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Synchronicity as Time:
E-Series Time for Living Formations

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The enigmatic nature of time has puzzled scientists for centuries. We can, for instance, think of the discrepancy between physical and personal time. Time may not be only one kind. We propose a time system based on synchronization that is more intimate to living organisms. E-series time refers to the consequence of the local acts of synchronization of an interactive nature. G. Bateson's notion of punctuation is the cornerstone of our theory. The local synchronization for punctuation can yield global synchrony in the transcription, if the finished local act is recorded in the third-person description in an objective manner.
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(1) Introduction

Through his examination of differing series of time, J. E. McTaggart (1908, 1927) arrived at his philosophical conclusion that time does not exist. He divided time into three series: the A series, the B series, and the C series, roughly corresponding to subjective time, objective time, and static non-time. The adoption of *series* may be justified, since whether it is about the distinction between today and tomorrow or between before and after, changes plotted along points in time are expressed in terms of series, although the character of each series might be distinct.

Specifically, the series of positions running from the past to the present and from the present to the future is called the A series. The series of positions running from earlier to later is called the B series. The contents of a single position in time are events, and two or more events can occur at a point in time (McTaggart, 1908).

The theory has widely been known in the literature, enriching our vocabulary of time concepts. By separating time of the past/present/future from that of the earlier/later, the differences in the phases of time, which perplexed the philosophers for centuries, can be clarified to a certain extent at least. It should be noted, however, that the past, present, and future of the A series is more fundamental than the earlier/later of the B series—without the A series it is difficult to conceive of changes. For positions in time to be linked to changes and progress, the earlier/later of the B series is short for the purpose, since the events in the positions in the B series (e.g., President Kennedy's inauguration and President Obama's inauguration) occupy specific points in time plotted as a finished record. President Kennedy's inauguration did not become President Obama's. An element of change disappears from the scheme (Takiura,

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1976; Matsuno, 2013a). If we take tense out of the A series, what is left is the B series, a universal agreement of the sequence of the two inaugurations. Being tenseless, the earlier/later of the B series is considered a derivative or an abstraction of the past, present, and future of the A series.

McTaggart (1908) further questions the reality of time (i.e., the A-series and consequently the B-series), mainly for two reasons. One is the difficulty in accepting the independent contents of an event corresponding to each tense. If a specific point in time is assigned to each event, the distinction between the past, present, and future can be made explicit. However, it is awkward for an event being equivalent to each tense, since a memory of the past or an expectation for the future are both overridden by the present utterance: see such an example as "remembering an earlier-made appointment to meet someone tomorrow." The reason for the present utterance actualizing the past and future comes from the fact that they are both concepts that are situated in discourses, through which the past and future are expressed as statements in the present.

Furthermore, our past and present experiences are multi-faceted and Rashomon-like, fluid and uncertain.[3] For a person experiencing PTSD (post-traumatic stress disorder), for example, the past and the present may not differ in terms of contents of an event. Thus, the second difficulty in supporting the existence of time comes from the fact that the theory unwittingly assumes a subjective agent or descriptive author to distinguish the past, present, and future without naturalizing its agency. If the agency is expressed as an abstraction such as ego or self as the basis of the theory, time ends up as the result of something like ego-function, an issue limited only to the psychological domain.

Thus, viewing the contents of a position in time as event suffers from a theoretical dilemma: If events correspond to the past, present, and future, one must assume an agency; if agency is to be assumed, the past and future are incorporated into the present utterance. A way out of this dilemma is to shift out emphasis from the content of an event to the boundary of an event. That is about the act of cutting an event out of the environments. In the next section, we propose a different route to approach the reality of time based on communications theory.

(2) E-Series Time from Punctuation

We cut out and mark off ongoing phenomena into named events and call them *picnic* or *dinner*. Living organisms also demarcate the eatable from the non-eatable drawing a line between them. While listing the items making up picnic is one way to describe it, showing the boundary between picnic and non-picnic is another way of delineating the event. While it is true that the contents (a list of items) make up an event, it can

3. *Rashomon*, a film made by Akira Kurosawa in 1950, had given impact the social scientists to reconsider the nature of human observation, demonstrating the multiple characters of the same reality. The term has been known since Oscar Lewis, an anthropologist, used the *Rashomon technique* when he wrote his famous ethnography, *The Children of Sanchez* (1961).

also be true that the boundary upholds an event as an organized whole. Or, we may say that the boundary is a meta-content of an event. Since all events are punctuated in one way or another, Gregory Bateson's notion of punctuation may save us from the impasse by way of looking at whatever events in a bottom-up manner (Bateson, 1972a,1972b).

Punctuation is a boundary-making. Since an event is not a thing-in-itself (*ding an sich*), it is not an event per se that exists. Rather, the boundary demarcating content (e.g., picnic) from its context (e.g., non-picnic events) brings about an event. Thus, it should be noted that the act of punctuation or drawing of such boundaries, which separate something from the rest as a form of action, is agential (Nomura, Hashimoto, & Akashi, 2015). All living beings punctuate and make distinctions of the environment structuring an event to ensure their survival. Such an event is neither a static thing nor a stable content but the result of an organism's effort toward the environment. Therefore, this effort or the act of punctuation not only delimits the boundary of an event but also makes an appeal to the rest yet to be punctuated. More broadly, if a mind (or mental function) emerges through an aggregate of interacting components (Bateson, 1979), the act of punctuation would also be agential for the parts of the system as long as interactive relations are maintained. What makes the aggregate of interacting components agential is found within the capacity of experiencing surprises. Punctuation is unique in discretely distinguishing between what is going to happen and what has happened more than anything else.

Not only does one's punctuation interfere with another system nearby, but neighboring systems' punctuations would also interfere with one's own. The interference or sending of messages through punctuation is neither one-way nor two-way—it is multi-way, networked in a highly complicated manner. From this perspective, even the environment itself may become agential as long as it stays interactive within the network. Thus, a punctuated system punctuates another system nearby, and such event-makings reverberate through neighboring systems. Whether it is executed by sense organs or by switches in a homeostatic circuit, punctuation indicates the news of difference sending it out to or receiving it from other systems nearby. The aggregate of interaction between differentiated parts being considered mental, mutual punctuations in an interacting setting can also be inter-agential (Matsuno, 2013b).

Inter-agential interaction among systems in communication is stipulated by trial-and-error. Interferences reverberating throughout the local scene are the result of mutual correction or trial-and-error adjusting of the timing of punctuation to coordinate. Several systems in the neighborhood jointly *report* each other as to when and how the event has been punctuated and at the same time *command* each other as to how and when the following punctuation should be executed (Reusch & Bateson 1951). The report and command in the interactional parlance can be parallel to perfect tense and progressive tense in the single agential parlance, in which perfecting punctuation serves as the condition for the agent to progress toward the next punctuation (Matsuno, 1999).

One likely consequence of such incessant trial-and-error is the formation of a particular pattern of punctuation, which we might call habituation. The habit of expecting certain punctuation for elucidating events of interest tends to become self-serving by promoting certain behaviors and discouraging others (Bateson, 1963). The self-serving cycle of stabilized habituation may be the system's identity. In biology, the system's identity may correspond to the identity of a material body as a whole, that is, a material body of a larger scale that can maintain its class identity even if the component elements are constantly exchanged with different individuals of similar kinds (Matsuno, 2015).

Consider, too, the oxidative citric acid cycle synthesizing adenosine triphosphate (ATP). ATP is the main source of energy for all living beings. Pyruvate, the glycolysis product of glucose, is transferred to mitochondria for use as raw material for the citric acid cycle, eventually synthesizing ATP through the electron transport chain. In short, the oxidative citric acid cycle is a reaction cycle maintained through oxidizing the reduced carbon atoms. Hydrogen is extracted by the carbon flow circulating through the system, moving in the direction of citrate to isocitrate to α-ketoglutarate to succinate to fumarate to malate to oxaloacetate and back to citrate with a confluence of acetyl CoA. Coming into the system are pyruvate, acetyl CoA, and water; going out of the system are hydrogen and carbon dioxide. The incomings and outgoings are balanced so that the cycle is maintained to keep going.

The kind of self-regulation and control observed in the citric acid cycle make up a feedback loop that is isomorphic to other types of systems (Bertalanffy, 1962; Maruyama, 1963). Allowing the loop to maintain the reaction cycle suggests the robustness of the system, where self-regulation and control observed are the system's identity when seen from within. Thus, metabolism in biology is sustained by the class identity of the material body continually exchanging atomic components, and vice versa. What is unique here is the robustness or durability of the material body, which maintains class identity by way of exchanging the components. The reaction cycle can go on indefinitely unless it detects a major disturbance or any significant change of exogenous origin during the process (Matsuno, 2014).

Note here that the identity of the citric acid cycle is put on a different logical order (i.e., logical type) than that of each molecule that is also self-regulatory in managing what atomic component to take in and what to release. If the reaction cycle has a class identity, the molecule within the cycle may also have an individual identity. The class identity as well as the individual identity is maintained through the act of making both ends of the incoming and outgoing atomic flows meet via internally processing the intervening through-flow; otherwise, the metabolism would be jeopardized.

This internal processing in the metabolism is only made possible with use of some kind of measurement apparatus that is internal and durable (Matsuno, 2015). For example, α-ketoglutarate in the citric acid cycle takes in necessary molecules identifying and demarcating them from unnecessary ones—to change itself to succinate. Chemical affinity in this context, being stable over a period of time, suggests the likelihood of the measurement occurring internally (Matsuno, 2013a).

The reaction cycle in the natural setting may be such an example of internal measurement achieved by self-regulation and control.

As seen in the citric acid cycle, the molecule's making both ends of the incoming and outgoing flows balance is no more than synchronization between the two material flows occurring at their intersection. The incoming being synchronized with the outgoing, its consequent synchronization is constantly spilling over into the immediate neighborhood because of the lack of the means for instantaneous synchronization all over the place all at once. That is, the news of difference as synchronized punctuation reverberates in the biological realm indefinitely because of the inevitable and unpredictable interference with other metabolic bodies of a similar nature in the vicinity (Matsuno, 2013b). The act of synchronization, a time alignment between systems, is necessarily local, and any punctuation for synchronization does not fail to cause interference with other nearby metabolic bodies. E-series time is going to refer to the consequence of the local acts of synchronization of an interactive nature (Nomura et al, 2015; Nomura & Matsuno, 2016).[4]

E-series time in the making is in the mutual coordination toward more extended synchronization, while constantly failing in achieving the perfect sync every time and continuing to minimize the deviation as negligibly small as possible. A living system's effort to stay in bias, which is toward synchronization to be achieved, is made possible only through constant self-correction by feedback. Such an effort of trial-and-error is a response to deviation or to failing in meeting the objective of the perfect sync on the spot. The ongoing adjusting of the timing of punctuation is grammatically in the present progressive tense, whereas adjustment just having been made is a product registered in the present perfect tense (Matsuno, 1999). Thus, E-series time is locally agential in the forward direction, while globally regulative in the backward. Like land surveying of virgin soil, the surveyor, the agent, keeps drawing maps of not-yet-surveyed territory. At every step of punctuation, as a difference is transformed and propagated along its pathway, the embodiment of the difference before the step is a "territory" of which the embodiment after the step is a "map." The map-territory relation is at every step of boundary making (Bateson, 1972b).

The local act of synchronization for punctuation can yield global synchrony in the transcription if the finished local act is recorded in a globally accessible manner in a third-person description. When a map made by the agent wins universal recognition, the users' actions become more coordinated (as if synchronized) with the standardized recognition of the terrain. Scientists, too, prepare such a record through empirical or experimental observations. That is, E-series time registered in the record that has already been deprived of the agential capacity can safely be equated to B-series tenseless time, since what has been put on record is the series of positions running from earlier to later, corresponding to McTaggart's definition of the B series. A map

4. Since McTaggart defines a phase of the C series that has incremental characteristics as the D series, this paper then employs the term, the E series, for our argument.

drawn after survey or the after-steps of the reaction cycle may be in the B series if seen in the earlier/later relations.

In addition, E-series time in the making also internalizes the capacity of punctuation, which A-series time lacks when it is detached from the agential self. In other words, the mutual negotiations of punctuation yield E-series time, while the past, present, and future of the A series are rendered in the non-interactive environment. Put it differently, E-series time is time made by internal observers that continually negotiate and coordinate their punctuations with each other. E-series time is immanent in interaction.

Furthermore, unlike B-series time, the E series in the making can frame a near-future anticipation on a local basis, because the consequence of punctuation by one agent serves as the cause for another punctuation by other nearby agents. Of course, E-series time does not accommodate itself to the full-blown mold of the future tense.

Thus, one advantage of E-series time over A-series time is that it has the inter-agential competency of punctuation for making the tenses generative. The tenses of the past, present and future are not static existence but incessant re-authoring, so that E-series time registering in the record permits anticipating the succeeding series of its own to come—even in a primitive manner. On the other hand, the punctuation for making the tenses unique to A-series time functional comes from the nature of the standing-alone self in charge of maneuvering and overseeing the series from the outside, such as a descriptive author. Single authorship characterizes A-series time.

3. Discussion

To be sure, metabolism provides empirical support for the functioning of E-series time upon the local cycle of perfecting and progressing. The citric acid cycle may be an example, where the agential synchronization is sought by making both ends of the incoming and outgoing flows balance. Once the consequence of the balance-making has been recorded, the result—deprived of agential capacity—can be equated to B-series tenseless time. E-series time thus precipitates B-series time to be completed in the record.

Nonetheless, this may not be the whole story, because B-series time alone can sometimes accommodate itself to a scheme of integrating both local synchronization and global synchrony. The problem may be epitomized in the following question: what if two different B-series time systems come to interact? A system designed according to a set of variables—or according to the completed records—follows a certain trajectory within the range of expectation. If two such systems come into the interactive environment or if a material body possesses the receptive capacity of being punctuated, it might develop a different story despite the two systems being expected to operate according to the way they are designed. Then, the dichotomy of local synchronization and global synchrony may be in sight. A case in point is the synchronization of an array of similar pendulum clocks hanging on the wall of a

clockmaker. It is empirically observed that the swinging motion of each pendulum becomes synchronized with others, and eventually any pair of swinging pendulums enters into synchrony. This is called entrainment.

The synchronization between the pendulum clocks is due to the mutual adjustment of deformation or displacement of the pendulum movement. Displacing the movement resides within the inter-material act of adjusting the boundary conditions, even though only slightly, applied to the movement following the laws of motion. Each pendulum clock is supposed to mark its own exact time even if the ticking sounds between any two may be out of phase. Nonetheless, in the long run, the ticking sounds come to be in synchrony among all of them, although, on the microscopic level, time alignment by adjusting displacements among pendulum clocks continues incessantly. This is due to the interactive capacity of a material body being punctuated through mutual adjustments, as promoting certain behaviors and discouraging others. A material body receives news of difference from other systems nearby, and effects reverberate among them, reporting the magnitude of difference and commanding to coordinate actions to each other. Putting difference to work is agential, and the internal efforts for coordination generate E-series time.

This is again a shortcut toward approaching B-series time registered in the finished record, with no unnecessary detour via A-series time. The embodiment after each step of punctuation becomes B-series time, if the result is registered in the record. Thus, the contour of B-series time, the physical time, comes into our sight. Although B-series time has been conceived of as a time series taking tenses out of the A series, it should not be the only way to approach the earlier/later sequence of the B series.

4. Concluding Remarks

Physics has been competent in manipulating the symbol of a movement as demonstrated in the implementation of the physical laws of motion standing on a single point in time. Time, *t*, is given as a sole parameter so that interaction and synchronicity of times ticking differently is not expected. However, when a dozen metronomes on the same table starting at different positions come to synchronize within a few minutes, the hands of the metronomes are not in complete synchrony but in the small time lag continuing to keep up with each other. Thus, the displacement of pendulum movement suggests interaction between pendulum clocks nearby. The situation suggests interaction where one system's punctuation affects the other's and vice versa. Distinguishing between punctuation and interaction may be the area largely neglected in physics. While movement is conceivable in terms of a single tenseless parameter called *time* in the standard practice of doing physics, the likelihood of displacements of the movement may make time multi-parametric in distinguishing the participating tenses.

One remedy for recovering from the present quandary may be to give due attention to the inter-agential nature of the displacement of a movement which goes

beyond the strict stipulations of the physical laws of motion. The mutual correction of displacement of a movement in interactive environments allows creating room for punctuation if such strict stipulations are not applied, or, differently phrased, if the displacement of a movement does not accompany already-determined digital markers.

The importance of making room for punctuation becomes most vividly apparent in the contrast between the local synchronization in the making and the global synchrony in the product. It is from this point of perceiving the contrast where E-series time comes in. One of the systemic goals of inter-agential interaction toward synchronization (synchroactive state) is the creation of room for displacement. This room is saved for material bodies experiencing what is called time, that is to say, a moment of duration for negotiating a range of calibration for adjusting punctuations, where the short-term memory is mutually updated repeatedly.

Whether it is the case of a dragonfly catching its prey such as a mosquito by intercepting the target's trajectory or the case of a mechanical circuit where messages are handed down through an aggregate of interacting parts, the additional capacity of displacing the movement is set in place on top of the physical laws of motion (Matsuno, 2015). What survives there must be the reverberating relational act of displacing the physical movement by effectively changing the boundary conditions, rather than the physical movement specified by the laws of motion alone. More specifically, the likelihood of displacing the movement can be attributed to the sequential nature between the durable act of detection and its punctuation, while such a sequential character is totally missing in the standard practice of physics to be grasped in tenseless time. Physics has been peculiar in allowing the physicist as the externalist to monopolize the control of punctuation as in the form of setting up the boundary conditions or fabricating the measurement apparatuses, in place of directly focusing upon the durable act of punctuation of material origin.

The moment of duration is an inter-agential product of now, the durable now, from which other grammatical tenses are abstracted. The durable now, an invariant frame of reference for the flow of time, is prior to tenses of the past, present, and future, as well as to all the other series of time. E-series time then is a concrete demonstration of contrasting the local progressing and the global perfecting where the incoming "territories" are continually transformed into the outgoing "maps" of the tenseless physical time of B-series time.

The logic of E-series time can also be applied to biology. Recent chronobiological research ascertained endogenous rhythm processes of circadian clocks that adapt to daily alteration in environmental conditions. In addition to the negative-feedback regulation of clock genes through transcription-translation, which had been considered essential in circadian oscillation of biological clocks, the clock protein, KaiC, in cyanobacteria was newly found to show stable circadian rhythms through a phosphorylation-dephosphorylation cycle (Tomita et al, 2005; Nakajima et al., 2005). It is nothing but a surprise that only three kinds of clock proteins in cyanobacteria, KaiA, KaiB, and KaiC, can independently keep stable 24-hour rhythms with ATPase in vitro.

Since the circadian oscillations are temperature-compensated, the system is robust enough to possess certain durability that offers a stable 24-hour cycle. The robustness comes from the class identity maintained by the feedback loop through continuous exchange of components, such as in the oscillation between phosphorylation and dephosphorylation. The oscillation is coordinated within the loop and synchronized between the two. This process is only thought to be possible by assuming the endogenous agency's internal measurement. In addition, the phosphorylation cycle may be further coordinated and synchronized with the transcription-translation negative-feedback loop that is photosynthesis-based, and this combined biological clock may be even further coordinated and synchronized with the day/night cycle of the outside environment. Such may be the way biological beings punctuate their own reality and create time. Through interactive steps for synchronicity, living formations come in view.

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