

# Sources of Complexity in Human Systems

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**Abstract:** “Complex” is a special attribute we can give to many kinds of systems. Although it is used often as a synonym of “difficult,” it has a specific epistemological meaning, which is going to be shared by the incoming science of complexity. “Difficult” is an object which, by means of an adequate computational power, can be deterministically or stochastically predictable. On the contrary “complex” is an object which can not be predictable because of logical impossibility or because its predictability would require a computational power far beyond any physical feasibility, now and forever. For complexity refers to some observing system, it is always subjective, and thus it is defined as observed irreducible complexity. Human systems are affected by several sources of complexity, belonging to three classes, in order of descending restrictivity. Systems belonging to the first class are not predictable at all, those belonging to the second class are predictable only through an infinite computational capacity, and those belonging to the third class are predictable only through a trans-computational capacity. The first class has two sources of complexity: logical complexity, directly deriving from selfreference and Go’ del’s incompleteness theorems, and relational complexity, resulting in a sort of indeterminacy principle occurring in social systems. The second class has three sources of complexity: gnosiological complexity, which consists of the variety of possible perceptions; semiotic complexity, which represents the infinite possible interpretations of signs and facts; and chaotic complexity, which characterizes phenomena of nonlinear dynamic systems. The third class coincides with computational complexity, which basically coincides with the mathematical concept of intractability. Artificial, natural, biological and human systems are characterized by the influence of different sources of complexity, and the latter appear to be the most complex.

**Keywords:** artificial; complexity; computation; chaos; evolution; gnosiology; human systems; intractability; mathematical logic; self-organization; self-reference; semiotics.