The Kairos Syndrome

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Abstract
The ancient Greek notion of the *kairos* is defined as the key moment in which the future may be influenced. It defines a specific moment as a bifurcation point, a singularity from which new order may emerge. An embedded observer whose fractal temporal interface translates his embedding context accesses the *kairos* from within, from an endo-perspective. This observer is part of the reality generated at the bifurcation point. In fact, he is part of the *kairos*, and thus an example of strong anticipation. *Syndrome* literally means *running together*. The term is used when the reason that certain features occur together has not yet been discovered or been made explicit. This paper tries to identify and relate what runs together in the *kairos*: the dynamics of both the observer and his context, which together form an interface with anticipatory properties.
Keywords: Now, *kairos*, anticipation, embeddedness, fractal temporal perspectives

1. Introduction: The Kairos Arises from Nested Simultaneous Rhythms

This paper describes what runs together in the Now and gives rise to the *kairos*, i.e., the dynamics of both the observer and his environment, whose interaction generates an interface with anticipatory properties.

The ancient Greek term *kairos* refers to the key moment in which the future may be influenced. In contrast to *chronos*, which refers to linear, successive time and is quantitative in essence, the *kairos* is a bifurcation point which gives rise to a new quality. According to Greek mythology, *Chronos* emerged from primordial chaos and henceforth personified clock-time, as the man turning the Zodiac Wheel, thus generating succession without giving special weight to any of the successive events. *Kairos*, on the other hand, who personifies the opportune moment, allows for the emergence of new qualities.

Whereas *chronos* may be described on one temporal level of description (LOD) in terms of succession, the notion of the *kairos* requires simultaneity in the form of nested LODs. The *kairos* arises from fractal temporal structures, i.e., nested rhythms of varying lengths. Nested rhythms which phase-lock give rise to the *kairos* for the embodied observer participant. Nested rhythms which do not phase-lock generate pink noise, a temporal fractal which facilitates phase transitions and thus also gives rise to the *kairos*, albeit in an indirect way. These ideas are discussed below. However, before going into detail, it is necessary to make a case differentiation.

Phase-locking is also referred to as entrainment or synchronization. I shall use these terms synonymously. There are two different types of synchronization: Type A refers to the synchronized behaviour of individual agents which manifests itself in a collective rhythm. An example is populations of fireflies which flash together. This type of synchronization is not nested in the sense that longer and shorter rhythms lock into each other – it is simply a collection of individual entities pulsating to one rhythm. Although a second LOD (defined by the respective order parameter) is implicit in self-organized behaviour and we may refer to both the level of the individual agents and the level of collective behaviour, this scenario is not sufficient to give rise to the *kairos*, i.e., a window of opportunity in which the future may be influenced. Nested LODs are a necessary but not sufficient condition for the *kairos*. The *kairos* requires *nested* phase-locking. I shall refer to synchronization in the form of nested phase-locking as Type B phase-locking. In order to explain what I mean by nested phase-locking, I need to briefly differentiate between the notions of succession and simultaneity.

2. Fractal Time Describes Nested Simultaneous Rhythms

In my Theory of Fractal Time (Vrobel, 1998), I differentiate between two mutually exclusive temporal dimensions: the depth of time (Δt_{depth}) and the length of time (Δt_{length}). Δt_{depth} describes simultaneity – it is the number of compatible events on two or more LODs. Δt_{length}, by contrast, describes succession, i.e., the number of incompatible events on one LOD. (There is also $\Delta t_{density}$, the density of time which relates Δt_{depth} and Δt_{length}, the fractal dimension of a given interval which, however, is not relevant in this context.) Note that there is no Δt_{length} without Δt_{depth}; there is no succession without simultaneity, as successive events can only be arranged on one LOD against the background of an embedding framework time.

Our Now, our temporal interface with the world, is extended and displays a fractal structure (Vrobel, 1998). The past is nested into current and future Nows. Usually, when we imagine our Now in context, we conceive of it as a point or (for an extended Now) an interval on an imaginary line extending from the past to the future. Depending on our mother tongue, we imagine the past on the left side of the Now and the future on the right or vice-versa. My Theory of Fractal Time gives up these arbitrary directions for succession when we imagine our Now in a temporal context and replaces them with one which runs from the inside to the outside when portraying the direction from the past or from the present into the future. Conversely, the direction from the future or from the present into the past is portrayed as running from the outside to the inside. Imagine a model of nested temporal bubbles, in which past Nows are continually nested into more recent ones, with the current Now usually forming the outer boundary of this nesting cascade. If we take also future impacts into account, the outer boundary is shifted up to the point in the future which provides the outermost reference frame.

Both Type A and Type B synchronization involve more than one LOD and can therefore be described in terms of both Δt_{depth} and Δt_{length}. Type B, however, requires the additional property of nested phase-locking. This is brought about when the individual rhythms do not span the same temporal interval, i.e., when shorter rhythms are nested into longer ones.

Type B synchronization gives rise to the *kairos* if the simultaneous nested rhythms are integer multiples of the embedding rhythm.

An example of Type B synchronization is overtones: When we hear a naturally produced tone, we hear not just one sinusoidal wave (a pure tone) on one LOD, but also its overtones, simultaneously on several LODs. If the nested overtones are integer multiples of the fundamental frequency, we refer to them as harmonics. Not all overtones, however, are harmonic: There are also musical instruments which produce overtones that are not integer multiples of the fundamental frequency.

The superimposed rhythms form a harmonic series if the overtones are integer multiples of the fundamental frequency. For instance, the first overtone of the fundamental frequency of an oboe (440Hz) is the first harmonic (880 Hz). The second overtone is the third harmonic (1320 Hz) (Fauvel et al, 2003).

When we hear overtones, we generate both Δt_{depth} and Δt_{length}, i.e., simultaneity and succession. When we hear an artificially produced pure tone, we generate succession only, as there are no nested overtones. As overtones are integer multiples of the fundamental frequency, they are an example of nested phase-locking, the prerequisite for the emergence of the *kairos*. In Section 4, I shall describe the case of the missing fundamental as an example of the *kairos* at work: The listener anticipates the longer, embedding frequency when he constructs the missing fundamental.

Strong anticipation as defined by Dubois (Dubois, 2000, 2003) becomes possible for an observer who is nested in a Type B synchronization. An embodied observer, whose neural oscillators are linked to much slower metabolic ones, is another example.

3. Endo-Observers Can Phase-Lock into Nested Simultaneous Rhythms

The perception of nested rhythms requires an observer whose internal differentiation (including the observer‘s body and the measuring chains of an extended observer) matches those of his environment. According to Rössler (Rössler, 1998), there are two types of observers: endo-observers and exo-observers. Endo-observers see the world they are embedded in from within, via an interface which distorts the outside world. Exo-observers, on the other hand, see the world from an outside vantage point. Just like Laplace's demon, an exo-observer is an idealized construct, who observes a system from the outside without interfering with it. It is a pure observer, as opposed to an observer participant – a notion which finds no counterpart in reality. We are all endo-observers and thus observer-participants.

An exo-observer would not be able to lock into rhythms of an environment, therefore the window of opportunity for the exo-observer allows for weak anticipation as defined by Dubois (Dubois, 2000, 2003). By contrast, the endo-observer is able to entrain into the rhythms of his environment. His window of opportunity is characterized by strong anticipation in Dubois' sense, as this endo-observer is part of the reality generated at the bifurcation point, in fact, he is part of the kairos.

To an endo-observer, everything is happening in the Now, his only window to the world. As Rössler pointed out, Nowness is pure interface (Rössler, 1995). The *interfacial structure* of the observer's Now determines his degree of complexity, i.e. his ability to phase-lock into environmental rhythms. As I have briefly outlined above, the observer's Now must be assumed to be extended and to display a nested structure which allows for the generation of two mutually exclusive temporal dimensions: Δt_{depth} and Δt_{length}. The emergence of nested simultaneous rhythms and nested phase-lockings occur in the temporal dimension of Δt_{depth}.

4. Nested Simultaneous Rhythms Display Two-Way Causation

One way endo-observers may bring about the *kairos* is to phase-lock into a nested temporal structure. We do this, for example, when we perceive overtones and give rise to missing frequencies:

"If the fundamental frequency is removed and only the overtones are played, the listener hears the same pitch as he would hear if this fundamental were included. Even if one takes away not only the fundamental frequency but also the first overtone (plus the second, third, etc.) this does not change the perception of pitch. This phenomenon is used to trigger the perception of low frequencies which are physically non-existent, such as in stereo speakers which do not produce low frequencies, to generate a bass sound the speakers cannot physically produce. In telecommunications, only the higher frequencies are transmitted, as the listener can hear the missing fundamental and the first few overtones, even though they are physically not present in the signal." (Vrobel, 1997).

This phenomenon is usually explained by the fact that our brains calculate the difference in frequency from the relations of the overtones and thus calculate the lower overtones and the fundamental frequency. However it is also conceivable to interpret this completion process performed by our brains as a result of creating simultaneity from a multi-layered signal, such as a cascade of overtones, as being simply the result of *the listener locking into a wider anticipated context.* Although this wider context may not be physically present in the above example, the listener can still synchronize, as his internal differentiation has created an interface which anticipates also lower frequencies (including the fundamental frequency). The observer participant infers from experience that there are temporal embeddings which belong to the temporal structures perceived. This adds an anticipatory level to his temporal interface: From now on, the observer expects to perceive longer rhythmic intervals which embed and influence his present Now. There is no way an endo-observer can judge whether or not the fundamental frequency was generated by himself, the outside world or both. The reality generated on his interface is the same for both cases.

The missing fundamental has been described as an example of shorter nested intervals of time, i.e. higher frequencies, having a causal impact on (and, even generating) longer intervals, i.e., longer, embedding frequencies. However, nested LODs exerting a causal influence works both ways. Not only shorter, embedded temporal structures influence or bring about longer, embedding temporal structures, but also vice-versa: Longer rhythms influence shorter, embedded ones (cf. Buzsáki's description below).

Not all simultaneous rhythms phase-lock, as in the above example of overtones. Simultaneity alone is not sufficient for the induction of phase-locking. It may simply generate noise as a result of the superposition of its simultaneous frequencies. However, if this noise is scaling, this fractal temporal structure can also translate among LODs, with the result that shorter temporal nestings (higher frequencies) are causally influenced by their embedding, longer temporal nestings (lower frequencies). This has been observed by Buzsáki in the power density of the EEG, where slow oscillations have a causal impact on temporally embedded faster local events:

"(...) This $1/f^{\alpha}$ power relationship implies that perturbations occuring at slow frequencies can cause a cascade of energy dissipation at higher frequencies, with the consequence that widespread slow oscillations modulate faster local events. The scale freedom, represented by the $1/f^{\alpha}$ statistics, is a signature of dynamic complexity, and its temporal correlations constrain the brain's perceptual and cognitive abilities." (Buzsáki, 2006).

This means that the present event is influenced, one may even say caused, not only by past rhythms but also by rhythms extending into the future, into which the Now is temporally embedded. This is so because, for the overtone example, for instance, the entire interval (one period) of the embedding rhythmic interval is anticipated by the nested rhythmic interval (of shorter frequency) which represents our Now. Locking-in can only occur if the longer structure to be locked into is already "existent" in the Now (in the sense that its impacts are already felt), although this embedding structure extends into the future and is therefore at least partly not-yet-existent from the endo-observer's perspective.

How come? Aristotle (Aristoteles, 336-323 BC) differentiates between four notions of causation: formal, material, efficient and final cause. Questions addressing the formal cause (*causa formalis*), the material cause (*causa materialis*), and the efficient cause (*causa efficiens*) contemplate the past to explain as a result of what and out of what something is happening. The final cause (*causa finalis*) addresses the question as to what purpose something is happening and thus refers to the future as the explanatory source. Final causation was advocated by Aristotle and today plays an essential part in Dubois' Anticipatory Systems (Dubois, 2001) which take into account both the *causa efficiens* and the *causa finalis*, and thus poses both questions: as a result of what and to what purpose does the present state arise?

A similar approach describes two types of causal relations at work in fractal time – one in each of the two mutually exclusive temporal dimensions, Δt_{length} and Δt_{depth} (Vrobel, 2007)

In my Theory of Fractal Time, causal relations in Δt_{length}, i.e. succession, are attributed to the *causa efficiens* only, whereas causal relations in Δt_{depth}, i.e. simultaneity, are attributed to both the *causa efficiens* and the *causa finalis*. (Both are at work in the above example of the missing fundamental where nested, high frequencies give rise to embedding, low ones and Buzsáki's observation that global slow oscillations modulate faster local events.)

In many cases, i.e. whenever we do not need to consider anticipatory effects, causal relations in Δt_{length} can be described by the *causa efficiens* alone. This is not longer true, however, if we are facing emergent phenomena. Even synchronization on one LOD (e.g. fireflies flashing together) is an emergent phenomenon which cannot be explained by the *causa efficiens* alone. A further embedding reference frame must be assumed to explain emergent synchronization, so the introduction of this new LOD performs the transition from Δt_{length} to Δt_{depth}. The cause of the emerging rhythm is both the *causa efficiens* and the *causa finalis*: As the new embedding LOD (the reference frame) is, by definition, a longer temporal rhythm, as it embeds the rhythm of the current Now, the *causa finalis* is at work (it represents top-down causation). But the resulting circular causality, which is maintained by the order parameter and its enslaved constituents, requires also the *causa efficiens* in order to explain the bottom-up causation the enslaved constituents give rise to. Often, we can infer that there must be a higher embedding LOD to explain phenomena we experience such as strange loops or tangled hierarchies (Hofstadter, 1980). However, we cannot always identify this LOD, i.e. we do not always know all the parts which run together in the *kairos*.

As endo-observers, we cannot distinguish between a kairos, which actually allows us to causally interact between nested LODs, and what Jung called synchronicity: the temporally coincident occurrence of acausal events (Jung, 1943). We may suspect that an embedding LOD will explain the ordered behaviour on the embedded level and look for likely candidates such as embedded anticipatory systems, which have an inbuilt stabilizing purpose navigator in the shape of a delay-compensation mechanism. Sometimes, however, a shot into the dark is necessary in order to reveal causal relations between LODs.

Strong anticipation requires both the assumption that longer temporal intervals can influence embedded shorter ones and that shorter intervals can influence longer, embedding ones. As described above, both are possible and are actually happening in emergent phenomena, although we may not be aware of it.

However, a difficulty remains when we try to define the embedded endo-observer. The notion of an observer participant presupposes that this observer type is both phase-locking into his environment, but, at the same time, is able to communicate his observations. Just as a pure observer would not be able to participate, so a pure participant would not be able to observe and thus communicate his observations. Therefore, the notion of an observer participant must define an interfacial cut between the observer and the rest of the world, stating what belongs to the observer and what belongs to the outside world (Rössler, 1996).The notion of an embodied observer often makes us forget that, logically, there must be a part of the observer which resists phase-locking.

5. To Phase-Lock or Not to Phase-Lock: Defining a Core Observer

Simultaneity can give rise to phase-locking between nested levels of description. According to Buzsáki, although, for instance, neuronal oscillators may be linked to (much slower) metabolic ones, there is no entrainment among neighbouring cortical oscillators, i.e., among adjacent bands of frequency. This is so because the ratios of the mean frequencies between neighbouring cortical oscillators are not integers. Therefore, adjacent bands cannot linearly phase-lock. Instead, the temporally nested oscillators generate pink noise as a result of their superposition:

"The $1/f^{\alpha}$ (pink) neuronal "noise" is a result of oscillatory interactions at several temporal and spatial scales. These properties of neuronal oscillators are the result of the physical architecture of neuronal networks and the limited speed of neuronal communication due to axon conduction and synaptic delays." (Buzsáki, 2006)

The pink noise generated by nested oscillators provides a perfect temporal background structure for humans to induce phase transitions, whenever the need arises (e.g. to adapt to a change in the environment). It is, so to speak, a prerequisite for a window of opportunity, in which new structures may emerge as a result of phase transitions. The bifurcation point, which is a singularity from which new order may emerge, corresponds to the *kairos*, the key moment in which the future may be influenced.

Note that also the period-doubling cascade before the onset of chaos is a window of opportunity. Period doubling is a process governed by "frequency-halving bifurcations (which) occur at smaller and smaller intervals of the control parameter" (Moon, 1987). The doubling of a periodic motion to a period twice the period etc. of the original may be interpreted as phase-locking in the direction of Δt_{length} (Vrobel, 1999). This process may be interrupted before the onset of chaos, for example, by means of anticipatory regulation. Ironically, if this opportunity is missed and chaos sets in, it is this very state of chaos which is the precondition for the emergence of new order from self-organizing processes, which, then again, generate new LODs and thus Δt_{depth} as a result of their synergetic circular causality.

This differentiation between domains which allow for phase-locking and those which do not makes it possible to set an interfacial cut within embodied cognition: Phase-locking may occur between the brain and the rest of the body and between the observer's body and his environment. If Buzsáki is right and there is no phase-locking between adjacent bands of frequencies of neighbouring cortical oscillators within the brain, this would entail that a further interfacial cut has to be taken into account: the cut between the phase-locking and non-phase-locking temporal domains of the embodied observer.

This differentiation would demarcate an incommensurability within the observer, i.e., it would not be possible to translate between phase-locking and non-phase-locking temporal domains. The latter comprise neighbouring neuronal oscillators whose frequencies cannot phase-lock into each other. I suggest that this observation may help to define the interfacial cut between a "core" observer and an extended observer (Vrobel, 2000) who may encompass the rest of the world: If the capacity to resist phase-locking is the defining feature for the establishment of a "core" observer, the temporal domains in which phase-locking may occur may be assigned merely the status of a "close environment". This close environment includes the temporal domains of the brain in which phase-locking may occur, as well as the observer's body, the extended observer (one who has integrated parts of his environment into his measuring chain) and his environment, that is all those domains into which the observer may phase-lock. All play an indispensable role in our reality-generation game. The new suggestion presented here is that the observer parts which phase-lock are, in principle, no different from the immediate environment the observer is embedded in. Only the „core" observer resists interaction in the form of phase-locking and may thus be assigned the status of an observer as opposed to an observer participant. Note that these distinctions refer to temporal domains, not spatial ones.

It may be said that the "core" observer, i.e., the neighbouring cortical oscillators whose adjacent bands cannot linearly phase-lock, is the prerequisite for a complex adaptive observer, as it generates the pink noise which renders possible fast phase transitions (which are necessary to respond to environmental changes).

What runs together in the *kairos* is the dynamics of both the observer and his context, which together form an interface with anticipatory properties. Human observer participants are basically nested antennae (Vrobel, 2000), both internally differentiated by nested LODs and externally embedded into nested LODs. They form a system of nested oscillators with their environment by entrainment (e.g. circadian rhythm, female cycle). However, not all of the observer's rhythms lock into rhythms of his environment.

If there were an overall phase-locking, which emcompassed every temporal frequency the observer generates, no observer participant and thus, no perspective, could evolve but only a "pure" participant who would be totally immersed in his environment as a result of phase-locking on all temporal levels (Vrobel, 1997). Approaching this state is accompanied either by a feeling of "fearful ego dissolution" or of "oceanic boundary loss" (Metzinger, 2006). However, if a state of total immersion were reached, the former observer participant would cease to function as an autonomous entity and therefore could not generate a perspective: No interfacial cut could be set between such an "observer" and the outside world: thus he ceases to be an observer participant and turns into a participant only. Therefore, we have to assume a "core" observer – a domain which resists phase-locking – in order to define an observer participant with a temporal perspective.

6. Conclusion

Two nested, i.e., fractal temporal structures may give rise to the *kairos*: pink noise and Type B phase-locking. The embodied observer participant gives rise to both and is thus able to generate a temporal fractal interface. He is an endo-observer and thus an example of strong anticipation.

Simultaneity is a necessary but not sufficient condition for the emergence of phase-locking and the *kairos* (e.g. pink noise in the brain). Type B phase-locking is a sufficient condition for the emergence of the *kairos*. The inside-outside and outside-inside causality at work in nested temporal structures allow the observer participant to influence the dynamics of shorter temporal intervals via the dynamics of longer temporal intervals, and vice-versa. This causality is at work only in the temporal dimension of Δt_{depth} and describes a causal relationship for what is referred to as a coincidence of acausal events if the LODs involved cannot be identified.

I have suggested that what runs together in the *kairos* is the dynamics of both the endo-observer and his context, which together form an interface with anticipatory properties. However, if we cannot define a "core" observer who resists phase-locking, no interface between inside and outside can be defined and, thus, no *kairos* may arise.

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