

Chapter 4: Lagging Realities

Temporal Exploits and Mutant Speculations

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How long does the beachball spin before you hard-reset your computer? Detecting the difference between a lag and a crash has become a fraught problem for everyone involved. Of course, our tolerance for different forms of delay changes historically: browser loading, phone dial tone, email response time. We adjust and readjust to them.

There is an early passage in Ellen Ullman's book *The Bug* (2003) in which the programmer protagonist is standing in a checkout line while the cashier rings out the purchases. Buttons press, numbers appear on display, chime, repeat, door open. There is a second-long delay between button pressing and the number display, however: a brief lag. The programmer realizes that this is a bug she never could track down fifteen years earlier and that the bug still exists, causing this unneeded lag. She meditates on how pervasive such delays are in our lives, how inevitable and unconscious they seem to us. A life of little waits, a real life of lags.

Lag often seems to be something we wait on, putting us on pause, while it does something in the background—like a traffic jam. We habituate to lags, up to a point. Adjustments are themselves lags: the time of adjustment. We often normalize them to ourselves and declare that others who adjust more slowly are lagging, therefore we are adjusting properly = no lag. But experienced time itself takes the form of durations, chunks, in which the chunking itself is the material of the experience. Just pause, for a moment, on all these lags: the time it takes for a cable box to switch channels, the phone to get a dial tone, a website to actually show up, your phone to switch gears, a friend to answer the phone, a student to turn in a paper, or a colleague to answer an email. What is lag and what isn't?

Lag is usually invoked when a delay is perceived as *too long*, calling attention to our own now frustrated anticipation, the speculation we didn't necessarily know we were involved in. The event is not proceeding as planned. If it is slowness, then it can be accounted for, anticipation reduced to calculation. Irritating when you don't know how long to wait. Psychologists have helped us program our devices to settle us down: the difference between the "Don't Walk" light that you wait impatiently for and the one that counts down. The difference with the countdown is

the direct interpolation of time into the equation. Is there anticipation when you know *exactly* how long you have to wait?

Everything takes time. This seems a banal truism, but there is much more in it than we first suppose. The time that things/actions take is sometimes visible, but often not. When visible and noticed, we sometimes, like Ullman, see it as a mistake. We become sensitive to what we feel are unnecessary delays. We might call these lags. Something that could be corrected. Time saved. Literally, we have saved time from the monster of waste. In these cases, we embody a capitalist time that seems to be the opposite of speculation: we should not have to wait for the future!

The desire of technologics, like that of the dual inheritors of rationalism called capitalism and science, is to obliterate the delay. Everything should be instantaneous and always the newest of the new—and, thus, the uncanny and its pluralized proxies. The just-in-time inventory of absolute information should be always at hand, at the click of a button, at my beck and call, so that there can be a quick turnaround. Waiting should be outlawed. (Kochhar-Lindgren 2005: 185)

Of course, this is not true at all. Capitalist speculation *depends* on futures and delays at the technical and social levels. Analyses from science and technology studies of corporate speculative power and reflexive market creation that draw upon and reinforce existing inequalities have investigated these speculative dynamics in genomics and biomedicine (Fortun 2008; Thacker 2005; Cooper 2008; Sunder Rajan 2006), pharmaceuticals (Peterson 2014; Dumit 2012; Sunder Rajan 2017), finance (LiPuma/Lee 2004), and security (de Goede 2012). Analyses of positive uses of speculation are rarer but include affirmative speculation (uncertain commons 2013), the affordances of glitches and delays in digital culture and gaming (Krapp 2011; Boluk/Lemieux 2017), and cultural resistance and invention (Moten 2003; Bhabha 1991).

Whereas Kochhar-Lingren and others (e.g. Lampert 2012) treat delay as something to universalize, asking about its ontology and its philosophical implications, in this chapter I am interested in the shared speculative experiences of lag. What happens when lags are persistent, when we encounter them as things we have to creatively adapt to? How do they in turn warp reality by warping time to be lagged time—never lagged-time-in-general, but always specific forms of lag? The empirical question is never: What is lag? Or much less: Is this lag? But rather: What kind of lag-time is this?

To study lag, therefore, to make it a method, we cannot start with a concept of time, of timescapes—or even of lag—but instead we follow where and how “lag” shows up, where it *must* be put into speech, how and where it becomes a matter of concern, a material-semiotic actor named into existence that has the potential to

warp existence and time itself. My technique for following lag is that of empirical philosophy (Mol 1993)—following how “lag” is enacted in its naming—and substance as method, investigating how each lag is worked on, made into a substance that often transforms worlds by becoming its own form of time (Dumit 2020). In this chapter, I use thick description to treat texts (written accounts in textbooks, websites, chats, news) ethnographically for how they use lag to make lives. Lag, delay, latency, synchrony, etc. are all seen as active constructions—forms of time that are being tamed and strategized, even as they structure what one can do, how one can speculate.

Even basketball, like most competitive sports, can be looked at this way. There is a clock keeping track of game time, it counts down from twelve minutes to zero each quarter. But there are also actions that stop the clock, that lag the end of the game, stretching it out. These actions are part of the game but they can also be (perceived to be) abused, to the point where the rules committee has to institute new sanctions: “delay of game” penalties to prevent the lag strategies from overtaking the “proper” game strategies. At one point, a dominant player, Shaquille O’Neal (Shaq), was also a very poor free-throw shooter. A strategy against him developed: foul him repeatedly, bumping him, hitting him. “Hack a Shaq,” it was called. Each foul stopped the clock, giving him the opportunity to shoot two free throws—which he would often miss, giving the hacking team the opportunity to get the ball back. As this strategy spread, new types of players were identified: those who can almost always make free throws (and who were now put onto the court in certain circumstances), and those who cannot. The examples can be multiplied, but the point is that the attempt to make a game fair within time depends on implicit lags that can be made explicit and warp the time of the game, making it unfair in unforeseen ways.

This may seem banal, but what fascinates here is that inside of every shared time is also a set of lags that can become actionable. They unshare the time. They recompose game time to the point where it becomes legitimate, over and over, to ask: What game are we playing? What time is it? What is happening? What happened to the time? And how to do things with lag?

Even as it slows things down, each lag (experienced as such) invents a kind of future: it provokes a sense that the future is being interrupted, that something is getting in the way of the smooth unfolding of time. This frustrates the forward rush, yet it presents unexpected opportunities, soliciting anticipatory practices that, by playing with the temporal disruptions, also try to exert control on *the future*. Each lag, by delaying a future, itself produces new ways of speculating: accelerating and even inventing some futures at the expense of others. In this chapter, therefore, we follow specific lags that have had transformative and disorienting effects on digital finance, games, and life, conjuring into existence new forms of temporality, creating new kinds of time. I dwell on gaming, in particular, because

I have been studying it as an anthropologist, and because lag is a continual explicit challenge to both game designers and players. Among other things, games are pastimes: many are literally designed and used to pass time, to lag life, until something else happens. Gaming thus offers a deeply reflexive site for noticing how lag is made into opportunity.

Lag Is a Bug, Lag Is a Feature

The delay that Ullman noticed does not mean that once it is fixed there is no time taken. Just normal delay = no lag. Or rather, no lag that matters ... until it does. Financial speculation, markets, depend upon information but also time. You can know more about what is going to happen, or you can know about it sooner. Both are advantageous in reducing the risk of your bets. Stock markets are full of spatial and temporal lags, small differences in prices between two markets that can be arbitrated, or the actual minute or microsecond delay between price changes and information about those changes. These are constant targets of algorithmic, network, and hacking exploitation that manipulate a presumed equality of speculation time (MacKenzie 2015, 2017; Hayles 2017; Miyazaki 2013).

Fidelity Investments, a behemoth financial services company based in the U.S. that holds my retirement funds, once sent me an email in 2011 pointing to their webpage on “Preventing Another Flash Crash.” The webpage explained that, although it might look like they were up to something nefarious, they were just being competitive by “leveling the playing field for all market participants”:

Co-location facilities: Orders from data centers that are physically located near exchanges can shave milliseconds off of the time it takes to complete a trade. Being faster than rivals to the best price—that is, having the lowest “latency”—is an advantage that some traders seek in today’s markets. Regulators are concerned that these facilities may give trading advantages to professional traders and thus disadvantage regular retail customers. (Fidelity Investments 2011)

This is Fidelity telling me not to try and trade on my own. They automatically lag less, and I have no chance. The truth was far worse, though.

The financial speculating act is often presumed to operate without delay, yet all speculations are a kind of exchange that takes time. Even for computers, time is materialized in chunks that are defined by its internal clocks and by the built-in sensors that make up *moments* of incoming and outgoing signals. The entire point of having a clock was to keep the variations in signals *in time*. Lag was only noticed when it was too long, when signals didn’t arrive *on time*. Otherwise, moments were standardized and variations within them didn’t matter. Speculations

didn't take lag into account, at least, until a way was found to exploit it, to turn it into the difference that made a difference. A difference that mattered—materialized delay that became a new *kind* of speculation.

In 2015, Brad Katsuyama explained this transformation. He recalled that, back in 2006, a trader would see on his screen that there were 100,000 shares available on an exchange for a specific price, hit a button, and purchase them all. By 2007, however, the trader would only end up purchasing 80%, and by 2009, only 60%. This turned out to be because his one order would be divided up into four different exchanges, essentially server farms located in physically different buildings in different areas of New Jersey. Each 25,000-share part of his order would take a different amount of time to get to the four exchanges, depending on how much further out they were. Compared to the first exchange, the sixty-mile distance to the final exchange would take an additional two milliseconds for the order to arrive at it. Two milliseconds may seem fast (an eyeblink takes 300 milliseconds), but some high-frequency traders (HFT) had built special fiber optic cables that could race ahead four times faster (476 microseconds). These cables ran in a straight line rather than following the railroad tracks. *What had once been fast was now a significant lag.* The HFT computer could now see that someone had purchased the 25k shares and block them out of the other ones before their order arrived, forcing them to buy it at a higher price. *This was called "latency arbitrage," taking advantage of the fact that information, even at the speed of light, takes time to travel and can be outraced* (Katsuyama 2015; cf. Lewis 2014).

Many financial exchange institutions had morphed from the marketplaces where the trades take place—a kind of neutral institution that would take a small fee from each transaction for providing that neutrality—into time brokers, selling new forms of speed for extraordinary amounts of money. They sold “fast data,” access to data with less lag. “Why do people pay hundreds of millions of dollars for the technology to be right next to stock exchanges? Because it gives them the ability to trade hundreds of times, thousands of times, before that same piece of information makes it to the last person” (Katsuyama 2015).

The standardized lag of clicking contained within it not just delay but its own form of time. This was truly insider trading, trades taking place inside the time of speculation. This warped the very possibility of previous kinds of speculation: now you couldn't speculate because you would always be late, always lag behind those who paid for the new time. Speculation here created the need to talk about microseconds and then nanoseconds: new forms of financial time that now mattered.

One brilliant response by a Canadian group was to create a new kind of exchange, one that aimed not to race time but to freeze it:

What we've done at IEX is we've slowed everyone down by an equal amount. We actually did this, we simulated physical distance [in a little box]. We've coiled 38 miles of cable in a box, and it creates 350 microseconds—millionths of a second—of a delay. And that delay actually deters many of the high-speed trading strategies. (Katsuyama 2015)

Literally turning space into time, the spool of fiber optic cable means that all trades have to travel an extra 38 miles at the speed of light to get into and out of the exchange. This “speed bump” or “magic shoe box,” as it is called, creates a new level of lag that renders speculative trades relatively equivalent in time, eliminating the ability to conduct latency arbitrage.

What we learn from this example is that lag can become an exploit, which in turn transforms/terraforms the market (situation) it inhabits. This is not an aberration or a bug but a feature of lag: each lag can make its own kind of time, and has the potential to take over the form of time of the system it started in. The story I just narrated from the financial industry takes place over and over in the digital gaming world.

Lag Is (In)tolerance Is Reality

The first thing to realize about lag is that most of it is tolerated. We adapt to lag so that it becomes our background, the environment within which we act. Adrian Mackenzie writes,

Players habituate themselves to the delay in the circuit between hand and eye and eventually, within certain limits, do not even regard it as an obstacle. Embodied anticipation can ‘overcome’ the delay, or render it latent, so that delays in the flux of images are not even obvious to the player. (Mackenzie 2006: 166–167)

The “input lag” time between clicking a button and one’s digital character jumping is unnoticed, incorporated, literally part of our bodies—we do things with this time.

And yet, there is a limit. Overly long delays in the digital world become frustrating: the environment effect breaks down and the jump feels not like the *same* thing as the button press, but instead like *another*, separate thing. And yet, the limit is different for different people. Some people feel this annoyance and separation at 200 milliseconds (ms); most people, like this author, notice it around 100 ms. But a few notice even *small* lag, as little as 13 ms. It bothers them, interrupts their play, and they complain that they cannot stand it. It seems to rattle their nervous system.

Discussions of input lag are riven by these differences in people: “People like to throw that idea out there [that 100 ms input lag is okay], but they are wrong. I can clearly notice and it’s impossible to play serious games with that kind of lag” (R.Rettig responding to *GivingCreditWhereDue* 2016). Psychologists have researched this problem and have investigated the effects of too much input lag on people.

Lag intolerance marks the human edge of digital interactivity shaping the very features of devices and interfaces. Most multiplayer digital games, like most multi-person digital interfaces, balance on the edge between better resolution with more features and less lag. Skype and other video-chat programs try to upgrade and downgrade video quality to prevent delay-degradation from becoming too annoying. But the internet is finicky, with its own ebbs and flows and jitters and stutters. We adjust, we switch to audio, we hang up and try again, we blame the wifi, the cell service, the program.

Lag is also the reality of multi-person online interaction. Whether you are Zooming or working on a document together or playing a game in “real time,” you cannot escape the experience and frustration of lag. Multiplayer game designers in particular have to design their games not only to minimize frustration but to maximize fairness. For turn-based (asynchronous) games such as chess or *Scrabble*, this is not a problem. But synchronous, high-speed reaction “twitchy” games such as first-person shooters, races, and brawlers need to be played across the internet. This means figuring out how to balance the fact that each player’s computer must communicate to a server somewhere (with some at a delay of 50 milliseconds and others over 300) which registers all the players’ moves (key presses or joystick actions), coordinates them, and sends them back (with another delay). This turnaround time between a message from one computer to the server and back is called “ping” (the imagined sound of sonar hitting an object and returning).

In a first-person shooter game such as *Quake* (a real-time game simulating soldiers shooting at each other in a building complex), everyone is simultaneously moving, shooting, and speculating on where everyone else will be moving and shooting, as fast as their thumbs can twitch. Yet because they are separated by lags longer than twitches, the results of everyone’s actions are a bit behind and possibly conflicting: I shoot where you are right now (from my perspective on my machine), but you have already moved (from your perspective on your machine).

The server-side software coordinating the various players’ actions must therefore split the difference and sometimes rewind time to make the best of the simultaneously delayed actions. Players can adapt to this lag (even when they see their avatars jitter), but oftentimes some of the players are only delayed by 50 ms (a low ping) while others are delayed by 200+ ms (or 4+ times more). This is asymmetry in relative action time: the machines that have a low ping can literally act and react before the high-ping machines even know that something is happening.

According to one player, “A Low Ping Bastard (ping under ~100 ms) was generally able to see and kill you before you had a chance to react” (fappaderp, responding to TokingMessiah 2016). Another player writes,

I was an LPB (low-ping bastard) thanks to my job—I worked for a national ISP and we had a T3 [high-speed internet connection] in our call center, which had all of 6 people using it when I worked the overnight shift. It was glorious, that quarter-second edge we had against the majority of players made you feel like you were the best player in the world and everybody else was a slow loser. Me and my co-workers would find a busy server near us (we worked in Dallas), all join at once, and dominate the top of the scoreboards until the admin would almost invariably boot us. (MelsWhitePubes, responding to TokingMessiah 2016)

The author here describes himself as a “Low Ping Bastard,” a name that arose to describe the unfair advantage that less lag accorded over “High Ping Bastards,” whose machines were too many internet hops away to react as speedily. The term has oscillated between insult, envy, and admiration as the lag difference came to create new kinds of players and interactions based on virtual–real spacetime differences that are not linear.

This lag difference formed not only player types but divided games into types: “Quake 1 introduced a scoreboard that not only had someone’s name and score, but also their ping time in milliseconds. This allowed players to judge who was an LPB and HPB (and hope to justify their skill or lack thereof)” (fappaderp, responding to TokingMessiah 2016). Players created servers that were limited to HPB or LPB only. Other players developed playstyles that depended on their system’s lag: “I lived in Alaska. My ping averaged about 900–1000. I practiced playing the maps blind, because relying on what you could see would throw you off and get you stuck in a doorway or falling into lava” (Shalrath, responding to TokingMessiah 2016).

Players from the days of extreme lag report that they have compensatory “muscle memory”: “Whenever I have lag, the muscle memory to compensate kicks right in. If it’s server side lag, it’s actually a bit of an advantage, since most of the other players never learned to play that way” (definitely_not_cylon, responding to TokingMessiah 2016). While others had their bodies trained to play with lag so much that when new systems decreased it, or they played not over the internet but by LAN (physically connecting the systems together with cables), they had to unlearn these habits: “I can remember my first LAN, we played Team Fortress and Unreal tournament. I was so used to lag it was impossible for me to get used to no ping” (Stupidpuma1, responding to TokingMessiah 2016).

The above mutations in game play were player driven. As twitchy multiplayer games gained in popularity and “seriousness,” including tournaments, game designers increasingly had to find ways to make the games more fair across unequal

lag differences. The result was a unique and evolving set of “Lag Compensation Algorithms” that attempted to manage this sense of playing on an even battlefield:

In fast-paced action games, even a delay of a few milliseconds can cause a laggy gameplay feeling and make it hard to hit other players or interact with moving objects. Besides bandwidth limitations and network latencies, information can get lost due to network packet loss. To cope with the issues introduced by network communication, the Source engine server employs techniques such as data compression and lag compensation which are invisible to the client. The client then performs prediction and interpolation to further improve the experience. (Valve Developer Community 2005)

Lag compensation algorithms turn out to be a collection of modifications and tricks because player experience is the key variable: how to give the player the *sense* that the game world is fair and predictable. David Aldridge, network designer for *Halo*—one of the most popular online shooter games with tens of millions of players—has noted that “player perception is everything,” describing how he needed to become friends with everyone on the design team in order to make the game feel fair (Aldridge 2011). Creating the sense of a fair, lagless world involved several tricks: limiting the data sent between computer and server in order to maximize the data that matters; changing the appearance of certain actions, such as throwing a grenade, by partially blocking the player’s view and thus disguising the delay between hitting the button and lobbing the grenade; pulling back the in-game camera during a knife attack to hide the fact that the other player is also moving and may not be there; and so on. As Aldridge suggested, “Players fill in the gaps. So—no visible latency, no complaints of lag” (Aldridge 2011). The physics of the game engine often had to be altered in order to prevent lag from becoming noticeable to players. Aldridge summed this up with four rules:

1. [Decide:] Which parts of your gameplay need to be adjudicated by a single authority?
2. Always ask: where am I hiding the lag?
3. Don’t be afraid to change game mechanics to improve networking.
4. Reserve time to iterate. (Aldridge 2011)

Network lag, in other words, was not a problem to be overcome, but the fabric of reality that had to be designed. The challenge was to make speculative risk-reduction equitable, and there were multiple solutions to this. Where *Halo* aimed to create a seamless lagged world, other games created lag compensation algorithms that created multiple universes within one game according to their lag. Some

first-person shooter war games, such as *Call of Duty: Black Ops 2* (2012), altered game physics according to one's lag:

It's really hard to explain lag comp in a simple way. Really, really hard. BUT....I can explain its effects on players relatively simply [...] Low latency/good connection [experiences] faster bullets, faster movement into cover, [but] appears out from cover/corner earlier [...] High latency/bad connection [is experienced as] Sneaky—your appearance is delayed to enemies when coming out of corners/cover [...] enemies are slower to escape into cover, [but your] bullets travel slower, [and] your movements are [more] sluggish. (Darius510 2012)

The intended effect of these coexisting multiple physics was to create a shared world in which the tradeoffs of different lags could be equalized. But players took this further, with some purposefully throttling their own internet connection speed in order to “get the lag comp that players with poor internet get” (Noteful, responding to TemperVOiD 2016). These players were choosing the physics that fit their playstyle. In response, other games have revised their lag compensation scheme in response to this type of advantage and now explicitly “favor players that have the faster and more stable connection [..., giving them] the best experience possible while maintaining the accessibility for higher ping players” (*Rainbow Six Siege* Developers 2017).

Game designers often build in extra lag (similar to the financial “magic shoebox”) in an attempt to mitigate the vicissitudes of various latencies. Solving this sometimes means that they also give a bit too much control to players’ consoles. One game allowed the player with the fastest connection to “be the server” rather than having a central server that everyone connected to. This created better experiences for many players but some found a way to take advantage of it. For example, numerous YouTube videos instruct gamers on how to build a “lag switch,” in which you cut open the Ethernet cable connecting your Xbox to the internet and install an old-fashioned light switch. You are then able to temporarily cut yourself off from the internet. If your Xbox happens to be the server for a first-person shooter game, then all of your opponents experience lag but you do not—during which time you run up and kill them. Then you reopen the switch and they find themselves dead without knowing why.

In other games, such as the online role-playing game *Runescape*, which hosts thousands of players simultaneously playing fighters and wizards in a shared digital world full of dungeons, dragons, and magical runes, the system is tuned to as much fairness in speed as possible. Of course, in a competitive world, if you lag even slightly while fighting, you die. Yet lag is always there—due to slow computers, internet delays (especially around 5:00 PM), wireless connections, and so forth. The game stutters, freezes, jumps—and players take advantage.

Some players have found a place in the game where two servers meet, meaning that everyone crossing an invisible line experiences a slight delay as their character is ported from one server to the next. The players in the know call this a “lag line” and wait on the other side of it for someone to cross. For a second or two, they appear frozen, but can be attacked. In what they call a “lagxploit,” the nefarious players rush the laggard. The little delay now means that when the laggard unfreezes, they are dead by dozens of hits and their corpse has been looted. Again, there are countless videos online explaining how to take advantage of a lagxploit. Playing the game requires not overcoming but attuning to the reality of lag.

Are these invented playstyles cheating? And/or are they forms of affirmative speculation, making each kind of lag itself into something new out of the previously predictable digital world? At minimum, they are thick descriptions of the ways in which people do things with lag.

To combat this type of invention, most competitive e-sports, especially those with money on the line, have to invent a notion of complete uniformity for competition between players at different computers. Everything down to inches of Ethernet cable must be identical:

One concern is uniformity, or verifying that playing conditions are equal for all players in a match. This is important because it would be an unfair advantage for one team to get lightning fast computers while the other is stuck with the spinning hourglass. This starts with installing identical hardware on all computers in the arena, including those used by the referees and elsewhere, Veiser said. Additionally, when they first set up an event, they create a master image of a single hard drive and copy it onto every computer, so that every single bit is the same. This level of attention to evenhandedness even extends to the length of Ethernet cable that connects players to the game. Both teams in a match will sit symmetrically in a row of computers, so that there is no speed advantage for being positioned very slightly closer to the local router. This might sound like overkill, something that no one would notice, but these players are so good that a few milliseconds could be the difference between a win and a loss. (Johnson 2015)

Lag, in other words, defines and splits and then invents game physics as well as players and playstyles. Whereas games like finance may initially imagine an idealized world without lag, a world where pure speculation and play can take place, taking account of lag requires a complete reinvention of the firmament of the world, even whole new worlds.

Lag Is Human, Humans Lag

Lag doesn't just shape digital gaming, it is also the very foundation of many games, especially multiplayer role-playing games (RPGs). Digital RPGs are fascinating in part because they are incredibly time consuming; many are designed to pass time, to lag life. Some games brag about 100+ hours of content! Online forums reviewing and discussing games often compare the price of a game to the number of hours it takes to complete. Many players agree, for example, that a game that takes forty hours to play is worth more than one that can be completed in twenty. From an outside perspective, these players have a lot of excess time to pass! The challenge for game companies is how to monetize this excess, speculating on how to get players to pay to lag.

Massively multiplayer online RPGs (MMORPGs, such as *Runescape* and *World of Warcraft*) can have thousands to tens of thousands of players sharing in a virtual world, each controlling their own character, each spending hundreds to thousands of hours adventuring with that character (or serially with multiple characters). The games have developed complicated processes to enable characters to advance in ability and power regularly, though slowly, through repetitive activities that are derisively and approvingly called "grinding." Gaining more skill in woodcutting, for instance, means clicking on a tree, waiting five seconds until the tree is cut, then clicking on another tree, waiting five more seconds, and so forth, until 250 trees have been cut down. At that point, one "gains a level" in woodcutting and can use a better axe to cut down harder-wood trees—which one then does 500 more times to gain the next level to cut down even bigger trees, now 1000 of them, and so on: exponentially more clicks regulating the real-world time it takes for one to achieve status and power within the game.

This enforced lag in advancement spreads out those who have "put the time" into the game. Lag = Power. The more time one has spent not living outside but inside the game, the more advancement one's characters have. From the game and most gamers' perspective this is a desired type of fairness. Unlike the first-person shooter games where one's status comes from being very skilled with high-speed twitching, in most MMORPGs one's status is a fairly direct measure of the time one has put into the game, as well as the social networking and information-gathering one has managed to acquire during all of this clicking time through in-game chatting and out-of-game forum browsing.

But grinding is tedious. Too tedious for many. Game designers face an array of challenges in providing enough micro-rewards alongside repetitive activities to keep them interesting, or at least tolerable, and providing shortcuts to advancement that risk making the "equal lag for equal advancement" patently unequal. Many games offer "pay-to-win" options, in which players can make cash payments to advance their characters. Pay-to-win is a variation on decades of some players

putting in the clicking-time and then selling their advanced characters to others who have money but either no time or no patience. For contemporary game designers, advancement lag has in turn become the new economy: how to design a game so that the delay is not ideally suited to equal status, but instead just frustrating enough that more and more players pay a little to get a little jump, or pay a lot to get a big jump. Lag, in other words, is no longer about passing time but about generating enough temporal friction against just enough desire to get players to speculate that skipping the lag is worth it.

Around most massively multiplayer games there is also a lively economy crossing in-game and out-of-game worlds. I might spend two days clicking on enough high-value trees in *Runescape* to make a superb magic weapon and trade it to you for a rare Pokémon in another game, or perhaps sell it to you for cash. At eleven years old, my son referred to the in-game accumulation of items by clicking as “work,” and he made money at it. There are various methods employed by the *Runescape* company Jagex to prevent too-rapid accumulation. Most of these methods involve delaying acquisition. It takes a lot of mouse-clicks to get a thousand runes. There is labor—prosumption—being paid for.

But when he was twelve years old, he was banned from *Runescape* for a week because he was detected using “bots,” in other words, macros that automatically repeat the mouse-clicking process in precise ways over and over. These bots saved him the tedium of becoming a robot himself. His bot activities were not detected by a human, however; he was “auto-banned” by the system itself. A program detected the too-quick clicking: the lack of normal human lag was the key to detecting that my son was using a bot. Here, this autoplay was not allowed. He was not playing fair, he was banned.

Runescape was using its own automated programs—“botcops”—to speculatively detect the difference between a human player doing something robotically and a bot pretending to be a human doing something robotically. Here is another flipside of passing time: the entire premise is that the human finds the activity repetitive and boring and dreams of automating it to do it faster, or at least, to do something else while it is happening.

One of the first solutions *Runescape* employed to prevent bots was to create “anti-macro monsters,” special creatures that would appear whenever someone spent a lot of time doing the same thing repeatedly. For players attentively clicking, the monsters were easy to dispatch; but for bots mindlessly clicking, the monsters could be deadly. That is, until they could be anticipated.

Soon the bots became more sophisticated. In the world of “botting” today, one uses programs that simulate all manner of human-appropriate lags—curved mouse movements, mis-clicks, programmed random breaks (to represent time away from the keyboard, perhaps for eating, bathroom use, sleeping), and even mini-conversations—in order to mimic the mindlessly robotic behavior of a hu-

man stretched to the limits of boredom playing the game. Whereas simulation is often used as a form of reductive speculation, calculating an array of possibilities in order to reduce the risk of being surprised, here the hackers reverse engineer the surveillance in order to give the company exactly what it wants to see, precisely in order to get away with something underneath. In this metagame, the hacker-simulated human is designed not to figure something out, but to jam the speculative practices of the humans at the game company trying to programmatically detect the difference between these robots imitating humans playing robotically and actual humans playing robotically.

The following summer, my son took up botting again. This time, he ran an entire bot farm, with each bot on a different account, each one running as fast as it could. He was playing two metagames at once. In one, he was participating in forums discussing the best bot strategies with meta-contests to see who could last the longest before getting caught and banned. This was “Getting Banned Is Fun.” Videos and descriptions of epic “suicide botting” runs were posted on sites such as powerbot.org.

In his other metagame, he was accumulating gold as fast as possible, then trading it online for cash—PayPal, Amazon gift cards, and so on. He got scammed more than once, but he made enough money to buy some high-end bots. Then, he got banned from PayPal. Not fun.

I learned that there were entire forums devoted to bot makers; but even more fascinating were the forums devoted to bot *users* who would create new accounts, program their bots, and run them in different types of competitions. Similar to the speed runs analyzed by Stephanie Boluk and Patrick LeMieux (2017), these bot users had all sorts of categories to differentiate: how long a bot could run, how much gold it could accumulate by chopping down trees, killing monsters, and so forth, before it got banned. The game was not so much to elude banning altogether, but to elude capture longer or better than others.

In the *Pokémon Go* hacking world of 2016, tens of thousands of hackers gathered on Reddit and Facebook and Github to exchange tips in order to spend less time catching the digital *Pokémon* that they wanted. Many of them instead spent their time making bots: programs running on laptops that did not need the phone apps at all but instead pretended to be phones. *Pokémon Go*’s maker Niantic was overwhelmed by the millions of mobile players in the first six months and spent most of its time upgrading its server capacity rather than preventing the relatively few creative hackers. The main challenge for the hackers was what they explicitly called “human’ randomization”: making one’s pretend phone behave as if it were in the hands of an actual human moving at walking speed and clicking with “human like” delays (jabbink 2016). These automated human lags were imagined to aid in evading detection by Niantic.

Much more collective action went into this practice than can be discussed here, but for our purposes, the lag in detection was being exploited. Speeding up Niantic's change detection, checking every millisecond, would be possible in theory—but the detection itself takes time, and the effect would be to slow the entire system down. This reveals a Heisenberg uncertainty problem plaguing digital security: the act of checking is an action that changes the system it is checking, because it lags everything else. In Cory Doctorow's novel *For the Win* (2010), an internet worker revolution occurs through this exact speculative strategy: namely, causing security measures to escalate so much that the whole system lags catastrophically and crashes. Some video game players today find out that the security settings of their home routers, inspecting every packet of data coming in or out of their homes—normally a virtue for preventing viruses and attacks—actually slow down their ping to the point where the game may not be worth playing.

Lest all this seem a bit removed from everyday life, let us recall that Alan Turing's classic 1950 essay, "Computing Machinery and Intelligence," defined machine intelligence through a test: using a typing interface, can a man tell the difference between a computer pretending to be a woman, on the one hand, and a man pretending to be a woman, on the other? Turing noted that the computer would have to be prevented from answering questions (for example, math or chess questions) inhumanly fast: its programming would have to ensure appropriate lags. (The answer Turing had the computer give was also wrong.) Lagging in behavior and conversation is part of what we recognize as human. Temporality proper to humans involves normal delays, normal lags. Responding too quickly can be as suspicious as responding too slowly.

Humans take time to make decisions, they are made up of delays that define them. Experimental psychology was founded, in no small part, on reaction time measurements. Different lags in reading words, for instance, provided clues to psychic mechanisms and their diagrams. Though everyone takes time to respond, lags have their social limits, wherein too much delay in response is read as meanness, cognitive deficit, disease, and so forth. Americans often use the language of lag—for example, "that person is slow" and "mental retardation"—to define proper and improper lag. These lags vary historically and culturally.

In researching sufferers of Chronic Fatigue Syndrome (CFS) and ADHD, I found many instances where the asynchronous lag of email enabled them to achieve a fluency not achievable in net-chatting or phone or face-to-face talking (Dumit 2006). In person, people with CFS were often frustrating to other people, because they were experienced as too slow to respond to the speed of neurotypical conversation. But a two-hour message-typing session resulting in a paragraph reads quite fluently when received in email or on a bulletin board. In one, I found that a slowly written description by one CFS sufferer about her experiences convinced a friend (who read it quickly) that she was actually suffering.

Lag temporalities that are proper to humans need to be investigated. Human lags are part of interaction, and delays are not simple at all. It is our temporalities, with our lags, that are in fact the measure of what matters for us in machines and games. In 2019, the fact that computers can beat the best players at Go has been hailed a breakthrough. A computer beating someone at tic-tac-toe or even checkers is uninteresting: we expect that these finite games are computationally solvable, and it is silly to compare humans to computers in regard to these games as it would be for humans to compete with a calculator at long division. Similarly, the fact that a computer could beat someone at chess if it had hundreds of years to make a move is not meaningful. We all might agree that, given enough time, chess is finite—unimaginably huge, but computationally solvable. Like all games, chess is, in fact, defined by time. Matches give each player a limited amount of time to play their moves (sometimes each move has a time limit, sometimes the total move time is limited, as in speed chess). The fact that players lag in making a move (but not too much) and that computers initially could not play fast enough to seem human meant that, in the last forty years, we could witness *computers catching up*.

Lag Is Another Time

Lag is a gateway twixt worlds. On one side, it is ignored, devalued. We speculatively leap over it, seeing only what it delays. We treat it as compressible, imagine it quantitative—to be reduced to zero if possible, or else to become imperceptible. No one need care much about it. On the other side, it gnaws apart our reality, inventing new times, new forms of temporality. It terraforms our metric life—transforming standardized milliseconds into gaping eons of profit, an in-breath into an opening, a server switch into a kill zone, thirty seconds into thirty minutes of clutch basketball, an injury in the moment of defeat into a delay of game into a victory, awesome hair into a crashed system. That which had been tolerated as part of the duration of the world (page loading, switching servers, enough time to trust a transaction) becomes a strategy to put the world into disarray.

While there is no time to go into the technical details, I would be remiss if I did not mention the most ironic and vile combination of speculation and lag: bitcoin. The darling of investment speculation in the twenty-first century, bitcoin and the blockchain ledger promise a fully trustable digital currency that does not require banks or governments. Its value soared and now remains a core icon of a speculative future cyber-economy. Yet at its material core is an endless need for more computing power: its trust model requires that a large number of computers solve a cryptographic puzzle so difficult that the world's fastest computers need ten minutes to calculate it. This prevents any one group from being able to cheat the system: it is truly a brilliant form of crowdsourced trust. The tragic side effect

of increasing computing power is that bitcoin mining never gets efficient; rather, the very lag that enables trust requires more and more energy to stay trustworthy (Bitcoin Wiki 2010). As one analysis put it, “if more computing power joins the network, the result isn’t that more bitcoins get created. Instead, it takes more computing power to produce each bitcoin, making existing mining hardware less profitable than before—and driving up the energy consumed per bitcoin” (Lee 2018). By the end of 2019, bitcoin-mining computers, run mostly in giant clusters—and often located in cold climates to reduce the hardware cooling costs—were consuming as much electricity as Belgium, now somewhere around 0.33 per cent of the entire world’s energy consumption and rising (Cambridge Centre for Alternative Finance 2019).

As with other forms of lag, this one also transmogrifies the form of time it is supposed to inhabit. Here, the lag that is supposed to create trust among humans starts to contribute to global warming and the end of humanity. The ten-minute lag becomes a speculative contributor to a planetary countdown.

Clock time, which was supposed to standardize us, turns out to be an excuse to not pay attention to how each type of lag makes a new form of time measured by a new kind of clock (Galison 2004; Bender/Wellbery 1991). This is not the impossibility of measuring time that Wittgenstein ([1977] 1980) talked about, but the time of measuring itself which turns out to be reflexive of the world. And it is not generalizable: in fact, it is ever specifying. Each lag is unique. Each generalization is precisely what is turned on its head: to generalize is to speculate that time remains the same—and therefore to be caught flatfooted when it varies within itself.

What varies in lag time is the very consistency of what is in time and what is out. Each form of time also has its exceptions, the ineradicable metagame of the outside that time pretends to keep out. And because it is time, which has its limits, that becomes intolerable when it goes on too long, intolerable by humans and machines, it opens itself to more lags. Because they are in time, the very rulings and interruptions and reflections all too take time. And then we have to ask again, which kind of time do they take? What kind of lag time is this?

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