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## Developing the Ability to Specify in Pre-School Age as Condition for Forming Problem Sensitivity

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### Abstract

The article presents results of a long-term study into the specifics of sensitivity to cognitive problems in pre-school-age children. The ability of children of this age to single out significant and insignificant situational elements and details is considered to be an essential condition of the formation of the above aptitude. The article also discusses the results of a training experiment aimed at enhancing the degree of detailed elaboration in children with weak problem sensitivity.

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### 1. Introduction

This 30 year-long study detected and repeatedly documented patterns of reaction to cognitive contradiction that result in problem definition and solution (or a refusal to include one for resolution). Specific to large groups of people, this response makes it possible to conclude that success in problem detection (problem sensitivity) is determined by particular features of emotional- attitudinal complexes representing a certain unity in which

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emotions and attitudes form a new integrative quality [1],[2]. The psychological nature of this formation is that it serves as a tool and a basis for the functioning of the main mechanism of activity transformation. In the process of interacting with objects different people perceive different meanings and values in these objects. This study provides grounds for an important statement that as an ability to detect and resolve cognitive contradiction, problem sensitivity is determined by specific features of the value-and-meaning structure of an evolving situation.

The materials obtained during the experiment allowed us to pose the question of how these features manifest themselves during the period of their early formation and whether their formation results from training and upbringing. These emotional-attitudinal complexes act as a unity of evaluation (emotional evaluative structures) and execution (non-situative personal structures) and determine the specific features of meaning-making. The formation of these complexes has been proved to occur as early as in pre-school age. In practice, however, the problem of cognitive development has not as yet been formulated actually as one of sophistication of the human mind in ontogenesis [3],[4]. Furthermore, it should be deemed as qualitative sophistication, not just a mechanical growth of knowledge or an accumulation of new cognitive schemes, actions and operations.

In order to discern a cognitive contradiction, it is necessary to have learnt to specify, i.e. to be able to single out particular parts of objects and phenomena and correlate them based on one's own experience and knowledge. Quite some time ago, we formulated a hypothesis that there is a relationship between the degree of the development of a child's ability to specify and the level of the child's sensitivity to problems [5]. Since then psychology (in particular psychophysiology and neuropsychology) has reported new discoveries that enable to reconsider the very phenomenon of detail elaboration and to determine its role and place in the system of higher psychological functions, especially in thinking. Today the area of the brain which processes language [6] has been defined quite accurately. Two years ago another discovery was made: by means of magnetoencephalography it was proved that when a child learns new words, the words are perceived directly in connection with the objects and actions that they denote. When, for example, a child's mother pointing at the sun says: "the sun", the child's brain becomes activated in the areas that are responsible for hearing perception, articulation, visual perception, and/or the control of movements, all at the same time. Thus is formed a whole network of nerve cells located in different areas of the brain, including those that have traditionally been connected with muscle movements rather than with speech [7].

Considering these discoveries from the viewpoint of their interrelationship, it is possible to make a statement that at the beginning (at the stage of the development of object-focused consciousness) objects and phenomena that make their way into a child's life world appear as integral wholes. Detailed elaboration, i.e. the ability to specify parts of objects (their details) is formed at a later time. Yet, its emergence has a special psychological significance: the ability to specify serves as a predictor of major intellectual (logical) operations. It is clear that all these operations (analysis, synthesis, analysis through synthesis, abstraction, comparison, generalization, etc.) should be based in the course of their formation on the already developed ability to specify. For example, in order to make a comparison, it is necessary to be able to single out the elements to be compared; in order to single out significant parts, it is necessary to have an idea of the elements which one should abstract oneself from, etc. It is easy to see that virtually all of today's training programs in pre-school institutions include forming the skill of

detailed elaboration as a special task. Perhaps this explains increased problem sensitivity in modern children, which is what we dwell upon below.

## 2. Method

The evaluation of the degree of the ability to specify in children was performed by using a widely known psychological method of studying children's drawings which was modified to match the conditions of the experiment [8],[9]. Each child was asked to make an arbitrary drawing of a person and then the drawing was used to determine the ability to single out significant parts. The level of the skill of detailed elaboration was graded as a ratio of the number of points that the child's drawing had scored to the maximum possible score of points.

Problem sensitivity was determined by using a special technique [3]. The method is to create an experimental situation which, in conditions of perceptive activity, allows transition to thinking activity through independent goal-making, meaning-making and motive-making to be fulfilled by the subject of the experiment. The subject of the experiment was given several pictures (also containing a cognitive contradiction) aimed at actualizing the child's empirical knowledge. The child was asked to speak about the content of the pictures. The experimental situation contained an opportunity to formulate a cognitive contradiction and try to solve it independently without being encouraged to do so by the experimenter. Alongside with the fixation of the child's verbal and non-verbal behavioral reactions (first with the use of audio recording and standardized observation, then with the use of video recording), a simultaneous registration of galvanic skin response was conducted enabling to single out elements of the stimulus material that were emotionally significant for the subject of the experiment by estimating the dynamics of the skin conductance level. This research approach allowed comparative analysis to be made of emotional and verbal reactions reflecting the model forms of response to cognitive contradiction. The problem sensitivity index was calculated as a ratio of the number of points actually scored by the subject of the experiment according to the results of the study in comparison to that in the maximum possible score of points (in accordance with the key to this diagnostic procedure). Being the result of the training experiment, the dynamics of problem sensitivity were fixed with the use of a second set of stimulus material (pictures with neutral content and pictures containing a cognitive contradiction).

Further development of the level of detailed elaboration was to get the children to work with Raven's colored progressive matrices which were used here for training purposes rather than for traditional diagnostics. Such stimulus material had been chosen because this test implied that the child was to analyze the structure of a picture and to understand the interdependence of its structural elements by comparing the entire sample with its constituent parts which led to the solution. The training provided for special sessions at which the subjects of the experiment were offered tasks of varied degrees of complexity. We used the test both in the form of an enlarged landscape layout and the variant with the so-called inserts where some parts could be inserted and removed freely and the child had an opportunity to insert the selected missing part of the solution and, in doing so, to ensure the solution was correct. The training sessions were performed both in groups and individually. When working with the matrices, the subjects of the experiment were taught to single out certain parts of the whole and to compare them to one another.

## 2. Results

The studies were conducted in different years (1982-1984, 1997-1999, 2001-2003, 2006-2008, and 2010-2012) in different pre-school educational institutions in Kazakhstan, Altai Territory and Tomsk Region. The study involved about 300 children aged 5-7 years.

The recorded index of problem sensitivity showed that when faced up with a cognitive contradiction, only a part of the children (18 - 20%) were willing and able to formulate the contradiction detected and attempt to solve it independently without being encouraged to do so by the experimenter. Characteristically, these children combined emotional evaluation of vague and contradictory elements of a situation with a tendency to identify the source of their misunderstanding and to sort out its core basis. Most of the other subjects of the experiment fell into the category of those “evading the problem”. Typical of these children’ reactions was the resulting sense of a mismatch, inconsistency, often not fully realized and objectified, which lead the subject of the experiment to a directed analysis of the image, slowing down their story about the picture and impeding their answers. If such children did direct their activity at the analysis of the inconsistency, they concentrated on selecting a compromise solution by means of which, in the child’s opinion, the cognitive contradiction of the situation could be removed. The galvanic skin response records clearly showed how the child talked himself into an emotional agreement testifying that the situation then was perceived by him as free of contradiction. Some of the children (12-16%) demonstrated their inability to single out contradicting elements in the situations in the pictures presented to them. These children were unable to select significant and insignificant parts of the picture, to compare them and to take notice of the resulting inconsistency. Their perception of the picture did not change even after the experimenter, using special questions, tried to “guide” the subject of the experiment to help them see the contradictions in the picture.

Measurements of the level of detailed elaboration showed a pronounced variation of the values (from 0.30 to 0.98). A correlation dependence was established between the level of detailed elaboration and the problem sensitivity index in pre-school children ( $r=0.67$ ,  $p<0.05$ ). Table 1 shows averaged data on the problem sensitivity index and the level of detailed elaboration for all the subjects of the experiment.

Table 1. The level of detailed elaboration (LDE) in typical groups with different levels of the problem sensitivity index (PSI)

Group	PSI	LDE
“Those taking notice of and solving cognitive contradictions”	0.75-0.91	0.75-0.98
“those evading the problem”	0.21-0.66	0.40-0.78
“those not reacting to cognitive contradictions”	0.09-0.12	0.30-0.42

The experiments showed that low levels of the ability to specify do not allow pre-school children to single out individual elements of a situation and to detect the existing cognitive contradictions. However, a fairly high level of detailed elaboration in some subjects of the experiment who were categorized as “those who evaded the problem” was not a sine qua non for high problem sensitivity. Apparently, added to this are the children’s personal attitude to “evade” controversial situations and the ability to solve cognitive problems.

The training experiment aimed at increasing the level of detailed elaboration was performed with the children who were classified as “those evading the problem” and “those with no reaction to cognitive contradictions”. The measurement of the degree of the detailed elaboration level before and after the training experiment showed that the majority of these two groups of pre-school children (72%) increased their level of detailed elaboration following the training. A comparative analysis of the problem sensitivity index before and after the training experiment showed that the subjects of the experiment who had not reacted to contradictions before the training, demonstrated attempts to formulate questions and began to ask the experimenter questions more often and with greater enthusiasm. This proves the fact that at this age the development of the ability to specify by means of training contributes to a spontaneous involvement in the detection of contradictions.

However, in a certain part of the subjects of the experiment (18%), improvement of the ability to specify failed to noticeably affect their problem sensitivity. Apparently, the hitherto prevailing factors were overtaken by other factors involved in the formation of self-regulation.

## **1. Discussion**

One of the tenets of developmental psychology is that the primary forms of self-awareness that manifest themselves in the form of knowledge, assessment of one’s own abilities and discovery of one’s own emotions are evolved by the end of the pre-school period, and that they constitute the child’s major new psychological formation. It is the child’s awareness of his own intellectual abilities during his interaction with an object that causes him to discover indistinct knowledge as an opportunity to ask a question or to formulate a task. The ability to think is the result of correlating the subject’s abilities with those of an object, accompanied by internal willingness to realize these abilities. The study showed that the ability to detect and set problems independently goes through certain stages of its formation.

The first stage (prior to the age of 5 years) is characterized by spontaneous cognitive activity manifesting itself in the emergence of questions addressed to an adult. This involuntary process of transition from the ability to put a question to the need to formulate one is oriented to an adult to whom this question is addressed. This process is underlain by a developed ability to specify and a special function of emotions associated with their involvement in the newly forming self-evaluation and self-regulation, through which the object acts as an opportunity to ask a question. The more developed the ability to specify is, the more opportunities to raise questions the child has, and the more likely the formation of intentions to raise questions becomes. As a result of it, the records of our experiment show that development of the ability to specify is manifest in enhanced spontaneous problem sensitivity in the form of an increased ability to self-dependent formulation of questions.

By the age of 6 to 7 years children begin to address their spontaneous questions not only to adults but also to themselves. First ties are formed between emotional evaluative situational factors and personal attitudes as a child's willingness to interpret the unclear, the puzzling and the unknown in a certain way. This period is characterized by the formation of internal determination when not knowing something causes not just a spontaneous formulation of a question addressed to an adult but also to oneself. An increased ability to specify (development of analytical skills) in the course of special training leads to an increase in the number of spontaneous questions raised by children.

Further development of the ability to specify does not have a clear cut effect on the number of questions that might be raised. A special cycle of studies with junior schoolchildren [2] demonstrated that children of 9 years of age do not demonstrate any explicit dependence between the degree of the ability to specify and problem sensitivity, which is characteristic of children of 6 to 7 years of age. There is a decrease in the determining role of the external due to an increase in the determining part of the internal, which entails a decrease in involuntariness and syncretism alongside with increased voluntariness, conscious volitional control, and determination by means of unity of the internal and external life. After pre-school age we observe sustainable forms of reaction to potential cognitive problems similar to those identified in adults with all the features of their typical manifestations [2],[3].

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