PNL: Precisiated Natural Language and its Impact on Scientific Theories

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It is a deep-seated tradition in science to view the use of natural languages in scientific theories as a manifestation of mathematical immaturity. The rationale for this tradition is that natural languages are lacking in precision. However, what is not widely recognized is that adherence to this tradition carries a steep price--the inability to exploit the richness of natural languages in a way that lends itself to computation and automated reasoning.

In a significant departure from existing methods, the high expressive power of natural languages is harnessed by a process termed precisiation. In essence, if *p* is proposition in a natural language (NL), then precisiation of *p* results in a representation of the meaning of *p* in the form of what is referred to as a generalized constraint. In a generic form, a generalized constraint is expressed as X isr R, where X is the constrained variable, R is the constraining relation and *r* is a discrete-valued indexing variable whose values define the ways in which R constrains X. In general, X, R, and *r* are implicit in *p*. Thus precisiation of *p* involves explicitation and instantiation of X, R, and *r*.

The principal types of constraints and the associated values of *r* are the following: possibilistic (r = blank); veristic (r = v); probabilistic (r = p); usuality (r = u); random set (r = rs); fuzzy graph (r = fg); and Pawlak set (r = ps). With these constraints serving as basic building blocks, composite generalized constraints can be generated by combination, constraint propagation, modification, and qualification. The set of all composite generalized constraints and associated rules of generation and interpretation constitute the Generalized Constraint Languages (GCL). Translation from NL to GLC is governed by the constraint-centered semantics of natural languages (CSNL). Thus, through CSNL, GCL serves as precisiation language for NL.

Precisiation Natural Language (PNL) is a subset of NL, which is equipped with constraint-centered semantics and is translatable into GLC. By construction, GCL is maximally expressive. In consequence, PNL is the largest subset of NL, which admits precisiation. The expressive power of PNL is far greater than that of conventional predicate-logic-based meaning-representation languages.

The concept of PNL opens the door to a significant enlargement of the role of natural languages in scientific theories and, especially, in information processing, decision, and control. In these and other realms, a particularly important function that PNL can serve is that of a concept definition language--a language that makes it possible to formulate precise definitions of new concepts and redefine those existing concepts that do not provide a good fit to reality.

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