning of a specific neolithic statue,[5] even down to more personal complexities like anxiety disorder,[6] grief,[7] or the experience of queerness.[8] It should be noted that this is not a simple task, and several concerns often appear in the related academic discussions (e.g., on the role of empathy in these representations; see Rouse 2019; Ruberg 2020).

The question on how to effectively represent complexity through the digital medium has been variously discussed since almost the beginning of the history of video games studies. Already in 1997 Murray has been discussing affordances of interactive digital narratives for representing complexity (Murray 2017 [1997]). Such discourses have been progressing since, closely following each technological advancement introduced in the field (3D graphics, open authoring platforms, accessible mobile technologies, photorealism, virtual and augmented reality, generative artificial intelligence). Following this perspective on the digital medium and its relationship with narrative, the field of interactive digital narrative (IDN) studies established itself as closely related to video games studies, but more focused on narratives and on the narratological qualities of (not only) video games (see Koenitz 2023 for a more thorough history of the field). Scrutinising the proceedings of the International Conference on Interactive Digital Storytelling, from the year of its foundation in 2008 until the latest edition in 2024, an undeniable upward trend is visible in the academic interest on how to represent complexity in narrative-heavy video games and IDNs, with a spike after the Covid-19 pandemic outbreak. Furthermore, the existence of various networks of researchers and practitioners focusing on the topic,[9] demonstrates that the question of how to accessibly represent complexity through narrative-heavy video games and IDNs is of live and wide interest in the field.

4 See the interactive documentary *Last Hijack – Interactive* (Pallotta et al. 2014).

5 Cf. Barbara (2020).

6 See *Adventures with Anxiety* (Nicky Case 2019[2005]).

7 See *That Dragon, Cancer* (Numinous Games 2016[2005]).

8 E.g., *If Found…* (Dreamfeel 2020).

9 See, e.g., the COST Action 18230 – Interactive Narrative Design for Complexity Representation (https://indcor.eu), and various efforts of the Association for Research in Digital Interactive Narratives (https://ardin.online).

The academic debate identifies several affordances of the digital medium for representing complexity. Beyond simulating complex systems, narrative-heavy video games and IDNs make complexity cognitively manageable through the combination of digital properties and narrative capabilities (the latter as identified by Walsh and Stepney 2018; Caracciolo 2021). The most discussed affordances include: 1) empowering users as active participants who can choose between alternative courses of action and observe consequences in a safe environment (Dubbelman et al. 2018; Grace 2025); 2) enabling exploration of multiple perspectives on the same topic (Goud and Lombardo 2022; Sizemore and Zhu 2011); 3) incorporating multimodal content, extensive detail, and live data while adapting to individual audience preferences (van Enschot et al. 2019; Gifreu-Castells 2014; Hanna 2022); and 4) leveraging cognitive strategies that reduce mental effort (Bellini 2025). Additionally, users can replay artifacts to explore alternative "what-if" scenarios (Koenitz 2023), deepening their understanding of represented complexity and developing systemic thinking (Patton 2013), a cognitive approach that favours holistic vision over direct causality (Gallón 2020).

Nonetheless, the research on video games and IDNs representing complexity has highlighted several critical points that require further attention. The lack of empirical studies and of empirical tools to test the effectiveness of these kinds of artifacts is increasingly evident (Roth et al. 2024). As it might be apparent, conveying a complex topic is inherently difficult, and the success of a representation can vary due to an almost unforeseeable number of factors (as I will touch upon more thoroughly below, talking about the complexity of the sensemaking). This is even more true when such representations are aimed not only at making visible the complexity, but rather at being a call for action. Empirical research investigating whether interactive representations are more effective in accessibly representing complex issues has discovered that in fact they might not always be (van Enschot et al. 2023), and that it largely depends on how the individual representation makes use of its expressive language (Roth 2019).

This is connected to a second critical point, that is the need to ensure that the aim of the representation is reached – a concern that is far from being easy to address. In an augmented reality representation on the complex history of a Maltese building, for instance, design choices taken for practical reasons resulted in an inadequate portrayal of the complex cultural heritage site, turning it instead into a social media content generator (see Barbara et al. 2023). Lastly, the ethical concerns raised with regards to the simulation of complexity certainly apply to the representation of complexity in general, and while foundations of ethical frameworks in this direction have already been laid (Koenitz et al. 2022) additional work is surely needed.

A further sidenote to be added is that making complexity cognitively manageable through accessible representations and simulations has the advantage of

reaching further to the general public. Yet, such accessibility should not replace, but rather complement, explicit training in dealing with complexity *per se*. Video games can serve as entry points to complex topics, but critical thinking remains effortful and requires dedicated cultivation – a point other contributions in this special issue explore in depth. Nonetheless, the representation of complexity is a thriving and promising research trend that invites cross-sectorial collaboration and further research.

5 Narrative complexity

It should be immediately noted that the complexity of narratives has found various articulations in the academic literature. To avoid confusion arising from conceptual overlapping, I will cover in this section only the formal complexity of narratives, i.e., what concerns the design of games and specifically narratives. The other meanings of narrative complexity in games examined in the academic discourses feature in the other relationships between video games and complexity discussed here, and they should not be intended as unrelated to these formal qualities.

Narrative (formal) complexity is a recent research paradigm in narratology. In a nutshell, a narrative is formally complex when it defies the established norms,[10] and the principles of simplicity. As narrative complexity resists immediate comprehension, narrative complexity requires audiences to engage in an active interpretive work to construct meaning, and it is for this reason more cognitively stimulating. The analysis of the complexity of narratives has focused particularly on cinema and TV series (see e.g., Hven 2017; Kiss and Willemsen 2017; Mittell 2015), although with notable exceptions (e.g., Grishakova and Poulaki 2019). Only recently have narratologists started to discuss the concept of narrative complexity in relation to video games[11] and, conversely, the game-like nature of narrative complexity.

10 As narrative complexity can arise from unexpected formal organisations, closely following an established norm necessarily entails some level of expectedness (as implied by the very meaning of "norm"), thus lowering the overall complexity.

11 Ryan (2006) has systematically explored how interactive narrative structures complicate traditional narratological frameworks. These interactive architectures enable formal organisations unavailable to linear media like branching paths that players actively traverse or embedded narratives that players must piece together through exploration. Ryan ultimately stresses the difficulty of fully reconciling narrativity and interactivity, arguing that strong narrative often requires limiting player agency (the so-called "narrative paradox"). However, while providing foundational frameworks that subsequent scholars have built upon to theorise narrative complexity in games, Ryan's work does not explicitly engage with complexity theory as such.

A number of narrative devices are usually employed to make narratives formally complex. While these devices are generally shared between different media, differences in their application and mode of appearance necessarily exist. The devices discussed in the relevant literature (e.g., by Arnavas and Bellini 2023; Bordwell 2023; Hven 2017; Kiss and Willemsen 2017; Mittell 2015; and more specifically for games by Barkman 2024; Bellini 2025; Caracciolo 2024) include non-linear temporality, disrupted cause-effect chains, unreliability in the narrative, presence of cruxes (Abbott 2008), of multiple lines, branches, perspectives, or embedded narratives, breaking of the ontological boundaries of narratives through metalepsis, absence of narrative closure, fragmentation, spatialisation, or serialisation of the narrative, use of non-conventional structures and tropes, or required employment of different and changing interpretive frames through intermediality. A caveat is, however, that the complexity of a narrative is always relative and never absolute, and it is therefore possible to describe a narrative only as "more complex" or "less complex" rather than "absolutely complex" or "absolutely simple."

The literature on narrative complexity concludes that this form of complexity is ultimately visible in the response of its audience (Grishakova and Poulaki 2019; Kiss and Willemsen 2018). It is possible to treat the appearance of confusion, cognitive dissonance, or other epistemic emotions as the symptomatic sign of narrative complexity. This is not to say that all confusing narratives are complex (as a narrative can be confusing simply because it is badly structured or designed), but rather that a well-formed complex narrative elicits these cognitive states in its audience (also) through the mentioned devices, as it has been empirically established (Bellini 2021).

Yet, narrative complexity is not only confusing but also engrossing, and it can greatly enhance the appreciation of a story and the audience satisfaction with it (see empirical proof by Roth and Koenitz 2019). Several reasons for this have been discussed for movies (Kiss and Willemsen 2018) and video games (Barkman 2024; Bellini 2025), but one of the most interesting (at least for the scope of this survey) is that these narratives present a certain game logic and can be said to gamify narrative comprehension (Willemsen 2025). By resisting immediate understanding, complex narratives elicit hermeneutic play (Kiss and Willemsen 2018), i.e., a sort of continuous cognitive mechanisms of probing hypotheses regarding the continuation and meaning of the narrative that is constantly checked against the actuality of the narrative at hand. Sometimes these hermeneutic games are carried out collaboratively by groups of players/fans (Bordwell 2023; Caracciolo 2024) in complex ways, as discussed below. Hermeneutic play is pleasurable not only because it permits the use of our cognitive capacity, but also because it empowers audiences to hold their own interpretation of the narrative, since complex narratives elude a single, definite understanding.

As a quite elusive concept in itself, and one based in cognitive approaches to the study of narrative, narrative complexity is far from being exhausted as a research direction. For instance, empirical data on the cognitive mechanisms at play when an audience member is experiencing a complex narrative has been collected and analysed (Fayn et al. 2022; Willemsen 2025), but not in relation to video games, for which only deferred data is available (Bellini 2021). Additional research can also further illuminate our understanding of narrative cognition. Moreover, being narrative complexity the deviation from established norms, and due to the increasing popularity of ever more complex narratives, the norms against which to evaluate the complexity of a narrative are in constant evolution, and potentially present considerable differences across cultures. All of this calls for additional, comparative studies. Personal differences are also clearly detectable (Willemsen et al. 2022) and analysing them further might provide additional insights.

6 Sensemaking complexity

Sensemaking complexity refers to the way video games and players collaboratively generate meaning as a complex system – one characterized by non-hierarchical, dynamic interactions between multiple components that give rise to emergent properties. Unlike other forms of complexity discussed here, this complexity is not an external property encoded in the artifact (as with simulated or represented complexity) nor a deliberate design choice (as with narrative complexity), but it rather describes the intrinsic functioning of the medium's semiosis.

The idea of looking at the way in which games and players collaboratively generate meaning as a system has been variously discussed by several researchers. A first model in five parts has been proposed by Sutton-Smith in *Toys as Culture* (1986), and over the years other followed: the model of player experience by Salen and Zimmerman (2004: Chapter 23), the IMP framework (Elson et al. 2014a, 2014b), the ludonarrative model (Toh 2018), the model of the aspects of human activity and agency in gameplay (Rambusch 2016), the MDA framework (Hunicke et al. 2004) and its further refinement in the DDE framework (Walk et al. 2017), or the SPP model (Koenitz 2023). These models, while understanding the video game sensemaking as a system, did not acknowledge its complexity.

Advancing further Lindley's concept of *gameplay gestalt* (2002), Karhulahti's double hermeneutic (2012) and Knoller's hermeneutic spiral (2019), the sensemaking of video games can be regarded as emerging from the interaction and constant negotiation of sense between the games and the players exactly as a complex system (Bellini 2025). The process of meaning-making in video games sprouts from the constant negotiation between game and player, neither fully determined by the

designer's intentions nor solely constructed by the player's interpretation (Nguyen 2020). The notion of complex system can therefore be used to explain in a holistic way how video games and players collaboratively create sense, in a framework that can accommodate and encompass the vast majority of currently existing literature on the semiotics of video games without being reduced to it.

As it can be inferred, the line of research on sensemaking complexity has a scattered history and has developed unsystematically in the field of video game studies, but it is a fresh and holistic take that promises to shine additional light how video games create meaning, on how their expressive language works, and on the functioning of the human mind when dealing with these artifacts. The first propositions of this encounter of games and complexity leave ample room for expansion, reformulation and critique. Furthermore, while first empirical studies have been presented (Bellini 2025), additional research on the functioning of the complex video games sensemaking are yet another open field for inquiry.

7 Ethical complexity

Ethical complexity in video games refers to the multi-dimensional moral entanglements that arise from the interactive medium's capacity to implicate players in ethical decision-making. Unlike passive media where audiences witness moral scenarios, video games require players to enact choices and experience their consequences, creating a system where personal values, design affordances, and gameplay contexts interact in ways that resist simple ethical resolution. This complexity operates across several interconnected dimensions: the design and implementation of moral encounters by developers, the perception and engagement with ethical content by players, the labour ethics of the production industry itself, and the broader cultural dynamics of gaming communities (Hanussek 2023; Zagal 2009).

At the most superficial level, video games are traditionally uninterested in ethics or even plainly unethical, and focused on violence and masculine dominance (Ferguson 2008; Kümpel and Haas 2016). While a number of games have indeed based their advertising campaign (and to some extent their fortune) on these ideas, this is often not the case. The participatory nature of video games creates a space for moral experimentation and ethical exploration that extends beyond value affirmation and allows critical reflection (Sicart 2013).

The interactivity of video games has been often harnessed to provide players with significant ludic and dramatic agency in morally difficult moments. This participatory property of the medium makes it so that players can not only imaginatively explore the moral choices presented to them (as per any kind of fiction, also

non interactive), but they can also actively respond to it, side with one of the parties, and be responsible for the outcomes of their actions (Sicart 2009, 2013; Zagal 2009). This phenomenon can make the moral decision more pressing and personal, and it means that players bring into play their own ethical values and stance, and no longer just witness the moral (or immoral) choices of a third party. This is true both when players project their own personal values on the game (what Švelch 2010 calls "honest play"), and when they adopt in-game stances that deliberately explore alternative ethical positions ("role-playing" in the terminology proposed by Švelch 2010): even if players decide to "play along" with a character moral alignment in role-playing, their "moral engine" (Mattingly et al. 2017: 1) is not annulled but willingly suspended in a way similar to their disbelief (Coleridge 1817). Nguyen (2020) similarly argues that games allow players to temporarily inhabit different motivational structures and value systems through gameplay, following design-dictated frameworks but without being subjugated to them. Indeed, experimental research has documented that players experience actual guilt even when role-playing immoral actions in video games, and this guilt leads to significant increase in moral sensitivity (Grizzard et al. 2014). Beyond controlled experiments, organic player accounts also reveal strong ethical response. For instance, the widely discussed discomfort surrounding *Middle-earth: Shadow of War* (Monolith Productions 2017) in relation to a mechanics of dominating and controlling orc characters that has been deemed a form of virtual slavery (Gault 2017). Such instances demonstrate how interactivity transforms moral scenarios from observed narratives into personally enacted choices, making ethical consequences viscerally present in ways that can generate genuine moral reflection or even refusal to continue playing. The perception of morality by players and how it affects moral engagement has received considerable interest (see, e.g., Groen et al. 2020; Zagal 2012), but a stronger connection to theory of complexity can provide interesting insight into the many factors that impact ethical decision-making.

Contrarily to the common tenet of games being inherently unethical, the moral aspect in contemporary production finds space even in not immediately ethically charged design choices and game mechanics. For instance, Caracciolo argues that the poison swamps appearing in many of the games produced by the Japanese house FromSoftware are an allegory of the affective and ethical difficulty of these games, representing "the way in which players are entangled in a world that raises numerous ethical questions and offers few answers" (2024: 102). In these cases, various layers of meanings complexify the ethical aspects of the video game in ways that are just as subtle as they are powerful, complexifying also the conventions of the respective genre in the process.

Responding to the need for a pragmatic approach to evaluating (overt or covert) moral content in video games, Hanussek (2023) proposes the concept of "moral

complexity," defined as the degree to which a game offers alternatives and/or commentary to violence and deceit as gameplay options. Games with low moral complexity offer no alternatives to violent or deceitful actions (such as traditional first-person shooters, where violence is the only means of progression), while games with high moral complexity provide non-violent solutions and critical commentary on violent actions. By treating morality as a game design element that can be quantified and analysed, Hanussek provides a tool for identifying and discussing how games operationalise ethical choices through their mechanical structures, or how they fail to do so.

In addition to the represented morality, scholars have also focused on the harassment campaigns against feminism, diversity, and progressivism in video games, for instance during the infamous case of the so-called "Gamergate" (for a recapitulation, see Hanson 2022). These phenomena have not been systematically connected to complexity yet, but notions of societal and cultural complexity might be extremely beneficial for their analysis. Similarly, the ethics of working conditions in the video game production industry have recently received increased scholarly attention, particularly regarding exploitative production cycles, dubious business practices and discriminatory working climates in the video game production industry (Bulut 2020; Cole and Zammit 2020). However, further research is needed to understand how complex structural factors like corporate culture and gendered labour dynamics shape ethical responsibility within production environments.

For these reasons, the research on the complexity of the ethical dimension of videoludic artifacts appears only at its genesis, notwithstanding the morality of video games has been discussed for a long time already. Detecting layers of meaning, nuances, and counter-grain themes in videoludic representation (and in their complex sensemaking) is a line of inquiry that promises to bear ripe fruits.

8 Complexity and emergence

The concept of emergence is strictly related with that of complexity. Emergence refers to the phenomenon in which macro-level properties of complex systems like clusters, patterns, or macro-scale behaviours, arise from the interactions of simpler constituent elements, without being explicitly encoded at the lower levels of organization. Put differently, emergent properties are those that cannot be entirely predicted or foreseen from the characteristics of individual components. Emergence is ultimately the order germinating out of the apparent chaos of complex systems.

This term often appears in video games studies publications, with slightly different meanings. Probably the first of these meanings in the field (chronologically speaking) is in relation to gameplay. Jesper Juul famously distinguishes between

games of emergence and games of progression, where the latter are games that present a linear, predetermined development, while the former admits much more freedom, being only constrained by a relatively simple set of rules (Juul 2005). This typology has been significantly blurred over the years, and video game genres typically characterised by "progression" have included more and more "emergence" aspects (and, at least partly, also vice versa). Several other theorizations of gameplay emergence have been proposed over the years (e.g., by Soler-Adillon 2019) to discuss the different ways in which the complexity of video games mechanics offer freedoms that are enabled by the ruleset but not entirely (or not at all) foreseeable *a priori*.

In the history of video games, gameplay emergence has played a major role in shaping modern genres conventions. The most famous of these occurrences is found in the 1996 game *Quake* (id Software 1996), where players discovered they could use the explosive force of a rocket launcher to propel themselves to greater heights in the game map (the so-called *rocket jumping*). This mechanic was unintended by developers and emerged due to the complex rules governing the game's physics engine, but it became a fundamental mechanic in competitive *Quake* play, and it greatly influenced the future of the entire FPS genre (Dormans 2014). More extreme examples of emergent gameplay are the exploitation of bugs and glitches, for instance in the phenomenon of *speedrunning* (completing a game or level in the shortest possible time, see Ly and Lee 2024).

In addition to emergence in relation to gameplay aspects, often discussed is also the emergence in narrative. Emergent narratives are undoubtedly connected to emergent gameplay aspects. Games like *The Sims* (Maxis 2000), a quite prototypical game of emergence with relatively simple rules governing the interpersonal relationships of the highly customizable portrayed characters, have been long examined as platforms for emergent narratives (see, e.g., Jenkins 2004; Pearce 2002). Emergent narratives have been discussed also for games with much less to no inter-characters interactions, like *Minecraft* (Mojang 2011). Furthermore, re-tellings (Eladhari 2018) and other forms of narrative generation out of players' experience of single- or multi-player games (e.g., online game session streaming) have been discussed as a pervasive form of narrative emergence in video games (Caracciolo 2024; Koenitz 2023; Spawforth and Millard 2017).

The concept of emergence in interactive media, and specifically the assimilation of emergence from game mechanics and emergent narratives has been problematised in narrative studies (Walsh 2011). Yet, as generative AI is finding increasingly more space in the videoludic industry, the notion of emergence will foreseeably find renewed interest, both from a gameplay and from a narrative point of view. Further discussing the differences and relationship between the two will also be of increased importance, as the combinatorial rules governing artificial intelligence systems will be likely implemented in the run-time generation of

narratives. Lastly, as ways to harness and embed user-generated content into video games are increasingly being explored (see, e.g., the *Realspawn* project[12]), a new kind of reabsorbed emergence (possibly, in turn, giving rise to further emergence) is soon to be finding its space in the academic discourse.

9 Other complexities and underexplored directions

The term "complexity" appears more sporadically in a number of other publications. An overview of these (to date) less systematic and cohesive investigations of complexity in video games could facilitate aggregation and lead to discover new, exciting connections between concepts. With a similar hopeful attitude, I will also point out what seem like underexplored but promising connections between video games and complexity, in an attempt to highlight further research directions.

9.1 Production complexity

Producing a video game has been described as a complex task (Goh et al. 2023). The number of professional figures involved in the design, development, iterative testing, publication, marketing, and deployment of videoludic products is often very high, even in the cases when a single developer/designer is involved in the actual making of the game (e.g., *Undertale*, Toby Fox 2015). In this case, complexity refers to an interconnected net of interests and factors ultimately involved in the release of a video game. The academic literature on the topic generally focuses on how to manage complicated production practices, discussing the relationship between different business entities (developers, publishers, platform providers) and the many interests involved, mainly economic but also cultural, and legislative. However, this complexity is discussed scatteringly, with a plethora of approaches but without a coordinated direction, resulting in fragmented perspectives. Although systematisation attempts exist (e.g., Goh et al. 2023), a thorough examination of this complexity could provide valuable results for a deeper understanding of video game production.

12 http://www.realspawn.com.

9.2 Collaborative creation complexity

Connected to production complexity is another aspect that received at least hints towards being considered complex. Some researchers tend to regard the multiplicity of professional figures participating in the creation of a cultural objects as a complex self-organised system (e.g., Knudsen and Olesen 2018). Game production exists along a continuum: from solo-developer projects to large, multinational studios; yet, even within smaller teams exist collaborative dynamics and distributed decision-making that can produce emergent results. Moreover, even individual developers often rely on pre-existing assets sourced from online marketplaces or open repositories. These practices introduce external creative inputs and further dilute the notion of fully centralised control over the (emergent) result. The tendency towards distributed creation becomes even more evident when communities of players are involved in production processes directly or indirectly. Developers have drawn direct inspiration from players' feedback to implement changes to the games (most famously in *League of Legends* (Riot Games 2009), *Fallout 3* (Bethesda Game Studios 2008), or *Mass Effect 3* (BioWare 2012)). In other cases, developers responded indirectly to aggregated player data like usage statistics to refine game design aspects – a common practice for online titles. These direct and indirect influences of the community of players over the video game further problematise the idea of centralised control over a video game product, opening to a view where the notion of complexity can be illuminating. Similar research directions are currently being explored for movie production, but this sort of analysis promises to produce valuable results also in video games studies, particularly when coupled with discussions of ethical production practices (see, e.g., the arguments in Silva et al. 2022, 2024).

9.3 Transmedial and serial complexity

The several aspects of production complexity can be pushed even further, when video game narratives span across series of games and/or are entangled in transmedial worlds. It is possible to argue that the renewed interest in narrative complexity has been greatly inspired by serial narratives (particularly in the form of TV series, see, e.g., Mittell 2015). Parallelly, transmedia storytelling has been discussed as complex in itself (Gambarato 2012). When coupled with the complexities of production discussed above, these two elements generate (super) complex phenomena (that is, complex phenomena composed of other complex phenomena – see Morin [2008]), that probably are as difficult to analyse as they are fascinating. One could go even further and look at fan-made transmedial or serial productions, adding another layer of complexity to the picture.

9.4 Fan-base complexity

Talking about the community of fans, several phenomena have been described as related to complexity. Community-driven hermeneutic approaches to complex narratives have been discussed as showing features of complexity (Bordwell 2023) even in relation with video games (Caracciolo 2024). In particular, the dialogic nature of these collaborative hermeneutic efforts interlaces individual perspectives and interpretations with a collective experience that is at the same time identical and different for every player (both objectively, in each players' emergent traversing of the game sprouting from the complex set of identical available rules; and subjectively, in each player's own sensemaking and interpretation based on one and the same object). These fan-made efforts have played a considerable role in the fortune of some games specifically crafted to support them (like FromSoftware games; see Caracciolo 2024) sometimes even becoming the main attraction of entire games (as in *Buckshot Roulette*,[13] Mike Klubnika 2023). The complex relationship between video games and fan communities has also been discussed regarding its most troubling manifestations, particularly when real-world violence is framed or performed through videoludic aesthetics, as it has infamously been the case for the Christchurch Mosque shooter (see Ensslin 2022). Approaching such phenomena through frameworks attentive to systemic complexity, which account for multiple interacting factors including platform dynamics and networked radicalization, may help capture the nuances that monocausal or reductive analyses risk obscuring.

9.5 Metareferential complexity

Studies of the phenomenon of metareference sometimes intersect with complexity. Metareference indicates the instances where games reflect on their own mediality and/or break the fourth wall. Recent scholarship has begun to articulate how metareferential strategies generate complex interrelations among different metareferential elements in video games (Krampe 2025). What remains largely unexamined, however, is how metareference functions specifically as a generator or intensifier of complexity across the various related domains. In particular, metareference can be said to complexify narrative and ludonarrative structure by multiplying diegetic levels, as in games like *The Stanley Parable* (Galactic Cafe 2013), or by making game mechanics themselves narrative objects, as in *The Magic Circle* (Question 2015). Metareference can also complexify the player's cognitive and interpretive labour by

13 https://www.reddit.com/r/HorrorGaming/comments/1duaelb/mystery_found_in_buckshot_roulette_a_breakdown/.

requiring navigation between different ontological frames, and can be used to transgress them to connect in-game moral with the real world. While an increasingly rich body of research explores the phenomenon of metareference (see Gualeni 2016; Jannidis 2009; Krampe and Thon 2025), the explicit connection of metareference with complexity represents a promising direction for future inquiry. Research in this direction can both elucidate metareference as a mechanism able to foster different dimensions of complexity, and explain metareference as a complex phenomenon in itself, interweaving narrative, ludic, semiotic, and phenomenological layers in ways that resist linear analysis.

9.6 In-game societal complexity

Online multiplayer games, and particularly MMORPGs (massively multiplayer online role-playing games) also allow for another kind of complexity to arise. This genre of online games allows players to enter worlds populated by hundreds or even thousands of other players at the same time. In these worlds, players are given the possibility to choose for instance jobs (which allows the identification of different roles), equipment (gained and improved by playing the game) and appearance of their avatars. From the countless possible combinations of these and other features (see the sections on game complexity and on gameplay emergence), extremely complex in-game societies emerge. These in-game societies are so similar to real-world ones to even display similar phenomena resulting from their complexity: fluctuations in the internal financial market, in-game fashion trends, (game)-world-wide oppositions of factions, and economic stratification of the population are just some of the emergent phenomena one can observe. These in-game societies are also (somehow metaleptically) connected to the rules of the games itself, as they indirectly prompt developers to apply ongoing changes in mechanics, environments, or non-player characters (see the section on collaborative creation complexity). This possibility offered by video games to produce rather than represent or simulate complexity are still largely untouched by the academic literature.

Yet, some specific phenomena sprouting from this complexity have received unexpected scientific interest. A famous example in this direction surrounds the so-called “Corrupted Blood Incident,” happened in the MMORPG *World of Warcraft* (Blizzard Entertainment 2004). In 2005, due to a coding oversight by developers, an epidemic spread uncontrollably in the game world. This in-game event soon attracted the attention of epidemiologists and has been studied to better understand the behavioural impact of a spreading disease in society (e.g., Lofgren and Fefferman 2007). More recent pandemic times prompted a renewed interest in this fictional epidemic and its societal implications (Elker 2020).

Additional studies investigating the ontological status of these mediated (but not at all fictional) societal complexities can reveal important insights about real-world societies. Moreover, in-game societies can have a number of other unexpected yet epistemically invaluable information to offer. For instance, the foreseeable injection in these societies of entities controlled by more advance artificial intelligence technologies can produce situations able to foretell possible, even plausible real societal futures – futures that so far could only be imagined in science fiction but not actually tested.

The relationships between video games and complexity are various and variously articulated in the field of video games studies. While I have tried to outline here the main discussions linking video games to complexity, and to reflect on less established and even underexplored views, investigating additional entanglements of the two is in itself a rewarding line of inquiry.

10 Conclusions

In this narrative review I have outlined the most discussed entanglements of complexity and video games in the relative academic literature, and I have provided what are (in my opinion) the most promising directions for future research. As I have shown, the notion of complexity is itself changeable and variegated, and, consequently, discourses on complexity and video games can take various forms and involve various disciplines (mathematics, combinatorial computation, physics, systems science, narratology, cognitive sciences, semiotics, ethics, sociology, epidemiology). This makes the investigation of video games and complexity particularly complicated, but it is undoubtedly also what makes it so fascinating and rewarding. For these reasons, this article wants to be not only a summary of the ongoing research, but also an incitement to engage further with these research directions.

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