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An inner picture of health as a factor in changing a child's behavior to health-promoting behavior

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Background. An inner health picture (IPH) includes a person's image of him- or herself as healthy, and knowledge of the methods needed to achieve the behavior necessary to maintain his (her) health. The IPH of a preschooler is formed by his (her) parents, and the high level of physical activity which is needed for supporting his (her) IPH could change a child's capacity to orient in sensory flow.

Objectives. The objectives of this study were twofold: 1) to compare the children's IPH with that of their parents, and 2) to study the connection between a child's IPH with his (her) capacity to recognize consistent patterns in the structure of a stream of sensory signals.

Design. 82 primary school children and their mothers participated in the study. The study was conducted in two stages. During the first stage, the internal picture of health (IPH) of the children and their parents was evaluated by means of a questionnaire. To describe a child's ability to discern some kind of order in a stream of sensory signals, the models of simple and complex sensorimotor reactions were used.

Results. Parents whose children have a well-developed IPH steer their children toward a healthy lifestyle, whereas they themselves do not do what is necessary to maintain their own health. The process of developing an IPH is accompanied by an increase in control during performance of a serial reaction task, which is reflected in a decrease in the number of lapses or missed stimuli. **Conclusion.** An IPH is an internal mental model that not only predetermines a child's notion of themselves as a healthy person; it also has a psychological basis in the form of a system that strengthens the child's control over his (her) own actions.

Keywords: an internal picture of health, simple and complex sensorimotor reactions, primary school children

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Introduction

One of the most important problems that humanity is facing today is the disparity between our modern lifestyle and the evolutionary demands of a healthy body (Nikolaeva, 2015). Our body evolved under conditions of constant motion and limited access to food, as well as the absence of great quantities of readily obtainable carbohydrates in the environment, and, all the more so, substances that are today recognized as being harmful to our health.

The human body has not changed over the last 100,000 years, but our lifestyle has (Frith, 2011): spending time at a workplace or at school has sharply limited our mobility, and the unique features of food preservation have led to the constant availability of food for the vast majority of people. In neither case does this conform with the evolutionary framework that determines how effectively we function and how healthy we are.

It is obvious that even when a person understands that his (her) behavior is undermining his (her) health, this does not, in the overwhelming majority of cases, lead him (her) to change his (her) way of life (Webb & Sheeran, 2006). In order to prove that this is true, we do not need to do any research; all we have to do is to go out onto the street, where we will see a great number of people who are overweight.

The most widely accepted theory which allows us to predict the likelihood of a behavioral change that would lead to a healthier lifestyle is the theory of planned behavior (Ajzen, 1985, 2011). It establishes how much a person's change in behavior depends on his (her) intention to perform the behavior, and on his (her) perceived behavioral control. In turn, a person's intention depends on his (her) attitude towards the behavior, his (her) subjective norm, and his (her) perceived behavior control.

This theory is most accurate in predicting behavioral changes if the research is conducted on students or young adults (McEachan et al., 2011). There is a problem, however: the most effective time to influence a person's behavior is during childhood, and this influence is most successfully accomplished by a person's parents. In this case, a parent answers for control of his or her own behavior as well as for that of the child, and the child's intentions are often introjected intentions of the parents.

In an earlier study, we asked preschoolers this question: "What do you need to do to be healthy?" More than 60 percent of the five-year-olds answered that you "need to take pills and go to the doctor." Children between the ages of six and seven, however, gave such an answer in just 40 percent of the cases. Clearly, the children's answers were prompted by the behavior of their parents. As long as a child is healthy, health is not a topic of conversation with them, since it is a given. Accordingly, these children are not told about what it is that leads to good health. But when they fall ill, their parents become emotional when they describe both the child's condition and the measures that need to be taken to return the child to a state of health (Nikolaeva et al., 2014).

It is for this very reason that, when describing the influence that parents have on behavior in their children that would lead to good health, the concept of an "internal picture of health" (IPH) seems appropriate (Nekrasova, 1984). It includes, on the one hand, a person's image of him- or herself as healthy and, on the other hand, a knowledge of the methods needed to achieve the right behavior to maintain

health and–this is extremely important–to actually perform it. Consequently, it is assume that, to form an internal picture of health, a person needs to know not only what he (she) has to do; the person also has to do it, i.e. realize the knowledge so that it becomes a part of his (her) own behavior. It is likewise assumed that the concept of an internal picture of health raises the threshold of a person's susceptibility to disease (Nikolaeva & Merenkova, 2013).

This internal picture is formed by the child's parents, but how are the parents' IPHs and child's IPH connected? They could be identical, or they could be different. In cases where parents teach their children based on their own example, the parents and children have the same IPH. But parents could teach their child to play sports but not behave this way themselves. These strategies would have a different influence on the child's IPH. But we lack information about the real situations in families.

The IPH is a mental picture. If it is an actual picture, it influences the brain's characteristics and is influenced by them (Frith, 2011). It includes both the functions of the person's behavior planning and the control of this behavior. In our study we assumed that a person's conscious attitude towards his (her) own health, which is manifested in specific behavior (for example, a child going out for sports regularly), should be connected with objective psycho-physiological characteristics: first of all, the ability to orient one's self within the structure of a stream of sensory signals, and to perceive (perhaps unconsciously) the order in that structure, if it exists. It is known that sensory and motor processes are temporally integrated in order to control behavior (Karmarkar & Buonomano, 2006; Merchant et al., 2013). This assumption seems warranted since the formation of an internal image of health, and the ability to control it, call for a person to be sensitive to streams of sensory stimulation.

For this reason, the objectives of our study were twofold: 1) to compare the children's internal pictures of health with those of their parents, and 2) to study the connection between a child's ability or inability to form an internal picture of health with the child's capacity to recognize consistent patterns in the structure of a stream of sensory signals.

Method

Participants

There were 82 primary school children who participated in the study (the mean age was 9.1 ± 0.5 years); 39 of them were girls and 43 were boys. The study was carried out at a school in Lipetsk, a city in the central part of European Russia. The children's mothers (the mean age was 33.8 ± 5.7 years) also took part in the research. Practically all of the fathers agreed to enroll in the study, but in reality only a few were involved, not enough to provide evidence-based conclusions. Hence, only the results for the mothers and children were subjected to analysis.

Design and procedure

The study was conducted in two stages. During the first stage, the internal pictures of health (IPH) of the children and their parents were evaluated by means of a questionnaire (Nikolaeva et al., 2014). Parents filled out the forms themselves,

and the children were asked questions by psychologists who filled out the forms for them.

The questionnaire for parents consisted of two parts: in the first part, the parents needed to answer questions about what it means to be healthy; in the second part, they had to answer what they thought was involved in creating health. For each question, the subject chose one from a set of given answers, and each answer was given a certain numerical score. Then the results of the first and the second parts were compared, allowing us to assess whether the person acts in accordance with his (her) ideas of a healthy person.

The child was asked questions about what he (she) needs to do to be healthy. The answers were compared with the scale of answers that corresponds to certain numerical scores, which correspond to age norms.

To determine a child's ability to discern some kind of order in a stream of sensory signals, the following methods of evaluating simple and complex sensorimotor reactions were used. To test his (her) ability on a model of simple sensorimotor reactions, the child sat in front of a display screen on which different colored circles would appear. When a circle appeared on the screen, the child was supposed to press down on the spacebar. When they were being tested on a model of complex sensorimotor reactions, the children were instructed to press the spacebar at the appearance of any circle except a red one. The inhibitory processes in the children's central nervous systems were thus evaluated. The program ReBos was used (Vergunov, Nikolaeva, 2014).

Measures

While a child was describing his (her) IPH, it became clear what he (she) felt when he (she) was healthy, how he (she) looked at that time, and what he (she) thought was needed in order to be healthy. Using a special inquiry form, the child's frequency of attendance at specialized sport clubs, swimming pools, and classes involving outdoor games was also evaluated. After analysis, it was possible to divide the children into three groups. A response reflecting the child's notion that a healthy lifestyle involves the need to constantly be active, engage in sports, and eat the right food showed that the child had a well-formed IPH (more than 12 points). If, in his (her) assertions, a child associated a healthy way of living with taking pills and going to the doctor, then the child was relegated to the group with an unformed IPH (no more than 8 points). Children who received between 8 and 12 points were put in a group considered to have a partially formed IPH. Allowing for the difference in their ages, the children's mothers were asked similar questions in versions designed to assess their IPH.

In this study, the evaluation of the process of constructing order in a sensory stream was based on the fractal properties of the stream. Fractality is characteristic of long-period correlations in streams of signals that can be represented by using the Hurst Index, which is one of the markers of the degree of order in stimuli (reactions) over the course of time. The range of values from 0.5 to 1 corresponds to an increase in the order of the stream, and a Hurst Index equal to 1 reflects a linear dependence during the sequence of the stimuli in the stream (Fraisse, 1984; Coull et al., 2011).

In our case, the structure of the stream corresponded to a Hurst exponent of 0.953 for the simple sensorimotor reactions, and 0.827 for the complex reactions.

There were, however, two Hurst exponents that were evaluated:

- Hurst exponent *Hy*, which pertains to the time between the appearances of stimuli on the screen. (On different computers with different Windows systems, the appearances of the stimuli occur with an accuracy of ± 15 msec from what is prescribed, and therefore measurement of the time that the stimuli actually appear is part of the procedure for testing simple and complex sensorimotor reactions.)
- Hurst exponent *Hx*, which is related to the recording of the intervals between the times the test subject presses down on the spacebar.

The stream of signals used in testing both the simple and the complex sensorimotor reactions consisted of two identical parts, but the children were not informed of this. Thus, it was possible to evaluate the test subject's ability to recognize a highly-ordered stream of signals in the first part of the task, and to use that recognition in the second part (consciously or unconsciously).

In addition to the Hurst Index, the following variables were also recorded: the reaction times in the tests of both the simple and complex sensorimotor reactions; the number of lapses (when a child failed to react to a stimulus); and the number of mistakes (the test subject failed to follow the instructions for the complex sensorymotor reactions and pressed down on the spacebar after a red circle appeared on the screen).

At the halfway point of every task, the Δ exponent was assessed by subtracting Hx from Hy, taken in absolute value. Low values of this exponent indicated that the degree of order in the test subject's reactions conformed to the given degree of order in the actual stream of stimuli.

Since one and the same stream of signals was repeated twice in every task, it was possible to assess a child's ability to recognize and use that order, whether consciously or unconsciously. This could be done by comparing the value of Δ1 for the first half of a task with the value of Δ2 for the second half. This comparison produced the Ω parameter, which gauged the difference between Δ1 and Δ2. If the value of Δ2 was less than or equal to that of Δ1, that meant the child was able to recognize the structure in the stream of signals and adapt their reactions to it. Assessment of the parameters specified above was carried out based on dividing the test subjects according to their IPH levels, as well as analysis of their ability to predict when the stimuli would appear (hereafter we will denote this parameter as either "recognized" or "did not recognize"). A statistical data analysis was performed using IBM SPSS Statistics Version 23.

Results

First of all, the children's and parents' answers to the questions were checked against each other. On the question of what a person needs to do in order to be healthy, there were no differences between the answers of the children and the parents (Table 1).

The differences were substantial, however, when the children and their parents answered the question about what they actually do to be healthy. The children significantly more often said that they work out, go to the swimming pool, attend

specialized sports clubs, etc. The parents talked about how they don't have time to engage in the activities that are essential if they want to maintain their health, or that they don't have enough money to pay for their own sports activities, since in their hierarchy of values, the health of their child comes first (Table 2).

Table 1. Answers to the question "What a person needs to do in order to be healthy" (scores)

Mean and SD	
Mothers	Children
8.02±4.99	7.32±3.74

Table 2. Answers to the question "What you actually do to be healthy"

Mean and SD	
Mothers	Children
1.24±0.88	1.6±0.8*

Note: * = 0.007 (Wilcoxon's criteria)

It was no surprise then, that on average, the children turned out to have higher ratings in terms of an IPH than the adults (Table 3).

Table 3. Comparison of the IPH levels of children and their mothers (mean and SD)

Groups	**Level of IPH**
Mothers	5.50±3.04
Children	7.32±3.74*

Note: * = 0.000 (Wilcoxon's criteria)

Even so, a breakdown of the children according to the level of their IPH showed that a majority of them (54 percent) do not have a completely formed IPH (see Figure 1).

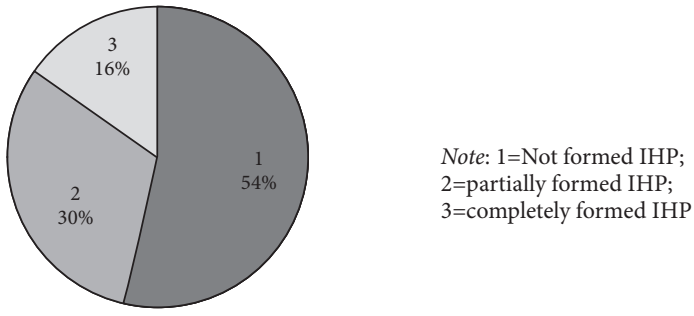

Figure 1. The distribution of the children on the levels of IHP

Table 4 shows our evaluation of how well children with different levels of IPH recognized the order in a sensory stream.

Table 4. The quality of recognizing the order in a sensory stream by children with different levels of IPH (%)

Type of reaction	Level of IPH	Quantity of children (%)	
		recognized	did not recognize
simple sensorimotor reaction	0	38	62
	1	67	33
	2	78*	22*
complex sensorimotor reaction	0	58	42
	1	67	33
	2	56	44

Note: * = 0.013 (Wilcoxon's criteria)

An analysis of these results provides evidence that among those children whose IPH is undeveloped, more of them do not recognize the order in a simple sensorymotor reaction than the children of the other two groups do. In our study, this difference was significant for the children with highest level of IHP in comparison with two other groups.

At the same time, when it came to the complex sensorimotor reactions, there were no significant differences among the children. This can be explained by the difficulty that all children of this age have in completing tasks connected with the inhibitory process, since the frontal lobes, which are in charge of this process, have not yet fully developed. This is also confirmed by the results in Table 4, where other relevant parameters of the simple and complex sensorimotor reactions are presented.

As can be seen by the findings presented in Table 5, in the testing of simple sensorimotor reactions, the children with an undeveloped IPH did not notice that the second segment of the stimulus material was a duplicate of the first. They had even more lapses (i.e., omitted more stimuli) in the second series than in the first, which was perhaps a reflection of their inattention. The children with a partially developed IPH were significantly better at completing the task, and in the second part they had considerably fewer lapses than in the first. This shows that they had inner control and were attentive as long as the stimulus material was being presented. As for the children who had a well-developed internal picture of health from the very start of the testing, they had fewer lapses than those in the other two groups, and they performed at a consistently high level throughout the entire task.

In the part of the study devoted to complex sensorimotor reactions, no differences were found between the groups of children. Analysis of these reactions can bring to light the processes of inhibitory control, which are just beginning to develop in children at the age of those in the experiment.

The findings certify that there were no significant differences in reaction times in any of the groups for either the simple or the complex sensorimotor reactions, and in either part of the series.

Table 5. Omission of stimuli by children with different levels of IHP

Type of reaction	Level of IPH	Lapses (part 1 of task)		Lapses (part 2 of task)	
		recognized	did not recognize	recognized	did not recognize
simple sensori-motor reaction	0	8.7±6.7	3.4±2.6	9.3±6.7	5.2±4.4
	1	3.5±0.7	12.0±0	2.0±2.8	7±0
	2	2.4±2.1*	6.0±4.2	2.3±1.6**	8.0±2.8
complex sensori-motor reaction	0	5.8±3.98	6.5 ±4.04	3.5±2.9	5.9±5.4
	1	8.0±7.07	7.0±0	3.5±3.5	3.0±
	2	3.8±2.2***	2.8±0.5	5.0±2.2	4.0±2.2

Note: * = 0.001; ** = 0.000; *** = 0.008 (Wilcoxon's criteria)

Discussion

Our data confirm that parents' IPHs have an obvious influence on their children's IPHs, but this is impossible to prove, since many parents whose children do have a well-developed IPH steer their children toward a healthy lifestyle, whereas they themselves do not do what is necessary to maintain their own health. Furthermore, as they point out, they pay for the activities that their children need to be engaged in, and economize on their own health. On top of that, due to the time required to transport their children to these activities, they do not leave themselves any time to participate in such activities.

It is interesting that parents do a lot to provide for their children's physical activity in special places (swimming pool, sport classes, and other), but do not organize joint family activities. That is, children participate in various sport classes, but they do not see their parents involved in the same activity. It is possible that later, when they grow up, they will prefer to help their own children participate in sport classes, but not participate in them themselves.

Our findings also show that children with a well-developed internal picture of health are better at recognizing order in the structure of a stream of sensory signals when called on to make simple sensorimotor reactions. They are also in better control of their actions, which leads to fewer missed signals.

In their complex sensorimotor reactions, children at this age with varying IPH levels do not excel in the quality of their performance. This is attributable to the difficulty that all children at this age have in executing inhibitory control, because their cerebral structures are insufficiently prepared to do so (Anderson & Weaver, 2009; Berkman et al., 2014).

Obviously, a child of this age is unable to control his (her) own actions related to health, since such actions are, to a great extent, determined by adults. Our findings, however, show that children whose parents actively control this process not only have an idea of what good health is, but they are also more successful at controlling their own simple sensorimotor reactions.

It is generally thought that sensorimotor reactions reflect the particular way that sensorimotor integration manifests itself in the human brain. We can assume that the processes of sensorimotor integration are more effective in the brains of children with a well-developed IPH. This allows a child, consciously or unconsciously, to recognize order in sensory signals.

It is assumed that a well-developed IPH raises the threshold of a person's susceptibility to disease. We can suppose that what lies behind this raised threshold is the ability to recognize order in the structure of an external or internal sensory stream, and, in the case of a child, to inform the parents in a timely fashion of changes that have occurred, which will allow the latter to do whatever is necessary.

At the same time, it can be said that an IPH is not simply a mental model that incorporates a child's notion of what it means to be in good health, and what they need to do in order to maintain that condition; it also has a psychological underpinning in the form of more effective sensorimotor integration, and, accordingly, it gives the child a more effective system of control over his (her) own actions when he (she) is met with a stream of signals.

Conclusion

Thus, the following conclusions can be drawn:

1. Parents' IPH has an obvious influence on their children's IPH, but this is impossible to prove, since many parents whose children do have a well-developed IPH steer their children toward a healthy lifestyle, whereas they themselves do not do what is necessary to maintain their own health.
2. The children with a partially developed IPH found it significantly easier to complete tasks on the model of simple sensorimotor reaction, and in the second part of the task, they had considerably fewer lapses than in the first. This shows that they had inner control and were attentive as long as the stimulus material was being presented.
3. The children who had a well-developed internal picture of health from the very start of the process involving simple and complex sensorimotor reactions, had fewer lapses than those in the other two groups, and they performed at a consistently high level throughout the entire task.
4. The process of developing an internal picture of health is accompanied by an increase in control during performance of a serial reaction task, which is reflected in a decrease in the number of lapses, or missed stimuli.
5. An IPH is an internal mental model that not only predetermines a child's notion of him- or herself as a healthy person; it also has a psychological basis in the form of a system that strengthens the child's control over his (her) own actions.

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