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The Conceptual Construction of Time

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Before Kant, one might say, we were in time; now time is in us.

Schopenhauer[1]

Let me say at once, the tentative and rather speculative ideas I am presenting here are not intended to answer the question of what time *is*, in an ontological sense. I am interested in how the thinking mind might come to have a *concept* of time. This concept has been a problem from the beginning of Western philosophy. It was implicit in the irreconcilable conflict between Parmenides' notion of an eternal, changeless world of being and Heraclitus' unceasing flux. The history of modern science, and especially biology - as Stephen Gould so convincingly argues - manifests the dichotomy expressed by the contrasting metaphors of "Time's arrow and Time's cycle", which he took as title for his book. As Gould remarks:

> "We often try to cram our complex world into the confines of what human reason can grasp, by collapsing the hyperspace of true conceptual complexity into a single line, and then labeling the ends of the line with names construed as polar opposites ..."[2]

What human reason grasps, it grasps by conceptualizing, and then relating the results in its thinking. I therefore want to change Gould's statement and say, it is the hyperspace of experience that we collapse into our concepts. In this sense, knowledge is always our own construction.

Jean Piaget has shown us that it is more fruitful to ask how we construct the notions and conceptual schemes that enable us to deal with the experiential world than to engage in the ultimately undecidable metaphysical debates about the nature of reality.

As you all know, Piaget developed a theory of cognition that is in many ways compatible with Kant's approach to reason. But he vigorously opposed Kant's notion that the ideas of space and time are given a priori. Consequently, he developed a model to show the possibility of constructing a concept of time that is neither innate nor, as evolutionary epistemologists claim, predicated on adaptation to a universe presumed to be temporal in itself.

The section on time in Piaget's fundamental work, *La construction du réel chez l'enfant,* ends with two important conclusions:

> L'enfant, devenant capable d'évoquer des souvenirs non liés à la perception directe, parvient par cela même à les situer dans un temps qui englobe toute l'histoire de son univers.*

and

> ... la durée propre est situe par rapport à celle des choses, ce qui rend possible à la fois l'ordination des moments du temps et leur mesure en relation avec les point de repère extérieurs.**[3]

In his inimitable way, Piaget showed in this section of the book, how he developed these conclusions by minutely observing his children, Laurent and Jacqueline. As in all construction of conceptual models, Piaget begins by observing cognizing organisms and then conjectures and analyzes their experiences. This is necessarily speculative and at best hypothetical. First, because in each and every one of us, rational reflection begins much later than the construction of the first basic schemes that enabled us somehow to order and provisionally systematize experience and observations. Second, because when we eventually begin to reflect upon conceptual operations, we are already well accustomed to the use of language and its metaphors. Even the most meticulous scientist cannot be aware of all the implications of the words he or she uses in an analysis. Common expressions such as "history" and "duration" implicitly involve the notion of *continuity,* and we therefore tend to think of time as a *flow.* It is an image we tacitly accepted when we first heard it said that "time goes by" or "*le temps passe";* and the image persists regardless of whether we visualize time as an arrow or as a cycle.

I believe, that the image of time moving and "going by" is misleading. What goes by are our experiences.

We know that while we are experiencing one thing, we cannot experience another. Experiences, therefore, are manifestly sequential. But they do not move like boats floating down a river. There is no moving substrate that carries them along. Each one is superseded by another - just as are the words when you are reading or, indeed, listening to me now. There are no intervals filled with the flowing of time. Some items are retained in memory, others not. If there are gaps in retrospect, we know that they were filled with other experiences, or sleep.

A conceptual model of the operations that generate a particular piece of knowledge must not take any image for granted. I repeat - I am focusing on *knowing,* not on the metaphysical question of what things *are*.

From my point of view, the passages I have quoted from Piaget provide an excellent description of the general process, but they do not cover certain details. There is one point which, although Piaget touches upon it in the context of "object permanence" (1937, p.75), I have not found explained anywhere in his writings: it is the construction of the kind of *continuity* that is implicit in concepts such as history, duration, and flow.

All authors I have read agree that the relation of continuity is a crucial component of the concept of time. It, too, must be analyzed in terms of sensorimotor experience, mental operations performed with this material, and reflective abstraction from these operations.

The model I am proposing uses elements which, although not those actually used by Piaget, could be seen as compatible with his. My conceptual analyses are built on the presupposition that, because experience is inherently sequential, abstract concepts begin with a reflection upon sequences constituted by moments of attention.

The idea to characterize events by sequences of static situations, like the single frames of a film, was formulated by Silvio Ceccato at the Cybernetics Center in Milan in the 1950s, while we were working on a project to make the meaning of verbs accessible to a computer.[4] Only recently did I discover that Henri Bergson, half a century earlier, had already written: "The mechanism of our ordinary knowledge is of a cinematographical kind."[5]. Later, however, he said that this was "a habit of thinking and perceiving that needed to be broken".[6] To explain the notion of duration, he shifted to the example of a tune. Although the sounds of the notes are separate, he said, the continuity (and, by implication, duration) arises because each is modified by the preceding one.[7]

In a tune, there is, indeed, a connection constructed with the help of the successive interaction and modification of sounds. But this is an empirical abstraction from the recurrence of individual notes and it functions in the manner of links in a chain. I would call it *sensorimotor connection*, because it does not bestow continuity on other notes or other elements. It links changes and creates a succession. Piaget describes this in the context of experiments with moving objects (Piaget, 1969, p. 67)[8]. Although this provides suitable material for the construction of a concept of time, it does not itself involve that concept.[9]

What I am pursuing is, I think, close to what the mathematician William Rowan Hamilton called "pure time" and described as:

> ... distinguished on the one hand from all actual Outward Chronology (or collections of recorded events and

> phenomenal marks and measures), and on the other hand from all Dynamical Science (or reasonings and results from the notion of cause and effect).
>
> (Hamilton, *Mathematical Papers,* 3:7)

The frame metaphor of cinematography helps to illuminate a relation that remains implicit in the patterns of change such as musical tunes. In a succession of separate frames, connections between two or more frames are not *given*. They may be suggested by the quality of their content and thus give rise to an empirical abstraction. But such an abstraction merely links a specific succession of static frames, such as successive individual sounds that compose a tune. The frames are static, and only an active mind can supply a relational concept beyond the simple succession.

A further act of reflection is needed to separate the pattern of connectedness from the specific material, so that it may become available as a general concept of continuity and duration.

Piaget indeed mentioned the need of such an act of reflective abstraction in a passage in which he explained how an object finally acquires its "permanence":

> En effet, par le fait même qu'il entre dans le système des représentations et des relations abstraites ou indirectes, l'objet acquiert, pour la conscience du sujet, un nouveau et ultime degré de liberté: il est conû comme demeurant identiqué lui même quels que soient ses déplacements invisibles ou la complexité des écrans qui le masquent.*** (1937, p.75)

It is the ability to re-present the object to oneself when it is not actually available in the perceptual field, that leads to the conception of a maintained identity. Piaget provides an important hint when he locates the origin of this ability in the child's experience of a moving object that is temporarily hidden by a screen. In that situation, the child tracks the object visually, continues the tracking motion of her eyes when the object disappears behind a visual obstacle, and picks it up again when it reappears. This has been demonstrated experimentally and it shows that the connection between the object before and after its disappearance is provided by the continuous motion the child carries out with her eyes. But this, too, is still a sensorimotor continuity. It is not unlike the continuity of a tune, where the preceding notes, because they continue to reverberate, are linked to the following ones.

In the construction of permanence, it is essential that the object, when it is perceived *again*, is taken to be the self-same individual as before - not merely an object that happens to be *like* the former one.

Such an individual identity is often tacitly assumed when there are no sensorimotor elements, such as visual tracking, or the reverberation of a

sound, to provide an experiential continuity. In these cases it is a purely conceptual construction, and the use of language tends to obscure it. The word "same" in English (and "*le même*" in French) is a case in point. If we say to our friend Tom: "You are wearing the same shirt Jack is wearing," we are speaking of two shirts; if we say: "You are wearing the same shirt you wore yesterday," we have only one shirt in mind.

In Piaget's terms, both instances could be described as *assimilation*. The results, however, are different, and the difference opens the path to two divergent conceptual constructions. In the first case, Tom and Jack may or may not both be in our visual field. It is irrelevant, because the judgment of sameness is based on the comparison of two separate sensory impressions which, in themselves, entail no permanence. We merely have to be able to re-present to ourselves the former shirt when we see the second. Indeed, this re-presentation can serve as prototype of a class, if we meet other people with shirts that we find "the same" with regard to the characteristics we have retained from the earlier experience.

In the second case, however, we regard the shirt, as Piaget says, as *demeurant identiqué lui même,* that is, as the self-same individual that we encountered before. This individual identity has to be stretched and preserved throughout the interval between our first perception of the shirt and the perception we are assimilating to it now. For us, this interval between the two perceptions was filled with a succession of other experiences (perhaps even a night's sleep). Hence there is no sensorimotor continuity whatever. The shirt's preservation of identity, therefore, extends through a domain *outside* the field of our experience. I have elsewhere suggested that the creation of this domain eventually serves as foundation for what we think of as "being" and what philosophers call ontological reality.[8]

Here, however, we are concerned with the concept of time, and in this context I want to stress that, although the imaginary domain where objects can preserve their individual identities provides the opportunity for the construction of time, it does not by itself constitute it. An additional operation has to be carried out, and I return to the example of the shirt to explain it.

When we assimilate Tom's shirt to the one we saw him wear yesterday, we attribute individual identity to it and assume that it is the self-same shirt. The assumption may of course be wrong. Tom might reply that he has half a dozen of these shirts. This would compel us to conceive of a class instead of an identity. But if our assumption of identity is not contradicted, we have to think of a single shirt, one and the same individual that has a continuous connection with the one we saw yesterday. Yet, we have no continuous sensorimotor elements to warrant such a connection, and therefore have to construct it as a continuity *outside* our own field of experience. We have to think of it as a link that is separate but, as it were, parallel to the succession of experiences we have had in the interval between the two shirt-perceptions. We

remember the succession of our actual experiences as continuous and having a sequential order, and we can now project the pattern of sequentiality on the imaginary line that preserved the shirt's individual identity. By this projection we generate a sequentiality without events, an *abstracted flow.* This is what Hamilton called "pure time". In fact, he gave an excellent description of this operation of projection:

> "... we form the *nearest approach* to the idea of time when we think of one order as the mental basis of another, and consider the latter arrangement, which in this view resembles the course of events, as reducible to a mental dependence on the former arrangement which corresponds to the course of time.[10]

Wittgenstein, incidentally, expressed the same idea in his earliest work, the *Tractatus logico-philosophicus,* which he wrote during the First World War and which, although he later discarded parts of it, contains a great many valuable intuitions. He there wrote: "The description of the temporal sequence of events is only possible if we support ourselves on another process."[11]

Let me end by emphasizing once more that what I have presented here in no way contradicts Piaget's expositions. It is nothing but a slight amplification which, in my view, strengthens his position against Kant's *a priori* and highlights his account of the construction of reality.

Acknowledgment

My thinking was greatly expanded by reading Thomas L. Hankins' wonderfully lucid analysis of Hamilton's ideas (Note 10).

Notes

1. Schopenhauer. A. (1851) *Parerga und Paralipomena, Vol.1,* Halle an der Saale: Otto Hendel, undated; p.81.

2. Gould, S.J. (1987) *Time's arrow, time's cycle.* Cambridge, Massachusetts: Harvard Universioty Press; p.191.

3. Piaget, J. (1937) *La construction du réel chez l'enfant.* Neuchâtel, Delachaux et Niestlé; p.306.

4. We used this method successfully in many semantic analyses, but Ceccato did not publish it until much later; Ceccato, S. & Zonta, B., *Linguaggio, consapevolezza, pensiero.* Milan: Feltrinelli, 1980.

5. Bergson, H. (1907) *L'évolution créatrice,*

6. Bergson, H. (1938) *La pensée et le mouvement.*

7. Bergson, H. (1889) *Essai sur les données immédiates de la conscience*.

8. Piaget, J. (1969) *The child's conception of time*. (Translation: A.J.Pomerans), New York: Basic Books. (Original: *Le développement de la notion de temps chez l'enfant.* Paris: P.U.F., 1927)

9. See my "Notes on the concept of change" in *Cahiers de la Fondation Archives Jean Piaget, No.13* (91-96). Geneva: Fondation Archives Jean Piaget, 1993

10. Hamilton, W.R. Manuscript in Trinity College, Dublin; Box VI, 21 April 1832. Quoted in Thomas L.Hankins, "Algebra as pure time: William Rowan Hamilton and the foundations of algebra" in P.K.Machamer & R.G.Turnbull (Eds.), *Motion and time, space and matter* (Ch.12), Ohio State University Press, 1976.

11. Wittgenstein, L. (1933) *Tractatus logico-philosophicus.* London: Kegan Paul, Trench, Trubner & Co. (revsd reprint,1933), §6.3611.

* As the child becomes able to recall memories unrelated to direct perceptiion, it succeeds in this way to situate them in a time that comprises the entire history of its universe.

** ... the child's own duration is placed in relation to the duration of things, which makes possible at once the ordering of moments of time and their measurement in relation to external reference points.

*** Indeed, by the very fact that it enters into the system of representations and abstract, or indirect, relations, the object acquires an ultimate degree of freedom in th subject's consciousness: It is now conceived as remaining identical in spite of all its displacements and the complexity of the screens that mask it.