The Shape of "Computime": How Silicon Valley Time is Becoming Everyone's Time

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ABSTRACT

This article presents findings from ethnographic fieldwork in Silicon Valley investigating how computers utilize time and how human engineers and designers use and understand time. We found common themes across computational and human uses of time, including the quantification and calculation of time as a finite resource; the imbalance of clock time versus "event time," and linear versus cyclical time; the perception and reality of the acceleration and fragmentation of time; and an approach to programmability which is applied to time, people, and the world as a whole. We show how these cultural assumptions become embedded into digital devices.

INTRODUCTION

This article is about the temporal culture of Silicon Valley and how its cultural assumptions become embedded in the digital clock on every mobile phone and other computational device. We started with a simple question: Why is the digital clock the first thing we see on our phones, and why is it almost impossible to remove?

Working across art, technology, and research, we have been investigating alternatives to clock time through installations [1], events [2] and performance [3]. Lately we have expanded our work to encompass anthropology (the lead author's background) in order to investigate cross-cultural effects of digital temporality on individual and social wellbeing---specifically exploring how global time

standards, perpetuated by the “always on” culture of Silicon Valley, have colonized other cultures. To our knowledge, no one has investigated the effects of “computime”---defined by Jeremy Rifkin [4] as “the final abstraction of time and its complete separation from human experience and rhythms of nature”---across cultures.

We shaped our initial query into a research question: *What are the characteristics of digital temporality arising from the culture of Silicon Valley?* We designed a pilot study to uncover these characteristics, which can be separated into two broad areas: First, we look at how computers utilize time; second, we look at how Silicon Valley technology designers and engineers understand and “use” time in their own lives (we put “use” in quotes because it implies time is a resource---an assumption we question below).

We focus on Silicon Valley because to us it represents the main global center of technical development, particularly of software for mobile phones and computers, and it embodies a particular technologically-oriented culture according to anthropologist Jan English-Lueck [5]. She details general aspects of the culture of Silicon Valley, but not temporality specifically. The sociologist Judy Wajcman [6] investigated how Silicon Valley tech workers use digital calendars, but not time more generally.

To explore how computers utilize time, we researched the relevant literature, interviewed computer scientists, and reflected on our own experience using and programming computers. Technology workers’ uses and understanding of time were investigated through ethnographic fieldwork undertaken in Silicon Valley in June and July of 2023. In total, we conducted 12 in-depth, semi-structured interviews with technology designers and engineers at large technology companies, including Apple, Google, and Meta (of which the first two create the two most widely used mobile phone operating systems), as well as small- and mid-sized startup companies making mobile apps focused on productivity and mindfulness. We chose these areas because they represent explicit and overlapping approaches to “time management.” The in-depth interviews were supplemented with many informal conversations with other Silicon Valley tech workers purely for background and anecdotal information.

Most participants were in their 20s and 30s, in keeping with the Silicon Valley average age of 28 [7]. In all cases, participants are anonymized in this article, and we did not discuss corporate secrets

or work covered by non-disclosure agreements. As a mix of designers and engineers at technology companies, we refer to our sample collectively as “tech workers” or simply as our participants. Our interview questions were focused around participants’ uses and understanding of time in practice (“Do you use an alarm clock?”) and theory (“What do you think time is?”).

Given our small sample size, our findings are necessarily provisional. This is part of a larger research project investigating how diverse cultures align with, work around, or push back against digital temporality, given that smartphones are now in the hands of a majority of adults in every country on Earth [8]. This is why we chose ethnographic methods: we intend to replicate aspects of this study in other countries in order to compile multiple views (not comparisons) on temporality across cultures. We intend to then bring our ethnographic work back together with artistic practice to evaluate alternative approaches to temporality and investigate whether technologies might inform solutions instead of problems.

We detail our findings on how computers use time and how our Silicon Valley participants use and understand it in order to triangulate on how much these assumptions are shared, embodied in, and perpetuated by digital devices.

The shape of computime

Artificial timing mechanisms---those that do not rely on natural rhythms such as the day/night cycle or astronomical phenomena---date back to the first automated water clocks in ancient Egypt, Greece, and China [9]. Marx took clock time in the factories of his era as a measure of the value of objects and labor [10]; industrial precision seemingly reaching a pinnacle in Taylor’s scientific management, where the stopwatch supplemented the clock today for measuring worker productivity [11]. The computer, however, enables microsecond-level precision in the temporal analysis and structuring of human behavior, impacting users of, for example, productivity and health-tracking apps. While the circular clock at least alludes to the day/night cycle in its general form, the numeric digital clock represents the complete disconnection from any natural rhythms, being independent of both nature and the individual, subjective experience of duration, according to Rifkin.

The sociologist Helga Nowotny [12] shows how increasingly precise scientific time became societal time through technological objects like clocks, computers, and mobile phones. Such

objects, she observes, offer availability but also demand it from their users, creating a mutual interdependence [13]. Moreover, they dictate particular forms of work, knowledge, abilities, attitudes, and behavior, which then become internalized---by the technological objects, as well as the people who use them.

Rifkin proposes that when computers separated time from both nature and the individual experience of duration, this resulted in "a new language of the mind and an altered state of consciousness" [14]. When people have problems with time (such as the perception of not having enough of it), they recalibrate themselves to clock time through "time management" and self-discipline [15]. But chronobiologists have identified adverse effects when artificial time-givers conflict with natural rhythms such as the day/night cycle and individual circadian rhythms, resulting in a range of psychological and physiological consequences [16]. Chronosociologists discuss a perceived acceleration of time with which many people feel they cannot keep up [17], with the resulting stress, overwork, and lack of sleep causing "burnout syndrome." In 2019, the World Health Organisation classified shiftwork that disrupts circadian rhythms as a carcinogen. Then came Covid-19 and a questioning of working and living patterns. "Our temporal imaginary, where time is seen as universal rather than infrastructural, is ripe for challenge" [18].

We address this challenge by characterizing the temporal condition by means of language on one hand, and the more intangible dimensions of time on the other, as experienced by both computers and humans. Next, we detail our findings regarding each of them.

How computers use time

While we focus on the clocks used by computers, we should first identify on a general level the nature of both clocks and computers. We will not detail the history of clocks, but based on our previous research [19,20], we can say that clocks generally exist for synchronizing systems. By "systems" we mean social systems as well as technological ones such as multiprocessor computers and computer networks. Computers are inherently time-based, as reflected in the term "processing"---so much so that one technologist writes "A computer is a clock with benefits" [21]. As one engineer told us, "All processors both have---and basically are---clocks, with different clock speeds."

Accordingly, in the computer, time is treated purely as quantitative information. This, according to philosopher Byung-Chul Han [22], regards time as ahistorical and disconnected from human culture. One of our participants echoed this in saying "Technology only communicates information, not the fuzzier aspects of temporality."

Taking these two insights together, one of the "benefits" that computers bring to time is that time-as-information can be calculated and remixed at will. For example, in A.I. systems, time is variable and has no fixed rate; it depends on what the A.I. model doing, and time can be accelerated and slowed down as needed. A simple example is OpenAI's ChatGPT: when a query is sent to the system, a response is generated almost instantaneously (in human terms), but it is then artificially slowed down and printed to the screen at human typing speed in order to "humanize" the technology. This is a common approach in human-computer interaction. With asynchronous functions, background processes, and parallel processes, A.I. systems (like generally all computational systems) do not simply operate at imperceptibly high speeds, but rather at variable rates.

We can add another nuance to digital time by distinguishing between linear and cyclical time. This distinction dates back centuries and across cultures, with some individuals or whole societies regarding time more as a continuous forward progression and others more in terms of recurring cycles [23]. Computers utilize both of these perspectives: for example, in serial processing where code is executed line by line in a linear sequence and alternately in loops or subroutines which return back to (or return a result to) a specific part of a program. Parallel processing and deep neural networks add a multiplicity of temporalities in which processes can occur simultaneously but at different rates.

It is also important to distinguish between clock time and *event time*. The latter refers to the duration of an event regardless of clock time---for example, for some people a meeting starts when all its participants arrive and ends when they are finished, which may not align with specific clock times. Both clock time and event time can be found in the computer. For example, Unix (or Epoch) Time is treated as linear, emanating from the arbitrarily chosen time of 00:00 on 01 January 1970. By contrast, *events* occur at different hierarchical levels of a system, as in JavaScript's "event bubbling" up a hierarchy and "event capturing" down from a higher level. Clock time and event

time are linked: in computer science, “a clock is just a way of assigning a number to an event, where the number is thought of as the time at which the event occurred” [24].

Another “benefit” that computers bring to time relates to *programmability* in relation to other types of data. With microsecond-level precision, computers can process data about people by means of recorded keystrokes, sensor-enabled tracking of biometric data and various types of physical activity, and text- and image-based content analysis. To some, this effectively constitutes machines programming people and not the reverse, whether in terms of human labor [25] or as “programming the future” by means of directing people’s behavior [26].

We next turn to our participants’ perceptions and uses of time to see where these overlap with computers’.

Silicon Valley time

In Silicon Valley, we found human temporal perceptions and processes to be increasingly aligned with---and driven by---computational cycles, both individually and socially. We detail the main themes we found below.

Time as finite resource

“I just think of time as a nuisance or a burden,” said one our participants. “I feel like there’s not enough of it.” Another referred to time as “a resource we all share equally.” This zero-sum view of time is shared by many people in clock-oriented (as against event-oriented) cultures [27].

Equating time and money is not merely a belief but material reality in contemporary capitalism: employers literally buy the time of their employees, who in turn might spend their income to buy themselves time---for example with food delivery or ride-sharing services. As one of our participants said, “You spend more money so as to not spend too much time on something.” This statement raises the question of what that “something” is not to spend too much time on and what is perceived as “worth” more time.

Treating time as a monetary resource implicitly extends to treating human labor and lives as *human resources*. “In this world,” writes artist Jenny Odell, “when I give some of my time to you, I have less. Our interactions can be nothing other than transactional” [28]. The social implications of this include a kind of class divide between those (generally Silicon Valley tech workers like those we interviewed) who buy the time of others---the cleaners, drivers, delivery workers, etc. Such sociological factors are outside of our focus and are covered in depth by English-Lueck [29] and Wajcman [30]. We would, however, make two observations. First, this is not a simple divide between two “classes” (also a computational term---binary classification, for example, is a primary function of A.I. systems). As tech workers’ time is purchased by their employers, companies in turn are subject to product cycles, quarterly reports, and investors’ timescales.

Second, time-as-money now extends to “leisure” time as well as “work” time, though the boundaries are increasingly blurred. Indeed, in Silicon Valley, work has gradually become a new religion, according to Wajcman [31] and Chen [32]. One of our participants pointed out the temporal anxiety that extends into “free” time: for example in traffic delays encountered while driving to the coast on a weekend, followed by anxiety about hitting traffic again on the way back home. According to Nowotny [33], time *not* subject to money is now the exception, but for this reason it is perceived as more valuable than work time. Our participants confirmed this. Leisure time therefore becomes another form of work, when one treats time, like money, as an investment [34].

Productivity

Productivity is surplus value that results from increasing the amount of time that money buys or by increasing the amount of work performed within a given timeframe, as measured by the clock. Thus for the worker, time is indeed money, but the buyer of work always seeks to maximize profits, and one way to do so is through gains in productivity [35].

Accordingly, most of our participants felt, or observed, continual pressure from corporate management or marketing teams to increase productivity. As one said, “I have a love/hate relationship to [productivity]—I’m doing it but hating it.” Another told us that he aimed to keep meetings as short as possible, as these are considered *unproductive* times compared to time spent “producing” output such as programming code. Another of our participants took a dim view of A.I.,

believing that it “promises to free up our time but won’t.” This accords with accounts that purportedly time-saving technologies conversely create more work, not less, thereby lowering productivity [36].

Acceleration

Closely related to endless increases in productivity is the perception that time---or more specifically, the pace of life---is speeding up, and all of our participants reported either experiencing this directly or observing it in their peers. Wajcman [37] discusses the “time pressure paradox”: the average number of working hours in the U.S. has remained constant, or even decreased, over the past 60 years, while life expectancy has also increased, indicating that there is more leisure time than ever before; but by contrast, the feeling of being rushed is more present than ever before. However, we add that people are working until later in life, perhaps reducing some of the supposed gains in leisure time.

The speed at which people move and conduct business correlates strongly with the importance they place on clock time [38]. They also point out that countries with an overall fast pace of life also have high indices of coronary heart disease and other negative health impacts. Perceptions of acceleration, therefore, vary according to lifestyle, working culture, and, as our participants pointed out, life stage: one for instance noting that acceleration was present “especially here [in Silicon Valley], at this point in my life.” Another participant in his 50s linked the perception of increasing time pressure with growing older.

Speed relates not only to linear acceleration. Computational efficiency (productivity) is measured not only by raw processing speed but by *clock cycles* (the number of cycles a processor executes per second)---a term also used to describe human time-based work in Silicon Valley, as English-Lueck observes [39]. One of our participants, for example, lamented “I’m spending way too many processor cycles on this task.” Another spoke of regular “cycles of fatigue” to be overcome. Overall, most people conceptualize time as both linear and cyclical, but these example show how “Valley-speak” (as English-Lueck terms it) explicitly references computational language.

Fragmentation

There is an alternative view to temporal acceleration. Han [40] sees not acceleration, but *atomization* of time. Acceleration, he says, implies a trajectory, a direction; and these, he says, have disappeared---time has become point-like and is spinning out of control. Clock-based productivity apps and constant social media encourage us to jump from one thing to another, destroying any experience of continuity. "This," he writes, "makes the world *untimely*. The present is reduced to the point of actuality. It no longer lasts" (author's emphasis) [41].

In work contexts, Brislin et al [42] discuss multitasking or *polychronicity*---"people's tendency to work on several activities at a given time." One of our participants illustrated this: "For years I relied on memory---I knew what I had to do and I did those tasks. But I was working very serially. Now, you're going from one meeting to another with different topics. So I have to be much more disciplined about capturing all of that. And I'm still not as disciplined as I need to be."

Positioned to counter such fragmentation is an explosion of mindfulness and wellbeing apps to slow workers down and promote "focus." These are generally pitched at increasing productivity as well as self-improvement; importantly for our purposes, all of the ones we investigated explicitly use clock times. One of our participants who works in this sector also noted the irony of using the phone to counter screen-related fatigue, but justified this by saying "We need to meet people where they're at, and reframe people's relationships with tech." To direct people away from the phone would go against the very business model of the companies that produce these apps.

According to Wajcman [43], "The proliferation of apps, whereby you can simply click and anything under the sun is provided in record time, adds to the illusion that technology puts time fully at one's command." Or as one participant told us, "Apps are a tech solution---they make you less aware of your own cycles." We would add, however, that many people do find it useful to track menstrual cycles or other recurring phenomena using apps.

The fragmentation of time was undoubtedly exacerbated by online, flexible and hybrid working brought about by Covid-19, which most of our participants mentioned. But there is an additional social dimension to fragmentation: shared calendars. While Wajcman covers these in depth, we placed our focus instead on the phone and smart watch. But our participants explicitly pointed to shared calendars as an additional source of temporal fragmentation. One, for example, uses his Apple Watch primarily as a calendar and not to check the time: "I don't even know what time it is, I

just know that I have to hop on another meeting with somebody." Another said "If someone sees a 30-minute slot they're gonna take it. And then you're finding yourself going 'Well, when am I gonna, you know, eat, go to the bathroom, whatever?'" According to [44], people "use calendar apps to preprogram the rhythms of their future", and when calendars are shared, this constitutes collaborative programming to create a shared future, reflecting Van de Velde's [45] notion of the world as computer.

DISCUSSION

Van de Velde's vision was a thought experiment in which the world-as-computer computes one thing---the future---and such a computer is programmed through design and the choices (conscious or not) made by each individual. He imagines a personalized computational agent, which communicates information and makes suggestions to a user which, if followed, have the effect of changing the user's future and thereby our collective future.

Fourteen years later, English-Lueck [46] observed that the increasing ubiquity of computers gives the human world "machine-like characteristics that influence how Silicon Valley people view their own lives." More specifically for our research, we found strong support for Nowotny's [47] claim that increasingly precise scientific time has become internalized by technological objects and the people who use them, dictating specific forms of work, knowledge, abilities, attitudes, and behavior. This also seems to confirm Rifkin's [48] assertion that "computime" has changed our actions, attitudes, and consciousness. As evidence, we uncovered the following qualities and approaches to time shared by computers and humans.

In Silicon Valley, both computers and humans treat time as a finite, external resource (as opposed to a variable, subjective state) that can be measured and calculated. People calculate or "manage" time by trading it with money, or planning using clocks, calendars and other technological tools such as mindfulness and productivity apps. "Productivity" is indeed equivalent to calculation; in computers it manifests in increasing clock speeds, and in relation to human actions, in the aforementioned apps as well as actions and practices undertaken by individuals and organizations, which are applied to "human resources" and can be described as algorithmic.

Both computers and humans treat time as both linear and cyclical. For people, linearity manifests in human lifespans and one-way aging processes, as well as in accomplishing tasks. These contrast with recurring product cycles and commute periods.

Both computers and humans also harness both clock time and event time. But in people, we encountered evidence for the latter only in discussions about other cultures outside Silicon Valley, as when people spend time with family from (or in) other countries. Clock time is much more apparent and pervasive in Silicon Valley, as for example in shared calendars and online meetings. We found, however, evidence of a multiplicity of temporalities, as in parallel processing by computers, and in multitasking, as well as increasingly fragmented attention spans in people.

Acceleration is so plainly obvious, in both perception and reality, that it almost goes without saying. The current rapid development of A.I. technologies (requiring ever-faster compute times) translates into greatly accelerated product development cycles, but also into increasingly compressed boom-and-bust economic cycles. In the year or so that elapsed since we undertook our ethnographic work (Summer 2023) and when we write this, funding to A.I. companies increased by $1 billion [49], while tech industry job losses nearly doubled over the same period [50].

How are the temporal phenomena we have identified being embedded in digital devices? We started this research by questioning the primary and ubiquitous presence of the digital clock on every device. In the past year, this ubiquity has not changed. “Smart” watches from Apple and other companies still utilize the circular “analog” clock (depending on user preference), but to us, the data tracking capabilities of these devices more than offset any minimal benefits in human time perception. In addition, the centuries-old form factor of the wristwatch keeps clock time close to the body and the center of attention. Gell [51] calls the wristwatch “the little slavedriver,” and despite the decolonial push to eradicate such terminology, on the whole we see much more centralized control of human behavior and attitudes emanating from Silicon Valley than individual control of time.

Accordingly, we come back to Van de Velde’s notion of programming the future and his imagined device that acts as a mechanism for doing so. In 2010, the writer Douglas Rushkoff exhorted technology users to “program or be programmed” [52]. While Silicon Valley boasts one of the greatest concentrations of programmers on Earth, we observed programmers and other Valley

denizens instead being programmed by devices and their rhythms. This can be self-directed, whether through the use of mindfulness and productivity apps; externally directed by digital alarms, timers, clocks, and calendars; or organizational or social temporal imperatives. Computers can "sleep" and die like humans, but when operable, they only perform work, knowing no leisure time; this extends to their role in shaping humans' supposed leisure time into work.

CONCLUSION

We have presented a fairly monolithic picture of Silicon Valley tech workers, but we would be remiss if we did not acknowledge individual and cultural differences. One of our participants observed, "for some people the clock is a source of anxiety, but for others it's a source of routines and structure that decreases anxiety." We met people from India, Korea, Poland, and elsewhere who retained connections to their home cultures through local family and ethnic communities, as well as trips back and forth. These cultural differences inevitably translate into differing approaches to time. We do not detail different cultures' general orientations toward time [53,54]; as one participant told us, "Cultural differences can be difficult to put into words."

Yet despite these important differences, our participants evidenced how Silicon Valley is many cultures, but one meta-culture, supporting English-Lueck's finding that "Silicon Valley workers believe that their distinction is based on technology, or more precisely, on a worldview in which technological metaphors and models predominate" [55].

Phenomena such as the increasing attention to mindfulness practices may signify a shift from quantified time to "quality time," which places emphasis on the ethical dimensions of time instead of as empty quantitative units to be filled with "meaningful" activity. As the physicist Carlo Rovelli writes, time is what *matters* to us, both individually and socially [56].

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