The following sketches a theory of time in games. This is motivated by: 1) plain curiosity; 2) theoretical lack: much work has been done on time in other cultural forms, but there is very little theory of time in games; 3) the hope that a theory of game time may help us examine specific games, help trace the historical development of games, connect to the big question of how a game feeds player experiences, and generally serve as an analytical tool for opening other discussions in game studies and game design.

Most computer games project a game world, and to play them is therefore to engage in a kind of pretense-play: you are both "yourself," and you have another role in the game world. This duality is reflected in the game time, which can be described as a basic duality of play time (the time the player takes to play) and event time (the time taken in the game world). The relationship between play time and event time is, as we shall see, highly variable between games and game genres: action games tend to proceed in real time, but strategy and simulation games often feature sped-up time or even the possibility of manually speeding or slowing the game. Running counter to this, abstract games do not project a game world at all, and therefore do not have a separate event time.

The play-element of games is reflected in the way we discuss them: if we utter the sentence "Brian is a pig," this is usually considered a metaphor and an insult. A metaphor, since we would propose a transfer of our ideas of a pig to Brian as a person, and an insult, since this would cast Brian in a negative light. But as Ana Marjanovic-Shane describes, to say, "Brian is a pig" while playing a game does not describe Brian as person; it only says that in this play context, Brian assumes the role of a pig. Marjanovic-Shane describes this as a proposition about a fictive plane, rather than a proposition about reality. So computer games are much like the pretense-play of children (and adults); if we play the World War II game Axis and Allies, all our actions have a double meaning. We move a piece around a board, but this also means invading Scandinavia with our troops. We click the keys on the keyboard, but we are also moving Lara Croft.

The harmless statement "Brian is a pig" can obviously also be said of an actor in a play, but not of the audience: if Brian is watching the movie Babe, we don't say, "Brian is a pig." This means that when we talk about games, we assume a much more direct connection between the game and the player than we would in movies or novels, because games map the player into the game world.

My inquiry therefore proceeds from the belief that a game theory is best built not so much by plainly importing assumptions from other cultural forms, as by examining actual games. The primary focus here is on computer games (in a broad sense, including arcade and console games), but non-electronic games are also included for an historical perspective.

The theory primarily describes the relation between the linear, objective time of the player and the event time of the game world constructed by graphics and other cues. An obvious objection to this would be that because the playing of a game is a subjective experience, objective time is of minor importance. But this is a faulty assumption since the experience of time is strongly affected by the objective time of the game: game design and game rules work with objective time in order to create the player's subjective experiences. So examining objective time in games is, paradoxically, a way of understanding how the formal structure of a game feeds the more elusive player experience. The aesthetic problems surrounding "save games" are a prime example of this.

Finally, game time can be used for examining game history; the development of time in computer games can be seen as the interaction of two different base models: the adventure game that creates coherent worlds that the player must explore in a coherent time, and the action game that favors unexplained jumps in world and time by way of unconnected levels.
and rounds.

**Abstract games and the state machine**

To play a game takes time. A game begins and it ends. I’d like to call this time *play time*. Play time denotes the time span taken to play a game. As a first example, we may look at checkers. In abstract games like checkers or *Tetris*, it would seem that this was all there was to it: that we play games, that everything in the game happens *now*, while we play. In soccer - which is really just a physical abstract game - the same thing would be true. To draw a diagram of time in such a game is rather trivial:

When playing checkers, tennis, or *Tetris* it does not make sense to say that you are immersed in a world: they do not contain play-pretense. The more fundamental part of games is a change of state, the movement from the initial state (the outcome has not been decided) to another state (the outcome has been decided). To help understand this, we may take a cue from computer science, saying that a game is actually a *state machine*: it is a system that can be in different states; it contains input and output functions, and definitions of what state and what input will lead to what following state. You can move the piece from E2 to E4, but not to E5; if you are hit by the rocket launcher, you lose energy; if your base is taken, you have lost; etc. When you play a game, you are interacting with the state machine that is the game. In a board game, this state is stored in the position of the pieces on the board; in sports, the game state is the players; in computer games, the state is stored as variables and then represented on screen. In the rest of this article, I will be referring to the state of a game as the *game state*. When you play a game, you are simply interacting with the game state:

If you cannot influence the game state in any way (as opposed to being unable to influence it in the *right* way), you are not playing a game. The difference between a real-time abstract game and a turn-based abstract game is simply that in the latter case the game state only changes when the player takes a turn. In a real-time game, not doing anything also has consequences. Additionally, turn-based games do not specify the amount of play time that the player can use on a specific move. (Though this may be specified by tournament rules or social pressure.)

**Real-time games with worlds**

If we then play a real-time game like *Quake III* or *Unreal Tournament* we experience the duality described in the play section above: you are both "yourself," and a character in the game world. I propose the term *event time* to denominate the time of the events happening in the game world. In most action games and in the traditional arcade game, the play time/event time relation is presented as being 1:1. The frenetic *Quake III* is a good example of the urgency and immediacy provided by a real-time game:

*Quake III*

Pressing the fire key or moving the mouse immediately affects the world inside the game. So the game presents a parallel world, happening in real time:
SimCity

In SimCity we also find play time and event time. But what happens in the game - investing in infrastructure, building houses - happens faster than we would expect it to, were these real-life events. The event time depends on either explicit marks such as dates or on cultural assumptions about the duration of the game events. SimCity has both: we know that building a power plant takes more than a few seconds, and the interface displays the current date in the event time. Playing for two minutes makes a year pass in the event time/game world.

Mapping

The relationship between play time and event time can be described as mapping. Mapping means that the player’s time and actions are projected into a game world. This is the play-element of games; you click with your mouse, but you are also the mayor of a fictive city.

In this way, there is a basic sense of now when you play a game; the events in a game, be they ever so strange and unlike the player’s situation, have a basic link to the player. Games require at least one instance of the player interacting with the game state; so games that are not abstract also require at least one instance of mapping - one instance where the player performs some act, such as moving a piece on a board or pressing a key on a keyboard, that is projected as having a specific meaning in the game world. The moment of mapping is one that has a basic sense of happening now, when you play. Pressing a key influences the game world, which then logically (and intuitively) has to be happening in the same now.

As described, action games tend to have a 1:1 mapping of the play time to the event time. In some games such as Shogun: Total War, or The Sims, the player can select the game speed, thus specifying the relation between play time and event time. So the play time can be mapped to event time with a specific speed; the player decides how long a period in play time will map to in event time.

There is one extra point about the mapping itself; many games claim to depict historical events: Axis and Allies (about World War II) may be a good example, as may the computer game Age of Empires. In these games, the event time is assigned to a specific historical period. It is thus perfectly possible to play a real-time game that takes place in 15th Century France or in space in the 32nd. This can be indicated by something as simple as the text on the box (“The year is 3133”), or it can be something the player deduces from the game setting. The year specification
in *SimCity* serves the same purpose: so the play time can be mapped to event time with a specific speed and it can be fixated historically.

**Modern games with cut-scenes**

But not all event time is mapped from play time; it is quite common for the computer games of today to contain intro-sequences and cut-scenes. As an example we can look at the game *Giants: Citizen Kabuto*:

A cut-scene presents you with a setting or a mission

Playing the game

Having completed the sub-mission, you are rewarded with a cut-scene

The single-player game in *Giants* is a mission-based real-time game where each mission is framed by cut-scenes. Cut-scenes depict events in the event time (in the game world). Cut-scenes are not a parallel time or an extra level, but a different way of creating the event time. They do not by themselves modify the game state - this is why they can usually be skipped, and why the user can't do anything during a cut-scene. While action sequences have play time mapped to event time, cut-scenes disconnect play time from event time:
Interestingly, there is something of a convention that the play sequences use the full screen, while the cut-scenes are "widescreen," i.e. black bars are added at top and bottom. This presumably signifies "cinema," and also indicates the absence of interactivity. The wide-screen presentation cues the player to interpret the graphics using cinematic conventions rather than game conventions.

**The chronology of time in games**

Regardless of inspirations from cinema, time in games is almost always chronological, and there are several reasons for this. Flash-forwards are highly problematic, since describing events-to-come means that the player’s actions do not really matter. Using cut-scenes or in-game artifacts, it is possible to describe events that lead to the current event time, but doing an interactive flashback leads to the classical time machine problem: the player’s actions in the past may suddenly render the present impossible, and what then? So time in games is almost always chronological.

But one of the more interesting developments in recent years is that game designers have become better at creating games where things in the game’s event time point to past events. Modern adventure games tend to contain not only cut-scenes, but also artifacts in the game world (event time) that tell the player what happened at a previous point in event time. This is the basic detective game model. In Myst, books in the game world will also tell you of events that happened prior to the time of the playing, or at least outside the time that you can interact with.

**Adventure and Pong: coherent time vs. level time**

Many, especially newer, games are careful to craft the event time as being continuous, creating a believable world. In Half-Life, the entire game world is presented as coherent (even if it features teleports). When loading, this is indicated by the word "loading": the event time is described as continuous, but the play time is on pause while loading.

But on the other hand, many games are quite imprecise with event time. In the classical arcade game, the changing of levels is usually not described as making any sense in the game world; in fact arcade games tend to present several ontologically separate worlds that simply replace one another with no indication of any connection. One way to soothe the passage between two levels is, of course, to use cut-scenes. One of the earliest examples of this, from 1982, is Pengo.
Pengo: After level 2, penguins dance to Beethoven’s An Die Freude

This cut-scene does not actually make any kind of temporal sense; it does not mean that something happens in the game world, but rather presents a break between two separate worlds in the game; the timeline of both play time and game time are broken. Play time is not mapped to event time; there is no connection between the event time of the previous level and the coming level:

Similarly, in newer games like Quake III or Counter-Strike, the jump between different levels is not explained, and the display refers to the materiality of the game (“loading”/“awaiting gamestate”) rather than to the game world.

If we think of games as fiction or stories, these kind of abrupt jumps seem unwarranted and esoteric. So why these series of separate worlds without sensible connection? Tracing this historically, we can look at the 1977 game Space Invaders, since this game also features several levels: having destroyed all the advancing aliens, the player is simply presented with a new wave of aliens without any explanation. There is no clear relation between these levels. The popularity of this kind of incoherent time can be explained by way of the 1971 Pong: Pong is presented as a kind of tennis, and each session is played with several balls. Pong is structured like a meta-game consisting of separate rounds, but it makes sense here – this is, in fact, just like tennis. Space Invaders borrows the concept of rounds and projects a game world. So levels seem connected to the rounds found in sports and other pre-electronic games. This makes sense as an activity (in play time), but not when the game projects a world (in event time). But players do not seem to have any problems with such discontinuities.

Standard violations of game time

In addition to the lack of connection between levels in some games, there are also some standard violations of the play time/event time relationship. Since the play time is mapped onto the event time, pausing the play time should also pause the event time, bringing the game world to a standstill. The most common violation of this principle regards sound; in Black and White, the environmental sounds continue playing when the game is paused. In The Sims, the CD player you’ve purchased for your Sims continues playing when the game is paused. Space Quest has a rare but serious violation: Space Quest has several speed settings which then influence the play time/event time relation, making the player move faster on higher speeds. In one scene, acid drops falling from a ceiling have a constant speed regardless of the speed setting, and it is thus much easier to outrun the dangerous drops on the high-speed setting (example from Rau 2001).

Save games

So far, this discussion has been about time in individual game sessions, but adventure games and action-based exploratory games such as Half-Life require many game sessions and many saves to complete. In fact, the author’s playing of Half-Life included literally hundreds of saves and reloads. The same save games were reloaded many times until progress had been made.

Save games are manipulations of game time. They obviously allow the player to store the game state at a moment in play time and then later continue playing from that position. In retrospect, my playing of Half-Life is a combination of a multitude of small play sessions that
There are several arguments against save games, and all relate to the fact that save games allow the player to chop up the game time. First of all, save games are accused of decreasing the dramatic tension of the game, since the player simply reloads if something goes wrong. Another argument is that saves make the game easier or too easy. Both arguments could apply to my experience with Half-Life, since a large part of the game was played in a slightly disinterested save-try-reload routine. While save games make Half-Life much easier, it nevertheless appears humanly impossible to complete the game without them. And another counter to these two arguments is the immense frustration to be had if you are forced to replay an entire game level simply because you made a mistake at the very end. For example, the recent games Hitman: Codename 47 and Giants: Citizen Kabuto have been blasted for lacking an in-level save function (see Osborne 2000). A third argument is that the possibility of saving destroys the player’s sense of immersion. The fourth is Chris Crawford’s uncompromising position, that the need for save games is a symptom of design flaws:

Experienced gamers have come to regard the save-die-reload cycle as a normal component of the total gaming experience... Any game that requires reloading as a normal part of the player’s progress through the system is fundamentally flawed. On the very first playing, even a below-average player should be able to successfully traverse the game sequence. As the player grows more skilled, he may become faster or experience other challenges, but he should never have to start over after dying. [Crawford; in Rollings and Morris, p.80]

It seems that Crawford is thinking mostly about fairly replayable games rather than exploratory and adventure games, and in fact there are hardly any games that fit Crawford’s description of being completable in the first go and being replayable and interesting afterwards. Save games are probably not an evil to be avoided at all costs.

But save games are mostly tied to single-player games, and mostly to exploratory and adventure games. Persistent games such as MUDs or EverQuest only have one play time/event time, and the players do not have an option of saving the game state and going back in play time (i.e. they can’t save time, only things).

The experience of time

What I haven’t touched on so far is the question of subjective time: how the player experiences time in games. The objective, linear time described in the game time model feeds subjective time experiences. The experience is a product of both the play time/event time relation and of the tasks and choices presented to the player. Games are supposed to be, if not fun, then at least enjoyable experiences, but this is obviously not always the case: I’d like to invoke the concept of dead time: dead time is when you have to perform unchallenging activities for the sake of a higher goal. One example is that to progress in EverQuest or Ultima Online, you must spend hours or days doing mundane tasks such as walking, waiting for monsters to respawn, or even fishing or chopping wood. It makes perfect sense within the context of the game world but it is a dull experience - this is the dead time. You have to perform a specific task to advance in the game, but the task in itself holds no interest.

What makes a game interesting? According to game designer Sid Meier, a game is a series of interesting choices [Rolling and Morris p. 38]. This means that for every choice the player faces, there must be no single obviously best option; neither may all options be equally good; and finally the player needs to be able to make some kind of qualified choice within the time allocated to the task. Obvious choices make for uninteresting gameplay. The counter-argument to the idea of games as interesting choices is that in the author’s experience, some sequences bear repetition even though they contain no interesting choices. Repetition of a trivial task can even be hugely enjoyable - such as getting a perfect 100% score on the challenge stage in Galaga.

The concept of flow described by Mihaly Csikszentmihalyi can be used for shedding some light on this: Csikszentmihalyi claims that flow is a mental state of enjoyment shared by people in a variety of situations, such as rock-climbing, chess-playing, and composing music. Flow has eight key traits, two of which are clear goals and feedback (very game-like!). The flow experience also alters the sense of duration: “Hours pass by in minutes, and minutes can stretch out to seem like hours.” [Csikszentmihalyi, p.49] To reach a state of flow, a game must be neither too hard (which leads to anxiety) nor too easy (which leads to boredom). This means that the experience of time is tied not only to the play time/event time relation and to the challenges provided by the game, but also to the relation between game difficulty and player ability. This creates some design problems by itself since players have varying skills. There are then a variety of ways to deal with this such as skill settings, training missions, handicaps (in multiplayer games), and secret areas to explore (letting the good player experience more). The player’s options of changing game speed on the fly in the aforementioned Sims and Shogun...
also affects the difficulty (and thereby the cognitive effort needed), allowing the player to select a game that matches his or her skills.

According to the flow framework, the player will only enjoy playing if the challenges match the player’s abilities and thereby lead to a state of flow (the player loses the sense of objective time - time will fly). If the game is too hard, the player will experience anxiety or frustration. If the game is too easy, repetition or triviality of choice will make time be experienced as unimportant, dead time (time will drag).

Flow is a compelling angle on games, but it does not explain everything: David Myers has noted that the fascination of mechanically repeating trivial tasks in some games contradicts flow - repetition should lead to boredom but doesn’t always. It also seems to me that frustration is a more positive factor than in Csikszentmihalyi’s description, since frustration may actually motivate the player to improve in order to escape frustration. Finally, flow can only explain games as a challenging activity in play time but ignores the projected world, the event time.

A history of game time

Time in games has become increasingly complex and varied during the history of the computer game, but it is a development that moves in two directions. The root of games in play time allows them to define their worlds much more loosely and less coherently than we would accept in most other cultural forms. At the same time, the continued developments in processing power and data storage make it possible to craft event time with increasing detail and precision. These two directions can be traced to two original computer games: the round-based, sports-like game of Pong (the action game) and the world-creating, explorative game of Adventure (the adventure game).

One of the biggest changes in computer game history is the movement from being primarily played in arcades to being primarily played at home. One of the selling points of the original Pong machine was actually "Ball serves automatically" - the economics of publicly available arcade games demanded that arcade game designers create extremely short (real-time) game sessions in order to have more players insert coins. The home game has made possible games of longer duration, save games, slow games... in fact, more varied game time.

On a historical note, traditional board-, sports- and card games tend to be quite abstract, whereas computer games mostly project worlds. Though card games in some sense present a third option since the cards are, at least historically, assigned symbolic meanings and are therefore neither abstract, nor world-projecting. Chess is, depending on your interpretation, probably symbolic and somewhere between abstract games and non-abstract games: it is possible to see chess as two societies at war (even if it isn't "realistic"), but it would be very hard to interpret chess as specifying event time; that the moving of a rook would "really" take three hours in event time. This is because event time needs to be created by textual and visual cues, and chess is very low on these.

The main difference between the computer game and its non-electronic precursors is that computer games add automation and complexity - they can uphold and calculate game rules on their own, thereby allowing for richer game worlds; this also lets them keep pace. So computer games create more worlds, more real time, and more single player games than non-electronic games. (The combination of automation and pace essentially paved the way for the real-time strategy game.) Games with pace seem to be more compelling, or at least more immediately appealing, than turn-based or non-pacing games.

But as always, new forms do not simply annihilate the older ones. Some of the strangest play time/event time mappings can be found in modern pinball games, whose basic rule continues to be "hit all the flashing things," but this is now augmented by a small display sending the player on "missions." The 1993 Star Trek: Next Generation contains (among others) a "destroy the asteroid" mission, where an asteroid threatens "the ship," and it is the player's job to destroy the asteroid... by hitting a flashing thing with the ball. There is no way that we can believe in a connection between the player’s shooting the ball around and the story happening on the display, but it does not seem to matter.
Conclusion
This article has described some fundamentals of time in games. The duality of play time and event time appears basic since it is a basic play relation. As shown, the time model proposed here can be used for examining variations in the worlds constructed by different games; it connects to the player’s relation to the game, and it can be used for thinking more broadly about game aesthetics. It is also a strong genre indicator, and an essential part of game history. A further step would be more detailed examinations of how game time is constructed through manuals, visual and acoustic cues, and gameplay. Much work is also needed to understand how game time and gameplay create player experiences.

When playing a game that projects a world, the player is (or the player’s actions are) mapped into the game world in a very direct way - this is the play element of computer games. A more open question is whether this means that we long for the virtual reality dream of being completely immersed in games. Many of the games mentioned here work against the idea of immersion, since their discontinuous times and worlds point strongly to themselves as being games rather than believable fictional environments. This, however, does not make them any less enjoyable. Games do not need to make sense to be fun.

Looking at the terms and diagrams in the text above should not make us forget how incredibly quickly we grasp the complexities of game time when playing. The question “When was the power plant built?” has two answers: July 2001 and September 1934. Doing several things at the same time, acting both here and in a fictive world, comes naturally to most people.

Even so, this duality has been the source of much theoretical confusion: Computer games are easily described as being either actual player action in real time or as projected worlds. But as indicated by this study of time in games, they are, mostly, both.

Notes
1 In the play perspective, computer games have several unique traits, one being that play works by projecting actual objects into a fictive plane (such as saying, “This mouse is a spaceship.”) A common problem when playing is that the real objects do not have the properties to simulate what they are supposed to represent, i.e. the mouse does not actually fly. It may not matter that much, since it is then possible to say, “The spaceship is flying,” but the objects used (the props) are unable to simulate this on their own. In other words, play is good at producing any kind of world, but has problem with consistency. (Computer) games are much better at providing consistency, but they cannot easily create the worlds that play can: the subject matter of a game has to be formalized and created as rules before the game can start.

2 See Juul, 2001 for a discussion of the problems of using narrative theory in the study of games. To briefly compare, my concept of play time is in some ways related to the narratological concept of discourse time; my concept of event time is comparable to story time. (As defined in Chatman 1978.)

3 On a technical note, most games are discrete, finite state machines; meaning that the ball is objectively either in or out, and that there is a limitation to the number of possible positions (this is in games such as tic-tac-toe, chess, or Quake). Sports are basically analog, infinite state machines; meaning that the ball may be in any number of positions between in and out, and that there is no limit to the possible soccer matches that can be played. Sports often have an umpire to decide in doubtful cases, since there may be argument about whether the ball was in or out. This doesn’t happen in chess.

4 The play time/event time relation depends somewhat on the familiarity of the game events. The real-time strategy game StarCraft (1998) is set in space, and the player doesn’t have strong expectation for the speed of the units of the Zergs or the Protoss: the speed selection is consequently not described in relation to the play time (such as “twice as fast”), but simply named “normal,” “faster,” etc.

5 Flash-forwards can be included as indicating something either outside the player’s influence or something that the player has to fight to reach. (This then ceases to make sense as a flash-forward, if the player doesn’t reach it.)

6 This kind of paradox can be found in Max Payne (2001) where the game simply restarts the flashback level if the player fails.

7 The prevalence of unchronological time in traditional narratives is afforded by the fixed nature of the events. Since the story in a sense has already happened, the events can easily be presented in non-chronological order for aesthetic effect.

8 Donkey Kong is a year earlier (1981) and features cut-scenes that actually make sense in the game world.

9 Rau’s interpretation is that this incident in Space Quest destabilizes the notion of event time; I...
think it has the appearance of a mistake and so rather confirms the idea. While I think it is perfectly possible to deliberately create such clashes and illogic, I do not think it is the case here.

10 And then again, the joy of winning correlates positively to the amount of frustration experienced on the way, but the general trend from the 1980s till now is to make games easier or at least more tuned towards giving the player many small victories and fewer long stretches of frustration.

11 Age of Empires II (1999) is one of the few multiplayer games to contain a save function. This obviously requires a bit of cooperation and communication between players.

12 In an interview, game designer Starr Long comments on the dead time in such games:

> Up until now, we've been building these big, giant virtual worlds. And we like to brag about, "Oh, it takes four hours to walk from one end of the continent to the other." Somewhere along the line we lost that it's not really fun to walk for four hours. That's why people don't do it a lot. Imagine if I could go from doing one fun thing to another fun thing without this big dead time in between, where I was either getting lost because it's hard to find my way around, or I get killed on my way and have to start back over. [MacIsaac 2001]

13 This is a simplistic description of computer game history, but the 1980s term "action adventure" captured the marriage of action with exploration. The third major influence on computer games is probably board games, particularly strategy games. Card games do not seem to have had a significant impact on computer games. (Most likely because they are the only major non-spatial game genre, whereas computer games are almost exclusively spatial.)

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EverQuest. Verant Interactive; Sony Online Entertainment, 1999.
In my opinion, playing computer games is not a waste of time. I feel this way basically for two reasons that I will explore on the following essay. To begin with, playing videogames can develop one's overall knowledge and culture, which are two things kids seek but are difficult to achieve in some more traditional and passive manner like books or classes. On a more engaging and interactive scenario, computer games have a much more appealing approach and can be a much more easy and pleasurable way to teach the often curious mind of a child. My own experience is a good example of this. In conclusion, I strongly think computer games are not a waist of time, specially for children. This is because it can help improve one's culture and knowledge and it can improve people's cognitive system. It takes a special kind of game to get temporal mastery just right. Many games involve time travel in one way or another, letting you warp back to the past or leap into the future. But today, we're looking at those games that make time-warping an actual gameplay mechanic--so classics like Chrono Trigger, The Legend of Zelda: Majora's Mask, and Timesplitters: Future Perfect aren't eligible, despite their excellence. Despite all the sequels, playing around with time travel is at its best in Super Scribblenauts for DS. Hopping into a Time Machine will whisk you away to the age of dinosaurs, ancient Egypt, medieval times, the Wild West, or a Terminator-style future. Outta time. Did your favorite game featuring temporal shenanigans not make the list?