Conclusion

This study has examined the manifestation of two ancient human preoccupations in the contemporary media landscape: time and play. Play, like any other activity, unfolds in time. For the act and cultural artifacts of play to be fully understood, it is crucial to elucidate the mechanisms of time perception. Only a few decades ago, interactive computers entered the scene and, with them, the medium of the video game was born—which gave way to a novel mixture of games and storytelling. The capacities of computers to simulate systems and display interactive moving images were rapidly assimilated as means for the creation of games that could not exist in the physical world (think of SPACEWAR! or TETRIS) and fictional worlds in which players themselves can act as protagonists.

Our sense of time has shaped these new cultural artifacts and given rise to gametime: a simulation of time as it behaves in the Middle World in which our perception evolved, but with some characteristics of its own—it can be paused, reset, reversed, slowed down, and accelerated. Gametime, as this study has shown, relates to time perception in two ways. On the one hand, it conforms to the limitations of the human cognitive apparatus. Accordingly, gametime is neither too fast nor too slow, and it does not follow the laws of relativity or quantum mechanics, but the laws of physics as they manifest at the scale our minds can perceive. On the other hand, gametime can behave in ways that enhance and manipulate our experience of time, offering a new set of possibilities.

In light of this duality, I examined gametime from two complementary angles: the formal analysis of video games and the cognitive science of time perception. By bringing together these perspectives, the above pages have shown how time perception shapes the medium of the video game, and how the medium can, in turn, manipulate our perception of time.

Formal analysis has helped uncover the basic constituents of video games that determine their temporality. Drawing from work on gametime by game studies scholars as well as my own observations, the typology of temporal struc-

tures (section 1.2) divided gametime into its fundamental components. Three different aspects of gametime were classified in three categories: how events unfold on the mediated layer (change of state), how they are arranged in the gamespace (space-time), and how they are delimited by systemic boundaries (conditions). Some of these features of gametime were scrutinized in more detail in subsequent sections, uncovering three main points of friction. First, I discussed the use of triggers, which leads to player-centric gametime. Events can clash with our causal intuitions if they are portrayed as independent of the player character's presence yet rely on their proximity to unfold. In the case of open world games, triggers provide players with the freedom to explore while the story waits for them to resume. This elicits the problem of freedom vs. urgency. Second, I addressed a temporal paradox brought about by the Groundhog Day Effect, which occurs whenever players go back in gametime and replay a segment of a game with knowledge of the 'future.' This leads to a knowledge gap between player and player character. Some possible solutions were described, though most of them address the problem only partially. Third, I discussed the issues that can arise with the implementation of verbal narrators. In a medium where players can make decisions that affect the unfolding of events, the implementation of a narrator can be a challenging task. I have argued that a hybrid narrator emerges from the combination of retrospective and real-time narration, which fits the blending of play and storytelling.

Throughout a significant part of this study, I have analyzed the temporal characteristics of video games through the lens of time perception, as understood by the field of cognitive science. Theories put forward by experimental psychologists, neuroscientists, linguists, and philosophers have been of the utmost importance to this study. The concept of apparent motion explained how the experience of a moving image arises from the rapid succession of frames—a fundamental aspect of gametime. The construction of the present moment addressed the properties and limitations of our experience of time—limitations that shape the design of video games. The mental connection between space and time—illustrated by language (for example, the ego-moving and time-moving metaphors) and spatial representations of time (calendars, hourglasses)—was the basis for the space-time category in the typology of temporal structures, which analyzed how gametime can be organized through the gamespace.

But our minds do not just process raw information that the senses gather from the environment. They also rely on assumptions to extract meaning from the world, as in the case of causation. Video games tap into the mechanisms that govern our sense of causation, described by the theory of force dynamics. The events that take place in gamespaces are structured by causal relations that play-

ers must elucidate in order to reach their goals. The freedom vs. urgency problem is a mismatch between our causal intuitions and the fact that events in open world games typically do not unfold unless players explicitly initiate them by actively starting quests. The theory of action-oriented predictive processing showed how Grodal's aesthetic of repetition works at the mental level by combining prior knowledge with sensory information to create a model of the world. The accumulation of prior knowledge allows players to act on the basis of models and rely less on incoming sensory signals, which allows for faster and more precise reactions. The mechanics and aesthetics of bullet time were also examined through studies on the experience of time in life-threatening situations.

This study has also demonstrated that video games can affect time perception. They can accelerate or decelerate the passage of time, and influence the temporal frame (past, present, or future) in which players focus their actions, which impacts player behavior. The deeply engaging state of flow explained why hours can fly by while playing video games. The psychology of self-control, based on our experience of time, was shown to be a central component of many video game genres—especially those which involve the administration of limited resources, such as survival horror. I have also argued that setting expectations influences the player's behavior and experience of the game. These expectations can be used to create suspense, as well as misdirect and challenge players.

All of these aspects have expounded the many ways in which gametime contributes to the captivating interactive experiences that have players fixed to the screen for hours on end. Therefore, to fully comprehend the medium of the video game, it is of paramount importance to analyze it through the lens of time perception.

THE TIME WE WANT

With the capacity to create interactive worlds, we also have an opportunity to shape them in ways that please us. Our cognitive apparatus constrains our cultural artifacts, but our creative imagination and technological prowess take us to fictional worlds where the rules of Middle World can be twisted and turned in creative ways.

In this fashion, gametime behaves less like a tyrant and more like a genie who can make our wishes come true. Would you like death not to be final? Granted. Do you want to fast forward through this boring sequence? Sure thing. Is this experience too overwhelming? Pause time and reflect. Are you not ready

to face a particular challenge? Take your time and start it whenever you feel prepared.

The malleability of gametime grants game designers and storytellers fascinating new tools to work with. At the same time, it constitutes a profound challenge for those who wish to create cohesive fictional worlds and make players feel responsible for their actions. In this context, perhaps the most significant victim is the genre of tragedy. After all, tragedy rests on the inexorability of the passage of time. Events, as they transpire, must be deeply lamentable and final. Jesse Schell expressed his worries on this issue in a talk at the Game Developer Conference (GDC) in 2013. He stated that

> "[tragedy is] not really a thing for us [game designers]. If we're doing an interactive Romeo and Juliet, what happens? Oh, my God, she died! Well, let me go back to the checkpoint, we're gonna fix that up (…) I'm not saying doing tragedy is impossible in video games. It's just hard" (Schell 2013).[1]

The power to bend time comes at a high price if it deprives the medium of one of the most memorable forms of art—the one epitomized by the works of Sophocles and Shakespeare. The section on the Groundhog Day Effect explored a possible solution in which games like HEAVY RAIN do not allow players to reset the timeline—the *deal with it* category. Nevertheless, even this workaround cannot stop players from starting a game anew or watching gameplay videos of alternative endings.

Games can also combine linear storytelling with interactive gameplay, funneling the player's actions into one single ending through narrative segments—such as cutscenes. Some, like Schell or Crawford, argue that the medium is not being used at its full narrative potential in these cases. In their eyes, this approach does not constitute a solution to the problem, but it is rather a part of it. It might be the case that video games will not be able to solve this issue. Perhaps they should simply embrace the malleability of gametime—making the most of what sets video games apart from other media.

Whatever happens, the future ahead of us offers promising avenues of exploration that could take gametime in novel, fascinating directions. If there is one conclusion from this study for game scholars and designers alike, it is that time perception is a constituent aspect of our interaction with video games. Our experience of time is malleable but dependent on a constrained cognitive apparatus that is constantly making assumptions about the world. Understanding how we

1 See also Schell 2008, p. 269-270.

arrive at time is crucial to appreciate the present and shape the future of gametime.

Our ability to predict future events is too limited to tell us exactly what new developments the medium of the video game will bring about. For this, we have no choice but to wait and see. Only (real) time will tell.