

Symbol as a cognitive tool

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The article describes various aspects of symbolic mediation and is aimed at showing its specificity. The author views a situation of uncertainty as a structural element of a symbol and introduces the notion of a symbol being a special tool for orientation in such situations. On the one hand, a symbol is contrasted to a sign, and on the other, is regarded as a transitional form in the process of its mastering. Author pays special attention to understanding the role of symbol in connection with understanding of play and its role in child's development. Emotional and cognitive functions of symbol are defined and illustrated by examples.

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There is no unanimous definition of the term symbol. Researchers note that in scientific studies on signs and symbols the latter are often defined in terms of their types, such as indexes, images, schemes, allegories, metaphors and so on (Losev, 1976, De Loache, 1991, Zinchenko, 2010) and the widespread use of the “symbolic tools” expression disregards the distinction between a sign and symbols. At the same time there is a long-established philosophic and psychological tradition of viewing a symbol as a separate cognitive tool, with which we concur in our consideration of the distinction between a sign and a symbol to be effective.

The notion of a symbol

In the works of Gadamer (1975), Hegel (1977, 1969), Schelling (1936) and other researchers a sign and a symbol were set in opposition. Our research focuses on the cognitive aspect of symbol usage, which we find in the classic discrimination between a sign and a symbol by Hegel (1977, 1969). Hegel pointed out that a symbol is “a certain viewing with an essence and meaning that is more or less corresponding to the essence and meaning of the object it refers to; on the other hand, when it comes to the sign and its nature, the essence and the meaning of viewing and the ones of the object it refers to have nothing in common” (Hegel, 1977, p. 294-295).

The nature of the sign representation is such that it directs one immediately to the meaning of the signified, not taking, in a sense, the “external features” of the

situation into consideration. In contrast, orientation with respect to a symbol is happening *within the boundaries of the external features of a situation*, and those features, including the connections between its elements, when manipulated with, become meanings.

Another characteristic feature of a symbol is the way in which it appears — symbolic mediation occurs in a *situation of uncertainty*, when the objective and the ways of reaching it are unknown: a situation has external features, but its internal structural interrelations are hidden. Therefore a sign refers to the signified meaning or a set of meanings directly, whereas a symbolic image has no connection to certain meanings. We believe that a situation of uncertainty is a structural element of a symbol, and understanding the latter implies operation with or “movement” within its external features (Mamardashvili, Pyatigorsky, 1997). According to Mamardashvili, Pyatigorsky, a symbol indicates something unknown at the present moment, in other words — it performs a signal function.

As Eliade (1991) points out, myths and ritual forms of actions (which according to Losev (1976) and other researchers are the most vivid examples of symbolical cognition) make border situations conceivable for a human and for humanity. A border situation is a “situation in which humans recognize their place in the world”, in other words — the need for orientation. This viewpoint is also expressed in the works of Jung (1998) who discovered a peculiarity of symbol actualization — it happens when one’s customary means of orientation cease to be effective.

Symbolization development in ontogenesis

According to Piaget (1969, 1971), who in his works paid special attention to the development of symbolic (semiotic) function, a symbol becomes a part of children’s cognitive activity at the age of two years. Piaget’s understanding of a symbol is that a symbol is the signifier, though having similarities with, essentially stands apart from the signified. Therefore in Piaget’s opinion, the figurative (related to external features) element of thinking appears to be symbolic when an image is used for assimilation of some content. Piaget considered symbolic representation to be common in situations characterized by a gap between speech and action. That is why some researchers (Schmid-Kitsikis, 1987) note that symbolization is employed only in situations where children manifest it.

To exemplify symbolization, let’s consider the situation when a child sees their father shaving and then, in a manner of their father, runs their own hand up and down their face to understand the meaning of their father’s actions through their own movements. In this example the representational image becomes a symbol. It has to be noted that a presence of a figurative component in itself does not assume a symbolic function (for example, figurative perception is figurative but in essence it does not perform a symbolic function), because a sign also has an outer representation. A symbol appears only when figurative component starts to perform the function of assimilation.

However, Piaget considered the process of symbolization to be connected with and happening in the logic of a child’s cognitive development which results in the replacement of an individual symbolic representation with a collective sign. Furth (1967) points out that the works of J. Piaget assume continuity of cognitive develop-

ment, which cannot be said about the development of a symbol. At the same time, some followers of Piaget (1969, 1971) claim that symbolic representation coexists with sign representation during a child's development.

Parallel to Furth, Selfe described the unique case of the drawing ability developed by a girl named Nadia (Selfe, 1977). Although the development of the girl's speech was extremely poor (she couldn't operate with notions), her drawings were consistent with the developmental stage of formal operations. This opened up a discussion about the possibility of mastering notions in a symbolic form.

Child's play as a model of symbol interpretation

Many researchers consider child play to be an important stage in the development of symbolic representation (Vygotsky, 1983, Piaget, 1969, Leslie, 1987, A. Lillard, 1993, Perner, 1993). Child psychologists raised the question of what qualitative changes child play brings, and in what way they influence the development of the child's cognition. Piagetian and other researchers unanimously agree that the emergence of substitutions in child play manifests the shift to the new stage of cognition development when children become able to simultaneously operate within the planes of objective reality and its mental representation and consciously switch from one to another. At the same time the development of child play is often narrowed to mastering the double coding — a transition to sign representation (Lillard, 1993).

It should be noted that the realm of child play in itself is worthy of special study. Many researchers point out that something unavailable in a child's system of meanings is somehow accessible to the one in symbolic reality. For example, in a symbolic situation children of 4 to 6 years of age are able to solve syllogisms, although in real life this form of reasoning is unavailable to them. For instance, if a child of that age is asked what will happen if his or her mother plays football, the majority of them will say that his or her mother does not play football. But if asked what will happen if a toy dragon plays football, the majority of them will answer correctly — that a dragon will be tired, will become dirty, and so on (Kuczaj, 1981).

Having no other explanation to the progress of children's representation development in game activity, Lillard notes that "play is a child's zone of proximal development, in which there is no need in having a grown-up as a partner" (Lillard, 1993, p. 348), because when playing, children discover the double representation all by themselves. We believe that any effect play has on a child's cognitive development is largely attributed to the tools it is using — symbols. A symbol is unique in being a unity of children's cognitive and affective realms. Therefore, Vygotsky rightfully emphasized the importance of play to children's development. It was also noted by Leontiev (2000) that children operate within a symbol when reality is still unknown to them. In other words, a situation of uncertainty essentially underlies child play and brings about vivid emotions during the activity.

The uncertainty of the real world on the one hand, and the child's attempt to understand it through play on the other, result in a special form of representation. A pre-school child does not really know how to operate a car, but tries to understand it by enacting driving using available substitutes, that is, essentially, by using

emotionally colored make-believe reality in order to understand models and structural relations of the real world.

That is why uniqueness and the importance of child play, in our opinion, is not in its employment of substitutes, or in an improvement of a child's ability to use signs, but in that it brings about the qualitative shift in cognition by the use of such tools as symbols.

Functions of symbol

The researchers note different functions of a symbol, but we will view the most prominent ones: emotional and cognitive. The emotional function of a symbol helps to locate a situation of uncertainty, to convey through it the related emotional tension. For example, the work by Josephs (1998) studies people who lost their close ones and describes, among other things, how a grave becomes a symbol of a person who passed away. Through their treatment of the graves, people try to accept the death of their relatives. They take care of the graves in a special way, set and follow rituals that, in their eyes, express a good attitude towards the deceased, share their feelings, and tell what is happening in their lives (a vivid example: the author writes about a 76-year-old man who came to his father's grave to tell him that he had bought a new car).

In our opinion, such actions are conducted within a unique space — a symbolic content of a symbol (in this example — a burial site). By orienting in this space it is easier for a person to cope with their emotions and therefore adapt to the changed world.

The same is true for society regulations. As noted by Fadeeva (2004), “every culture regulates certain forms of behavior that, however unconditional, instinctive or appearing to be such, often are unexplainable neither in themselves nor by the people performing them. The structure of such an outlook is symmetrical: “the meaning” of something is equal to its perception and does not need an explanation because all the members of the traditional society regard it in the same way” (Fadeeva, 2004, p.47). In other words, performing the society established symbolic actions allows one to cope with the tension caused by various situations fairly quick.

Mamardashvili and Pyatigorsky draw attention on the way this notion, in their opinion, is explained by B. Pascal in his work on faith: “When a person has faith in God, there are rituals pertaining to that faith that express it, which include everyday actions and signs of devotion: people cross themselves and get on their knees and pray. Pascal means by this: you don't have faith? Try to do everything that this faith entails. In other words, try to use symbolic apparatus, the tangible side of the symbolic. From the Buddhist standpoint using the tangible side of the symbolic is similar to doing something which the meaning of is unknown, and that is wrong because people should be doing only what they know they're doing. But to this Pascal would have answered: one should do something which the meaning of *is* unknown, and the meaning will come by these acts later” (Mamardashvili, Pyatigorsky, 1997, p. 178-179).

Basically, these words describe a gap between an action and the actual meaning of the action, which remains undefined. This gap, in its structure, is a symbol that

has external features but no meaning. In this type of situation the actions demand interpretation which, in turn, constitutes the basis for a symbol to appear.

The cognitive function of a symbol is that in certain cases it helps a person to resolve subjectively a difficult situation by utilizing its interpretation capacity. In other words, a symbol is a certain space that allows one to model structural interrelations for a later practical application. As pointed out by Golosovker (1987), seemingly meaningless structural interrelations within a myth could make perfect sense in the real life: "The rules of causality cannot be applied to the shadow of Hades, as the existence of an intangible image can be reasonably explained only as a hallucination. The body of a shadow, or its visible shape, is as imaginative as a statistical existence of a positron — they both have negative mass and in terms of space, they take up zero of it. The shadow of Hades is fiction, but a positive electron is real. However, when it comes to logic, fiction (the shadow) and reality (an electron) have similar features. The imagination of a person or people who created this myth perceived something which the very existence of was scientifically proved only thousands of years later" (Golosovker, 1987, p. 76).

As was mentioned above, it is the external surface of a sign that performs the function of distinction and is transparent in a sense of directing one's cognitive inquiry immediately to the signified. Unlike a sign, a symbol's external surface is vivid and expressive, and becomes the focal point of the cognitive inquiry. The content of a symbol is encapsulated in its symbolic, external surface, creating a special situation to which one's cognitive activity is transferred. In this connection P. Tillich points out a symbol's dialectic nature, as "a symbol simultaneously affirms and denies symbolized reality. The meaning of a symbol itself is denied by the symbolized meaning. On the other hand, a symbol affirms the other meaning it points to" (Tillich, 1967, p. 239).

Once appeared, a symbol allows an interpretation which, in our belief, is what makes the realization of a symbol's cognitive function possible. By analyzing the external features of a symbol, a person discovers its meaning encapsulated in structural interrelations between its elements. After finding these interrelations in a symbol, a person can transfer them onto elements of the actual situation and resolve it.

For example, a symbol in Jung's view (1998) is archetype — a meta-structure that manifests itself in various forms which could further be interpreted by different meanings. It should be emphasized that what is meant here is not the transference of meanings from the symbolic side of a symbol to a situation, but we talk about the transference of the core principle on which the structural interrelations between the elements of a symbol are built. It is this principle that brings one to devise interrelations between the hidden properties of a situation. In this respect we can agree with Hegel, Kant, Schelling and other authors who claimed that a symbol's expression is similar to an idea (if it is meant that by using an idea as a principle by which interrelations between elements are designed).

Symbolic image as a stage in sign mastering

In the works of Salmina (1996) it was shown that teachers of elementary school often intuitively appeal to symbolic representation in which the meaning and the external features of a symbol are united. As Salmina points out, getting knowledge

through the application of a socially acceptable or specially developed sign and symbolic tools is not enough, as they are of a partial nature. Children are predisposed to symbolic representation and use it before turning to sign representation.

Some interesting research on children's learning notions has been done in the works of Ostroverkh (1998), Poland, van Oers (2007) and others. They found that the introduction of sign meanings (mathematical notions) into symbolic context (a game of sorcery) increases the educational effect. The appearance of symbolic space in an experimental situation was shown by Subbotsky (Subbotsky, 1994). In our own studies (Veraksa, 2011) we experimentally showed that when children face situations of uncertainty they spontaneously construct symbolic space. Operation within the space can be either non-productive (as not being related to the hidden meaning), or productive and guide one to a successful orientation.

We believe that education can be viewed as a model of transition from an ideal form (embodied in the concepts and other sign forms of reality representation) to its realization in the real world. In the moment of this transition, as Elkonin writes, "a subject of activity emerges". "The subject emerges "at the point" when the action is required and no pertinent automatism is available, i.e. at the point of form transformation" (Elkonin, 1994, p.32).

According to Elkonin (Elkonin, 1994), an ideal form, being a normative product, is internalized by a grownup who translates it to a child. To a child this ideality, even in its most vividness, remains obscure and uncertain until, according to Leontiev (2000), one's psyche accommodates to it. It happens when a child's activity collides with an ideal form. With regard to teaching mathematics, Vygotsky wrote: "In a child's development almost always important moments occur, a child's own arithmetic always collides with other forms of arithmetic taught by grownups. Teachers and psychologists must remember that a child's internalization of cultural arithmetic always involves conflict" (Vygotsky, 1983, p. 202-203). That is why, when encountered with, an ideal form is spontaneously symbolized by a child because its true meaning is not yet comprehended.

Children master new concepts through their own system of natural notions (Vygotsky, 1983). In this instance symbolization occurs in the learning process of children whose natural notions are far from "ideal forms" in their content (Ilienkov, 2009). Thereby, numerous empiric data supports the fact that pre-schoolers and young school children employ symbolic representation of the reality which is explained by the lack of sufficient cultural sign tools and represents a stage in the children's development.

Here we would like to draw attention to a similar tool of cognitive activity — a metaphor, which intermediary forms are noted by a number of researchers to resemble symbols and signs. In their classic work "Metaphors We Live By" Lakoff and Johnson (2008) define a metaphor as a tool of cognitive activity: "The essence of a metaphor is understanding and experiencing one kind of thing in terms of another: a metaphor is a metaphorical concept".

As Baranov (2000) points out, the existence of a metaphor can point to a crisis in a state of mind — an encounter with a problematic situation, which means that the conditions of a metaphor's appearance are similar to those of a symbol. For instance, in their life as a professional sportsperson, mastering new motor skills puts athletes in situations characterized by a high degree of uncertainty, especially

in dangerous sports where fear is often experienced. As we learned from interviewing diving athletes and their coaches, metaphors, as cognitive tools that are closely related to symbols, are frequently used in this sport. For example, while performing the “opening” — an element that precedes entering the water, divers tend to create and hold on to a feeling that they metaphorically describe as “a bent bow” (Veraksa, Gorovaya, 2012). As was showed by Hanin and Stambulova (Hanin, Stambulova, 2002), metaphors are used by athletes in various sports.

Lakoff and Johnson essentially discuss structural metaphors, when one concept is metaphorically structured in terms of another. For example, Lakoff and Johnson point to the metaphor “argument is war” that immediately transfers familiar meanings of war to such a phenomenon as “discussion”, revealing its various facets. It is not by coincidence, that discussing the issue of “dead” metaphors, Lakoff and Johnson draw an example of isolated transference of meanings (for example, “foot of a mountain”) — metaphors that are unable to expand our understanding. In their view, the new metaphor appears in this way: the elements of experience are chosen as a metaphor which renders the similarity between the chosen and the other experiences.

A number of works in the domain of mathematics by Sfard (1994), Presmeg (1992) and other researchers proved that metaphor is a tool that is used in mathematics along with abstract concepts. It should be noted that the aforementioned researchers do not consider the very process of an appearance of a symbolic image in regard to a metaphor as a complete, realized principle, whereas we believe that a metaphor is a result of an operation within a symbolic space and is, in its essence, a reduced symbol. Sfard differentiated between two categories of mathematical thinking: operational (procedural) and structural. And it is the latter that is using metaphors. Sfard (1994) and Sinclair (2004, 2008) emphasize that the structure of a metaphor cannot be explained propositionally, meaning that it cannot be described logically, but is used in mathematics for solving different problems.

We think it shows that the importance of symbolic representation grows as the level of complexity of logical problems increases, which happens as mathematicians are getting more experienced with age. We are positive in our answer to the question whether a symbol is a stage in mastering a sign.

Conclusion

In our opinion, the phenomenon of turning to a symbol in situations of uncertainty is currently not addressed and is not viewed as a stage of knowledge or skills acquisition. At the same time, symbolic space cannot be viewed separately from reality: it is not by coincidence that the conception of many inventions in science was accompanied by aesthetic experience: “a poet Mallarme inspires a mathematician Poincare, a philosopher Losev connects the relativity theory and the world of fairytales, the greatest contemporary physicist Wolfgang Pauli co-authors a book with a psychologist Jung, proving affinity between microphysics and depth psychology, with this conviction shared by another great physicist Werner Heisenberg who says that when studying the Universe and expecting to discover objective matters, “people meet themselves”. By saying this, we get to the core of the problem, as the way it has been said above is symbolical” (Svasyan, 2000, pp.18-19).

Symbolic language, the language of art, is an efficient tool of orientation within situations of uncertainty, at the very moment of cognizing the unknown, when a sign has yet to gain power. In this connection we agree with Jung who pointed out that “the true symbols are essentially different, they should be treated as an expression of intuitive ideas that cannot be formulated in any other way” (Jung, 1998, pp. 362-363). In other words, a symbol acts as a “zone of proximal development” within the cognitive activity of humanity in general, and every human in particular.

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