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CHAPTER 15

UNPACKING SIMULTANEITY FOR DIFFERING OBSERVER PERSPECTIVES AND QUALITIES OF ENVIRONMENT

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We take for granted that we know what an observer is. In actuality, there are many different kinds of observation that we employ, related to differing qualities of environment. These modes of observation include direct human observation; human observation that is augmented by differing tools and/or machines; computational models functioning as machinic observers, in which humans become super-observers; chemical observers where particular changes register particular qualities; and potential future observers - Neosentient machines. For each of these different kinds of observers, the notion of simultaneity is problematic in some manner. The definition is clear enough: simultaneous - existing, occurring, or operating at the same time; concurrent: simultaneous movements; simultaneous translation. Yet, notions of time are different on the micro and macro scale. Humans also have been observed to include up to a one half-second time buffer, adjusting for the body's distributed sensing functionality and potentially its embodied relation to memory and past thought. These facts throw off our concept of something happening at "the same time." Thus, time, spatial relations, the body, differing machines and chemical modalities each can be framed linguistically as having different perspectives in relation to the notion of simultaneity and/or the limits of registering simultaneous events.

1. Introduction

Our knowledge gained from direct observation is further informed by the knowledge that we have obtained through augmented forms of observation, new forms of machinic measurement, computer simulation, social and cultural learning, science as a set of fields, different forms of logic, linguistic framing, self reflection, and memory. The definition of the observer must in each case be carefully qualified in relation to the particular instance of study as well as the modality of that particular study. As we begin to work in teams of researchers that cross traditional boundaries, the definition of 'the observer' will need to be unpacked according to the particular domain of 'experience' and/or of 'experiment' that is being undertaken, as well as the perspectives that become enfolded in such an undertaking.

2. The Human Observer

Each individual is the center of his or her own particular sense of *now-ness*. Physics has shown how entities registering events in slightly different locations perceive the timing of those events in subtly differing ways. These differences of locality are amplified by distance to the event as well as by motion in relation to that event. The event's positionality and spatial movement are also factors that come into play. As we unpack notions surrounding definitions of the observer and their 'relative' natures, we discover a series of difficulties related to our conceptions of simultaneity.

The human observer has many interesting characteristics. They represent a physical volume in space that is continuously in motion across multiple scale domains from the micro, to the macro. Human observers are dynamically nested in an environment that enables them to consciously make observations. They are examples of *far from equilibrium* [a] dissipative structures, and are thus dynamic systems.[1] They become structurally coupled with their environment to maintain their

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[a] Scott Kelso has articulated a dynamic systems approach to cognition in his book Dynamic Patterns (cf. S. Kelso 1988).

living status, to make first-hand observations, as well as to communicate about those observations.

A definition of simultaneity is as follows: simultaneous - existing, occurring, or operating at the same time; concurrent: simultaneous movements; simultaneous translation.[2] Thus we must first ask what in particular is to be meant when two events arise simultaneously? What are the specific relational qualities which contribute to the notions surrounding the simultaneously registered?

We are interested here in events that are in some manner observable to the body without a machinic apparatus (in this human-observer-centered definition) via multiple modalities of human sensing.

Events have a particular set of qualities as do the sense modalities of the observer that register them:

(i) The event inhabits a particular volume (or changing volume) that is observable by the human observer who has a volume;
(ii) The event exhibits a spatial relation to the observer;
(iii) The event exists over a particular duration of time;
(iv) The event takes place in a particular environment that may have qualities that alter the observation of that event.

We must also agree that the observer has the intention to observe for simultaneity in regard to the particular event under scrutiny. In general, we could say that the observer has an intention to observe, and seeks to be aware of the observation. The observer socially, culturally and linguistically frames the observation as part of this process of observation. This framing may occur with more or less self-reflection in terms of its social, cultural and linguistic spheres.

In *A Dynamic Systems Approach to the Development of Cognition and Action*, Thelen and Smith point out the following: "…a category is created in a context in a trajectory of internal activity in time. The trajectory *always* is a complex product of the immediate context, the just prior internal activity, and the history of reentrant mappings between the heterogeneous processes that make up the system."[3] They talk about this process as being time dependent. "By 'time dependent' we mean that each event in brain and body has not only a here and now but also a history and an effect on the future."[3] Categorization as a linguistic framing mechanism is also always implicated as a human tool in articulating simultaneity.

One problematic notion of defining simultaneity for a particular human observer is the following: the human becomes aware of his or her environment at a different speed consciously than unconsciously. Benjamin Libet in his book *Mind Time* has experimentally shown that conscious awareness has a measurable lag. He states: "Our experiment showed that people thought they were aware of a sensory stimulus about 500 msec before they could possibly become aware of the stimulus. This discrepancy became known to us objectively; it is no longer a theoretical speculation. We called this phenomenon 'subjective referral of consciousness sensory awareness backward in time'."[4] If we are registering something to be classified as happening "at the same time" via one or more of our sense modalities, we therefore encounter a problem. If our consciously observed awareness of an event is actually approximately 500 msec after the event, which "same time" are we talking about – the actual time at which the event has occurred, or our delayed conscious registering of that event in time? In this case, we are considering our observer to be conscious of the event that he or she is seeking to observe. Yet, this consciousness registers a false reading of timing.

Libet also points out other qualities specific to our perceptual apparatus which may affect our understanding of "simultaneous" events. Given the distributed nature of the body and the time it takes for signals to reach the brain, the body brings these signals together to make a coherent understanding. Libet states: "The primary evoked potentials can have a latency between about 5 and 40 msec, depending on the location and the modality of the stimulus. If all simultaneous stimuli are perceived subjectively by different sense modalities as being synchronous, we would have to assume that the brain does not "consider" this range of variability in latencies as subjectively significant."[3] Thus, our notion of the "synchronous" or happening "at the same time", here must also include a human duration of acceptable latency or difference.

It is interesting to note that our enfolding of past experience also can potentially alter our observations. Libet argues the following:

> "Our evidence indicates that a substantial period of neural activity (500 msec of 'on' time) is in fact required to elicit awareness of the sensory event. That delay provides a sufficient psychological opportunity during which unconscious brain patterns can alter the content of the experience before awareness of it appears. Indeed, the experimental phenomenon of subjective referral of a conscious sensory experience backward in time provides relatively direct evidence for one kind of modulatory distortion of the subjective experience. The delayed experience is subjectively timed as if it were not delayed at all."[3]

The projective nature of our ongoing observations, enfolding our embodied history, is central to a deep knowledge of current context. Our 'meaning summing' enfolds a series of thought processes during the delay period, informing our understanding of our 'conscious' now. Thus the body intermingles multiple kinds of knowledge to inform our sense of the present context as it unfolds.

Yet Libet points to other kinds of distortions. He states: "Any modulations of modifications of the developing experience would be unique to the person involved. It would reflect the person's own history of experiences and his (or her, Seaman's insertion) emotional and moral make up. But the modulations are made unconsciously. Consequently, one may say that the unique nature of a given person can express itself in unconscious processes."[3] Thus, our enfolding of past experience also contributes to our understanding of the current context under observation arising from the subconscious domain. This may also *taint* our ability to register events as happening simultaneously or shift our linguistic framing of a particular interpretation related to the timing of an event. Such thought bias can even shape our ability to register an event in terms of a particular contextual classification or "category."

On a deeper level, we must state that time is a continuum functioning in ongoing relation to each 'observer.' We can humanly parse time to differing degrees, yet in actuality between any two moments is an infinity of potential fractional divisions. Humans have their biological limits in terms of parsing this infinity using their senses and self-awareness. The closer we are in bodily proximity to an event, the less evident timing differences become. Our "now" appears to us with events happening from many different distances. The experiential qualities of these many events become folded into our individual self-centric sense of the now. The speed of light and sound predicate a different *frame of observation* for an event relative to each observer. The observer can at times register a discrepancy in the witnessing of an event's simultaneity by differing senses, even at quite a short distance away from it. How often have we watched someone hammer something in the distance? The visual stimulus reaches us long before the sound, making an odd impression of the hammer making the sound as it has long since left the surface that it has hit. Thus, each sense also enfolds a particular set of qualities in terms of registering particular events.

Think of the light of a distant planet that just now reaches us – our human-centric now. We ask how much time has passed since that perturbation was originated? Given that particular time frame and distance, we do not know the current state of the source of emission, only our time-centric perception of it.

We may seek to define an "objective" delay time with which to adjust our approximation of the simultaneous. Unfortunately, due to the biological differences inherent to each observer[3], we can not accurately define a precise offset with which to "adjust" our measurements. Thus, human observers may only register a vague, shared sense of simultaneity based on location and motion of both observer and event and the particular properties of the sense modalities employed as well as the nature of the environment that the event is being registered within.

The human observer must accept what Brian Massumi calls the "smudging" of the now, where our limits and qualities of perception become the "now" as we know it, lived within the parameters of our human framing. In his work "Parables for The Virtual", Massumi, in the chapter entitled *Strange Horizon: Buildings, Biograms, and the Body Topologic,* states:

> "Experience smudges. You get a thirdness: a supplemental effect not reducible to the two stimuli's respective durations considered

> separately. You get a supernumerary difference, a qualitative difference arising from the interrelation of recursive durations. To put it bluntly, you get a relational time-smudge. A kind of hypertime. Think about it. Since any lapse of time is infinitely divisible, and at every instant there must be some kind of stimulus arriving through one sense channel or another, if you try to fill in what happens in the half-second lapses of awareness, things get downright hallucinogenic. Say at .01 seconds a second loop begins; at .02 seconds another begins ... but at .015 seconds there will have been an intervening beginning, and also at .0125. You're left with an infinite multiplication of recursively durational emergent awarenesses, madly smudging each other. You get an exponentially self-complicating relational mess."[5]

Accepting the spatial biases of bodies in motion and the subtle differences of bio-timing may well mean accepting a range of problematic notions surrounding simultaneity and the human observer. Another avenue to explore is the augmentation of the human observer with machinic affordances that may better register the qualities of events in time and space.

3. Human Observation of Measurements that are Augmented by Differing Tools and/or Machines

It seems a natural human desire to attempt to transcend the limitations of the body as regards time, space and simultaneity, and so we devise tools to augment our perceptions. Given the limitations of the human observer as discussed above, we seek to find other ways to measure or demarcate simultaneous events that do not become distorted. We do this by decoupling the measuring instruments from the human observer and their human-centric time frame. We devise tools and machines that amplify and/or transduce particular qualities (bringing us metaphorically "closer" to the seeming understanding of an event outside of the body's non-machinic capabilities); we elucidate systems of data visualization and sonification (various event transduction systems and/or simulation systems) to point at particular qualities of difference over time; and we seek to parse time to a finer degree with machines that can recognize a far greater number of divisions per unit time.

We must always take into account the time that a transduction takes to be registered by our observational systems, as well as the nature of the environment in which the event is being measured. In humans, this "difference" in biological time-frames, based on specific qualities of our physiology, becomes a problem as articulated above. One wonders to what degree we can also attribute a related set of problems to machines? Do machines always take the same time to register an event perturbation? Can we always subtract this duration (or make it equivalent across a series of measurements) to point at simultaneity? To what degree do the environmental circumstances also alter such a measurement? We must say that for every newly authored machine, a new set of qualities related to observation become enfolded into our human, observer-centric understanding of the world. We must in each case intellectually adjust and extend our linguistic frame appropriately in order to share our experiences of derived "transduced" and/or "simulated" data. Gordon Pask in *An Approach to Cybernetics* states: "Nearly always we can tell the machine something, and surely, we should tell it, as part of its programme. But we should not prevent it indulging its own breed of recognition or expect logical nicety amongst the attributes it selects. We do not really recognize signatures in terms of neat geometrical attributes - they 'remind us of faces' or seem more or less "wiggly" and we must tolerate just as unruly attributes in an automaton."[6]

Language as a framing and articulating device must also be seen as technology on an equal footing with the machinic data that it helps to articulate. Our mathematical systems and computer codes are expanded examples of these linguistic framing devices, yet as Pask elucidates, new qualities of interpretation enter the domain of observation engendered by the nature and qualities inherent to our tools. When we examine reality closely, we observe a series of cases in which what had seemed to be a scientific "certainty" proves to be of no certainty at all. On subsequent examination (or through additional study and/or advanced technological means), these "certainties" have proven to be false. The following litany, provided by Hamilton and Bonk, points to some of these cases:

> "Heisenberg's Uncertainty Principle, Von Neumann's Monte Carlo Method, Gödel's Incompleteness Theorem, The 2nd Law of Thermodynamics and statistical description of matter, Wittgenstein's verdict on the sayable and the sentence. These are all acknowledgements of the limitations of an hermetic cognitive system."[7]

In terms of the event qualities discussed above, we must in each case ask how a tool or augmenting machine alters our understanding of the observed:

- Any machine or tool will always have a degree of inaccuracy as the human does;
- The machinic observer, like the human, is a volume and represents a set of specific embodied qualities and a spatial locality as an observer-centric system;
- A machine or tool may be able to highly specify spatial location of an event over time as may a mathematical or computational system. Each of these modes of observation also has an 'acceptable' degree of accuracy with which we may (re)define notions of simultaneity.
- An event exhibits a spatial relation to the machinic observer or tool over time;
- Machines may be capable of far higher time resolution than human observers;
- Linguistic framing will continue to pose problems regarding how we define particular terms – e.g. the "observer" is defined differently in different experiments.

Machinic amplification and/or transduction systems have opened up entirely new worlds of observable domains – think of the scanning-tunneling microscope as one example. Yet we must always remember that we are in this case observing a mediated experience that has attributes unique to its environment, qualities specific to the mode of transduction, and qualities specific to the mode of legibility (visualization and sonification). Again, we ironically decouple the human observer from a time-centric perspective of direct observation in order to more accurately register and parse time via particular tools and machines that take on the observer-centric time frame for us.

We must always consider how our tools and linguistic framing bias our understanding of events. Can we objectively minimize the time it takes a tool to register an event, or measure aspects of it to an adequate degree of accuracy so as to better know the time/space qualities of the event in itself? Does the ambiguity of language also pose a set of hidden problems? When we truncate a particular number in a problem due to the limits of some computational system, how does that approximation affect future measurements?

Each event has an infinite set of parameters that we can never get at – an infinite depth of time/space qualities that fall outside of the human and/or machine potential of registering (see Von Neumann below). We devise systems and machines that enable us to better approach that depth, or delimit a piece of an event to study it. Yet, again invoking Zeno's paradox, we can only go part way there (given that time is a continuum), never reaching the exactitude of knowing the time of an event in and of itself. In our considerations of simultaneity we are always up against the limits of the tools, machines and framing languages in terms of articulating finite qualities of accuracy. This is not to say that we have not made extremely accurate devices. Additionally, we must account for the fact that human observers will subsequently interpret and frame the data that such machines and tools provide.

4. Micro vs Macro Time Scales

We have spoken of limitations in both human and machines observation systems in the registration of time/space phenomena. We have also discussed the limitations of framing languages including text, mathematical languages and computational code. When we shift scales and seek to study micro events, we again come up against a problem in our ability to demarcate the simultaneity of events. In his book, *Endophysics, The World As Interface*, Rössler states: "The observer is the sum total of the dynamical processes which go on inside him or her. There is a macro dynamics (the coarse-grained responses of the dissipative structure called "observer"), and there is an underlying, much faster microdynamics. Even the most rapid macro change in the observer lasts several orders of magnitude longer than a micro time slice does. The micro time slices therefore are necessarily 'integrated over' from the macro point of view. An analog to 'flicker fusion' – but much faster – can thus be predicted to hold good for micro time slices."[8] In terms of our ability to articulate simultaneity, we must point to an interesting fact, that time functions differently on the micro scale. Rössler states: "Norman Campbell proposed in 1921 that all the phenomena characteristic of the quantum domain might be explicable by a single monistic assumption; that time ceases to be well-defined in the microrealm. More specifically, he said: "[Time is] a statistical conception, significant only with respect to large aggregates of atoms [so] that it is as meaningless to speak of the time interval between atomic events as of the temperature of an isolated molecule."[9] In this light, we further point to problematics surrounding our subject. We again approach a limit that we must try to transcend. Alternately, it must also be clearly stated that the human observer, even if de-coupled, at this time, must always be enfolded in terms of linguistic interpretation of machinic results. Systems that include other classes of observer must at this time always include the human observer as the final linguistic interpreter of the results of the computation, even if the computer is contributing to results on a deeply informed manner through human programming. This situation may change when Neosentient machines participate as self-aware observers (see below, section 7).

5. Computational Models Functioning as Machinic Observers, in Which Humans Become Super-Observers

More and more regularly, we find ourselves using computer simulations to help provide insights into the nature of reality. By devising a highly specific model of the physics that characterizes our world on the scales of the micro and/or macro domains, we can begin to elaborate a system that houses both the (computational) observer and the environment within a single system. Peter Weibel provides this articulation of

Endophysics, named by David Finkelstein[b] and later elucidated at length by Otto Rossler:

> "Endophysics shows us to what extent objective reality is necessarily dependent on the observer. Ever since the introduction of perspective during the Renaissance and of group theory in the 19th century, we have known that the appearances of the world depend in a lawful manner on the localization of the observer ("codistortion"). Only if one is completely outside a complex universe is a complete description of the latter possible (cf. Gödel). According to endophysics, it is only in a model that this position on the outside of a complex universe is possible, but *not* in reality itself. Endophysics hence provides an approach to a general model and simulation theory (and also to the "virtual realities" of the computer age). It is an outgrowth of chaos theory, to which Otto Rössler has contributed since 1975."[8]

The human observer in the future will run such a computational simulation and gain insight into situations that might normally be inaccessible due to the nature of measurement problems and the nature of time at the micro scale. Rössler discusses another problematic aspect of discerning simultaneity as defined by Von Neumann:

> "A chaos-generated cellularity may, if it is the finest systematic feature of a macroscopic system like you and me, leave some indelible mark on everything one touches or tries to touch … The first who apparently saw this was John von Neumann, when he formulated: "The result of the measurement is indeterminate because the state of the observer before the measurement is not known exactly. It is conceivable that such a mechanism might function because the state of information of the observer

[b] Finkelstein designed a program for a "holistic" physics in the spirit of Bohr, but discrete. He hypothetically attributed both the quantum limit and the relativistic limit to the fact that the whole is not accessible to us. Later, he indicated an explicit example of a dissipative finite automaton (computer) whose internally evaluated state is different from the objectively existing one. Shortly thereafter, he endorsed the two notions "physics from without" and "physics from within," by proposing the antonyms "exophysics" and "endophysics" as more attractive terms. The name "endophysics" is his creation.

> regarding his own state could have absolute limitations, by the laws of nature."[10]

Rössler has posited the notion of giving "assignment conditions" to be authored for the virtual observer as part of computer code (or in equations) within a highly exact simulation environment as a means to approach this problem. Where "initial conditions" cannot be known, one might "specify" the observer "microscopically.":

> "Newton divided the world into laws and initial conditions. This ingenious reduction of the whole world to comprehendible machinery left out one element – assignment conditions. The spin theory of Michael Conrad and O.E.R. offers itself as a possible starting point. This macro-assignment needs to be differentiated from micro-assignment."[11]

Elsewhere, Rössler further elucidates the concept of "assignment conditions":

> "Besides the two types of agency introduced by Newton (the "laws" and the, once-and-for-all specified, "initial conditions"), there is a new type of agency: the "assignment conditions." Assignment is a deliberate accident, so to speak. This can be understood as follows. The same universe run in a computer, so to say, acquires many faces (interfaces or cuts) depending for which particular, microscopically specified, subsystem (called observer) the rest of the universe is put on screen. A microscopic change in the observer-world assignment can radically change the interface. "[12]

Thus, given the limits of computability, and the limits of reflecting the complexity of experience, such systems hold great promise in helping to elucidate the world in a manner that transcends the use of current tools and/or observational systems. Again, we point to the limits and qualities inherent to computation, mathematics and linguistic framing surrounding the articulation of simultaneity. Yet, pragmatically we must live within these limits and come to devise new technologies and linguistic framings to inform us about the world with increasing accuracy.

6. Chemical and/or Electrochemical Observers where Particular Changes Register Particular Qualities

Another class of observer might be called the chemical and/or electrochemical observer. Yet, we must also admit that humans are members of this class – functioning as sentient electrochemical observers. Chemical observers function in relation to an event and reflect state changes within particular chemical or electrochemical reactions. The diffuse nature of chemical reactions also make the notion of simultaneity difficult to discern – part of a chemical reaction may have transpired while other parts of the reaction are still in process (see 2. The Human Observer above). We might ask 'simultaneous with what part of the reaction process'? Chemical observation may be used in conjunction with other observational systems mentioned above, forming hybrid observational approaches. Again, we here speak of limitations of the observing system in terms of acceptable accuracy, and the qualities and nature inherent to the observing system be it singular or hybrid in nature.

7. Neosentient Machines - Potential Future Observers

Rössler and I have discussed the potential of creating an intelligent situated computer and related robotic system. This presents a new class of observer. In an operational definition, we consider a *Neosentient* robotic entity to be a system that could exhibit the following functionalities: it learns; it intelligently navigates; it interacts via natural language[13]; it generates simulations of behavior (it 'thinks' about potential behaviors) before acting in physical space; it is creative in some manner; it comes to have a deep situated knowledge of context through multi-modal sensing; it displays mirror competence.[14,15] We have entitled this entity *The Benevolence Engine.* We believe that the inter-functionality of this system is potentially complex enough to operationally mimic human sentience.[16] Such an observer might be able to dynamically function as a measuring system; function as a computational simulation system; parse time on a unique scale; have electrochemical computing devices participate in the process[16]; and have introspection about these observational potentials. Again, like the other systems, this system would also have a set of limitations, yet it may assert some interesting new characteristics in terms of being a first-hand observer to measurements, given that the system has introspective capabilities. It thus does not need to be de-coupled from the event in the same way a human observer does.

8. Conclusions and Outlook

I have shown our relation to simultaneity to be problematic as it pertains to different classes of observer and the relative perspectives that arise through their observatory natures. In particular each class of observer has a set of limits and qualities inherent to its processes of observation in relation to both the environment and scale on which the event occurs; as well as the nature and characteristics of the event itself. I have discussed a series of limitations that pertain to differing approaches to observation including the limits of language, the limits of mathematical systems (as an example of a linguistic system), the limits of computational systems (also linguistic in nature) and the limits of human observation related to sensing and cognition. In this light, one must carefully frame the acceptable limits that apply for a given experiment whenever articulating simultaneous events. Given the infinite nature and complexity of experience, we can never know the world in and of itself. We can only tend toward coming to know an event at the greatest "depth" that science and our framing methodologies allow. As Wittgenstein suggested… we can only point. Casti, speaking about Wittgenstein and complexity, articulates this relation:

> "The main claim of Wittgenstein's picture theory is that there must be a link between the logical structure of a given language and the logical structure of a real-world fact that a statement in that language asserts. Since the link is itself a relationship in the real world, it's reasonable to suppose that there is some way to express the character and properties of this link using the grammatical rules of the language. But after years of struggling with exactly how to do this, Wittgenstein came to the conclusion that the link between the real world and its expression in language cannot be 'said' at all using language; rather it must be

> 'shown.' We can't express everything about language using language itself; somehow we must transcend the boundaries of language. Thus Wittgenstein says that we cannot really speak about the world, but only 'point.'"[17]

As new technologies provide us with ever more exacting capabilities for "objective" measuring, it will be increasingly important that we remain mindful of the deep complexities surrounding conceptions of simultaneity.

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