



# **Generalized Convexity and Generalized Monotonicity : Proceedings of the 6th International Symposium on Generalized Convexity/Monotonicity**

*Nicolas Hadjisavvas, Jean-Paul Penot, Juan Enrique Martinez-Legaz*

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A famous saying (due to Herriot) defines culture as "what remains when everything is forgotten". One could paraphrase this definition in stating that generalized convexity is what remains when convexity has been dropped. Of course, one expects that some convexity features remain. For functions, convexity of epigraphs (what is above the graph) is a simple but strong assumption. It leads to beautiful properties and to a field in itself called convex analysis. In several models, convexity is not present and introducing genuine convexity assumptions would not be realistic. A simple extension of the notion of convexity consists in requiring that the sublevel sets of the functions are convex (recall that a sublevel set of function  $f$  is the portion of the source space on which the function takes values below a certain level). Its first use is usually attributed to de Finetti, in 1949. This property defines the class of quasiconvex functions, which is much larger than the class of convex functions: a non decreasing or non increasing one-variable function is quasiconvex, as well as any one-variable function which is non increasing on some interval  $(-\infty, a]$  or  $(-\infty, a)$  and non decreasing on its complement. Many other classes of generalized convex functions have been introduced, often for the needs of various applications: algorithms, economics, engineering, management science, multicriteria optimization, optimal control, statistics. Thus, they play an important role in several applied sciences. A monotone mapping  $F$  from a Hilbert space to itself is a mapping for which the angle between  $F(x) - F(y)$  and  $x - y$  is acute for any  $x, y$ . It is well-known that the gradient of a differentiable convex function is monotone. The class of monotone mappings (and the class of multivalued monotone operators) has remarkable properties. This class has been generalized in various directions, with applications to partial differential equations, variational inequalities, complementarity problems and more generally, equilibrium problems. The classes of generalized monotone mappings are more or less related to the classes of generalized functions via differentiation or subdifferentiation procedures. They are also linked via several other means.

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