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## A CONCISE GUIDE TO THE TEMPORAL MAZE

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The paper provides a concise historical survey of the expanding field of time psychology, pointing to the important contributions, in its early stages as well as today, of European psychologists. An evaluation of past and current research is proposed, and prospects for further development suggested, especially with regard to neglected areas and to issues related to applied situations.

### THE AMBIVALENT STATUS OF TIME IN SCIENTIFIC PSYCHOLOGY

It seems that time is at last receiving recognition in psychology. More books and articles devoted to time have been published, more conferences have been held during the last twenty years than in the preceding hundred and fifty years. A quick and admittedly superficial quantitative survey has been made from the main key-words in *Psychological Abstracts* (Figure 1): it shows the expansion by a factor of 15 or so from the early fifties to 1970 and thereafter. Students of time have been stubborn enough to persevere, and they now feel rewarded for their patience and obstination. Perhaps they were comforted in their efforts by the example of their chronobiologists fellows, which gained late recognition in biology at large after having been ignored for an even longer period of time. Their work is nowadays familiar to all, including laypeople, but it should be reminded that it was not until the nineteen fifties that the study of biological rhythms, carried out by isolated pioneers, called the attention of biologists and physicians, plausibly because of its sudden relevance to real life situation: jet-lags and shift-work, and soon chemical therapies, raised unexpected problems, which chronobiologists could address.

However, in spite of its recent development and success, the psychology of time has not quite reached the same status in psychology as chronobiology has in biology. It still lacks its striking applications to daily life, which favour wide audience, and it has not found its place yet in the package of basic knowledges offered to undergraduates. Most introductory textbooks keep totally silent about time: their subject

index has no entry for it, nor for time perception, time perspective, timing behaviour, time concept, or whatever key-words referring to one or another of the topics now familiar to specialists of psychological time. Exceptions are to be found generally in textbooks in French (although many of them share the same ignorance as publications in English). More surprisingly, major sources at a more advanced level

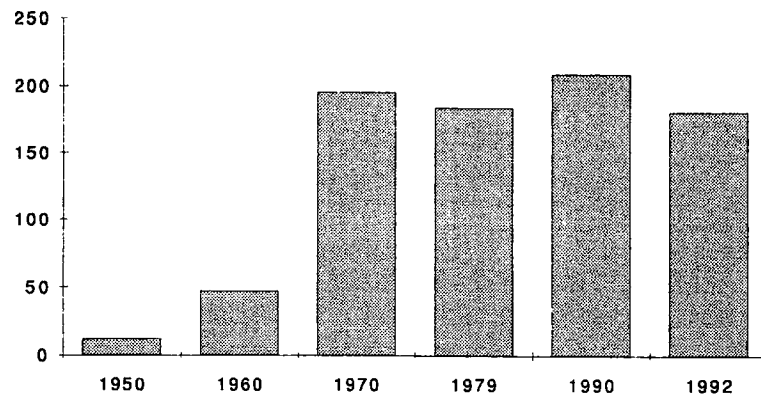


Figure 1. Number of publications concerning psychological time per year, every tenth year from 1950. Estimated from appropriate key-words in *Psychological Abstract* (for some accidental reason in the library, the year 1980 has been replaced by 1979).

are equally unreceptive to progresses made in the study of time, an extreme case being the dropping out of the chapter on time perception from the deeply revised and up-dated content of *Stevens' handbook of experimental psychology* (Atkinson, Herrnstein, Lindzey & Luce, 1988). Here again, comparable French publications give time the place it deserves (Richelle, Requin & Robert, in press).

Of course, time has been widely present in psychological studies as a dimension of independent variables, for instance when an experimenter controls the duration of display of visual stimuli on a tachistoscope screen, or the delay between presentation and recall in a memory task, or the stimulus onset asynchrony parameter. But this has little relation with what psychologists of time are interested in. Reaction time is clearly closer to their subject matter, but together with mental

chronometry, its by-product familiar to cognitive psychologists, it is used mainly as a basis for inferring mental processing of something else. What distinguishes psychology of time is that time is dealt with, so to speak, for its own sake, in all its facets. Looked at in this way, time has indeed been given little attention.

How can one explain such general neglect of time among psychologists, while it has been since ever the concern of poets, novelists and philosophers, as well as a major puzzle to physicists (Prigogine & Stengers, 1988; Hawking, 1988) and more recently an important theme for biologists (Aschoff, 1981)? One can only speculate on the reasons of an absence. Perhaps psychologists, in spite of their claims to objective knowledge, have been repressing a topic loaded with anxiety: a number of issues in the study of psychological time confront us with irreversibility and unescapable degradation. But, granting psychologists the capacity to cope with such discomfort, they might simply have postponed a thorough study of psychological time because technical tools were not at hand to deal with it efficiently. If this is the main explanation, inertia would account for the present state of affairs, since adequate tools have been for some time available, and have been used successfully by those engaged in what still appears as an esoteric subfield of psychological sciences.

#### A EUROPE-CENTRIC HISTORICAL REMINDER

We have alluded above to some exceptions, especially in French psychology, to the general neglect of time. This statement calls for a few words of comment. Awareness of historical roots is always beneficial to those who practice a science, and it is all the more so when a particular tradition is shown to be largely responsible for the survival of a line of research, which otherwise would have been exposed to disappearance. Fraisse (1948) is to be credited for having maintained the psychology of time alive throughout the late forties until its revival in the seventies. His early contributions in book size (1956, 1957) were in sharp contrast, in terms of both documentation and original work, with the rather poor content of Woodrow's review (1951). They quickly gained him international recognition (Fraisse, 1963). Fraisse has never stopped his research on time (see Fraisse, 1984) and a number of current experts in the field have been his students, or have been tutored by him in some way. His role has been

crucial in the development of what could be called the French school of time psychology, were it not for the doctrinal connotation of the term *school*, alien to Fraisse's approach.

Other names deserve mention if we want to trace back the interest of French psychologists in time. Pierre Janet (1928), whose insightful work has unfortunately fallen in oblivion, has written one of the most stimulating books on the psychology of time, a model in integrating emotional and cognitive aspects, and in linking time and memory. More fortunate was Guyau's book (1890) on the origin of the idea of time, eventually translated into English one century later (Michon, Pouthas & Jackson, 1988).

Contemporary with Fraisse's early work, not exactly in France but in the French language area, was the work of Piaget on the development of the concept of time in the child (Piaget, 1946). It has been the origin of further elaboration in the frame of constructivist theory, and its more recent re-formulations, some of which are represented in the present volume.

Extending this historical sketch to the rest of Europe, one will point to the contribution of the British psychologist Cohen (Cohen, Hansel & Sylvester, 1955) whose studies on the relation between distance, speed and time as experienced in real life situations (as opposite to the purely intellectual approach used by Piaget) had an ecological flavour which should appeal to today psychologists, who nevertheless tend to ignore them. In a quite different vein, Nuttin (1963, 1979) devoted part of his research in personality and motivation to time perspective (an equivalent for the terms *horizon temporel* in French), pioneering in one important area of the psychology of time especially relevant to current social and cultural issues.

Interestingly enough, these now classic contributions seem to have attracted the attention of chronobiologists more than from the part of psychologists. They were offered their place in pluridisciplinary conferences on biological time, such as the Bel-Air symposium organised in Geneva in 1967 (Ajuriaguerra, 1968). They provided the foundations for the revival that took place from the sixties on, in which European individuals and groups continued to take an important part. At the same time, American psychologists had eventually joined in the study of time, with a special interest, as could be expected from the *Zeitgeist*, on cognitive aspects and on models of temporal information processing (for a representative sample of international research by the eighties, see the introduction to this volume).

#### EVALUATING TWENTY-FIVE YEARS OF PROGRESS

Summarizing and evaluating what has been achieved in such an expansive field of research is no easy task. In the following tentative outline, we shall successively characterize recent and current research in terms of the rich diversification of areas and topics, in terms of cross-integration, in terms of pluridisciplinary outlook, and finally in terms of failures to deal with important issues which lay ahead of us for the future.

Topics explored now cover the wide range from elementary (though not simple) processes involved in time estimation to the aesthetic use of time parameters in performing or listening to music. A complete enumeration would take us far beyond available space. Hereafter is a selection of areas in which research has been especially fruitful.

*Psychophysics of time.* Time estimation, a topic already explored in the past century (Vierordt, 1868), has developed as a branch of psychophysics, using its methods and models. It has reached a level of accuracy in data measurement and of sophistication in theoretical models which match with psychophysics of sensory modalities, encompassing both human and animal subjects. In spite of the fact that the sense of time is but a metaphoric expression, since there is no such thing as a stimulus nor a receptor comparable to light or sound and the eye or the ear, data can be accounted for by the same sort of equations which fit sensory data. Of special interest is the application of psychophysical methods (including scaling) to time estimation of its own behaviour by an organism, as has been done in hundreds of animal studies of what we have labelled temporal regulation of behaviour (Richelle & Lejeune, 1980). In humans, psychophysical studies have been mainly focussed on the temporal dimension of external stimuli.

*Motor timing.* Timing of motor behaviour has been an increasingly important topic among specialists of psychomotricity (see Requin, 1980). Rhythmic responses, spontaneously produced or synchronized with some external rhythmic stimulation offer an apparently simple case (eventually turning very complex indeed when musical rhythms enter the stage). Different problems arise with respect to timing of movements involved in motor skills which require subtle and on-going adjustment to more or less unpredictable targets (as in catching a tennis ball). The latter area of research is obviously derived from

the insightful concept of motor programme proposed by Lashley (1951) and by Bernstein (1967) to account for the intriguing properties of skilled motor actions: the cognitive planning of complex motor acts involves anticipation of both sequencing and timing, while leaving place for final adjustments during performance.

*The concept of time.* Early studies by Piaget, originated in a discussion with Einstein, were focussed on the relations between distance, speed and time. Later studies showed that the grasping of such relations is far more complex than initially thought. More importantly, they pointed to other types of situations experienced in the physical world in which events and objects have temporal properties without any apparent link with movement. Also, the way we talk about time has been shown to be a basic ingredient in the construction of our concepts of time (see Bronckart, 1976; Ferreiro, 1971; Hornstein, 1990). The concept of time as it has evolved in modern science, although it plausibly had its starting point in the daily experience of human beings in the remote past, has undoubtedly gone far away from such experience, still constrained by the traps of our subjective evaluation of duration, by the categories in which natural language has moulded temporal relations, and by the world view imposed by our culture.

*Time experience, memory and time perspective.* Cognitive psychology has shifted from the concept of time, in the sense used by Piaget, to re-presentations of time. The emphasis is no longer on the prerequisites of a logical or scientific notion, but on the elaboration, in an individual's mind, of the temporal mapping consistent with his or her experiences of time, in its dual aspect of duration and order. A major breakthrough here is the merging of questions about time and the study of memory, which Janet would have applauded to. Representations of time involve integration of the past, both individual and social, and anticipation of the future: it is both remembering and planning. Issues raised in the cognitive study of time obviously converge with issues classically dealt with in studies on personality and on socio-cultural models, such as the opposition between linear and cyclic representations of time. This is a nice illustration of the cross-integration that is taking place.

#### CROSS-INTEGRATION WITHIN THE PSYCHOLOGY OF TIME

Varied as they are, these subfields of the psychology of time are undoubtedly tending to mutual integration, - testified, among other things, by the increasing number of meetings aiming just at that, again European meetings being especially broad in scope - even though we are far from a unified theory of psychological time. One might argue that such a theory is not likely to emerge, because the very diverse processes described under the general heading of psychological time are not facets of one single underlying mechanism or function, but basically distinct things; and therefore that each student of time should be advised to plow his own field.

There are, however, good arguments to look for unifying concepts. Empirical observations as well as formal models converge from different lines of research, for instance, as has been pointed out, from human and animal psychophysics, from studies on time estimation as well as motor timing. Organisms exhibit high accuracy with respect to time, and altogether variability - qualities already present in biological rhythms such as the circadian cycles. This dual feature might be understood as having adaptive value, and should anyhow be accounted for in formal models of psychological time, as it has been indeed by several authors in the recent past (for example, Wearden, 1985).

It is also heuristically and theoretically fruitful to look for continuities between various levels of psychological time, as it is for any psychological function. At first sight, an animal's response to the temporal dimension of a stimulus seems very far away from the time experiences of Proust's narrator or from the expressive modulation of notes duration by the expert performer. There are, doubtlessly, levels of complexity with respect to time, which make for discontinuities, and one can choose to focus on any level independently of others, in a purely structuralist manner. Nevertheless, the emergence of more complex levels would be inconceivable without the lower, more simple levels. Epigenic and phylogenic history has explanatory value in accounting for successive levels, and also leads to evaluate how far higher levels are free from the constraints characterising lower levels. Whatever the sophistication of our cognitive representations of time, we are still, as most simple living organisms, under the control of biological rhythms. Our symbolic, and eventually conscious, processing of time has not suppressed our more direct appraisal of duration, which we

share with lower animals; more than that, it is plausibly anchored in it (for a discussion of diverging views on this issue, see Michon, 1990; Richelle, 1992).

Another aspect of the trend toward integration is the increasing interest for study of time in various branches of psychology: work psychology and ergonomics, psychology of music, psychology of sports, psychopathology, are only a few examples.

#### PLURIDISCIPLINARY CROSS-FERTILISATION

The revival of psychology of time has, in the beginning, been stimulated, as mentioned earlier, by the encounter with chronobiology. The latter has, since then, made its way into many areas of applied psychology, especially in relation with work and school situations. In spite of a few promising studies, basic psychological research has not much addressed important issues concerning the links between biological rhythms and psychological time.

The psychology of time has, on the other hand, benefited from the growing attention for time in the neurosciences. Neurobiological and neuromimetic models might reveal more powerful in accounting for the internal psychological clock mechanism(s) than purely functionalist descriptions. There is also a need for more adequate formal tools, which temporal logics might provide.

#### FUTURE PROSPECT

It does not make sense to predict the forthcoming developments of the psychology of time. Nor to ascribe it specific tasks. Some speculative personal reflections might nevertheless contribute to extend the already rich proliferation of research into unexplored alleys. The subject matter of the psychology of time is typically amenable to the search for universals and altogether exposed to changes as a function of history, especially in our species. The search for universals has been the main concern of the last twenty years revival summarised above. Little attention has been paid on one hand to interindividual differences, and on the other hand to the new adaptive challenges with respect to time deriving from drastic cultural changes. Just as chronobiology has suddenly developed in the context of unprecedented

violations of biological rhythms, so psychology of time is confronted with hitherto unknown situations. Let us take only two illustrations.

Time has traditionally been a major element of music, and there are good arguments to think that music was originally closely linked with motor rhythmicity. The refined evolution of musical art has eventually produced pieces in which the rhythmic element is reduced or even eliminated. Material is available to test the role of time and rhythm in a listener's access to musical pleasure, in emotional and intellectual effects, in the spontaneous reproduction of music stimuli by non musicians. Admitting mankind cannot live without music, would a music void of rhythm have any chance to survive?

Another example, of much wider consequence, is offered by today culture with respect to time perspective. There is no doubt that the extension of the *horizon temporel* in past and future, both individual and social, is a function of memory processes and symbolic encoding allowing projects and plans, possibly beyond an individual's life time. New tools have been forged throughout mankind evolution which contribute to such extension: writing codes have been invented which amplify historical memory as well as time span of projects; mathematical models have made it possible to extrapolate with some accuracy from past and present events into the future; increased awareness of risks has favoured preventive actions with respect to retirement, health, protection of the environment, natural disasters and the like. In many ways, the time perspective of mankind has been drastically enlarged. But simultaneously, there are a number of features of modern civilization which go exactly in the opposite direction: economy encourages consumers' immediate satisfaction; politics is based on short term contract between citizens and candidates; communication technology dislocates time in smaller and smaller disconnected units. Such contradictions raise interesting questions to psychologists: how far is the human cognitive and emotional system able to cope with them? What sort of time perspective will individuals exhibit depending upon the particular balance of opposite weights they do experience? What sort of disorders, individual or social, might develop as a consequence of so divergent trends?

Needless to say, these and related questions take us beyond the quiet serenity of laboratory research. They have obvious practical implications, and psychologists might feel ethically committed to engage in appropriate action to inform their human fellows, and eventually to modify their behaviour toward more consistency with respect to time.

Specialists of psychological time might find themselves confronted, as medical experts have been for some time, with responsibility in remediation and prevention. Let us only hope this will not be the case, and that they will be permitted to explore further their basic research favorite themes, - in any case the best way to prepare themselves to possible social demand.

## REFERENCES

- Ajuriaguerra, J. de (Ed.). (1968). *Cycles biologiques et psychiatrie. Symposium de Bel Air III*. Paris: Masson.
- Aschoff, J. (1981). *Handbook of behavioral biology: Vol. 4. Biological rhythms*. New York: Plenum Press.
- Atkinson, R. C., Herrnstein, R. J., Lindzey, G., & Luce, R. D. (Eds.). (1988). *Stevens' handbook of experimental psychology*. New York: Wiley.
- Bernstein, N. (1967). *The coordination and regulation of movements*. Oxford: Pergamon Press.
- Block, R. A. (Ed.). (1990). *Cognitive models of psychological time*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Bronckart, J. P. (1976). *Genèse et organisation des formes verbales chez l'enfant*. Bruxelles: Dessart & Mardaga.
- Cohen, J., Hansel, C. E. M., & Sylvester, J. D. (1955). Interdependence in judgments of space, time and movement. *Acta Psychologica*, 11, 360-372.
- Ferreiro, E. (1971). *Les relations temporelles dans le langage de l'enfant*. Genève: Droz.
- Fraisse, P. (1948). Etude comparée de la perception et de l'estimation de la durée chez les enfants et chez les adultes. *Enfance*, 1, 199-211.
- Fraisse, P. (1956). *Psychologie du rythme*. Paris: Presses Universitaires de France.
- Fraisse, P. (1957). *Psychologie du temps*. Paris: Presses Universitaires de France.
- Fraisse, P. (1963). *Psychology of time*. New York: Harper & Row.
- Fraisse, P. (1984). Perception and estimation of time. *Annual Review of Psychology*, 35, 1-36.
- Friedman, W. J. (1990). *About time: Inventing the fourth dimension*. Cambridge, MA: The M.I.T. Press.
- Gibbon, J., & Allan, L. (Eds.). *Timing and time perception*. New York: Annals of the New York Academy of Sciences, 423.
- Guyau, J. M. (1890). L'idée de temps. In J. Michon, V. Pouthas, & J. L. Jackson (Eds.), *Guyau and the idea of time*. Amsterdam: North Holland.
- Hawking, S. W. (1988). *A brief history of time*. New York: Bantam Books.
- Hornstein, N. (1990). *As time goes by: Tense and universal grammar*. Cambridge, MA: The M.I.T. Press.
- Janet, P. (1928). *L'évolution de la mémoire et de la notion de temps*. Paris: A. Chahine.
- Lashley, K. S. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.) *Cerebral mechanisms in behavior*. New York: Wiley.
- Michon, J. A. (1990). Implicit and explicit representations of time. In R. A. Block (Ed.), *Cognitive models of psychological time* (pp. 37-58). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Michon, J., Pouthas, V., & Jackson, J. L. (Eds.). (1988). *Guyau and the idea of time*. Amsterdam: North Holland.
- Nuttin, J. R. (1963). The future time perspective in human motivation and learning. *Proceedings of the 17th International Congress of Psychology*, Washington. Amsterdam: North Holland and *Acta Psychologica*, 1964, 23, 60-82.
- Nuttin, J. R. (1979). La perspective temporelle dans le comportement humain. In P. Fraisse, F. Halberg, H. Lejeune, J. A. Michon, J. Montangero, J. Nuttin, & M. Richelle (Eds.), *Du temps biologique au temps psychologique* (pp. 307-364). Paris: Presses Universitaires de France.
- Piaget, J. (1946). *Le développement de la notion de temps chez l'enfant*. Paris: Presses Universitaires de France.
- Prigogine, I., & Stengers, I. (1988). *Entre le temps et l'éternité*. Paris: Gallimard.
- Requin, J. (1980). Towards a psychobiology of preparation for action. In G. E. Stelmach & J. Requin (Eds.), *Tutorials in motor behavior*. Amsterdam: North Holland.
- Richelle, M. (1992). From action to cognition: Bridging the gap? In F. Macar, V. Pouthas, & W. J. Friedman (Eds.), *Time, action and cognition: Towards bridging the gap* (pp. 373-382). Dordrecht: Kluwer.
- Richelle, M., & Lejeune, H. (Eds.). (1980). *Time in animal behaviour*. London: Pergamon Press.
- Richelle, M., Requin, J., & Robert, M. (Eds.). *Traité de psychologie expérimentale*. Paris: Presses Universitaires de France (in press).
- Vierordt, K. (1868). *Der Zeitsinn nach Versuchen* [Empirical studies of time experience]. Doctoral Dissertation, Universität Tübingen, Germany.
- Wearden, J. (1985). The power law and Weber's law in fixed-interval post-reinforcement pausing: A scalar timing model. *Quarterly Journal of Experimental Psychology: Comparative and Physiological Psychology*, 37B, 191-211.
- Woodrow, H. (1951). Time perception. In S. S. Stevens (Ed.), *Handbook of experimental psychology* (pp. 1224-1236). New York: John Wiley and Sons.

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