Time in Digital Games: A Comparative Map of Temporal Constructs

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ABSTRACT

Work on time in digital games has expanded across disciplines, and this diversity now offers opportunities for direct comparison and synthesis. This paper presents a comparative map of twenty-two temporal constructs published between 2003 and 2025 to illustrate this opportunity. We use the term temporal construct to identify named, reusable conceptual tools – typologies, frameworks, categories, etc. – that researchers use to theorise how time is structured in and around digital play. Each construct is positioned along two axes, derived from patterns in the analysed literature: temporal control (from player-controlled to system-controlled) and temporal scale (from moment play to lifestyle play). This visualisation identifies where constructs cluster, where gaps remain, and how constructs can be read alongside one another without flattening disciplinary differences. A companion web prototype provides author-level plots alongside the composite map, supporting closer inspection and laying groundwork for an evolving resource.

Keywords

game time, play time, game temporality, time in video games, narrative time, player time, time perception, typology, game theory

INTRODUCTION

Jesper Juul opens *Introduction to Game Time* by noting that "much work has been done on time in other cultural forms, but there is very little theory of time in games" (2004). Two decades on, that complaint no longer quite holds – we now have a tangle of temporal frameworks, typologies, and design constructs scattered across game studies, HCI, and industry publications. What still feels timely, though, is Juul's attempt to map the relationship between "play time" (the time the player takes to play) and "event time" (the time passed in the game world) in order to connect formal

Proceedings of DiGRA 2026

structure to player experience. This paper takes that mapping impulse and inverts the object of study to the constructs scholars use to theorise time in digital games. We build a comparative map of temporal constructs plotted along two axes – temporal control (where a construct locates the primary source of temporal organisation) and temporal scale (the span of play a construct is designed to describe) – to show where existing concepts group, where gaps remain, and how new understandings might emerge.

Time has been widely theorised in digital games (see our map below), but the resulting temporal constructs remain distributed across disciplines and are rarely brought into direct dialogue. Game studies, HCI, and socio-temporal theory have each developed their own vocabularies for describing time in and around games: narratological pacing frameworks (Wei et al. 2010); operational models of in-game and real-world time (Juul 2004); and classifications of temporal experience or agency (Gopinath & Holopainen 2025). Some focus on how games structure time through mechanics and systems (Igarzábal 2019), others trace how players manage or rework time through practice or rhythm (Deterding 2013), and still others look at how games sit within everyday routines and media ecologies (Carter et al. 2014). In *An Ontological Meta-Model for Game Research*, Aarseth and Grabarczyk (2018) note "this troublesome variety could also become a great advantage, as it may give us the opportunity to employ a truly interdisciplinary perspective." Their article then provides a granular framework for cross-cutting analysis across various definitions of games, which we do not follow procedurally, but in essence to find "mechanisms" that connect game-related temporal constructs – our temporal control and scale.

This paper brings these constructs together and plots them on a shared map to make overlaps, gaps, and tensions easier to see. The contribution is a comparative map, not a new formal framework; we do not seek to homogenise the necessary diversity of research. The map enables comparison without collapsing disciplinary differences. While some constructs draw on player experience, the unit of analysis here is the construct's conceptual scope – how it defines time, assigns temporal control, and frames the scale of play. These include widely cited models such as the previously mentioned distinction between play time and event time from Juul (2004) and Zagal and Mateas' (2007; 2010; 2015) Temporal Frames, as well as more recent or specialised constructs such as Rapp's (2022) MMO Game Temporalities. Where authors propose multiple layers or modes (for example, Gopinath and Holopainen's [2025] four Timeplay modes), we treat each as a separate construct so it can be placed independently when it differs in who sets the timing or what time span it addresses. We do not currently plot descriptive overviews that discuss temporal features without formalising a named, reusable construct (such as Wolf's discussion of time in *The Medium of the Video Game*, though these may be incorporated in future iterations). Applying these criteria and a staged search across game studies, HCI, and adjacent literatures, the map currently includes twenty-two distinct temporal constructs published between 2003 and 2025. In addition to the composite map in this paper, a web prototype presents an interactive version where readers can look more closely at individual constructs and author-level plots, see: http://www.tom-byers.com/time-map

In approaching a visual composite of existing temporal constructs, we considered two primary questions:

- **RQ1:** How have scholars categorised time in relation to games, play, and players?

- **RQ2:** What gaps or tensions become visible when these constructs are mapped together?

More broadly, this project is motivated by an interest in building something more longitudinal than a one-off review – an interactive, evolving map of temporal constructs that can grow through peer recommendation, critique, and extension, echoing practice-oriented and co-constructive research where the artefact itself becomes an ongoing practical inquiry (Stone 2025).

PROJECT OVERVIEW: THE TEMPORAL CONSTRUCT MAP

This paper represents the first consolidated iteration of a broader project to build an interactive, community-extensible map of temporal constructs in and around digital games. The project aims to provide shared infrastructure for comparing named, reusable concepts – typologies, frames, and design vocabularies – without imposing a new top-down taxonomy. The present contribution is a static comparative snapshot of twenty-two constructs plotted along temporal control and temporal scale, supported by a companion web prototype that renders author-level plots alongside the composite map with zooming and navigation. In later iterations, we intend to expand the dataset to incorporate practice- and industry-derived temporal vocabularies and to develop lightweight mechanisms for proposing additions, contesting placements, and annotating use. The current map presented here is intended as a seed structure – a starting point intended to invite contribution and discussion.

THE GROUNDWORK FOR MAPPING TIME IN DIGITAL GAMES

Historical work on time outside game studies already treats temporality as multiple, layered, and felt rather than as a single neutral clock. This section does not provide an exhaustive review (no “circles” here) but highlights a small set of frameworks that underpin contemporary discussion of time in digital play. In narratology, Genette (1980) provides literary theory with a practical toolkit for analysing narrative time by distinguishing between story time and discourse time and then tracking how order, duration, and frequency are rearranged. In sociological and cultural work, time becomes an organising principle of everyday practice. In a study of restaurant work, Fine (1990) uses Lauer’s (1981) five temporal building blocks – rhythm, tempo, synchronisation, duration, and sequence – to show how temporal organisation shapes behaviour and experience in ways that align with later accounts of everyday rhythms by Lefebvre (2004; originally published 1992). These frameworks have shaped later perspectives on time by recognising that players’ relationships to digital play are composed of overlapping temporal layers and representations, not a single temporal element or construct.

In contemporary scholarly applications, social theory extends these concerns into digital life. Kitchin’s (2023) account of digital timescapes shows how networked systems reshape everyday temporalities through background persistence, noting that “the embedding of digital technologies across all aspects of everyday life has led to the development of new temporal experiences, sensibilities and competencies” (p. 47). Research into time perception in games and virtual environments suggests that

how users experience time can shift dramatically depending on engagement, environment, and cognitive load. For example, Alvarez Igarzábal (2019) draws on cognitive-psychological models of time perception to argue that gameplay – through its formal structures and demands – can distort subjective temporal experience. More recently, empirical work by Niknam et al. (2024) demonstrates that dynamic VR environments tend to compress perceived duration compared to static ones, suggesting that environmental dynamics and user immersion influence our internal clocks. These studies underline that experiences of time in play are shaped by both designed factors such as mechanics and aesthetics, and emotional and contextual factors such as attention, arousal, and environmental dynamics. Writing from cognitive neuroscience and psychophysics on the "psychological present", Wittmann (2011) reviews empirical work on temporal integration and proposes a nested model of the present: millisecond-level functional moments that bind events into co-temporal snapshots, experienced moments of roughly 0.5-3 seconds that underwrite the felt "now", and a broader window of mental presence over many seconds to minutes that depends on working memory. This immediacy of experience informs the conceptual baseline for the "moment experience" elements of the map, since many of the game-specific constructs plotted there are directly concerned with single interactions and brief system-level episodes of play.

Temporal reasoning has also evolved within industry and player practice. At the smallest scale, designers increasingly tune moment-to-moment timing through response windows, cooldowns, and brief punctuations of tension and relief that shape how play feels in the now (Griesemer 2019; Byers et al. 2026). At the session scale, this logic consolidates into the game loop and its nested hierarchies of loop duration, giving developers a shared language for pacing, repetition, escalation, and stopping points within bounded play episodes (Sicart 2015; Zubek 2020). Between sessions, developers now also talk about continuity across days through return structures – asynchronous progress, ambient presence, weekly quests, and rhythm-based re-engagement (Howe 2017; Frommel 2022; Byers et al. 2025a). At the longest horizon, live-service and free-to-play models have normalised explicit long-term categories such as "lifestyle games" (Ilkka 2025), "black hole games" (Ball 2025), daily streaks, and battle passes that aim to secure a stable place in players' weeks. These layered vocabularies treat time, attention, and scheduling as designable resources, and reflect a growing preoccupation with how games fit into broader temporal architectures – in turn shaping how players evaluate games (Byers et al. 2025b).

The cross-disciplinary and industry perspectives above are included to help interpret the mapped constructs, not to represent the full history of time scholarship. They gesture to recurring concerns – scale, rhythm, persistence, interruption, and scheduling – that later game-focused models build upon. We therefore do not plot these earlier frameworks on the map, as the map is intentionally limited to contemporary, explicitly game-focused temporal constructs (2003-2025).

TEMPORAL CONSTRUCTS OF DIGITAL GAMES

Game studies has long engaged with time, but the resulting temporal constructs are dispersed across frameworks with different aims and vocabularies. To avoid adding another top-down typology, we adopt a cartographic approach. This aligns with work that uses visual mapping to hold conceptual differences in productive tension rather than resolve them – for example, Stone's (2022) continuum for plotting frictions between poetry and videogames and Aarseth and Grabarczyk's (2018) previously

mentioned ontological meta-model. This section briefly outlines the kinds of temporal constructs observed across disciplines and gestures to two recurring focuses – how researchers explain the organisation of time in play, and what span of play their concepts are built to describe. In what follows, we use short discipline-linked examples to show how these differences recur across otherwise distinct approaches.

Illustrative work from narratology and formalism examines temporality through event sequencing and its representation in play, often treating temporal organisation as a question of authored structure and local pacing. Wei et al. (2010) adapt Genette's (1980) categories to distinguish story time from operational time using order, duration, frequency, and polychrony. Anyó (2015) highlights looping and fuzzy temporalities that arise from interactive narration, while Ma and Bassi (2010) identify game-specific pacing patterns – ellipsis, speed-up, isochrony, slow-down, and quitting – shaped by persistence and session boundaries. From these perspectives, time is analysed through the logic of narrative structures and patterns.

A second pattern of research treats time as a layered feature of game operation, situating system-defined temporal structures across sessions and persistent worlds. Juul's (2004) distinction between play time and event time has become a common reference point. Zagal and Mateas (2007) introduce four coexisting Temporal Frames – Real-World Time, Gameworld Time, Coordination Time, and Fictive Time – while Hitchens (2006) distinguishes Playing Time, Engine Time, Progress Time, and World Time. Tychsen and Hitchens (2007; 2009) extend this to a seven-level model that adds Server Time, Story Time, and Perceived Time for multiplayer and role-playing contexts. These constructs situate temporality as a relational feature between software and player.

Another focus is on temporal agency – how players control, manipulate, or reflect on time in play – bringing player-led organisation into view alongside system design. Gopinath and Holopainen's (2025) Timeplay framework proposes four types of temporal agency (Adaptive, Strategic, Ethical, Reflective). Scully-Blaker (2018) distinguishes Stasis (mechanically enforced inaction) from Stillness (player-chosen lingering), including both designed and player-injected forms. Jayemanne (2020) offers a Chronotypology of Diachrony, Synchrony, and Unstable Signifiers, along with staged play relations, to describe how games weave and reconfigure multiple temporal schemes as play unfolds. These approaches shift attention away from systems alone and towards player practices.

Other scholars consider embeddedness – how games sit within everyday life and media ecologies – making longer horizons of play and routine formation central. Deterding's (2013) modes of leisurely gaming outline temporal norms tied to Relaxing, Socialising, Engrossing, Hardcore, and Competitive gaming, including characteristic session lengths and interruptibility. Rapp (2022) reads MMO participation through practice-based temporalities (Linear, Circular, Shared) linked to engagement forms. Carter et al. (2014) describe domestic multi-gaming and multi-screen game modalities embedded within screen ecologies organised around rhythms. Montola et al. (2009) introduce Temporal Expansion, distinguishing Dormant, Ambient, Asynchronous, and Persistent styles of engagement that stretch play across everyday time.

Finally, HCI and interaction design contribute more general frameworks for structuring time in interactive systems, offering language for thinking about control and sequencing across scales. Benford and Giannachi's (2008) Temporal Trajectories

map Story Time against Clock Time through Canonical, Participant, and Historic trajectories in shared interactive narratives. Lundgren's (2013) Temporal Themes offer a seven-part vocabulary – including Live Time, Real Time, and Unbroken Flow – for describing how interactive systems organise event sequences. These constructs are not game-specific, but they provide portable design language for temporal sequencing and perception.

The examples above represent only a small portion of the twenty-two authors included in the map. They also illustrate why temporal control and temporal scale are useful shared descriptors even when constructs emerge from different traditions. Below, Table 1 summarises the full range of scholars and constructs included in the map.

Year	Author(s)	Construct	Description
2003	Aarseth, Smedstad & Sunnanå	Typology of Games	Treats time as one design dimension among many, distinguishing external vs internal time and parameters like pace, synchronicity, mutability and savability rather than a simple real-time/turn-based split. *Note: First addressed in 2003 and later refined in 2007.*
2004	Juul	Game Time Duality	Separates real-world play time from fictional game time and examines how games map, accelerate, decouple or fragment the relationship between the two, including dead time and flow. *Note: First outlined in "Introduction to Game Time" (2004), expanded in Half-Real (2005).*
2005	Björk & Holopainen	Game Design Patterns	Defines temporal components – actions, events, closures, end conditions and evaluation functions – that structure how state changes become meaningful progress and outcomes in games.
2006	Hitchens; Tychsen & Hitchens	Layered Model of Game Time	Introduces four linked time views – playing, engine, progress and world time – to separate real-world duration, system operation, player advancement and fictional chronology, and later extends these into a seven-layer model adding server, story and perceived time for analysing persistence, branching and subjective temporality in multiplayer and RPG play. *Note: Developed further in 2007 and 2009.*
2007	Zagal & Mateas	Temporal Frames	Introduces four coexisting temporal frames – real-world, gameworld, coordination and fictive time – plus characteristic anomalies, to analyse how different kinds of time interact in play. *Note: Groundwork appears in 2005, then expanded across 2007, 2010, and 2015.*
2008	Benford & Giannachi	Temporal Trajectories	Maps story time onto clock time through three trajectory types – canonical, participant and historic – to describe scheduling, re-engagement and replay in shared interactive narratives.
2009	Montola, Stenros & Waern	Temporal Expansion	Defines temporal expansion as games becoming always-available and hard to "turn off," and classifies play modes and styles (dormant, ambient, asynchronous, persistent) that appropriate everyday time.

2010	Wei, Bizzocchi & Calvert	Narrative Pacing in Gameplay	Reimports narratology to games by relating story time to operational time through order, narrative speed (ellipsis, summary, scene, stretch, pause), frequency and polychrony.
2010	Ma & Bassi	Narrative Time in Video Games	Adapts tense/aspect theory to games via an “eternal progressive” present and five pace patterns (ellipsis, speed-up, isochrony, slow-down, quit) that distinguish persistent vs session-bound worlds.
2013	Lundgren	Temporal Themes	Offers seven temporal themes – live time, real time, unbroken flow, sequential, disordered, juxtaposed and branched versions – as a design vocabulary for how interactive systems organise event sequences.
2013	Deterding	Modes of Leisurely Video Gaming	Identifies five modes of leisurely gaming – relaxing, socialising, engrossing, hardcore, competitive – each with characteristic session length, interruptibility and fit with everyday schedules.
2014	Carter, Nansen & Gibbs	Game Engagement Modalities	Classifies games by their attention rhythms (pausable, intermittent, slow, timed, passive) to show which titles pair well in multi-gaming, multi-screen domestic settings.
2015	Anyó	Participation Time	Reworks discourse time as participation time – the rule-given but player-controlled time of interaction – to explain loops, retries and fuzzy temporality in game narratives.
2017	Goldstein & Khan	Taxonomy of Event Time	Standardises technical talk about time by classifying logical, simulation and wallclock time – and their scalar, vector and matrix forms – for designing and reasoning event ordering in digital systems.
2018	Hanson	Recursive Temporalities	Distils a distinct temporal mode where replay, looping and time manipulation become core mechanics that restructure player memory, learning and narrative experience.
2018	Scully-Blaker	Stasis & Stillness	Differentiates stasis (mechanically produced inaction) from stillness (player-chosen lingering), plus designed vs player-injected forms, to analyse how games structure meaningful pauses.
2019	Igarzábal	Time and Space Typology	Presents a three-part toolkit – Change of State, Space-Time and Conditions – detailing how events, spatial layout and constraints (timers, turns, objectives) together structure gametime.
2020	Jayemanne	Chronotypology	Offers a comparative vocabulary of diachrony, synchrony and unstable signifiers, plus staged play relations, to describe how games weave and reconfigure multiple temporal schemes over play.
2020	Yıldız & Coşkun	HCI Time Perceptions	Curates five emerging time perceptions – right, collective, plastic, clock and digital time – as design materials for rethinking how interactive systems represent and structure everyday temporality.
2022	Rapp	MMO Game Temporalities	Links game temporalities (linear, circular, shared) to temporal experiences (progression, repetition, assimilation) and engagement forms (desiring, mechanic, social) to explain long-term MMO retention.

2024	Byers, Gibbs & Nansen	Holistic Typology	Proposes three interconnected frames – Game Time, Play Time and Affected Time – to link temporal design to how games intersect with broader lifeworld schedules and inequalities.
2025	Gopinath & Holopainen	Timeplay	Introduces Timeplay as a typology of temporal agency, distinguishing adaptive, strategic, ethical and reflective ways that players manipulate and reason about time through game mechanics and stories.

Table 1: Temporal constructs included in the comparative map, ordered by year of first formalisation.

In the map we plot Yıldız and Coşkun's (2020) arrangement of five HCI "time perceptions", but treat their contribution as curatorial and give credit back to the original constructs. Right Time, from Taylor et al. (2017), frames time as a convergence of circumstances that make a moment appropriate rather than as a clock value; Collective Time, from Lindley (2015), treats time as socially entangled and shared across intersecting routines; Plastic Time, from Rattenbury et al. (2008), names the fluid, often low-intensity in-between periods filled by light media use; Clock Time, drawing on Offit's anthropology of timekeeping, describes abstract, numeric schedules that reorganise daily rhythms; and Digital Time, from Tomlinson's (2007) account of immediacy, captures the always-on, information-driven tempo of networked media.

MAKING A MAP

Axis Development

Building on the patterns outlined in the previous section, we developed two shared axes that capture recurring mechanisms across diverse temporal constructs. The two axes were developed through iterative reading of temporal constructs in game studies, HCI, and adjacent fields as well as prior research on time in games (Byers et al. 2025a; Byers et al. 2025b; Byers et al. 2026). The X-axis tracks temporal control – where a construct locates the primary source of temporal organisation – ranging from player-controlled through player-leaning to system-leaning and to system-controlled time. We define system-controlled constructs as those that organise time primarily through mechanics, infrastructure, and design. In contrast we define player-controlled constructs as those that organise time through player routines and discretionary behaviour. Because temporal control is a conceptual emphasis rather than a literal measurement of behaviour, these positions should be read as interpretive anchors – in practice, players retain autonomy in how, when, and whether they engage.

The Y-axis tracks temporal scale – the span of play a construct is designed to describe – distinguishing constructs that conceptualise time at four levels: moment, session, persistent play, and lifestyle play. Moment placements draw on Wittmann's (2011) work on functional moments and short experiential windows, aligning with constructs focused on singular interactions, brief response timing, pauses, or localised micro-episodes of play. Session placements reflect established game design and HCI language around bounded play episodes and gameplay loops. Persistent play captures the middle range between session and lifestyle – constructs that conceptualise continuity across multiple sessions or days (for example asynchronous return, ambient presence, or recurring rhythms) without assuming that the game has become

a routine-defining commitment. Lifestyle play marks the longest horizon – constructs that conceptualise play as embedded in everyday schedules and long-term engagement expectations.

We also note that we had not initially formalised what a centre or "0,0" position should represent. We ultimately position clock time at 0,0 because it provides the most abstract, standardised baseline in the dataset. On the temporal control axis, clock time represents an external scheduling regime that organises activity through shared measurement and coordination rather than player-negotiated rhythms, making it a clean system-aligned reference point. On the temporal scale axis, clock time is not intrinsically tied to any specific play horizon (moment, session, persistent, or lifestyle), functioning as a scale-neutral anchor. This allows more game-specific temporal constructs to be read as extensions or reconfigurations of a shared temporal reference.

Construct Selection

Construct selection combined prior knowledge with systematic search. We began with foundational texts familiar through teaching and research – including Juul (2004), Zagal and Mateas (2007), and Wei et al. (2010) – and used these as anchors for a staged search across game studies, HCI, and adjacent design literature. This process combined targeted retrieval of established frameworks, keyword searching for explicitly named temporal typologies, frames, taxonomies, or vocabularies, and backward and forward snowballing from highly cited time-focused works. Search terms included combinations such as "game time", "temporal frame", "temporal typology", "narrative pacing", "time perception", "asynchronous play", "persistent play", and "temporal agency". We prioritised named, reusable constructs intended as analytic language for describing how time is structured or experienced, and excluded descriptive accounts without a formal construct or relational models that primarily link existing categories rather than defining a plottable construct. As this work is a construct-focused mapping exercise rather than a formal systematic review, we did not track comprehensive counts of all records screened. The resulting dataset should be read as a scoped, construct-focused set of named temporal constructs intended for comparison, not an exhaustive census of all writing on time in games.

The current map includes constructs that categorise time as part of a primary theoretical intervention, but also those where temporal modelling is secondary or embedded. In some cases, categories were drawn from work not initially framed as a temporal theory – for example, Carter et al.'s (2014) modes of engagement, which contain buried temporal categories tied to how players interact across screens but which are not explicitly presented as a temporal typology. It was instead a secondary, explanatory framework for detailing the game systems of screen ecologies. Identifying such cases required close reading, particularly where temporal logics were buried within broader design or analytic discussions.

While the dataset aims for breadth across disciplines and use cases, it remains necessarily partial, and we take this opportunity to also clarify some notable exclusions. Wolf (2002), while comprehensive in describing temporal features in games, does not present a formal typology or claim his distinctions (stillness vs movement, looped time, time pressure) as reusable analytic categories. Similarly, Parra Bravo (2023) offers exactly the kind of relational modelling this map seeks to support: identifying Temporal Constraints as the mechanisms that regulate Progress

Time (from Tychsen and Hitchens 2009) across narrative and interactional layers. However, because this concept is explicitly about cross-layer coordination rather than a discrete typology, it resists fixed plotting and would be better captured through connecting arcs or relational overlays – a level of visual complexity not implemented in the current map. Other works, such as van Meurs (2011), demonstrate the interpretive power of combining existing models (Juul [2004] and Hitchens [2006]) to theorise phenomena like waiting and asynchrony, without proposing new constructs. These cases reinforce both the value and the current limitations of our conceptual vocabulary for time in play – and highlight the ongoing need for comparative, extensible tools.

Mapping Process

Each construct was treated as an individual unit of analysis and plotted independently, even when sourced from the same paper. For example, Zagal and Mateas (2007) propose four distinct temporal frames, each of which engages a different logic of time and thus required separate placement on the map. The aim was to preserve internal variation within multi-part models and avoid flattening complex frameworks into single points.

Placement across the two axes was interpretive, but guided wherever possible by how authors themselves described the scope and function of their constructs. Constructs were positioned based on how they framed temporal control and temporal scale. In cases of ambiguity or overlap, emphasis was placed on authorial intent, terminology, and use context. Although framed as a player-chosen mode, Deterding's (2013) Competitive Gaming is structured by system-led conditions: enforced rules, fixed pacing, and hardware-dependent setups like LANs and online matchmaking. Competitive play unfolds within tightly controlled environments that regulate performance and interaction. As such, it is mapped on the system-leaning side of the temporal control axis.

All twenty-two constructs were first plotted on individual author maps to reflect their internal structure and spatial logic. These author-level plots formed the basis for the final composite map, which was created by layering the individual placements and making minor adjustments where constructs overlapped or interacted. This process preserved relational meaning while maintaining visual coherence. Four examples are included in the paper (Figure 1 = Aarseth et al. 2003, Figure 2 = Deterding 2013, Figure 3 = Igarzábal 2019, Figure 4 = Gopinath and Holopainen 2025), and the full set of author maps is available via the interactive web prototype.

RESULTS

Each icon on the map represents a temporal construct. Icons that share the same dominant colour come from the same author/source. Where an author proposes a main construct with branching sub-elements (see Figure 1 & 3), the parent construct appears as a full-sized icon and its sub-elements appear as smaller icons with the same-coloured border. Shape shows domain: single-pointed shields mark game-focused constructs, while double-pointed shields mark broader HCI/digital-design constructs that are still relevant to games.

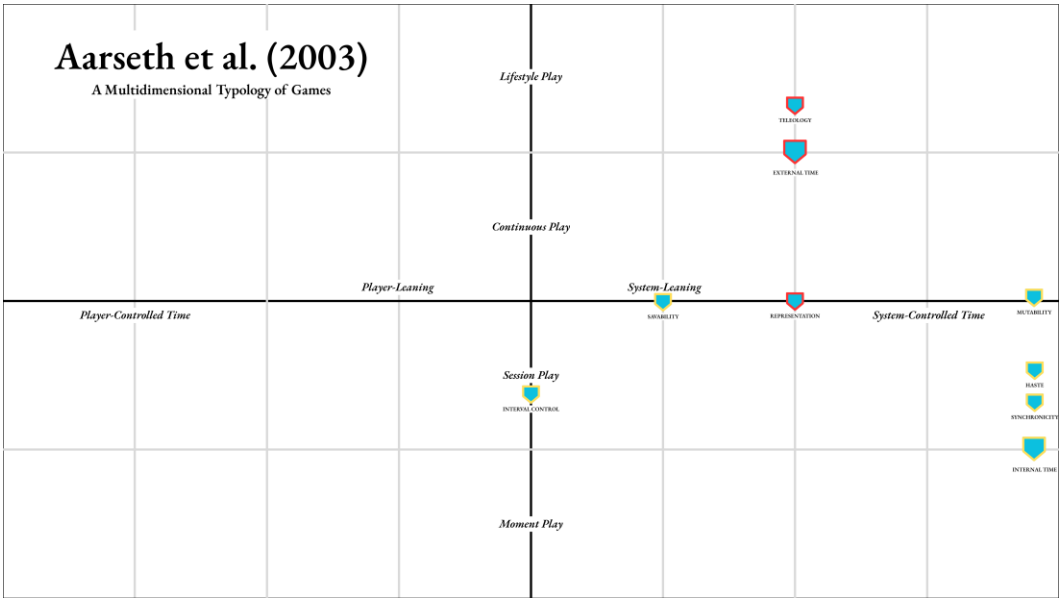

Figure 1: Author-level map for Aarseth et al.'s (2003) Multidimensional Typology of Games.

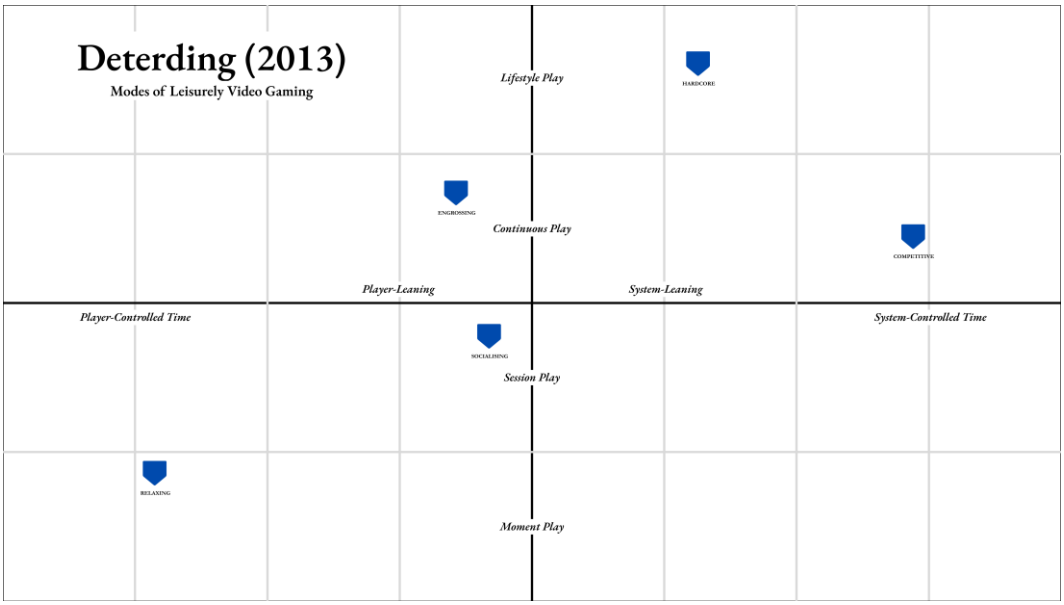

Figure 2: Author-level map for Deterding's (2013) Modes of Leisurely Video Gaming.

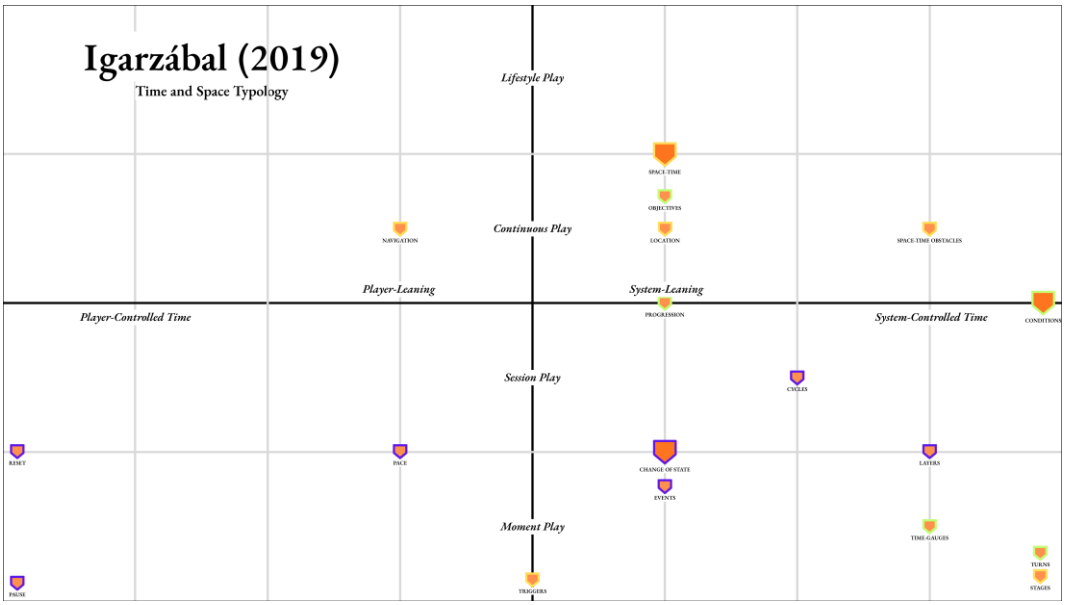

Figure 3: Author-level map for Igarzábal's (2019) Time and Space typology.

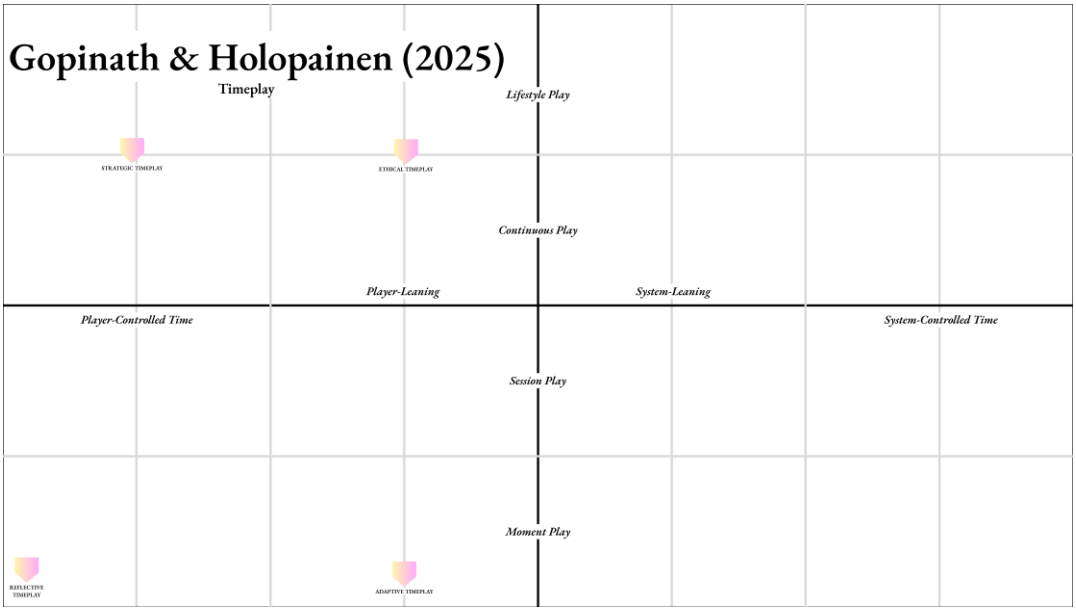

Figure 4: Author-level map for Gopinath & Holopainen's (2025) Timeplay.

Because of space and resolution limits, some labels in the individual plots and the composite map (Figures 1-4 and 6) may be difficult to read at print size. To support closer inspection, Figure 5 acts as a key, linking each construct in Figure 6 to its author(s) and source.

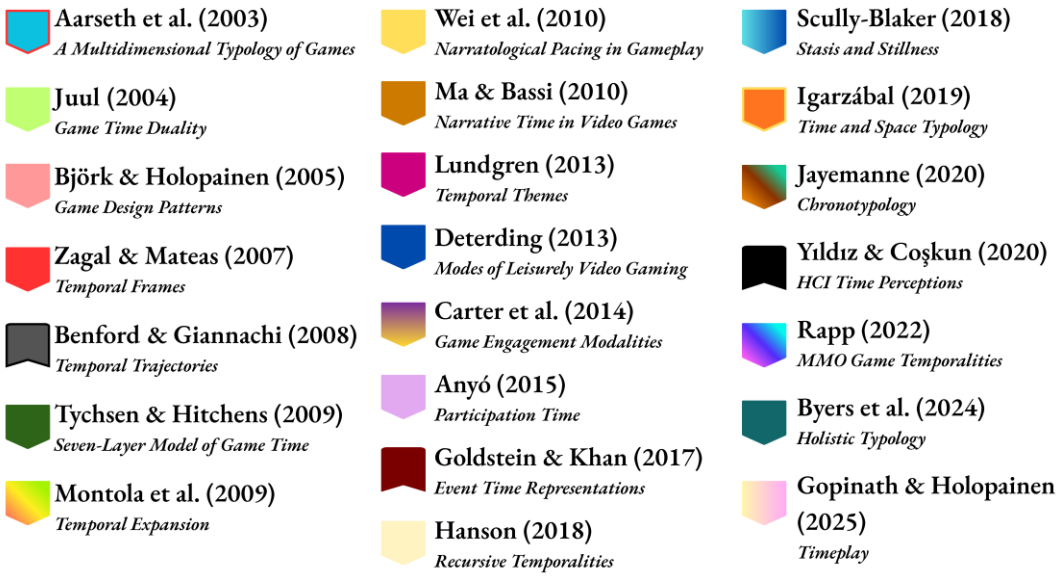

Figure 5: Legend for the mapped temporal constructs. Each colour-coded badge represents an author-construct pair (author, year, and construct title) as used in the individual plots and the composite map in Figure 6.

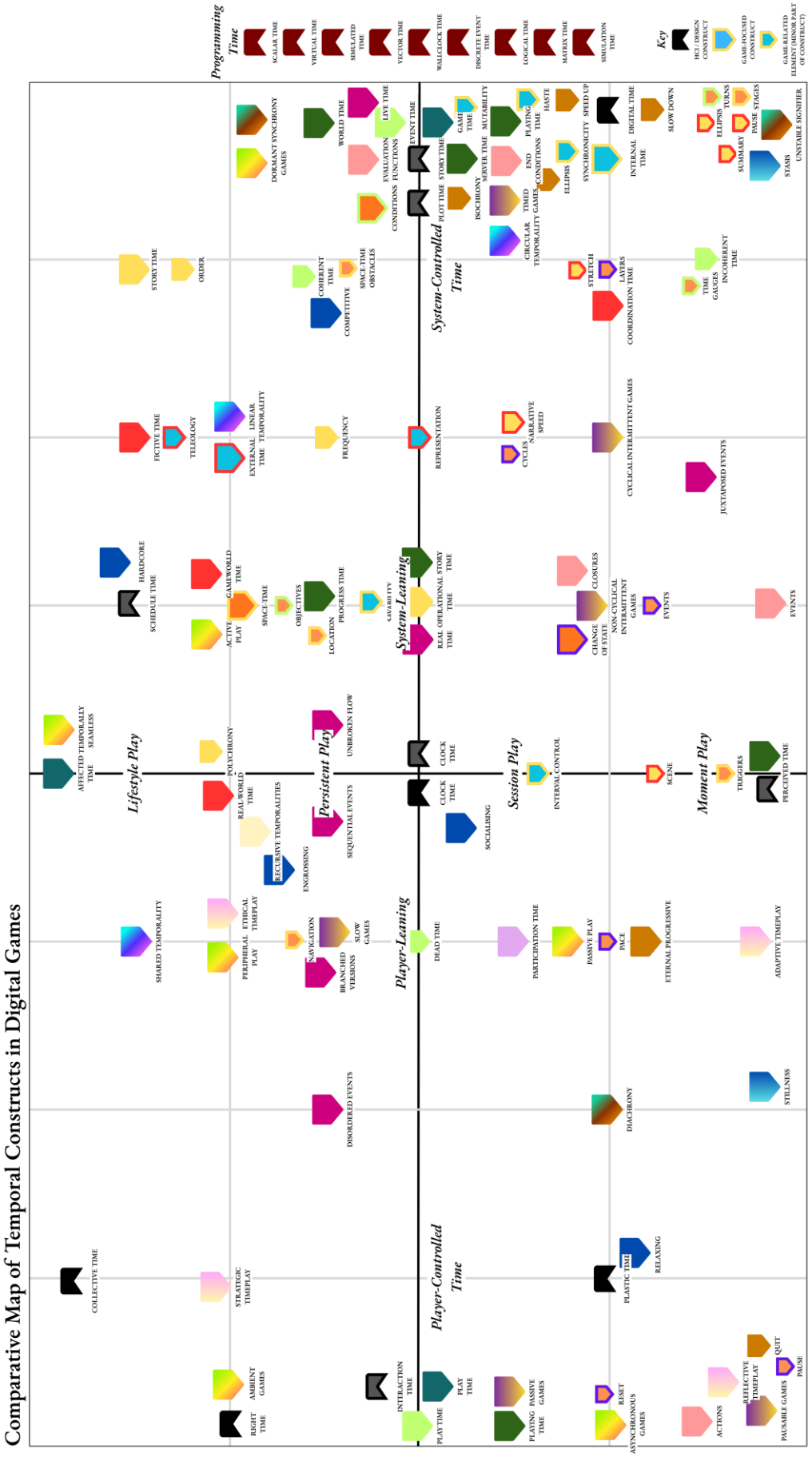

Figure 6: Composite map of temporal constructs in game and interaction design.

DISCUSSION

While there is no shortage of frameworks for understanding time in and around games – evident in Figure 6 – there has been little work comparing them directly. This map does not aim to resolve theoretical tensions or offer a unified model. Instead, it highlights how different traditions conceptualise temporality and shows where work has concentrated so far and where gaps remain. By plotting each construct according to who/what controls time in play and the temporal scale involved, the map reveals areas of overlap and omission. Several patterns stand out – including consistent distinctions between narrative and systemic time, a growing interest in subjective temporal experience, and recurring efforts to account for asynchronous or background play.

While it might be expected – and even encouraged, given the groundwork laid earlier in the literature positioning – to group these constructs into tidy categories, this map deliberately avoids formalising yet another typology layered atop the existing frameworks. Those groupings are available to the reader, and some alignments are clearly visible, but we leave those interpretations open to discussion. Future work may well build on this foundation to offer clearer taxonomies or theoretical unifications, but that is not the aim of this paper.

That said, the vertical axis does reflect a layered view of temporality in play. Lower regions group constructs focused on moment-to-moment interaction – triggers, pauses, response windows, and localised narrative timing – including Scully-Blaker (2018), Wei et al. (2010), and Anyó (2015). Upper regions map longer-term rhythms and embedded practices like lifestyle play, persistent presence, and domestic screen ecologies from Deterding (2013), Montola et al. (2009), and Carter et al. (2014). These layers distinguish between systems designed to respond in milliseconds and those unfolding over months or years – and some constructs, like Jayemanne (2020) and Rapp (2022), intentionally cut across both scales.

Horizontally, the map distinguishes between system-led and player-led temporal structures. On the right, constructs highlight infrastructural and mechanic-driven control – countdowns, server time, pacing, and cooldowns – as seen in Juul (2004, 2005), Zagal and Mateas (2007), and Tychsen and Hitchens (2009). On the left, models like Gopinath and Holopainen (2025), Deterding (2013), and Carter et al. (2014) emphasise player-driven rhythms and autonomy. The centre band reflects a more typical case: session play and mid-scale engagement shaped by both system logic and player negotiation.

A further pattern the map makes hard to ignore is the density of system-controlled constructs on the right-hand side. The diagram becomes stacked with “X time” labels – game time, world time, server time, story time, internal time, digital time, live time, playing time and so on. These layers dominate likely because they are the easiest to formalise and measure. By contrast, the left side remains relatively sparse though still populated with “X time” labels. The layout helps visualise a methodological skew: we have a rich vocabulary for programmable system time, but far fewer named constructs for player-organised or negotiated temporal concepts.

The map also reveals points of convergence across approaches and disciplines. Tychsen and Hitchens (2009), introduce perceived time to capture how players experience waiting and intensity across otherwise objective layers. Independently,

Benford and Giannachi (2008) arrive at the same label in their model of temporal trajectories, adding a perceived layer to explain how participants reconstruct and feel time. That both reach similar conclusions from different starting points reinforces the need for synthesis-driven tools that help researchers and designers connect these models. Relatedly, both Igarzábal (2019) and Wei et al. (2010) discuss pause, but from opposite angles. For Igarzábal, it's a player-driven affordance – a way to manage attention on the player's own terms. For Wei et al., it's a system-led mechanism that interrupts play. Both see pause as a meaningful temporal break, but they differ on who/what controls it. Across otherwise distinct HCI strands, "clock time" gets used as a common anchor – even when its theoretical basis diverges. Benford and Giannachi (2008), writing from performance and experience design, treat clock time as measured, external time that structures narrative pacing and interaction, explicitly distinguishing it from "real time." Yıldız and Coşkun (2020), working from infrastructural HCI, tie it to mechanical timekeeping and capitalist coordination. Different routes, but both end up using clock time to name a system-aligned layer for synchronisation and scheduling.

Finally, the map reveals under-populated and emerging areas. The top-left quadrant – player-controlled time extending into lifestyle play – remains sparse. A few constructs gesture toward it, including passive games from Carter et al. (2014) and ambient games in Montola et al. (2009), reflective Timeplay in Gopinath and Holopainen (2025), and player-organised commitments of right time from Yıldız and Coşkun (2020), but we lack formal vocabulary for long-term, player-led rhythms like seasonal engagement or intentional "cooling off" periods. Likewise, affective and aesthetic dimensions of temporality – boredom, tension, flow, dread, FOMO – mostly appear as byproducts of other constructs, not as categories in their own right. There is clear scope for future work to develop typologies of affective time or examine how games soften or amplify everyday temporal pressures.

The map is designed to plot temporal constructs by temporal control – whether they explain time primarily through player-led organisation or system-authored mechanics and infrastructure – and by temporal scale – whether they address moment-level timing, bounded sessions, persistent play across days, or lifestyle-level routines. Yet we also use the map to provoke and note what remains off the map. Developer- and industry-oriented constructs – the pacing of production, patch schedules, analytics cycles, and monetisation rhythms – are largely missing from formal typologies. These temporal regimes shape how time is built into games, from daily reset loops to seasonal arcs, but they tend to remain implicit. We therefore include Goldstein and Khan (2017) outside the main field as a boundary case. Their taxonomy formalises the computational logics that underpin event ordering and timing in digital systems, offering a precise account of how time is technically produced and synchronised in games without treating play experience as the primary object of analysis. Placing this work adjacent to, rather than inside, the map makes two points at once: first, that infrastructural time is foundational to many of the system-leaning constructs we do plot; and second, that a fuller account of temporality in games will eventually need to connect play-facing constructs with the production, technical, and operational temporalities that enable them. While the main map centres on how time is framed in analysis or experience, video games remain digital artefacts (Igarzábal 2019; Byers 2025), and these infrastructural logics underpin how time is processed and experienced. Conversely, we consider the polarity inferred by the map for temporal theorising: What does time look like before the smallest moment of interaction, or

after it becomes a lifestyle experience? What would it mean to model time that is wholly defined by player agency, without any system-imposed cadence or restriction?

Overall, the map is best read as a way of arranging theories of time in play and games rather than judging them. Each construct frames time differently, for different purposes, and in different analytic contexts. Some focus on representation and storytelling, others on interaction and pacing, still others on social negotiation or scheduling. The map merely marks where work on time in and around games has been conducted, and suggests where it might go next.

LIMITATIONS

The map presented here is necessarily partial. It reflects a selective, predominantly Anglophone sample of work on digital games and interaction design, and it prioritises contributions that formalise time as named, reusable constructs such as typologies, frames, and vocabularies. Close readings, empirical studies of player practice, community taxonomies, and vernacular industry language around time – including talk of "lifestyle" or "black hole" games – are only lightly represented. The figure should therefore be read as a starting point for comparing formalised temporal constructs, not as a definitive account of how all researchers, designers, or players conceptualise time in play.

There are also limits to what a two-dimensional, paper-based map can show. Compressing a heterogeneous body of work onto axes of temporal control and temporal scale necessarily sidelines other meaningful differences – including genre, platform, business model, method, and historical context – and can make dense visual representations harder to parse at print size. Placements are interpretive, guided by how authors describe who or what organises time and what span of play is in view. They should therefore be understood as reasoned readings and not objective measurements, and some alternative placements would be equally defensible.

Finally, the current web prototype mitigates but does not remove these constraints. While it supports author-level plots and basic zooming and navigation, it still reflects the same inclusion decisions and manual placements.

FUTURE WORK

We see potential to develop the map further in ways that remain cartographic rather than prescriptive. Future iterations of the map will expand the construct set to better include practice- and industry-facing temporal vocabularies, alongside more explicit affective and ethical framings of time in play. We also want to move beyond a points-only representation by adding relational elements that show how constructs connect – for example through thematic linkages, conceptual lineage, and citation-informed influence. Ideally, we also seek an extension to the map in how time in play is named and theorised across other language traditions and regions, addressing the methodological limits of this first, predominantly Anglophone iteration.

CONCLUSION

This paper has mapped how a heterogeneous field of games research has theorised time in and around digital play. By treating each named temporal construct as a separate point and arranging them along axes of temporal control and temporal scale,

the map makes visible where existing theories converge, where they relate, and which parts of the conceptual space remain thinly populated. Rather than advancing a new master theory of time in games, the contribution is cartographic: a shared matrix and accompanying web prototype that offer researchers and practitioners to see how their own work sits in relation to others.

The mapping also underlines that time in play is layered and multidimensional. It is engineered through systems and infrastructures, negotiated through player practice, and embedded in wider routines, metrics, and media ecologies. Reading across narratological, systemic, agency-focused, embedded, and design-oriented approaches reinforces that these perspectives are complementary rather than mutually exclusive.

This project is deliberately open-ended, and as additional constructs are discovered and theorised, the map is intended to evolve over time. To Jesper Juul, we hope this mapping firmly resolves the concern that there was "very little theory of time in games", while provoking future work on the topic of time in play. To the reader, we hope finding this resource evokes a Hyrulian moment: the lid lifts, the music swells, and the caption reads: **YOU FOUND THE ~~DUNGEON~~ TIME MAP!**

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