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## Parallelism

Parallelism literally means “beside-of-one-another” (from the Greek *parallelos*, *para* + *allelon*). It became a metaphor for quite a number of fields of human inquiry: philosophy, biology, psychology, rhetoric, literature, and fine art. More recently, literal parallelism, triggered by metaphoric interpretation (in extension of parallel electric circuitry or parallel pneumatic and hydraulic configurations) became an alternative to sequential computation. Embodied in machines of various types and forms of parallelism, this new understanding is simultaneously a form of computational knowledge of cognitive processes. As challenging as the goal of outlining the commonality (commonalities) of parallelism is, it has to be substituted by a historic and methodic account of its various embodiments in theories and in practical experiences.

In biology, parallelism describes expectations of developmental characteristics of groups of animals or plants in response to similar environmental constraints (or affordances). Although zoosemiotics (and what might emerge as plant semiotics) has not specifically focused on the subject, one can still expect inferences from the biological realm to that of culture.

As a figure of style, of interest to rhetoric and literature, parallelism provides means to emphasize and suggest relations by using repetitive patterns, mirrored sentences, or paraphrases. Effort is aimed at balancing one literary element with others of equal significance. Literary semiotics identified such examples in Biblical texts, the Psalms, in the oral poetry of almost all known cultures, and in the entire history of literature. During rhetoric-dominated forms of literary expression, parallelism flourishes.

In somewhat related terms, an entire aesthetics is built around a variation of parallelism within the symbolic movement in the arts. It holds that the inner nature of humanity can be most effectively expressed by repetitive patterns, including parallel lines, symbolizing the order (which some see as mystical) that underlies nature. Ferdinand Hodler, influenced by the symbolist poet Louis Duchosal, painted under the guidance of this aesthetics of parallelism. Many other artists followed his example, if not necessarily the concept.

By no surprise, parallelism strategies of emphasis are widely used in what over time became mass media, especially in advertisement. The types that emerged are synonymic (pertaining to the use of synonyms, words or images or sounds in order to ensure subtle repetitive patterns), antithetical (pertaining to the choice of something against something else presented in a parallel manner), and synthetic (pertaining to a selection synthesized from the parallelism of presentation). Some advertisements combine parallel synonymic expression, antithetical figures, and synthetic strategies.

Seduced in turn by the metaphor or parallelism, philosophers for the longest time entertained the notion that material and spiritual phenomena take place in parallel, though separate, sequences.

While along each sequence there are causal connection, one can at best state correlations between the two streams of occurrences. In the attempt to understand the relation between the body and the mind, the view furthermore focused on the relation between physiological processes and what would eventually be called cognitive (mental) processes. Parallelism states that mental changes are to be seen in correlation to neural modifications (the firing of a neuron is the most recent expression, inspired by the experience of electronic circuitry). No deterministic, at least not apparent, connection can be further assumed between cognitive (or conscious) processes and what takes place in the nervous system. The view offers an alternative to theories of interaction in an effort to avoid difficulties arising from explanations based on assuming that correlations are actually interrelationships. In none of the parallelism-based body-mind theories neither a spiritual substance, a substantial soul, nor a homunculus implied or accepted. A variety of theories evolve around an assumed, though not evident, underlying entity through which unity is reached. Therefore, mind and body could be seen as fundamentally identical, while the parallel mental and physical processes embody aspects of unified real processes.

The psychophysical conception, at least as varied as the philosophy of parallelism, states in a more radical form that between events in nature (the physical world) and mental states, one has to accept a one-to-one correlation. (Leibniz is the originator of this idea.) A more nuanced view refers to the parallelism and to the refined correlation between psychoses (affecting individual minds) and neuroses. Suggested within this view is that processes such as physico-chemical changes or neural activity might not have cognitive correlates.

Credited to Fechner (*Zend-Avesta*, third book, chapter XIX), the terms *parallelism* came into use after the thought it labels had literally propagated from the philosophy of ancient Greece to the religious concepts of the Middle Ages and to Spinoza's *Ethics* (where the doctrine seems to have been first explicitly articulated). The notion of correlation adopted by the Scholastics and Occasionalists was reactivated in the debates (triggered by Wundt's psychological experiments) of the nineteenth century idealist philosophy of Schleiermacher, Trendelenburg, Beneke, and Dühring. The solution advanced reflected the obsession with a scientific foundation of humanities, similar to that of the sciences but not so crude as to reduce the complexity of psychic phenomena to a mechanistic explanation of the relation between such phenomena and the brain's activity. The neo-Kantians and the Empiricists of the nineteenth century were quite critical of the doctrine of parallelism, but there were also arguments in its favor, especially those originating from the emerging hermeneutic philosophy. Dilthey, continuing Brentano's argument, and William James ascertained that a localization and explanation of conscious connections could not be accomplished from physiological laws. Each time new objections against parallelism were raised – and there were plenty of these – its proponents ended up refining the initial thought. What we have here is a basic explanatory model attractive in its clean answer to exceptionally complex problems. That some aspects of human psychology or psychic activity are describable in terms of parallelism seems clear now. So does the understanding that there is more to human psychic processes than parallelism can explain. "In short, from our perspective conscience is a system of implications (among concepts, affective values, etc.) and the nervous system is a causal system, while psychophysic parallelism is a special case of isomorphy between implications and causal systems," wrote Piaget. When conclusions are drawn through conscious processes from precise premises, the result is based on the logical content of the premises, not because of some causality, which leads from the premises to the inference. This makes

psychophysical parallelism the place where the circle of science from deductive mathematics to realistic inductive biology closes and in which psychology and sociology take intermediate positions.

More recently, the discussion was further refined through the implication of emergent properties or characteristics. W.C. Wimsatt, taking a cybernetic viewpoint, drew attention to the tripartition hardware-software-program performance. The psychophysical problem could be seen at the level of neuronal processes, the functional performance of a brain in the sense of a program, and behavior. It remains unclear to which extent the architecture of a computer program is comparable to an organism's gnoseological performance, and to which extent the brain's physiological organization imposes conditions upon the design of the program. In the terminology of older controversy around parallelism, this can be restated as to which extent physiological sequences, mental processes, and artificial intelligence modelling are isomorph or bound to create conditions for their reciprocal emergence. The new critics of parallelism (R.W. Sperry, K. Popper, J. Eccles, J.R. Searle) tend to accept the emergence view.

This birds-eye view of the subject, as it unfolded over time and in various theoretical approaches, evidently omits some of the successive views (probably parallel themselves) that eventually crystalized in the Gestalt theory, in post-Piaget cognitive projects, and in some of the more recent attempts within the neurosciences (especially chaos models of brain activity). From a semiotic perspective, parallelism is of extreme interest in view of the difficulties encountered in defining the sign (standing in parallel to what it designates), sign typologies (resulting from the type of representation), and sign processes. While we assume an operational view of sign processes, we really do not know where and how they take place. Semioticians might indeed be facing the challenge of choosing between the "Scylla of parallelism and the Charyba of interaction," as J.B. Watson expressively defined these two positions. Or, adopting a logical positivist perspective of semiotics, along the line of Carnap's theory, semioticians may, in sync with the new cognitive theories, discard parallelism altogether, since there are many parallel occurrences, but gnoseologically they offer little, if anything, to either our understanding of complex sign systems (such as language) or of their actual functioning in various pragmatic contexts.

Nevertheless, here the challenge of parallel computation emerges. In short, it states that the human mind does not operate sequentially (the so-called von Neumann paradigm of computation), but in parallel processes. The element of simultaneity is essential in both understanding and implementing parallelism. The two major types of parallel computation are defined by the data processed. Either all parallel processors operate the same way upon homogenous data (a new type of brute-force processing), or they execute in truly parallel different operations upon a variety of data. In some cases, this leads to very sophisticated connections among different simultaneous or successive processors. Another distinction refers to the granularity of the process: macro-parallelism (of a limited number of processors) is quite different from micro-parallelism (of a vast number of processors).

New concepts of distributed computation overlap with parallel processing. On the one hand, there is a need to decompose a problem into smaller parts, each to be operated upon in parallel in a distributed environment. On the other hand, there is a need to address the requirement of

synchronization and communication among these distributed tasks. While computer science met the challenge of designing powerful systems based on the expectation and requirement of parallelism, semioticians are still shy in taking advantage of technological progress in order to address questions pertinent to their own field of inquiry. The basic known semiotic theories imply that human beings operate in parallel upon various simultaneous signs, and that semioses are parallel and distributed processes. Elements of semiotic correlation could be understood if, using the knowledge gained in designing both parallel processors and algorithms for parallel processing, semioticians would indeed revisit sign theories. In many ways, these new cognitive engines are semiotic machines on which some of the hypotheses advanced to date could be effectively evaluated or through which new theories be formulated.

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