Temporal Frames: A Unifying Framework for the Analysis of Game Temporality

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ABSTRACT

This article introduces the notion of temporal frames as a tool for the formal analysis of the temporality of games. A temporal frame is a set of events, along with the temporality induced by the relationships between those events. We discuss four common temporal frames: real-world time (events taking place in the physical world), gameworld time (events within the represented gameworld, including events associated with gameplay actions), coordination time (events that coordinate the actions of players and agents), and fictive time (applying socio-cultural labels to events, as well as narrated event sequences). We use frames to analyze the real-time/turn-based distinction as well as various temporal anomalies. These discussions illustrate how temporal frames are useful for gaining a more nuanced understanding of temporal phenomena in games.

Author Keywords

time, videogames, temporality, temporal frame

INTRODUCTION

Any formal analysis of games must account for temporality. One of the dominant experiential effects of games as a medium is the sense of agency induced by the player taking meaningful action, action that influences future events in the game. The very concepts of "action", "event" and "influence" require an account of temporality in games – the myriad ways that temporal structure informs gameplay.

Consider the different temporal structures in *Pac-Man*, *Civilization* and *Animal Crossing*. In *Pac-Man*, when the player eats a power pellet, a "special event" is triggered; for a limited time Pac-Man can defeat the ghosts that previously had been chasing him [12]. In *Civilization*, the number of turns the player has taken are mapped against a calendar [11]. According to this calendar, the game begins in 4000BC, before the Bronze Age, and can last through to the year 2100AD, although the player may experience this progression in only a few hours. Finally, in *Animal Crossing*, the passage of time in the game is mapped to the passage of time in the real world [14]. If the player turns on the game at 3:00am, he will find the village dark, with his diurnal neighbors asleep and the nocturnal ones wide awake and anxious for interaction. As even only three examples shows, any account of game temporality must be able to describe a broad range of phenomena. Concepts such as duration, actions and reactions, timelines, turn-taking, and calendars are just some of the temporal elements commonly seen in videogames.

Time

The literature on the philosophy of time commonly distinguishes Platonist and relationist understandings of time [13]. For the Platonist, time is like an "empty container into which events may be placed; but it is a container that exists independently of whether or not anything is placed in it" [21]. Thus it is possible to conceive of all change ceasing throughout the universe for a period of, say, one year. For the relationist, on the other hand, discourse about time and temporal relations can be reduced to talking about events and the relationships between them. Without change (events), there can be no time.

As a methodological assumption for analyzing game temporality, we have found it useful to assume the relationist view. This allows us to tie temporal properties to player-perceived state changes (events), as well as define multiple temporal frames in terms of different domains of state changes. Every game has multiple temporal frames such as, but not limited to, those established by: hardware level state changes, state changes within the gameworld, and state changes in the real-world context in which the game is being played. The relationist approach to time allows us to both isolate these frames and analyze the relationships between them.

Temporal Structure and the Experience of Time

Our work is situated in the context of the Game Ontology Project[1] (GOP), a hierarchical framework for describing structural elements of games [27]. The GOP generally brackets experiential and cultural concerns. However, perfect bracketing is not possible; structural categories often make (implicit or explicit) reference to experiential

[1] Further details are available at www.gameontology.org

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categories. This results in a tension between the phenomenological (experiential) and structural (descriptive) accounts of time in games. By adopting a relationist view of time, experiential concerns become manifest from the beginning, in the notion of state changes associated with events.

In the relationist view, all talk of time can be reduced to talk about the relationships between events, and thus to relationships between state changes in the world. Videogames execute on a computational infrastructure, in which the fundamental state changes are the billions (on contemporary hardware) of computational state changes happening per second. Describing events at this granularity would achieve maximal precision, but be incredibly onerous. Further, players cannot perceive events at the level of individual instruction execution; such an analysis would fail to provide a description of game time relevant to players and designers.[2] The execution of instructions in the processor is simply too removed from the player's experience. Discussing the temporality of a game requires that a player perceive events and relationships between events. Thus, the experiential category of perception is fundamental to a relationist account of time.

Experiential categories also play a role in both temporal cognition and the socio-cultural references that reinforce a temporal fiction. Most of our understanding of time is a metaphorical version of our understanding of motion in space [10]. Common metaphors include time flowing past a stationary observer (ex: time flies by) and an observer moving relative to stationary temporal "locations" (ex: we've reached September). Experiments have shown that people switch metaphors depending on the priming provided by spatial experiences [4]. Thus, the player's experience of time can potentially be manipulated or influenced through game design via explicit design of tasks that trigger specific forms of metaphoric temporal cognition. This experiential aspect can be partially captured in a structural framework by developing ontological categories for the various metaphoric relations between embodied spatial experience and temporal cognition. Though we have not yet developed these categories, within our framework this would result in a cognitive temporal frame primed by the performance of embodied, spatial tasks.

Social-cultural references can create a temporal fiction within the game world. For instance, videogames can use either the passage of time, or real-world units or dates, to influence the perception of gameworld time. A game that "takes place" in the year 1492 sets expectations and mediates our understanding of the events that occur in the game. Playing a game where rounds are labeled as "years" also changes the player's experience of time in the game; the experience would differ if rounds were instead labeled "days". Inappropriate labels can break the player's suspension of disbelief. If the turns in *Civilization* were labeled as "days", the game would be "unrealistic" because the player could build the Great Pyramids in mere days. Finally, gameworld events may be experientially "special" through their participation in a narrative structure. In the beginning of *Half-Life* [23], the player moves a specimen cart into a machine. This action triggers the disaster that plunges the Black Mesa research facility into chaos, and motivates the rest of the game. Viewed purely as a state change within the game world, this action is undistinguished from many other player-initiated state changes, like opening doors and firing weapons. However, this event is special in that the player understands that the game "happens" only because of that specific event; pushing the cart into the machine is the inciting incident for the rest of the game. In our model, we capture the experiential aspects of socio-cultural references through a temporal frame we call fictive time.

A deep understanding of temporality in videogames requires multiple simultaneous perspectives, including the purely structural, as well as cognitive and socio-cultural aspects of time. Our relationist approach to time makes it natural to define multiple temporal frames in terms of different domains of reference events. Though the Game Ontology Project is primarily structural and descriptive, temporal frames provide a vehicle for recuperating socio-cultural references and (potentially) cognitive aspects into the model through the introduction of frames specific to those aspects. An analysis of game temporality then turns on identifying the temporal frames operating within a game, and the relationships that hold both within and between frames.

TEMPORAL FRAMES

When playing a game, say *Kingdom Hearts* II [20], the player perceives many events. In the bedroom where the player is playing, the hands of a clock turn, street noises come in through the window, the player's breath moves in and out and her pulse beats. Her avatar navigates different game spaces, moving continuously within discrete named locations, between named locations, and flying in spaceships between worlds. Additionally, she engages in a struggle against the Heartless and Organization XIII, piecing together the complex story that relates these enemies to the player character. Relationships between events constitute time; it follows that all of these events contribute to the temporality of the game. Rather than developing a single "temporal domain" consisting of the set of relationships between all these events, we have found it useful to identify specific event subsets, define a temporality relative to that subset, and then identify interactions between the times established by these different event subsets. In the example above, we would place the events happening in the bedroom (and the player's body) in one set, those involving the action of the player's avatar in

[2] The hardware temporal frame is occasionally relevant. See the temporal anomalies section below.

another set, and those involving the story line in a third set. A set of events, along with the temporality induced by the relationships between events, constitutes a temporal frame.

Most games support multiple temporal frames that may overlap or occur sequentially. In the sequential case, different levels[3] or player activities may establish distinct temporal frames. Many *Final Fantasy* games, for example, have distinct temporal frames depending on whether the player is involved in combat or exploration. In combat, gameplay is segmented by rounds; the player has time to decide what actions to perform while everything else is in stasis. When exploring, the game's temporality changes; inaction no longer prevents gameworld events from happening, requiring immediate actions and reactions from the player. When addressing the temporality of a game, it is thus necessary to identify and contextualize the distinct temporal frames that operate in the game.

We have identified four temporal frames commonly relevant for analyzing videogames: **real-world time**, **gameworld time**, **coordination time**, and **fictive time**.

Real-world Time

Real-world time is established by the set of events taking place in the physical world around the player; in the case of videogames, this is commonly physical events happening in the room in which the game is being played, as well as in the player's body. These events establish a reference temporality outside of the game. This notion is more expansive than "play time", or the time taken to play a game [9]. Play time addresses the duration of a play session, but does not account for other temporal frame interactions, such as events in a game that depend on specific labeled times in the real world, or on the passage of specific real world durations.

The concepts of **cycle** and **duration** are two of the most fundamental relationships established between events in any temporal frame. A **cycle** is a sequence of repeating events, that is, a sequence of events in which a subset of the world repeatedly reestablishes the same state. **Duration** is measured by counting events in a cycle. We measure the length of time of a composite event, such as playing in a park, by beginning to count repeated events in some reference cycle at the event initiating playing in the park, stopping counting at the event terminating playing in the park – the number of repeated events we count is the duration of the composite event. In the real-world frame, such counting is facilitated by temporal measuring devices (clocks) that encapsulate reference cycles such as repeated pendulum swings or oscillations of a crystal.

Real-world durations (game world durations will be analyzed below) often play a role in games. For instance, many games establish their total duration, as well as any sub-periods, in terms of real-world time. A game might last ten minutes and be played in two halves of five minutes each. Alternately, a player may be allotted an amount of time to meet a goal. Many games use a visual representation, like a clock or counter, to communicate a time-limit, literally displaying a reference cycle to the player. **Triggers** are another mechanism for relating to real-world durations. A trigger is an in-game event performed by the player that initiates a countdown of real-world duration. An event may occur at the end of the countdown, or the game rules may change during the countdown. As an example of the former, in *Aliens vs. Predator*, the player triggers the self-destruct sequence of a military complex; she must make her way to an escape pod before it's destroyed [16]. As an example of the latter, eating a power pill in *Pac-Man* establishes a countdown during which Pac-Man gains the ability to eat the enemy ghosts. Triggered countdowns may be communicated explicitly via a clock (player knows the exact duration of the countdown), or implicitly, such as the ghosts turning blue during the triggered countdown in *Pac-Man* (player does not know the exact duration of the countdown).

Gameworld Time

Gameworld time is established by the set of events taking place within the represented gameworld – this includes both events associated with abstract gameplay actions, as well as events associated with the virtual or simulated world (the literal gameworld) within which an abstract game may be embedded. Some games have multiple gameworld temporal frames defined by selecting subsets of gameworld events. For example, *Wolfenstein: Enemy Territory* has a different temporal frame for each mission. Gameworld time applies to abstract games as well. *Tetris* has a gameworld temporal frame established by event relationships such as the time limit for making decisions about piece placement (before it is placed for you), or the triggering of a new piece falling upon the placement of the previous one.

The gameworld frame can establish its own notions of cycle and duration that are potentially independent of cycles and durations in the real-world frame. For example, many games have a day/night cycle that establishes a new duration measurement in terms of gameworld "days". Gameworld days may be used to add atmosphere to a game (but not participate in the abstract rule system), to establish a time limit (which may have variable real-world duration since the passage of "days" can be affected by player actions), or may play a role in gameplay rules. In *Knight Lore*, due to the transformation of the player-controlled avatar from human to werewolf, the day/night cycle directly affects gameplay [22]. Cycles are also used to describe the behavior of other entities in the gameworld, such as enemy guards who might endlessly walk a patrol path.

A gameworld has **liveliness** if gameworld events continue to occur even when the player is not actively participating in the world [8].

[3] http://www.gameontology.org/index.php/Level

Coordination Time

Coordination time is established by the set of events that coordinate the actions of multiple players (human or AI) and possibly in-game agents. Coordination events are the markers that regulate gameplay through moments of synchronization and coordination. These events typically establish periods of play, limit availability of the gameworld, and/or delay the effects of in-game actions. For example, **rounds** are often used as a basic unit of play[4].The number of rounds played can trigger in-game events (eg. reinforcements arrive on round three) or serve as a game goal (eg. win before round five or best of three rounds). **Turn-taking**, on the other hand, limits the availability of the game to one player at a time: you only act when it's your turn. Rounds and turn-taking often, but not always, appear together. In *Poker*, players are dealt cards each round and then take turns placing their bets. In *Monopoly*, players take turns rolling the dice and moving their game piece, but there is no broader unit of play. Sometimes the effects, or resolution, of the player's actions aren't immediate. In **tick-based** games, like *Age of Wonders*, players act simultaneously, but need to wait until all players complete their actions before a new round can begin [5]. In *Poker*, players wait until the betting is done before the winner can be determined. The basic blocks described above appear in many other combinations.

Other games use an abstract **timeline** for organizing the order of player or character actions. Depending on in-game attributes such as character speed, some characters may act one or more times before slower opponents. Actions can also be assigned a cost in action points [3], with points regained in succeeding turns. "Slow" or "Lengthy" actions may require a player to wait many turns before they can be carried out.

Fictive Time

Fictive time is established through the application of socio-cultural labels to a subset of events. Labeling the rounds in a game as "days" or "years" changes a player's expectations of the granularity of action that can be accomplished in a round. Such expectations are established by activating temporal schemata in a player's head, that is, cognitive scripts detailing default event sequences and relative durations. For example, *Guitar Hero*'s "career mode" relates in-game progress with the temporal schema of a rock star's career path: rock stars start as unknowns playing in small run-down establishments, gradually playing larger venues, and becoming more famous. There are many kinds of temporal schemata. *Guitar Hero's* career mode is cultural, while others, such activity/recuperation, relate to biological cycles.

Representational elements strengthen the fictive frame; labeling the rounds as days or years in a game like *Chess* fails to establish a fictive frame. But if a game includes additional representations that refer to socio-cultural labels, such as calendars, day/night cycles, and visual representations that correspond to changes in "seasons" or "centuries", a fictive frame can be established and reinforced.

Fictive temporal frames are also established by association with a historical narrative. Crogan's analysis of *Combat Flight Simulator 2* describes its gameplay "as play in and with a reconstruction of historical temporality drawn from the narrative modes of more traditional media such as historical discourse, historical archives, war films, and documentaries" [4]. The campaign mode of this game features missions based on conflicts of the Pacific theatre of World War II such that the fictive temporal frame in this game fosters player immersion and historical accuracy.

Games may contain narrated event sequences; within our framework, this is accounted for by borrowing the different temporalities described by narratology and employing them as specific subtypes of the general category of fictive frame. Specifically, narratology establishes a distinction between the chronological order of a series of events (story time), how these events may be narrated (discourse time), and the time of narration (narrative time) [7]. Collectively, these are the *narrative frames*. Narratology identifies these co-existing times and describes how the reader or viewer must actively reconstruct story time from what was represented in the discourse, for example, reconstructing the story event sequence from a discourse sequence that makes use of narrative effects such as flashbacks, flashforwards, etc.

Cut-scenes, character dialogue, flashbacks and other elements are often used to establish the narrative frames. The first-person shooter *XIII* includes levels with playable flashbacks depicting situations encountered by the player character prior to the main narrative of the game. Differences in audio, visual style, and character dialogue help the player understand she is playing a flashback of the main storyline. Narrative can also be established across multiple games. *Half-Life*'s expansions, *Half-Life: Opposing Force* and *Half-Life: Blue Shift*, are noteworthy because their fictive temporal frame situates them as occurring in parallel to the original game. In *Opposing Force*, the player controls a soldier charged with, among other things, neutralizing Gordon Freeman, the protagonist of the original game [25]. *Blue Shift* presents a third perspective of the Black Mesa disaster, this time through the eyes of a security guard [24]. The player deduces the relationship between the expansions and the original game thanks to shared events, locations, and fleeting glimpses and references of Gordon Freeman's exploits.

INTERACTIONS BETWEEN TEMPORAL FRAMES

It is fairly common for videogames to possess multiple temporal frames; common frame relationships include sequential frames (e.g. different frames for different levels), and co-existing frames (e.g. fictive and gameworld often

[4] We use the term rounds instead of turns to avoid confusion with turn-taking.

co-exist in a game). This section describes some of the phenomena that occur when multiple temporal frames interact in a single game.

Real-Time vs. Turn-Based

The most common temporal distinction made when discussing games is that of "real-time" vs. "turn-based" games. This distinction, often treated as a simple binary, actually masks a number related phenomena resulting from the interaction of multiple frames. The theoretical structure of multiple temporal frames allows us to unpack the primitive, binary distinction into a more nuanced collection of related phenomena.

As a player interacts with the gameworld, she physically manipulates a controller (real-world control events) in order to cause events in the gameworld. When, the player is allowed to cause gameworld events, we say that the gameworld is **available**. When there is no perceived delay between the control manipulation event (eg. button press) and the corresponding gameworld event (eg. character jump), her actions are **immediate**. In *Pac-Man*, the gameworld is **available** because the player is always allowed to move Pac-Man, and he moves **immediately** because there is no delay between input and action.

At times, perceptible events in the real world may not correlate with gameworld events, resulting in a "sluggish" or "non-responsive" experience. To the player, the experience doesn't seem "real-time" because of a lack of immediacy that wasn't part of the game's design. For instance, playing over a high latency network can result in "lag": an extension of the time between a player's input and a perceived gameworld effect. Some games explicitly use action delays. In the first-person shooter *XIII*, there is a noticeable, and constant, real-time delay between reloading a weapon and being ready to fire it again, decreasing the immediacy of reload actions. If there were such delays for every action, *XIII* would suffer from a loss of immediacy, and would feel less "real-time".

If, in the coordination frame, a game makes use of turn-taking, then the gameworld isn't always available [3]. This loss of availability is also seen in tick-based games, like *Age of Wonders*, where, though they can act simultaneously, players must wait for others in order to continue playing. Loss of availability makes games feel less "real-time" as well. Other games, like *Neverwinter Nights*, mitigate this by allowing players to plan and schedule their actions at any time, even ahead of the round-based timeline used in the game. Actions are executed one-per-round, with transitions between rounds determined by the passage of real-time.

Games like *Fallout Tactics* limit the amount of real-time available during rounds. Unlike "pure" turn-based games, a player's inaction is penalized when it exceeds a certain amount of real-world time. Other games, like *Mario & Luigi: Partners in Time*, though primarily turn-based, allow players to gain bonuses by successfully synchronizing button presses in real-time. These games manage to maintain a certain degree of availability despite being turn-based.

Liveliness also contributes to the sense of a game being "real-time". If the gameworld is not lively, then the player is able to stop taking action for indefinite periods of real-world time and have no gameworld events occur during this period. A game with high availability but no liveliness has some, but not all, of the temporal features we typically associate with a "real-time" game. *Final Fantasy XII* lets the player choose between two modes: active and wait. In active mode, the game does not pause while the player issues commands. In wait mode, the player has unlimited time to choose their next move. In this case, liveliness is decided by the player!

We propose that common distinction of "real-time" vs. "turn-based" is really the result of a number of distinct interactions between the gameworld, coordination, and real-world temporal frames. Identifying these distinct interactions helps gain a more nuanced understanding of the phenomena that are masked by this binary distinction.

Embedded Temporal Frames

Temporal frames can co-exist in a game by appearing sequentially, overlapping and coexisting. There is another way a game's temporal frames can relate to each other: embedding. This often occurs in games that have other games included within them, usually in the form of mini-games. An embedded game may have a distinct temporality that is still related to that of the main game. In *Shenmue*, Ryu can visit an arcade and play fully functional versions of classic arcade games [19]. The temporality of these embedded games is distinct, and independent, of *Shenmue's.* [5] However, the time spent playing them correlates with time spent in the main gameworld. Players often played the arcade games to "pass time" in the main gameworld, since certain places or events only became active at certain in-game times. In contrast, in *Grand Theft Auto: San Andreas*, when the player is playing the embedded arcade game *Duality*, time in the gameworld is "on hold" [18]. Playing *Duality* is equivalent to freezing the "outside" game and playing another one.

Fictive Frame Grounded in Real-World Time

Animal Crossing contextualizes its fictive time with respect to that of the real world. When the player first starts the game, she must enter the current real-world date and time. From that moment, the gameworld tracks time just as a clock in the real world would. The synchronization is such that by not playing on December 25, the player misses all the Christmas day in-game activities. The game also discourages the manipulation of the GameCube's system

[5] Hang-On and Space Harrier

clock. Whenever a change is detected, the player is chastised by Mr. Resetti, the grumpy mole, for her "temporal manipulation". Animal Crossing's nuanced relationship between fictive time and the other temporal frames makes it interesting to study.

Temporal Anomalies

The relationships between different, often co-existing, temporal frames within one game can result in a sense of temporality that is inconsistent, contradictory, or dissonant with our experience of real-world time. We call these relationships **temporal anomalies.**

Temporal Bubble

Temporal bubbles can occur in the sequential transition between temporal frames. If a game begins in temporal frame A, continues with B, and then goes back to A, there is a temporal bubble when, from the perspective of frame A, no time has passed during the activity in frame B. In *Grand Theft Auto III (GTAIII)*, the gameworld has a day-night cycle that correlates with the actions the player's avatar performs in the game [17]. However, whenever the player enters a building, time in the outside world "stops", regardless of how much real-world, fictive or gameworld time was spent inside the building.

Many CRPGs[6] have temporal bubbles when comparing the temporal frame of combat with general navigation and movement. In combat, regardless of how many rounds a fight lasts, when the player "returns" to the regular world, no time has passed. This anomaly is referenced explicitly in *Legend of Zelda: Ocarina of Time*,[15]. When the player first enters Hyrule Market, he is informed that while in that location, time does not pass "outside"[7].

Temporal Warping

Temporal warping occurs when at least two temporal frames overlap and there is an inconsistency between them. In order to eliminate the inconsistency, it is necessary to warp one temporal system (by compressing, expanding, etc.) to accommodate the other.

In *GTAIII*, it takes roughly the same amount of time to perform in-game actions like shooting or driving, as it would to perform them in the real world. However, the game has a day/night cycle that only lasts a few minutes of real world time. In-game actions take a proportionally longer fraction of a gameworld day to perform than they do in the real world. This anomaly also appears in games where there is a real-world time limit that is inconsistent with in-game time keeping. Juul describes a mission in *GTAIII* lasting 20 minutes of gameworld time, yet requiring 49 seconds of real-world time, with both times displayed simultaneously on screen [9]. This example illustrates temporal warping between the gameworld and real-world frames.

Non-Uniform Temporality

The temporality of a game is non-uniform when the passage of time is not evenly distributed across different temporal segments (coordination units). For example, in a game that is segmented into rounds, if, according to the fictive temporal frame, the duration of each round varies, there is a non-uniform temporality. In *Civilization*, each round initially represents 200 years. Towards the end of the game, they are only one year.[8]

Hardware Related Anomalies

Usually the hardware frame is irrelevant to player experience since hardware events are not directly perceived. Occasionally, however, the relationship between gameworld time and real-world time is not uniform across different hardware configurations. Many older videogames are unplayable on faster computers because the amount of real-world time taken by gameworld events directly depends on processor speed (the main game loop is not throttled). On faster computers, these games are unplayable because game entities move too fast. Another anomaly, slowdown, occurs when the complexity of the gameworld exceeds the capacity of hardware resources. In such cases, typically caused when there are two many objects on the screen, gameworld events take place in "slow motion" (take more real-world time than usual).

DISCUSSION

We build on prior work that has identified many important issues and key concepts related to time and videogames. The case for a specific analysis of time in videogames is made by recognizing that games have more possibilities for temporal structuring than cinema or live theater [26]. Aarseth describes how the player and his actions play a crucial role in realizing the temporality in a videogame. The players sense of experienced time is determined by the actions carried by the player together with the events enacted by the controlling program [1]. Other authors have examined ways in which time playing a game relates to the events in a game [2, 6, 9].

Bjork and Holopainen's Game Design Patterns share much in common with our work. They identify "Temporal" as one of the four categories of their game component framework (GFC) and describe how its components (which include actions and events), can be used to describe the flow of a game [3]. Like ours, their approach is event-based and relational. For example, they describe "Game Time"[9] as a sequential order of game actions that is potentially independent of real-world time. In the GFC, however,

[6] Computer role-playing games

[7] This also occurs in other areas.

[8] There is some variation on the exact number of years per round depending on the difficulty setting and other issues.

[9] A member of the structural, not temporal category.

issues of temporality are not gathered under a unifying concept like temporal frames. Their patterns mostly refer to issues coordinating player actions (eg: turn-taking and delayed effects) or describing how real world time can influence a game (eg: time-limit, power-up) with little emphasis on the fictive frame, or analyzing the relationships between frames. By identifying the temporal frame as a unit of analysis, we can explicitly study frame interactions, rather than making such interactions implicit in individual ontology entries.

Elverdam and Aarseth [5] identify two temporal meta-categories, External Time and Internal Time, roughly corresponding to our real-world and gameworld temporal frames, though some of their categories in External and Internal time refer to the interaction between these two frames (in our terminology). External Time has two categories, Teleology and Representation. Teleology is either finite (game ends at a specific time or after a specific duration) or infinite (game can go on forever). We handle this in our coordination frame. This frame, which is part of the Rules sub-hierarchy in the Game Ontology Project, explicitly deals with rule-based temporal subdivisions and limits. The Representation category can take on the value mimetic (time represented as flowing "the way time would pass in our physical world") or arbitrary (it's not). For us, time representation issues would primarily be addressed by the fictive frame (the various ontological categories in the fictive frame) and by analyzing interactions between gameworld, real-world and fictive time. Like us, Elverdam and Aarseth are interested in disrupting the binary distinction of "real-time" vs. "turn-based"; their Internal Time identifies three categories, Haste, Synchronicity, and Interval Control, which describe various phenomena normally lumped under this distinction. Haste corresponds to our category of Liveliness and Synchronicity to Turn-taking. We have no single ontological category of Interval Control; however, these notions (do players determine when the next game cycle will commence) are distributed over several ontological categories in coordination time. We plan on pulling this category out explicitly (and using the name Interval Control) as we continue work on temporal categories. Our analysis of the "real-time" vs. "turn-based" distinction (treated as the interaction between temporal frames), introduces the concepts of availability and immediacy, which are implicit in Elverdam and Aarseth's categories. Finally, two high-level differences in our approaches are our use of temporal frames as a unifying theoretical framework, and our use of descriptive categories with central and peripheral members (strong and weak examples), rather than analytic dimensions that take on a small number of discrete values.

Games like *Viewtiful Joe* and *Max Payne* allow the player to manipulate time as part of their gameplay (eg. slowing down, re-winding). We have begun a temporal frames-based analysis of time manipulation actions which we look forward to reporting in a future paper.

We have presented a relationist model for analyzing game temporality, introducing the notion of temporal frames as an analytic framework. Temporal frames allow the handling of disparate temporal phenomena under a unifying theoretical framework, and highlights that much of what makes game temporality unique is the presence of multiple temporal frames and the interactions between them.

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