Time Dilation and Condensation: Our Judgement of Duration is Based on Content

Susie Vrobel
The Institute for Fractal Research,
Goethestrasse 66
D-34119 Kassel, Germany
Susanne.Vrobel@t-online.de

Abstract

The notion of subjective duration is discussed against the background of my Theory of Fractal Time. Bergson's concept of an indivisible *durée* is differentiated in terms of succession and simultaneity, the latter of which may be disentangled if a fractal structure of the Now is assumed. Husserl's notions of pretension and protension are adopted to describe the nested structure of the Now. Exemplified by Klinger's accounts of time condensation in stressful situations, it is suggested that subjective time dilation and condensation result from a temporal perspective enhanced by or deprived of simultaneous contrasts (Δt_{depth}). The proposed model describes how our judgement of duration is based on the distribution of content in Δt_{depth} (simultaneity) and Δt_{length} (succession).

1. Introduction: Duration

Subjective duration is a notoriously difficult extension to describe. Against the background of a third-person perspective or clock time, accounts of subjective experience of duration may be compared. However, the observer participant's internal structure, which determines the generation of duration, is poorly understood.

Henri Bergson describes internal duration (*durée*) as "the continuous life of a recollection which extends from the past into the present, so that the present may clearly contain the perpetually expanding image of the past" and states that "without this continuing existence of the past in the present, there would be no duration, only the existence of the moment" [Bergson, 1909].

In the fractal approach to describing duration, which is introduced below, the notion of succession is based on Bergson's idea of a perpetually expanding past within the Now. However, in the context of a fractal model of time, the notion of simultaneity requires a division and thus breaks with the Bergsonian notion of *durée*, which is characterized by indivisibility throughout. (Moreover, the fractal Now has additional properties such as anticipation and a nested structure. See 2. below.)

To Bergson, *durée* is an indivisible temporal interval. He has us imagine an infinitely small elastic band, which is contracted into a point. If we start stretching it, the point turns into a continuously growing line: "Let us focus our attention not on the line *qua* line, but onto the action of pulling it. Notice that this action is indivisible, given that it would, were an interruption to be inserted, become two actions instead of one and that each of these actions is then the indivisible one in question. We can then say that it is not the moving action itself which is ever divisible, but the static line, which the action leaves under it as a trail in space." [Bergson, 1909]

Durée is based on an indivisible action, whose division would produce two consecutive actions but never a divided duration. This makes sense but takes account only of successive divisions in a one-dimensional time. Other divisions of duration are conceivable if one considers simultaneous actions – this idea will be picked up in the section about fractal time below. Bergson refers to one level of description (hereafter denoted as LOD) only and does not consider temporally parallel actions or processes. For one level of description, his approach holds and for that level, we have to assume duration to be indivsible. However, this is a special case, which we normally do not encounter. Our Nows, which are the windows in which we perceive duration, are usually multi-layered structures, in which various sensory inputs and mental feedback loops are nested on several nested levels of description. In order to describe such nested Nows, we have to assume two mutually incompatible dimensions of time, namely, succession and simultaneity, which I shall define below. (Note that these extensions are incompatible only during the generation of the Now – in retrospect, an interval can be analyzed in terms of both dimensions).

2. Fractal Time

A fractal rather than a one-dimensional model of time allows a content-based description of subjective duration, which makes it possible to explain the perception of time being dilated or condensed on the basis of the number of temporal nestings taken into account. While Bergson's idea of the perpetually expanding image of the past is inherent in the idea of nested Nows introduced below, in fractal time, the Now is divisible in the "vertical" sense, in that simultaneous levels of descriptions which make up one Now may be separated.

My Theory of Fractal Time defines temporal observer perspectives in terms of Δt_{depth}, Δt_{length} and $\Delta t_{density}$. Δt_{depth}, the density of time, is the number of compatible temporal intervals on more than one LOD: it defines simultaneity. Δt_{length}, the length of time, defines succession as the number of incompatible temporal intervals on one LOD. $\Delta t_{density}$, the density of time, is measured in the fractal dimension of a temporal interval, thus relating Δt_{depth} and Δt_{length} [Vrobel, 1998].

Compatible intervals of time are arranged simultaneously in the Now. This multi-layered structure can be shown to be nested when we consider Edmund Husserl's answer as to why we are able to perceive a tune, rather than a succession of uncorrelated notes [Husserl, 1928]. We generate duration because the note just played lingers on in our consciousness of the present and, assuming this was not the end of the tune, we anticipate the next note to follow it. If this process is reiterated, a fractal structure emerges, consisting of nestings of retensions (memory of the past) and protensions (anticipation of the future). This nesting cascade of temporal LODs creates $\Delta t_{density}$, the density of time.

Simultaneous LODs also arise from the internal constraints of our perceptual apparatus. We merge simultaneous sensory inputs (visual, auditory and haptic perceptions) within our Now. As the thresholds for perceiving sensory input as one event rather than two successive events, vary, auditory perceptions (intervals of approx. 6 ms) may be nested in haptic ones (intervals of approx. 10 ms), which, again may be nested in visual ones (intervals of approx. 30 ms) [Pöppel, 1998].

The resulting nesting cascade forms simultaneous contrasts within one Now, which we merge into an indivisible, meaningful whole, a gestalt. Under certain conditions, however, we are able to disentangle our Now, by means of de-nesting, i.e., reducing Δt_{depth}, and focussing on a single or a small number of LODs [Vrobel, 2006].

3. Disentangling Levels of Description Modifies Subjective Duration

Disentangling LODs and a reduction of Δt_{depth} may occur spontaneously, e.g., in stressful situations. David Klinger describes the experiences of policemen who, in highly stressful situations, such as in armed confrontations, develop tunnel vision and have no auditory perceptions. They also report that time seems to have slowed down for them, in the sense that so much detail was perceived that, in relation to external clocktime, their Nows hosted an amount of content which would have filled a longer time span under normal conditions, i.e., when their LODs were not reduced to one or few levels of perception [Klinger, 2004].

Reduction of Δt_{depth} in the form of compromised auditory perception correlated with the start of the stressful situation and ended when the situation relaxed: "I knew the guy was shooting at us because I saw him shooting, but I didn't really hear the rounds going off. The audible start-up and 'BANG!' that usually happens when you pull the trigger wasn't there. (...) At the time, I didn't know my partner fired because I didn't hear his shots ..."; "As soon as the guy disappeared into the projects, everything got loud." [Klinger, 2004]. This was accompanied by another reduction of Δt_{depth}, namely, tunnel vision: "Another thing I remember is that when the guy turned and started firing, I got tunnel vision on him." [Klinger, 2004].

These reductions of Δt_{depth} were "compensated" by an increase of Δt_{length}, which dilated time for the policeman: "Then the guy reached down towards the bulge in his waistband. At that point, things went into slow motion, and I said to myself, 'If he reaches under the shirt, I'm gonna shoot him'." [Klinger, 2004]. Klinger also reports this officer's account on how he saw bullets entering and exiting the body of the person they shot, describing details which cannot be perceived under normal conditions, as they simply happen too fast to be picked up and processed (e.g. a detailed description of a bullet penetrating through the skin and the immediate damage caused to the body).

It seems that time slowed down when some essential parts of the perceptive apparatus shut down, so that percepts were constrained and limited to one LOD (or, at least, a number of LODs which is significantly lower than during perception in non-stressful states).

In this example of armed confrontations, focussing on one LOD (or a significantly reduced number of LODs) was helpful, because the officer was able to focus on a specific task in a situation whose outcome was a matter of life or death. In terms of fractal time, Klinger's accounts of auditory and visual deprivation may be interpreted as a reduction of Δt_{depth}. The more LODs are taken away, the less extended Δt_{depth} becomes, as there are fewer nestings (contextualizations) and the more extended Δt_{length} becomes, as more content can be arranged on

fewer LODs. By contrast, time speeds up again as soon as auditory perception returns and Δt_{depth} increases again. Nesting (contexualization) seems to condense time, whereas de-nesting (de-contextualizing) appears to dilate it. Thus, duration seems to be inextricably linked to the way content is internally arranged in the dimensions of Δt_{depth} and Δt_{length}, respectively. [Vrobel, 2007].

Here, the notions of content and context refer to temporal extensions and relations only. A content is a phenomenological concept: a quantity which represents the meaningful temporal extensions experienced by an observer participant. As meaning is generated interactively, content is inextricably linked to the observer participant's world and thus a subjective notion. In a nested, i.e., fractal temporal perspective, contents extend, in each case, on one LOD only. The concept of a context is also phenomenological in essence: A context is a temporal extension which serves as a reference frame into which contents are embedded and against the background of which meaning and thus contents are created by the observer participant. Contents may become contexts if the temporally extended content serves as a reference frame for other embedded contents.

4. Time at a Standstill

When we "forget about time" while playing or focussing on one task on one LOD, to us, time slows down in the sense that it is filled with so much content on one LOD that we feel that time around us has speeded up and that a shorter interval of clocktime should have passed. This judgement is based on our experience of how much content fits into a Now. If our Now hosts many nested LODs, the content is contextualized (nested) and spread over many simultaneous LODs, expanding Δt_{depth}. This would make the perceived interval appear shorter. If contents are not contextualized (nested), but arranged on one LOD, the Now can contain more content on that level, i.e., it is expanded in Δt_{length} and we underestimate the clocktime interval it occupies. Our judgement of duration is based on content.

Δt_{depth} may also be reduced intentionally, e.g. in deep meditation. Time may even be brought to a virtual standstill if only one LOD is focussed on, i.e. Δt_{length} is increased significantly, for instance, when we reduce our attentional focus in meditation to a tone of a specific frequency or to rhythmic drumming. Evoking such a state is not only relaxing, it also helps us to focus on detail such as our breathing, on a visualized image or an idea. By contrast, sensory deprivation may be counteracted by nesting performances (contextualizations), which leads to an increase in Δt_{depth}.

Note that this description of time dilation and condensation is true only for the present perception in our Now. In retrospect, our memory content of highly contextualized Nows, of eventful periods, is remembered as a long time interval, because of the full content being retrieved (and modified) on one LOD. In contrast, memory content of uneventful periods (no contextualization), which appear long in the current Now, are remembered as short intervals, because memory is measured in event units (contextualizations). Thomas Mann describes the observation that Δt_{depth} is perceived differently in retrospect through his character Hans Castorp:

"Emptiness and monotony may dilate the moment and the hour and make them 'tedious'; the great and greatest periods of time, though, they shorten and fade away even into nothingness. Conversely, rich and interesting content is capable of shortening and quickening the hour and even the actual day; on a large scale, though, it endows the course of time with breadth, weight and solidity, so that eventful years pass much more slowly than those poor, empty light years which the wind blows before it, and which fly away. So, actually, what we call tedium is, rather, a pathological diversion of time, resulting from monotony: in conditions of uninterrupted uniformity, great periods of time shrivel up in a manner which terrifies the heart to death ..." [Mann, 1924].

5. Conclusion

Our judgement of duration is based on content. We are able to condense or dilate the duration of our Now by nesting or de-nesting perceptions and thoughts. Condensation may prove useful when we wish to contextualize the content of our Nows in order to widen our temporal perspective. The resulting broadened perspective, which comprises many nestings of LODs of various extensions, allows us to relativize the narrowed reality generated by one unnested or a few nested LODs. Possibly, condensation by contextualization may prove useful in treating certain types of depression. In contrast, time dilation, which is brought about by reducing nestings and concentrating on one LOD, is useful in situations where we need to accommodate more detail in our Now (e.g. in stressful situations such as armed confrontation). It is also useful for many forms of meditation, in which we blot out the world around us to the extent that we focus on one LOD only (e.g. a mantra or rhythmic drumming). The relaxed state which accommodates such a one (or next-to-one) dimensional perspective, in which we generate succession rather than simultaneity, helps us to generate more content on one LOD, thereby giving ourselves a break from contextualizing and to focus on ourselves.

As this approach is phenomenological in essence, for the observer participant, reality checks are reduced to his interfacial perspective, i.e. the view from within [Rössler, 1998]. This means that for persons in stressful situations, in which the generation of Δt_{depth} is compromised, or for individuals in deep meditation, the world, as represented on their interface, actually slows down.

References

[Bergson, 1909] Henri Bergson: *Einführung in die Metaphysik*. Diederichs, Jena, 1909, pp. 8, 24ff. (my translations)

[Husserl, 1928] Edmund Husserl: *Vorlesungen zur Phänomenologie des inneren Zeitbewußtseins*. (Lectures on the phenomenology of the inner consciousness of time.) First published in 1928. Niemeyer, Tübingen, 1980.

[Klinger, 2004] David Klinger: *Into the Kill Zone*. Jossey-Bass, San Francisco, 2004, pp. 60, 68.

[Mann, 1924] Thomas Mann: *Der Zauberberg* Fischer, Frankfurt, 1984, pp. 110-111. First published in 1924. (my translation)

[Pöppel, 1989] Ernst Pöppel,: Erlebte Zeit und die Zeit Überhaupt: Ein Versuch der Integration. In: *Die Zeit. Dauer und Augenblick.* Eds: H. Gumin & H. Meier. Piper, München, 1989.

[Rössler, 1998] O.E. Rössler: *Endophysics.* World Scientific, Singapore 1998.

[Vrobel, 1998] Susie Vrobel: *Fractal Time.* The Institute for Advanced Interdisciplinary Research, Houston 1998.

[Vrobel, 2006] Susie Vrobel: Simultaneity and Contextualization: The Now's Fractal Event Horizon. Talk held at *13th Herbstakademie: Cognition and Embodiment.* Ascona, Switzerland, 2006.

[Vrobel, 2007] Susie Vrobel: Sheer Simultaneity: Fractal Time Condensation. Talk held at *Intersymp 2006*, Baden-Baden, 2006.