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The structure and regulative function of the cognitive styles: a new theory

The organization of human cognitive styles can be described as a kind of functional system or as an holon. In this framework it is possible to propose a new theoretical base for classifying the primary cognitive styles. The fundamental theoretical thesis is that for all styles there is one common mechanism of forming and scanning the perceptual and memory field induced by the situation, and by the differences in the manner of carrying out the processes of field scanning /codes interfering depend on the range of conceptual equivalency and cognitive control of behavior. In the functional describing of the basic set of cognitive styles we must take into account three elements of the chain: neurobiological modules -> organization of cognitive holon -> behavioral manifestation of styles.

Keywords: cognitive styles, cognitive styles theory, perceptual styles, memory styles, conceptual styles, control styles, cognitive holon

Defining the concept of cognitive style

Cognitive styles encompass individual differences in the way how information is processed on different levels of cognitive system organization. Comparing the course of cognitive processes, it's been discovered that cognitive outputs can be reached through various paths, qualitatively different manners, representing various personal pace (tempo), efficiency, type of difficulties occurred and errors made. These qualitatively distinct ways are determined by differences in organization of basic neuronal modules connected with the levels of cognitive system organization. For instance, style characterized by the ease/difficulty in detecting embedded figures (geometric patterns) depends on the interaction of several neuronal modules, which form the functional system, i.e. integrating processes of perceptual scanning of the information field, dynamics of attention and access to conceptual resources in the semantic memory (LTM). The definite style integrate a set of cognitive processes. In the case of relative simply processing during perception the final results are functionally determined by whole cognitive system.

Cognitive styles are contingent upon various cognitive and temperamental components. It should be noted, that within the framework of interactional model, characteristics of a situation also influence elicitation of the styles (cf.

Klimov 1969, Matczak 1982, Nosal 1990, 1992, Strelau 2002). For instance, time pressure have an impact on eliciting impulsive style, and ambiguity / uncertainty of a situation determine different styles of conceptual thinking. In an ambiguous situation specific for each individual style of conceptual categorizing will be elicited spontaneously. A style named as conceptual equivalency will then become the most important one; it mediates between the conceptual structure (the experience) of an individual and the characteristics of an external situation. In an uncertain situation probabilistic thinking style will be elicited. A set of potential states and likelihood of their occurrence will be delineated within the framework of this style.

When one's behavior is regulated by well consolidated knowledge, stable cognitive schemata, strong habits or learned strategies of activities (behavior), styles are not elicited then in a definite form. One area, which is scantily researched, pertains to relationship between cognitive styles and outcomes of implicit learning, which takes place unintentionally, unconsciously and automatically. Psychological body of knowledge on the subject of differences in cognitive styles is of great importance in the field of education (cf. Clauss, 1987; Witkin, 1977).

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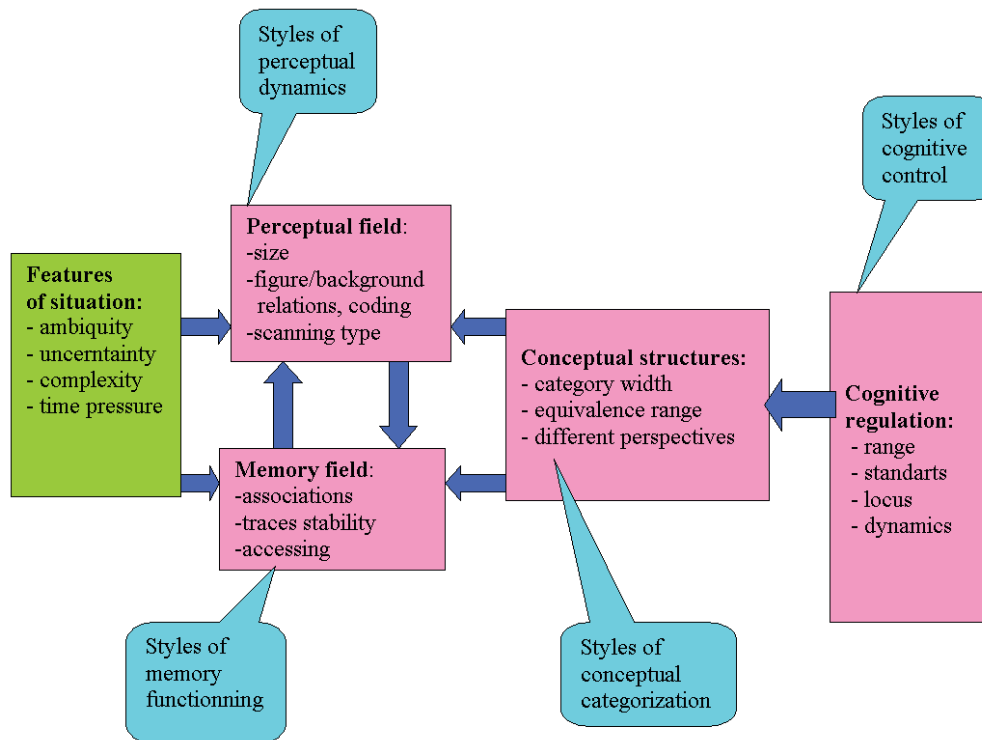


Figure 1. Cognitive styles as the functional system.

The components and categories of cognitive styles

In order to adequately describe dimensions of styles and explain mechanisms of their regulation, it is necessary to indicate components and characteristics, which determine them. It is also required to try to define neuronal modules, which determine different cognitive styles. For instance, when describing and explaining differences in perceptual styles we draw upon elementary features of attention field, the structure of semantic memory and the mechanisms of perception. Results of neurobiological research show, that outcomes of perceptual process depend on the interaction of sequentially and parallel working mechanisms of information processing (cf. Bichot et al., 2005). These research explain a great deal of cognitive style characterized as the independence *versus* dependence from perceptual field.

During the course of development and stabilization, styles determine differences in preferences and cognitive aversions of an individual, his or her ways of thinking, acting, communicating, making judgments, estimating risk and decision making. Research have mostly concentrated on the dominating preferences, ignoring the issue of differences in the area of aversion. It can be assumed however, that in the future, when much more systematic and well-organized theory of styles will be developed, its theoretical bases will include detailed description of the origins of cognitive preferences as well as origins of cognitive aversions.

How many cognitive styles are there, how can they be classified, what is the higher – order structure of styles? Dimensions of styles, which have been described until now, make up lists containing around 20 items (cf. Goldstein, Blackman, 1978; Jonassen, Grabowski, 1993; Kozhevnikov, 2007, Nosal, 1982, 1990). Styles are classified mostly in the context of cognitive processes, because the largest number of research studies have been devoted to perceptual styles, memory, learning, conceptual thinking and control of behavior. Unfortunately within this framework, styles are mostly described as isolated, bipolar dimensions. There are no many attempts to looking on the global structure of cognitive styles and explaining its role as the regulative units, which are emerged during information processing. For this reason in this article I would like to propose a new theory of the cognitive styles as any class of functional mechanism which mediate neurobiological basis of human individuality according to the environmental tasks, demands, and circumstances.

Is it possible to propose different theoretical base to classify styles other than the course of cognitive processes? Theories of temperament could make it possible, since there are attempts being made within the scope of these theories to describe differences in individual styles of functioning (cf. Klimov, 1969; Nosal 1983, 1990; Strelau, 2002). If we take into account three elements of the chain essential in describing cognitive styles: *neurobiological modules* → *organization of cognitive processes* → *behavioral manifestation of styles*, it becomes clear, that

Table 1
The basic categories of cognitive styles, and specific Dimensions.

Category	Examples	Scholar Year of publication
Styles of perceptual dynamics	field dependency - field independency	Witkin H. (1949)
Styles of cognitive coding	cognitive interference	Stroop (1935)
Styles of memory stability	leveling – sharpening	Holzman P, Klein G. (1954)
	category width	Pettigrew T. (1958)
	equivalence range	Gardner R. (1953)
Conceptual styles	simplicity - complexity	Bieri J. (1955)
	internal - external locus of control	Rotter (1966)
Styles of cognitive control	impulsivity - reflexivity	Kagan (1966)

different classifications of styles can be generated around each of these elements. Some classifications will be created closer to the neuronal base, others will be closer to specific indices manifested and measured through cognitive activity represented on the behavioral level. However, a complete description and clarification of styles must take into account all three elements of the chain. On the level of behavioral manifestation, cognitive styles are the results of the functioning of many compensating mechanisms. Putting it concisely, for a certain person, style represents specific functional invariant, which links the basic neurobiological level with cognitive and behavioral one. Therefore, these three levels, taken together, determine and represent (articulate) the style. Many classification of the cognitive styles pay attention on their behavioral manifestation. This tendency is useful for applicative goals, but a new theory is needed for explaining the regulative role of styles during information processing.

The functional structure of the cognitive styles as a kind of holon

Irrespectively of simple classifications of styles there are attempts being made to create a general theory of the structure of styles (cf. Kozhevnikov, 2007; Nosal, 1982, s.124 - 131). In my theory, I make an assumption, that **for all styles there is one common mechanism of forming and scanning the information field induced and stimulated by a situation, and the differences in the manner of carrying out this process depend on the range of conceptual equivalency and control of behavior.** According to this theory, styles form certain higher-order functional system (see figure below). This system can be named as an dynamically changing *holon*, referring to a sophisticated term introduced by A. Koestler (1980). This term represents a system, which changes its structure and is able to exists in different forms, however, it is always an indivisible (integral) whole, just like human mind. *Holon* constitutes a generative bases for manifestation of various cognitive styles.

Existence of the structure of styles representative for every individual implies that it is possible to consider individual differences in a global sense, that is, as **any mind types** being a combination of several cognitive styles. Such approach has not been considered in psychological literature as yet. It is worth to emphasize however, that this approach relates to a long psychological tradition, on the bases of which various mental types have been generated. (W. James, C.G. Jung, E. Kretschmer, I. Pavlov and other scholars). In these classical attempts, mental types have been formulated mostly intuitively. Precise, statistical methods, which could be applied for the extraction of these types, were at that time nonexistent. In contemporary psychology of individual differences we have many more options within statistical cluster analysis, profile analysis and other methods. Another important issue, which is only shortly commented here, are the methods for diagnosing cognitive styles and types. Empirical indices of the process of task solution under different conditions, provide essential information about individual differences. Within this research, questionnaires can only play a secondary (auxiliary) role.

To date, psychological literature describes major cognitive styles, such as field dependence-independence, sharpening-leveling of memory traces, interference between cognitive codes, width of conceptual categories, conceptual equivalence, impulsivity – reflexivity, locus of control (see Table 1).

These cognitive styles are relatively mostly studied. Their list starts with a dimension discovered by Herman Witkin (1916 – 1979), a great pioneer in this field of individual differences psychology. He discovered, that individuals who are field dependent manifest greater difficulty in detecting an embedded geometrical figure, meaning that they have a difficulty with structuring information, are characterized by passive style, weakly articulated, and dispersed. Individuals who are field independent quickly identify embedded figure, demonstrating active and analytical style. Witkin (1965) concluded, that different forms of adaptation disorders and pathologies are related to perceptual styles (cf. for large scope of empirical results: Nowicka-Gawęcka, 1975).

From the neurobiological perspective (Bichot et al., 2005) it can be stated that neuronal mechanism of style discovered by Witkin has been finally explained. The dual nature of this style can be also explained in the context of the interference mechanism discovered by Stroop (1935), and interpreted by MacLeod (1991) in the terms of parallel - distributed processing approach. This possibility of integrating Witkin's theory with the Stroop effect is not taken into consideration in the literature on cognitive styles.

Research on memory styles led to discovery of sharpening-leveling dimension. These two extremes (poles) of the style are the result of the pace of memory traces deformation. Small deformations cause sharpening (contrasting) as a style, whereas large deformation of memory traces trigger leveling out of the differences. Differences in memory styles are related to a tendency to alter experience, and even confabulation.

Among conceptual styles of thinking, narrow or wide range of equivalency, indicated by the number of spontaneously constructed categories, proved to be a key aspect. It's been found out, that conceptual equivalency range is quite stable but it depends on a domain of knowledge (cf. Garber, Miller, 1986; Sloane et al. 1963). In general, large number of spontaneously constructed categories indicates difficulties in generalizing, focusing on differences, deficiency of abstract thinking. Small number of categories indicates fluency in abstracting and reducing information, but discrimination processes are in this case limited. In general, different conceptual styles of thinking show some consistency, and indicators of the categorization range correlate positively (cf. Tajfel et al., 1964).

The poles of the style described as impulsivity – reflexivity refer to differences in ways of judging, decision making and organization of cognitive control. Within impulsive style, activity is not preceded by detailed analysis of a situation; within a reflexive style, activity is delayed by expanded analysis. However, it shall not be expected, that impulsivity is always disadvantageous and reflexivity beneficial. Adequacy of behavior in relation to characteristics of a situation is of great importance.

Essential dimension of cognitive styles relates to differences in locus of control as per external or internal standards. In both styles, regulation is based on negative feedback, but what makes them distinctive, is the *locus* of closing the loop of this feedback and aligned standards of regulation. Another important dimension of the style pertains to restrictive control *versus* flexible control.

Final remarks

The knowledge base about the structure of the styles is not so well organized as knowledge about general intelligence and special abilities. It is important to note that description of differences from the stand point of abilities and styles are complementary. Abilities pertain to differences in the *level of basic mental capabilities*, while the styles indicate qualitatively *different ways of processing*. Individuals with similar level of abilities (e.g. intelligence), can differ from one another based on thinking styles in solving the reasoning test, such as some of them employ analytical and sequential style, while others will prefer comprehensive or global processing style (cf. Hunt, 1974).

While planning research in the area of cognitive styles, one must progress in two directions simultaneously: organize the knowledge base in particular categories of the specific styles and search for functional systems, which combine the styles into new structure. I hope that a tentative version of the theory which is proposed in this article will be useful in planning of the future research. According this theory most important is looking for the basic structure of the styles in terms of reduction of existing knowledge. Very important with this way of thinking is recognition the regulative role of the style in human intellectual functioning.

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