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REGULAR ARTICLE

What are Higher Psychological Functions?

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Abstract The concept of Higher Psychological Functions (HPFs) may seem to be well know in psychology today. Yet closer analysis reveals that HPFs are either not defined at all or if defined, then by a set of characteristics not justified theoretically. It is not possible to determine whether HPFs exist or not, unless they are defined. Most commonly the idea of HPFs is related to Vygotsky's theory. According to him, HPFs are: (1) psychological systems, (2) developing from natural processes, (3) mediated by symbols, (4) forms of psychological cooperation, which are (5) internalized in the course of development, (6) products of historical development, (7) conscious and (8) voluntary (9) active forms of adaptation to the environment, (10) dynamically changing in development, and (11) ontogeny of HPFs recapitulates cultural history. In this article these characteristics are discussed together with the relations among them. It is concluded that HPFs are real psychological phenomena.

Keywords Higher psychological functions · Structural-systemic approach · Cultural-historical · Vygotsky

The concept of higher psychological functions (HPF) may seem to be well known in psychology today – some perhaps reject the idea of distinguishing "lower" and "higher" psychological processes whereas others agree that such a distinction is justified. But in both cases the idea is there. Yet there are many questions that need to be answered in order to decide whether "higher" psychological processes exist. One might be tempted to begin the discussion of HPFs from recent advancements in the study of them. In that case, however, this paper would end here. Now, I am sure, many readers would be able to bring numerous examples of studies of HPFs conducted in a last decade or two. So, I must be ignorant not to know them and not to write a nice summary of the state of art in the field. But I am arrogant and disagree with the diagnosis – ignorant. Before the reader modifies the diagnosis – instead of ignorant

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proposing severely ignorant with anosognosia – let us see some reasons as to why I suggest that studies of HPF are extremely rare today and almost nothing new has been discovered about them – in the limits of my ignorance, of course.

Let us imagine that there is a group of scientists who would like to study cars. In order to study anything, as Popper convincingly demonstrated (cf. Popper 2002; see also Münsterberg 1899), the researcher must first define what is going to be studied.[1] This group of scientists finds a nice theory, where a car is defined as an object with wheels, engine, and many other parts. But our scholars do not like long definitions. So they take what appeals to them most and define a car as a thing with wheels. And then they start studying anything with wheels declaring that these studies are conducted to understand cars better. It would not be surprising in such a situation that soon very different things are studied as cars by our scholars – some perhaps study cars, but others study bicycles, trolleys, wheelbarrows or whatever else happens to have wheels. Even children with roller skates would by that definition classify as cars. If now somebody would like to write a summary of recent research on cars, either nonsense emerges from synthesis of studies or the author has to suggest that there have been no studies of cars but studies of things with wheels some of which may be cars. And there is actually nothing to summarize as the authors of studies did not care to define what they studied more than by just telling that a car – a thing with wheels – was studied.

I suggest that the situation of studies of HPFs today corresponds to the state-of-art in imaginary *carology*, I just described: the definitions of HPFs are either missing or they are incomplete. Thus what is studied under the name of HPFs remains unclear and no coherent theory of them can emerge from recent research. There are two possible ways out of the situation. One would be to assume that psychology is just beginning to understand HPFs. In that case we would have to take the current studies and try to build a (more) coherent theory of what the HPFs could be or whether anything like that exists at all. The other way would be to look into history of psychology and ask whether the answers can be found there. Considering the historical blindness of the psychology today (cf. Toomela 2007a, 2010c, 2012; Toomela and Valsiner 2010) it will not be surprising to "discover" that all the needed questions are already asked long time ago and even more – theoretically well justified answers are also provided.

First let us take a (very) short look into the emergence of the idea that psychic functions can be hierarchically arranged so that higher and lower forms of them can be distinguished. I find again and again that the development of almost every fundamentally important idea in the history of the human thought can be traced back to Aristotle. It is also true about the notion of HPFs, as we see next.

[1] Very often the first and most important question to be answered by science is what exactly the studied thing or phenomenon is. The question may emerge, how can we define before, what we are actually going to find out after our studies? Popper, nevertheless, demonstrated that nothing can be observed unless we have defined what it is, about what we are going to make observations. The reason is clear here: the world can be described in endlessly many ways and therefore in order to observe, we need to select what we are going to observe (and, thus, what we are going to ignore – everything else!). There is no contradiction here. Our definitions before the studies are actually hypotheses about what we are studying. Through studies we either reject our hypotheses or keep them as theories or models until some falsifying evidence is found. So, one can say that in the beginning of studies, our definitions reflect what we guess the studied thing or phenomenon is and after studies our definitions become the theory of the thing or the phenomenon studied.

Roots of the Idea: Aristotle

The idea of the hierarchical nature of psyche was discussed by Aristotle in different works. He distinguished between nutritive power that characterizes all life, sensation or perception that characterizes animals, and reason, which characterizes only humans:

> This power of self-nutrition can be separated from the other powers mentioned, but not they from it—in mortal beings at least. The fact is obvious in plants; for it is the only psychic power they possess. […] it is the possession of sensation that leads us for the first time to speak of living things as *animals* […] the soul is the source of these phenomena and is characterized by them, viz. by the powers of self-nutrition, sensation, thinking, and movement. (Aristotle 1984c, p. 658; $413^{a}33–413^{b}12$)

Similar idea can be found elsewhere:

> Life seems to be common even to plants, but we are seeking what is peculiar to man. Let us exclude, therefore, the life of nutrition and growth. Next there would be a life of perception, but *it* also seems to be common even to the horse, the ox, and every animal. There remains, then, an active life of the element that has a rational principle (Aristotle 1984b, p. 1735; $1098^{a}1–5$)

Furthermore, it is not just the power of perception possessed by animals; animals also memorize the perceived:

> The animals other than man live by appearances and memories, and have but little of connected experience; but the human race lives also by art and reasonings. (Aristotle 1984a, p. 1552; $980^{b}26–27$)

Today we would not apply "nutritive power" or quality of being alive to the psyche. Yet perception and memory are psychic phenomena according to any modern understanding. But what distinguishes, according to Aristotle, specifically human psyche from that of other animals? Aristotle's psychology is quite complex; for our purposes there is no need to delve into details of it. Rather, I would like to provide two most interesting points Aristotle made about humans:

> […] man is by nature a political animal […] Now, that man is more of a political animal than bees or any other gregarious animals is evident. Nature, as we often say, makes nothing in vain, and man is the only animal who has the gift of speech. And whereas mere voice is but indication of pleasure or pain, and therefore is found in other animals […] the power of speech is intended to set forth the expedient and inexpedient, and therefore likewise the just and the unjust. And it is a characteristic of man that he alone has any sense of good and evil, of just and unjust, and the like […] the individual, when isolated, is not self-sufficing; and therefore he is like a part in relation to a whole. But he who is

> unable to live in society, or who has no need because he is sufficient to himself, must be either a beast or a god […] (Aristotle 1984e, pp. 1987–1988; 1253[a]3–29)

Thus, first, humans are "political" animals – they belong into organized society. Without society, a human would be just a beast. And second, it is a power of speech that allows humans to make sense of the world according to categories not available for other animals. Here, I think, it is worthy to stress that Aristotle was very well aware that external similarity of certain behaviors does not necessarily imply identity – other animals also make sounds to express themselves, but it does not follow that they have language. Far too often today scholars mistakenly deduce identity from (partial) similarity – as we are also going to see below, there are all reasons to distinguish (human) language from forms of signaling used by other animals.

Last, but not least, there are two very interesting Aristotle's thoughts more about the matter:

> Chance and what results from chance are appropriate to agents that are capable of good fortune and of action generally. […] Hence what is not capable of action cannot do anything by chance. Thus an inanimate thing or a beast or a child cannot do anything by chance, because it is incapable of choice […] (Aristotle 1984d, p. 337; 197[b]1–8)

From this quote we can see, first, that humans *become* psychically humans; children are in that respect more similar to other animals than to adult humans. This is quite natural considering, as we just found, that humans become humans in human community. And second, in today's language, we would say that Aristotle attributed free will – capacity of making choices – also only to humans.

Altogether, Aristotle attributed only humans certain language-based rational powers of psyche, which develop in human community. These specifically human powers are hierarchically higher; humans also perceive and memorize as other animals and have nutritive powers as all living creatures, including plants.

Emergence of the Science of Higher Mental Functions: Wundt

Now we skip more than 2000 years – many scholars have discussed ideas about human mind during that time and several interesting details have been added to the picture but nothing substantially new has been proposed. We stop for a moment at Wundt's ideas. The main reason for that is not that he had something interesting to add to the ideas about HPFs we found already from Aristotle's works. Yet he added something fundamentally important – he brought up the question of scientific methodology – how the higher psychic processes should be studied.

So, Wundt, following the ideas proposed by Lazarus and Steinthal, suggested that higher mental processes – those created in and by the society – must be studied differently from lower, individual mental processes; study of higher mental processes belongs to the realm of what he called "folk-psychology" (*Völkerpsychologie*):

> […] 'folk psychology.' The mental sciences began to realize the need of a psychological basis; […] All phenomena with which mental sciences deal are, indeed, creations of the social community. Language, for example, is not the accidental discovery of an individual; it is the product of peoples […] Today, doubtless, folk psychology may regarded as a branch of psychology […] Its problem relates to those mental products which are created by a community of human life and are, therefore, inexplicable in terms merely of individual consciousness, since they presuppose the reciprocal action of many. […] Thus, then, in the analysis of the higher mental processes, folk psychology is an indispensable supplement to the psychology of individual consciousness. (Wundt 1916, pp. 2–3)

Furthermore, Wundt also stressed the need to study the development, the genesis of mental processes:

> Folk psychology, however, in its investigation of the various stages of mental development still exhibited by mankind, leads us along the path of true psychogenesis. It reveals well-defined primitive conditions, with transitions leading through an almost continuous series of intermediate steps to the more developed and higher civilizations. Thus, folk psychology is, in an important sense of the word, *genetic psychology.* (Wundt 1916, p. 4)

Thus, Wundt's ideas about the nature of higher mental processes were not much different from Aristotle's. But he contributed substantially to the development of the methodology of psychology. Perhaps the most noteworthy of his ideas in this context was that in order to understand mind, history of the human kind must be studied; these studies do not involve individuals but communities, societies.

Yet I would say the most important ideas for understanding psyche and specifically human "higher" forms of it needed another substantial move. So far – and in fact also in practically all psychology today – HPFs were (and are) conceptualized either by the ways they are expressed in behaviors or results of behaviors, or by what seems to be related to them. So HPFs may be defined as behaviors not observed in other animals (e.g., language, arts, formal mathematics or logic, etc.) or they are defined by their putative origin (e.g., social, historical) or by relation to some other psychological concept (e.g., intersubjective, mediated by use of artifacts, mediated by language). What is still missing, is an attempt to ask and answer the question – *what* HPFs are? In fact, it is not surprising, because it is not only the lack of conceptualizing "what" the studied mental phenomenon is. Worse, psychology today (practically with no exceptions) has forgotten how "what" can be conceptualized and also does not understand why this questions must be asked. The only theory that really asked – and answered – this questions was Vygotsky's.

Before going to detailed discussion of Vygotsky's theory of HPFs, one important point must be made. It was suggested by a reviewer of the earlier version of this paper that detailed discussion of the characteristics of the HPFs, proposed by Vygotsky, might not be so interesting for non-Vygotskians. Psychology is indeed often separated into camps according to theories created by

certain individuals – who became almost as idols for the camp. Why it is so would need a separate analysis that goes beyond the scope of this paper. What is important, however, is that division into camps characterizes immature and problematic state of a science. Those who are divided into camps, make their choices among the existing theories they "like" or "dislike". Science, however, is not about choosing between nice theories by comparing them. Science is about truth, about whether theory corresponds to external reality or not. Thus instead of comparing theories, a scientist may better ask in case of each theory whether it is justifiably related to what we know about reality or not.

In case of HPFs, as far as I can tell, Vygotsky has defined special category of psychic processes that are real; at least his definition of HPFs can be organized into a coherent whole that fits with what is known about mental functioning today. This cannot be said about theories that either deny the existence of HPFs or define them differently from Vygotsky. Thus whether the reader would be Vygotskian or not, should not matter. What is important, is to provide clear and as detailed as possible account of how HPFs are defined in order to make a next step and go into focused studies of them. This is what I am doing in this paper. I provide the main characteristics provided by Vygotsky. As Vygotsky never discussed all the characteristics together, we discover that we need to go beyond him and elaborate his ideas. Yet, at the same time, it turns out there is no need to abandon anything from his account – by elaborating and connecting different parts of his definition, we end up with a coherent theory about important aspects of the specifically human mind.

Vygotsky – Theory of Higher Psychological Functions

Vygotsky discussed the notion of HPF extensively and in great details almost a century ago. He provided altogether 11 defining characteristics of the HPFs in different works. Today, most of the defining characteristics of the HPFs are just forgotten or ignored. So instead of them, quite in line with principles of research in our imaginary *carology* discussed above, everything with wheels .... sorry, everything with social origin can be studied under the name of HPFs. I am not alone when I say this. Valsiner (2012) drew attention to what he called "the strategy of *selective maintaining* in modern psychology: a way of writing an account of history of the discipline that highlights some part of the past for linkages with the present—while keeping other parts of the whole away from that highlighting" (p. 47). He continued:

> A similar example can be found in the selective maintenance of Lev Vygotsky's ideas. It is from his person-centered cultural-*historical* perspective that our contemporary *socio*cultural followers of Vygotsky selectively prioritize the role of the "social other"—social environment, "more knowledgeable" peer or parent/teacher of the child—and prefer to overlook the centrality of the person oneself. They hail Vygotsky for focusing on the primacy of the social in the ontogenetic process—overlooking the role of the active person who constructs one's own self *within* that social context. In that glorification of the social focus, Vygotsky's main idea of

> the hierarchical order ("higher" and "lower" psychological functions) is left in the periphery of the coverage, and the focus on the individual play and fantasy barely mentioned at all. (*ibid.*)

Definition of HPFs

Now we need to define HPFs. We take a look at how these were defined in Vygotsky's[2] theory. Doing that, we will look for an answer of an important question, question that emerges in comparison of Vygotsky's definition with that followed today. As I mentioned in the first footnote, we cannot study anything without some definition of the studied thing or phenomenon. At the same time, what the thing or phenomenon actually is, can be only revealed after studies. So the first definitions should be understood as guesses or hypotheses about what is studied. Therefore there is also a possibility that Vygotsky's definition was not well justified and further studies have helped to arrive at a better understanding of the so-called Higher Psychological Functions.

Vygotsky aimed at understanding human mind. Along his studies, and continuing the long tradition of distinguishing hierarchy of levels in the functioning of psyche, he arrived at the conclusion that there are specifically human forms of psyche or mind related to the fact that humans share cultural environment, the environment which continuity is not determined by biological factors but rather through social relationships of people. So he was looking to understand in what way human psychological functions are related to the cultural-social world. Vygotsky proposed the theory of Higher Psychological Functions to explain the emergence of specifically human forms of psyche. According to him, HPFs are mental structures of a specific type:

> As our studies show, there occurs not only an inner reconstruction and perfecting of separate functions in the process of psychological development in the child, but the intra-functional ties and relations are also altered in the most radical way. As a result of these changes, new *psychological systems* appear which unite in complex cooperation and in complex combinations various separate elementary functions. Lacking a better definition, we call these psychological systems, these units of a higher order that take the place of homogeneous, isolated elementary functions the *higher psychological functions* (Vygotsky and Luria 1994, p. 162, emphasis in original)

Altogether, I have found 11 characteristics of HPFs in Vygotsky's works. HPFs are: (1) psychological systems, (2) developing from natural processes, (3) mediated by symbols, (4) forms of psychological cooperation, which are (5) internalized in the

[2] I attribute all "cultural-historical" theory, as it is called today, to Vygotsky. This I do despite the fact that some important theoretical publications are attributed to him together with Luria. By comparing Vygotsky's early psychological works (between about 1924–1929), obviously authored by him alone, with the later ones, as if coauthored with Luria, I have reached a subjective impression that Luria did not add anything theoretically noteworthy to his theory. Quite clearly Luria has extended Vygotsky's theory and contributed substantially to the development of it, especially in neuropsychology. Yet all these novel contributions emerged years after Vygotsky's death. Perhaps it is worth mentioning that independently of whether my impression is correct or not, the arguments in this paper would not change.

course of development, (6) products of historical development, (7) conscious and (8) voluntary (9) active forms of adaptation to the environment, (10) dynamically changing in development, and (11) ontogeny of HPFs recapitulates cultural history.

Eleven Characteristics of HPFs in Their Hierarchical Relationships

The characteristics of HPFs, provided by Vygotsky in his different works, are not in complementary relationship at the same level of analysis. Rather, some of the characteristics are more general and the others actually follow from those higher-order attributes. I provided the characteristics in the logical, in my opinion, order to reflect the best the internal hierarchical relationships between them. I will start from the most fundamental. Along the discussion we also see that some of the defining characteristics of the HPFs are essential whereas others can be understood as secondary – these can be deduced from the essential characteristics. Yet even the secondary characteristics are important; they allow to elaborate the understanding of HPFs and perhaps they make also easier to recognize HPFs while studying psychic functioning.

HPFs are Psychological Systems

As we already saw in the quote above, HPFs are psychological *systems*. Such systems are not homogeneous but differentiated wholes, where different components perform different tasks. All these components are not connected mechanically; they comprise a unitary structure, which qualities are different from the qualities of its components (Vygotsky 1983a, 1984a, 1994). As parts of a whole, the components change also. So attention can be logical, logical memory is at the same time voluntary, etc. (Vygotsky 1983c).

Very important consequences follow, if to take this approach, I have also called structural-systemic.[3] Most importantly, what changes, is the essence of scientific explanation (see also Toomela 2012). If we want to understand systems, we need to know, what the components of it are, how these components are related one to another, and what characterizes the whole made of the components (Vygotsky 1982b, 1994). Therefore, if we want to understand why a structure changed, we look for an element that either was included into a whole in the process of hierarchical synthesis or excluded from it in the process of disintegration. Another possibility would be the change in the specific ways the elements are connected. Today almost without exceptions, another approach to scientific explanation is adopted in psychology. According to that view, emergence of novelty is attributed to "causes" that linearly make the "effect" to emerge.

[3] Structure and system were two terms that were used as synonymous by Vygotsky. Today both of the terms have acquired misleading connotations, especially in Anglo-American psychology. So structuralism can refer to atomism and system in so-called dynamic systems approach is understood as something opposite to structure. Instead of inventing a new term, I have used the term "structural-systemic" to refer to understanding according to which the world is a system composed from elements or components in specific relationships at different levels of analysis. What is whole at one level of analysis may be a component of a more complex structure at another. Wholes that emerge in hierarchical synthesis of elements have qualities (see for the definition of quality, Toomela 2014c) that are different from the qualities of the parts they are composed of. This view was followed by Vygotsky (and many other Continental European psychologists of his time, most notably gestalt psychologists).

I suggest, as I have also done elsewhere (most recently in Toomela 2015b), that Vygotsky's theory cannot be understood from the linear cause → effect perspective at all. Only consistent structural-systemic interpretation of his ideas allows to recognize the meaningful whole, his "cultural-historical" theory.

HPFs are Developing from Natural Processes

Vygotsky distinguished two lines of development, natural and cultural. According to him, cultural psychological functions, i.e., HPFs, develop from natural processes. Yet in the process of development, cause and effect change dialectically their positions so that the emergence of cultural processes from natural leads to change of all natural processes (Vygotsky 1983a; Vygotsky and Luria 1994).

How to make sense of it? It may seem that Vygotsky has relied on linear cause → effect thinking here and just proposes bidirectional cause-effect relationships between "natural" and "cultural" processes. What such linear explanation would mean, would be impossible to interpret in the whole of Vygotsky's theory. All becomes coherent immediately after we take the structural-systemic approach. "Natural" processes turn out to be components from which the "cultural" processes are synthesized. Theoretically, the qualities of the components change when they enter the whole; and whole emerges with qualities that do not characterize the components before they have entered the whole. After synthesis, parts of the whole acquire some of the characteristics of the whole. Particularly, when natural processes are synthesized into HPFs, they cease to exist *as* natural processes. Their functioning begins to follow the principles of the functioning of the whole.

Next thing under this heading is to find out, what were for Vygotsky the natural processes that ground the development of HPFs. I have not found a list of them in his works. However, he has discussed the cultural development of natural processes in different works. So, putting all them together, six natural processes were distinguished by him: perception (cf. Vygotsky 1960a, 1982b), practical intellect and planning (cf. Vygotsky 1982b, 1984b; Vygotsky and Luria 1994), memory (Vygotsky 1960a, 1983a, 1984a; Vygotsky and Luria 1994), attention (cf. Vygotsky 1956b, 1983a, 1984a), emotions (cf. Vygotsky 1926, 1960a), and speech (cf. Vygotsky 1934, 1984c). So these are the components which, when united into a whole in a novel way, make HPFs.

HPFs are Mediated by Symbols

According to Vygotsky, HPFs or cultural processes "include in their structure, as a central and main part of the whole process, the utilization of a sign" (Vygotsky 1934, p. 110). Thus the new element that distinguishes cultural processes from natural is the sign – which in Vygotsky's language was often used synonymously with speech. We just learned, however, that speech is one of the natural processes. Indeed, he was very clear about that:

> We found that the earliest flowering of the most complex sign operation occurs as early as in the system of purely natural forms of behaviour, and thus that the higher functions have their 'pre-natal' period of development linking them with the natural foundation of the child's psyche. (Vygotsky and Luria 1994, p. 148)

If we think about the rest of the elements of HPFs – perception, practical intellect, memory, attention and emotions – then all these must be parts of the natural mind as a whole. There would be nothing to memorize without perception and thinking, there would be nothing to attend to, nothing to feel about. Now sign operations also turn out to emerge as natural processes in the beginning of their development. Indeed, sign operations would be impossible without perception, memory, attention and thinking. Thus they must belong to the system of natural mind. How and why should in that case HPFs emerge, if sign operations belong already to a system of natural mind?

I have not found answer to this question in Vygotsky's works. Nevertheless, the problem does not require very complex solution. According to structural-systemic approach, systems at one level of analysis may become just parts or elements at another. If parts of the systems are systems themselves, then they can change – they change when novel elements are introduced to them or new kinds of relationships emerge between the existing elements. If the part changes, the whole will also change. This is how HPFs actually emerge: first natural sign operations develop in the natural mind. In the course of further development, sign operations themselves also change. HPFs emerge exactly when these new kinds of sign operations are synthesized with other natural elements of the mind.

We can also be more specific and define, what the essence of the development of sign operations from natural to cultural is. Two Vygotsky's ideas help us further. First, he suggested that the function of signs in HPFs is to mediate the influence of external stimuli on the reactions of the organism. With this mediation, an organism emancipates from the direct influence of the perceptual field on its behaviour (Vygotsky 1983a, 1994; Vygotsky and Luria 1930). In other words, sign operations allow to process perceived information differently from purely perceptual forms of organizing experiences. In this way possibility for choices emerges in perceptually similar environments. We come back to this issue below.

Second, Vygotsky made an interesting statement about the development of sign operations:

> Close study shows that the sign, applied here as a reminder of a certain stimulus, is not yet fully separated from the latter; along with the stimulus it forms a kind of *general syncretic structure embracing both the object and the sign* and as yet does not really serve as *a means of memorizing*. (Vygotsky and Luria 1994, p. 148)

In this quote, Vygotsky refers to studies of mediated memory conducted with children who already develop along the cultural line of development. If we read carefully, we should pay attention to "fully" – the sign … is not yet *fully* … separated from the (perceptual) stimulus. Later, again, we see that indeed sign operations continue to change qualitatively long after they became cultural. The main qualitative leap from natural to cultural sign operations is in my opinion nevertheless suggested in the quote: natural signs are not distinct from the perceptual images they refer to whereas cultural signs are increasingly differentiated from them.

The same idea can be expressed in a (hopefully) simpler way. Every cultural sign (or "symbol"; the term that can be used synonymously with "sign" in this context) is defined by four characteristics (Toomela 1996b). First, a sign must be an object,

behavioural act or phenomenon that can be directly perceived through sensory organs. The reason for that is clear: signs are in the first place used for communication. Communication would be impossible if the signs produced by one would not be sensed by the other participant in the act of communication.

Second, the meaning of the sign must be overlapping among the communicating organisms.[4] Here it is important that signs are artificial objects created by organisms; they are not natural physical or biotic things or phenomena (term "signal" could be used for inborn forms of communication, such as birds' songs or warning behaviors common in many animals). Thus overlap of meaning must be conventional; it must have emerged through learning failures and successes in attempted acts of communication.

Third, signs refer to something else, to some object, event, or phenomenon. Reference is the essence of social communication with signs: artificial objects are created by communicators in order to reach overlapping states of mind in communicated aspects of the world.

Commonly signs or symbols are defined only by the third or by the second and the third characteristic I provided. Forgetting the first, perhaps, does not make much harm in theorizing unless it is asked how signs are actually used in communication. As the sensory organs are the only systems through which we relate mentally with the world surrounding us, the first characteristic can not be ignored when real communication must be understood.[5] If we want to understand HPFs, if we want to understand unique characteristics of the human mind, the fourth characteristic of the cultural signs becomes absolutely necessary. So, fourth, it must be possible to use a sign either in ways or in contexts that are different from the ways or contexts where the referents of signs appear. Further, I add to it now the idea that remained to some degree implicit in my 1996 papers (Toomela 1996a, b): it is possible to use signs differently from their referents because the principles according to which signs are used are different from the principles according to which the signs' referents exist and interact in the world. It will be discussed below, why and how the emergence of the fourth characteristic underlies the emergence of uniquely human mind.

These characteristics help to distinguish natural signs from cultural signs: natural signs are defined by first three characteristics (availability for senses, conventionality

[4] In 1996 I used the term "shared" instead of overlapping. Even though "shared" is commonly used in such context, the word is misleading and does not convey the idea well enough. Sharing – even when referring to using or enjoying together implies dividing at the same time (cf. Barnhart 1988, "share", p. 993). If people share food, for instance, then they enjoy time of eating together but the food they consume is totally different. There would be no understanding of communicative signs, if the meaning would be truly "shared", i.e., divided. Understanding emerges actually, when sign meanings overlap (intramentally) among the communicating organisms.

[5] Very important theoretical consequences follow from understanding that communication is based on sensed artificial objects. These issues remain beyond the scope of this paper. I only mention one idea to understand the importance of this fact. Namely, the fact that all signs and symbols must be available for senses excludes the possibility that signs in the world surrounding us exist independently of an interpreter. Our senses react only to certain aspects of the physical and chemical worlds whereas signs belong to the social-psychological world. The objects we perceive as visual signs, for example, are actually broken into millions of pieces when the contact with light is transformed into a pattern of neural signals. On the basis of the pattern of activation of the receptors and corresponding neural signals, figures must be distinguished from the ground and synthesized into a whole sign again in mind. Signs also do not refer externally; a word "dog" does not directly connect to a real dog in the physical-biotic world. The connection is always and exclusively intramental. So sign – unity of communicative form and its referent – emerges only in the individual-environmental interaction, in psyche. This point may be hard to take. Perhaps it would help to understand it if to think whether there would be signs in the world if there were nobody to interpret them. Sign without meaning, form without (intramental) meaning is not a sign but just another physical object.

and overlap in meaning, and reference to something else). A sign becomes cultural when it acquires the fourth characteristic – it differentiates (not separates!) from its referent. Next we see how natural signs become cultural.

HPFs are Forms of Psychological Cooperation

All HPFs are, according to Vygotsky, forms of psychological cooperation (e.g., Vygotsky and Luria 1994). He also explained, why psychological cooperation is necessary: signs, which enter the structure of HPFs, acquire meaning only when they are generally understood (A.T.: i.e., signs are conventional and their meanings overlapping). Signs generalize; they distinguish from perceptual structures and include into structures of thought – and communication and generalization are internally related one to another (Vygotsky 1982c, pp. 166–167). To pass a meaning of a sign from one person to another, is possible only in activity; this is the reason, why HPFs "emerge initially as forms of social cooperation, which are passed over to the sphere of individual ways of acting" (Vygotsky 1956a, pp. 495–496).

This is perhaps one of the very few (sometimes even only) characteristic of HPFs, taken over by socio-cultural psychologists today. If the other characteristics – especially those just discussed above – are ignored, the meaning of this characteristic changes fundamentally. According to structural-systemic approach, novel structures emerge when different systems are hierarchically synthesized into a higher-order whole. There is no unidirectional cause → effect relationship between parts as causes[6] and effect as a whole. If, however, the systemic nature of HPFs is ignored or denied, what is left over is the theory of linear causality. And the relationship between social world and individual mind becomes treated as linear social = cause → changing individual = effect way. Exactly this happened in so-called activity theory, founded by Leontiev (1981) and followed by many today (see for critique of activity theory from structural-systemic perspective, Toomela 2000a, 2008a).

Another confusing interpretation of the idea that the development of HPFs emerges in psychological cooperation follows from Vygotsky's statement that HPFs are forms of cooperation before becoming individual. If this statement is separated from his theory as a whole, it may turn out that mental functioning may be carried out not only by individuals but also by dyads and larger groups (cf. Wertsch and Tulviste 1992, p. 549). *Mental* functioning is not possible for groups, mental functioning is exceptionally individual. The reason for that was already mentioned above: each and every organism with mind relates mentally with the world only through senses. There is no exception to this principle. Each of the sensory organs is composed, among other components, from tens of thousands (e.g., auditory system) to tens of millions (visual system) receptor cells; every sensed phenomenon of the world, independently of how well it is organized in the world, is first decomposed into tens of thousands if not millions of "pieces" from which sensory attributes (such as colour, contour, depth in vision or frequency, loudness, beginning and end of the stimulus in audition) are constructed. Mental representations that correspond to sensed events in the world are exceptionally constructed from these attributes mentally, by each and every

[6] In psychology today, the concept of cause is understood as if there is only one possible conceptualization of it – the Cartesian linear cause → effect understanding. Actually there are several different theories of causality; structural-systemic theory can also be understood as a theory of causality (see Toomela 2012, for a discussion of different theories of causality in psychology).

individual alone. For example – if one person says "2", the other says "plus", the third says "5" then no "equals 7" emerges in the group as a whole. There can be three individual "equals 7" emerging in this situation, but these results are all constructed individually after each of the individuals has thought alone: "2+5=?"

Thus we need to find another, structural-systemic, answer to the questions how and why HPFs are forms of cooperation before becoming individual. HPFs emerge when natural signs become cultural and synthesized into structure of the mind as a whole. It is important to notice what Vygotsky really discussed, when he analyzed the role of signs and psychological cooperation in the development of HPFs. It was not the content, the meanings of signs themselves in the first place. It was the general characteristics of them, the principles according to which signs acquire their meaning. This we also saw in the beginning of the discussion of this subtopic: according to Vygotsky, signs generalize and this generalization emerges in communication.

It is important to note that signs have two different roles: external or social, and internal or intellectual (Vygotsky 1926, 1934, 1982b; Vygotsky and Luria 1994). I think here is the key as to why signs must be social for grounding the emergence of HPFs (see Toomela 1996a, b, for detailed discussion). What makes social-communicative cultural signs special is the possibility to use them differently from their referents (see the preceding subsection). At the same time, signs are not used randomly but according to principles – these principles are the principles of social communication.

Now we need to stop for a moment to answer the question, why social-communicative nature of signs matters. Any novelty emerges, according to structural-systemic theory, when at least two systems are integrated into a higher-order whole. The same principle applies also to all thinking systems[7] (see Lotman 1978, 1981a for the principle, and for the application of this principle to individual organisms Lotman 1981b and cultures Lotman 1992a, b). Sensory-based thought allows an organism to construct a remarkably complex knowledge about the sensory world. Yet this form of thinking is absolutely limited – there is no way to realize that there is a world not available for senses not mentioning that this world can also be known. Thinking, internal organization of experiences (Vygotsky 1926), is essentially construction of representations, construction of knowledge about the world from sensory attributes. Knowledge is a structure of sensory attributes that corresponds to sensed events in the external world.

Humans obviously are able to explore the world beyond senses – such worlds are built in myths, religions, fairy-tales and other forms of fantasy first and then extended to the knowledge about the oversensory material world in sciences. How do we do that? We need nothing more but two mechanisms of thought where sensed events are organized according to different principles and consequently also with different results. Novelty – the world beyond senses in the first place – emerges in synthesis of these two forms of thought into one mental higher-order structure. We just found what these two mechanisms are – one is sensory based thought where sensory experiences are organized according to the principles of the sensed world and the other is thought based on the use of cultural signs, which are organized according to principles of communication. So with the emergence of cultural signs we become able to reach different conclusions about exactly

[7] Even though this principle as applied to thinking systems I learned from Lotman, to the best of my knowledge, he did not connect this particular principle to the general principles of structural-systemic theory, to the general principle of emergence of any kind of novelty in hierarchical synthesis.

the same sensory experiences. Understanding of the oversensory world emerges when the conflict between two different conclusions about the same event is solved. This is the essence of sign-mediated or semiotically mediated thought.[8]

Let us summarize all said above. Inclusion of cultural signs into the structure of mind causes (structurally) the emergence of a whole with new qualities – it becomes possible to make sense of the world, to think about the same sensory experiences differently. Different results of those different thought processes obviously result in different interpretations of the sensed world. In active search for solving the problem how to reconcile different and occasionally conflicting interpretations of the same sensory experiences ends with increasing understanding of the external and internal world, including the oversensory world, the world not available for our senses. Cultural signs are used according to the principles of social communication, i.e., psychological cooperation, and not according to the principles of the existence of the referents of the signs. These principles of using cultural signs emerge in activity of communication only. This is why and how HPFs are – or actually it is more correct to say, they emerge first – as forms of psychological cooperation. From this perspective, what matters is not the content of communication but the fact that such a communication takes place at all. So HPFs emerge because of psychological cooperation as such whereas the content of this cooperation is related to[9] the content of HPFs, to what aspects of the sensed world and how a person relates to the external world.

[8] I bring one example from the history of science, which in my opinion reflects the functioning of sign-mediated thought. Vitruvius described a story about Archimedes' famous discovery (Vitruvius 1914, Book IX, Introduction, 9–12; pp. 253–254). King Hiero contracted a goldsmith to make a crown from gold. The crown was made and given to the king; the weight of the crown was exactly the same as the weight of the gold given to the goldsmith. But after receiving the crown, doubts emerged whether the crown was really made of gold or perhaps some of the gold was replaced with silver of the same weight. Archimedes was invited to determine whether the crown was made of gold only or not. There was no obvious solution at hand for the problem. Once Archimedes went to take a bath and observed that the more he sank into it, the more water ran out of the tube (εὕρηκα!). Archimedes began to experiment with pieces of silver and gold of the same weight and found that less water runs out from a vessel if the gold was put in it. Then he compared the amount of water running out from the vessel when a piece of gold was sank there and when the crown in question with equal weight was sank. More water spilled over the vessel than was supposed to if it were made of gold. The theft was discovered.

Here we see all important aspects of sign-mediated thought. First, the emergence of doubt: visually and in weight, the crown was sensed as gold. The doubt that the crown could not be made of pure gold, emerged because of using language – the goldsmith was accused to be dishonest. We also observe here how generalization becomes crucial: the situation involved the crown, the dubious honesty of the goldsmith, Archimedes and his bath, vessels with water and pieces of gold and silver of equal weight. All these were generalized into one whole structure of the problem to be solved. Nothing in purely sensory-based experiences would lead to connecting such remotely related experiences into one whole. Further, actions – experiments – were conducted to discover the solution for the problem; these actions were aimed at solving conflict between knowledge obtained directly from senses and knowledge communicated with cultural signs. The solution is called now the Archimedes principle (cf. Archimedes 1897, Bk I). Thus we see here also the *historical* nature of sign meanings, another characteristic of HPFs – once created, the meanings can pass over to the next generations in the history of the human kind.

[9] It is worth mentioning that "is related to" is used deliberately here. The content of psychological cooperation is never determined by the external world alone; all messages (to be more precise, all external forms of signs without content) in communication are interpreted individually after experiencing them through senses and therefore the result of that interpretation can be very different from the intention of the other, who tried to communicate certain ideas. Increasing overlap of understanding one another, overlap in signs meanings, emerges in the very complex process of individual development, or, more correctly, in the process of the development of all individuals involved in the communication. The central thesis adopted by many activity theorists, according to which the social world (or, even more widely, the world of artifacts, cf. Cole 1996) can determine the content of individual minds, is wrong.

The following characteristics of HPFs, with the exception of the last two, in some sense follow from the characteristics discussed so far. In that perspective, these characteristics are secondary, they are consequences of the basic characteristics already discussed.

HPFs are Internalized in the Course of Development

Vygotsky characterized interiorization, or internalization as it is often called today, as follows:

> The process of 'interiorization' of cultural forms of behaviour […] is related to radical changes in the activity of the most important psychological functions, to the *reconstruction of psychological activity on the basis of sign operations*. On the one hand, natural psychological processes as we can see them in animals, actually cease to exist as such, *being incorporated in this system of behaviour, now reconstructed on a cultural – psychological basis so as to form a new entity.* This new entity must by definition include these former elementary functions, which, however, continue to exist in subordinate forms acting now according to new laws characteristic of this whole system. […] *It would be most superficial to suppose that the further reconstruction of the higher psychological process, under the influence of the use of signs, takes place on the basis of the inward transfer of the entire ready-made sign operation*. It would be equally incorrect to think that, in the development of the system of higher psychological processes, we have a simple superimposition of a higher stage over a lower and the simultaneous existence of two relatively independent forms of behaviour – natural and instrumented. Actually, as a result of the 'interiorization' of the cultural operation, we find a qualitatively new combination of systems that sharply distinguishes human psychology from the elementary functions of animal behaviour. (Vygotsky and Luria 1994, pp. 155–156, my emphasis)

Several ideas are clearly expressed in this quote (see also Vygotsky 1983b, 1986, for similar ideas). First, Vygotsky defines internalization in terms of structural-systemic thought – there are elements (natural psychological processes) that are synthesized into a higher-order whole in the process of development. This higher order whole is qualitatively different from the elements. The elements cease to exist *as such*, they continue functioning as parts of the whole. The fundamental difference between natural and cultural or lower and higher psychological processes lies in the incorporation of (cultural) signs in the structure of mind. In the context of this paper and the ideas discussed above, I think we can redefine internalization as I did in 1996 keeping all crucial ideas from Vygotsky and, hopefully, adding a little more understanding of what exactly changes with the emergence of HPFs:

> Internalization is a process whereby two different mechanisms of information processing, non-verbal ('sensory') thinking and conventional language, that have been differentiated from the 'natural' processes in the course of development become united within a new mental structure. The result of internalization is the

> development of semiotically mediated, 'cultural' mental operations. (Toomela 1996a, p. 286)

In some sense, the idea that HPFs are internalized or interiorized, is redundant. We could achieve the concept of internalization just on the basis of ideas formulated above in this paper. Yet I think the concept is useful. With it we can emphasize some very important aspects of the process whereby human individuals change in the process of interaction with the culturally organized environment. For instance, we can understand further reasons as to why ready-made transfer of social-cultural forms of behavior is impossible. The most important – biological – reason is already mentioned above: deconstruction of organized physical-chemical processes in the environment by and according to the laws of sensory organs essentially deconstructs all psychological and social forms of organization of the environment. Thus these aspects must be reconstructed mentally by each and every individual.

But there is another interesting aspect to it. Namely internal reconstruction and external structure of the environment can never be totally overlapping. This fact follows from the general principle of structural synthesis – qualities of the elements change when they are synthesized into a higher-order whole. Thus "the same" element is actually different depending on the kinds of a whole it belongs to. The same applies to communicative signs when they are synthesized into the structure of the individual mind. The components of mind – memory, sensation, planning, thinking, emotions – are different from the components of the social communication, the communicating individuals as wholes. Thus "internalized", i.e., synthesized into the structure of the individual mind sign has different qualities compared to the externalized signs, signs created for communicating certain states of mind. I think Vygotsky would fully agree with that observation as he wrote about interiorization also the following:

> On the other hand, the operation per se of the use of external signs is also radically reconstructed. Formerly a decisively important operation in young children, it is replaced here by essentially different forms. The inwardly instrumented process begins to make use of entirely new connections and methods unlike those that were characteristic of the outward sign operation. (Vygotsky and Luria 1994, p. 155)

Thus signs change when included into the structure of the individual mind. Through internalization, the qualities of the external sign also change and therefore communication with signs acquires novel aspects (see also Valsiner 2006, 2007, on internalization/externalization, where essentially similar idea, even though not explicitly in the structural-systemic framework, is proposed and justified).

Many important consequences follow from understanding the internalization-externalization differences. First, as Valsiner also proposed, it becomes possible to understand mechanisms by which novelty emerges in cultures, and how this novelty, in turn, is constructed by individuals. Every act of interiorization of sign meanings is related to emergence of novelty, every act of externalizing – which means bringing sign into another set of relationships – implies emergence of novelty again. Second, it becomes even more obvious that no message in human communication can be fully understood by the others; meanings always change when messages are interpreted, i.e.,

when they are constructed by communicating individuals. As each and every individual in any human society has experienced unique events, every mind is also unique in certain aspects, even though overlaps universally with (at least some) others in other aspects. Thus overlap of sign meanings is also never absolute.[10]

A further interesting aspect can be deduced from the concept of internalization. Namely, if signs are used both externally, in communication and internally, as components of HPFs, the "same" sign can be at the same time part of an individual mental structure and part of the higher order whole of social relationship. Thus, paradoxically, part – individual cultural sign – carries qualities of the supraindividual whole – culture. Thus the essence of the qualitative leap from natural to cultural psychological functions opens from yet another perspective.

We found, again, that the qualitative leap from natural to cultural processes is in a certain sense content independent – no cultural sign, of course, can be meaningless, but the exact content can vary endlessly. Thus, wherever we discover internalization of a cultural sign – independently of the particular meaning of it – we have found HPF.

HPFs are Products of Historical Development

Vygotsky connected the development of the specifically human forms of mind, HPFs, with the historical development of the human kind:

> Similarly in the area of the human psychological development, from the moment of inventing and using signs that enable humans to command the processes of their own behaviour, history of the development of behaviour to a large degree turns into the history of the development of artificial auxiliary "means of behaviour", into the history of man's command of his own behaviour. […] using of […] signs. The latter appears only in the historical period of the development of the human behaviour and constitutes the main content of the entire history of human cultural development (Vygotsky and Luria 1930, p. 53)

So, according to Vygotsky, signs and their use develops in the historical process of human cultural development. I think very little needs to be added or discussed here. Cultural signs, once created by humans, have continued to develop over the history of culture. So the structure of cultural signs, i.e., the unity of the communicative form and reference, we individually construct today in the process of psychological cooperation, emerged in the cultural history. Simply put – signs have been cumulatively reconstructed in the history of culture. When used individually, all individual experiences that grounded historical cumulative reconstruction of sign meanings, the whole human

[10] Perhaps full book chapter or an article should be written on this question alone. Intuitively my statement may seem to be incorrect. There seem to be messages with totally overlapping meanings. Yet I believe it is not so. Say, for instance, I ask a group of people to add "2+2=?" and everybody in the group would end up with an answer "4". Everything may seem to be overlapping here. But not necessarily. Every of the listeners or readers, in our case, might ask, why I asked to perform this task? Some may ask further, why this task and not some other? We can go further, and think, what "4" means for each of you, who got the result. I am sure, the overlap in answers to these and many other questions about the situation would decrease with every of such questions so that we would end up with unique patterns of answers to these questions.

cultural history, becomes into possession of every single individual who develops the sign. This is how and why through individual reconstruction of the whole human culture, in Lotman's words, "a single human personality is simultaneously part of a collective and the holistic equivalent of it" (Lotman 1992b, p. 18, Note 7).[11]

HPFs are Conscious and Voluntary

Vygotsky characterized HPFs as conscious and voluntary in several works (e.g., Vygotsky 1983c; 1934; Vygotsky and Luria 1994). Both the theory of consciousness and the theory of free will and related to it voluntary action are too complex subjects to discuss in this context. So I bring only the essential.

First some thoughts on consciousness. According to Vygotsky, consciousness emerges with the emergence and use of cultural signs – "not only thought but consciousness as a whole are in their development related to the development of the word" (Vygotsky 1934, p. 318). Not surprisingly, consciousness – as one of the characteristics of the sign-mediated cultural mind – emerges in social communication (e.g., Vygotsky 1960c, 1982a, d). In this context it is important to ask, what consciousness is. Vygotsky defined consciousness in many ways, I bring here the most relevant definitions: "Consciousness is experience of experiences"[12] (Vygotsky 1982d, p. 89); and "Conscious awareness is act of consciousness, which object is the activity of the consciousness itself" (Vygotsky 1934, p. 193).

I have had some troubles with understanding structurally, what consciousness is and how it emerges together with sign-mediation. As far as I can tell, Vygotsky did not really explain consciousness in that perspective. I ended up, first, with a different definition of what consciousness is: *Consciousness is psychic process, which results in organism's experience of its own mind* (Toomela 2015a).[13] It might be worth mentioning that it is absolutely irrelevant whether somebody agrees with this definition or proposes another. We are not defining concepts here; we are defining – theoretically – things and phenomena in the world. Thus the real question is whether such a phenomenon as I defined exists and whether it emerges with the utilization of cultural signs. Indeed, I think the answer to both questions is affirmative (see for elaborated discussion of these issues, again, Toomela 2015a). First – are we able to experience processes in our own minds? Obviously we do. We know that we see, that we feel, even that we think. These and similar experiences I call consciousness.

[11] According to several religious philosophers, (Christian) God not only created the universe but also continues constantly to preserve it; in this sense God constantly recreates the world (see, e.g., Descartes 1985a, b). Now we find that it is humans, who constantly recreate their culture and through this themselves. Just an observation.

[12] I translate Russian "perezhivaniye" here as "experience".

[13] I am not, of course, the first to end up with such a definition. John Locke arrived at a similar definition a little bit earlier than me: "Consciousness is the perception of what passes in a man's own mind" (Locke 1908, p. 220). Nevertheless, Locke also believed that consciousness accompanies any kind of thought, any kind of sensory experience: "When we see, hear, smell, taste, feel, meditate, or will anything, we know that we do so" (*ibid*. p. 466). I disagree with that idea: hearing, etc., is one kind of processes whereas knowing that we do it, is another; the first does not imply the second. In fact, I am not alone with this idea as well. Aristotle provided essentially similar argument far before Locke proposed his view on consciousness (cf. Aristotle 1984c, p. 677, 425^{b})

But, second, how is sign use absolutely necessary for the consciousness to emerge? I think the answer is straightforward, if we adopt structural-systemic theory of causality. HPFs emerge, when cultural signs are synthesized with natural mental functions into a higher order whole. Signs, by definition, refer to something else. Intuitively, it may seem that signs refer directly to objects and phenomena in the world around us. This, however, is impossible; there is no direct sign-external object relationship – reference is conventional and convention can emerge only intramentally. Thus referents of cultural signs are either other signs or images/icons, i.e., systems of sensory attributes that correspond to direct sensory experiences of the external world. In both cases, when we think a sign, we think at the same time something else – and both the sign we think and that "something else", the sign's referent, are components of the same mind as a whole. But this alone is not sufficient for the emergence of consciousness. Every percept contains different sensory attributes and when we think one, we may think another – like when we see an apple we can think its taste without tasting it at the moment. In that case we do not experience our own experiences; we experience the external world. Similarly, some communicative form can be associated externally with its referent, like in ape language taught them by humans. Apes, when they use communicative signs, just think the external world, not their own mind because the communicative form has not differentiated from the referent. With the emergence of *cultural* signs, the necessary differentiation emerges: cultural signs are distinguished from sensory-based thought by different principles, according to which they are used; thus signs are clearly distinguishable from the referents, even though by necessity forming a unitary whole with them. Thus when we think a cultural sign, we experience something else *of our own mind* – we are conscious about the referent. Thus, indeed, the word "is a small world of consciousness", as Vygotsky suggested (Vygotsky 1934, p. 318).

Will is, according to Vygotsky, command over one's own behavioral processes (e.g., Vygotsky 1983a, p. 237). In the context of the ideas discussed so far, it is easy to understand the psychological nature of free will and voluntary action. The voluntary nature of HPFs is another side of consciousness: "To grasp consciously (*osoznat*) – means in a certain sense to command" (Vygotsky 1983c, p. 251), or, in another place: "Self-command (*proizvol'nost*) in the activity of any function is always another side of grasping it consciously" (Vygotsky 1934, p. 189). We command our behavior only as much as we command the stimuli (Vygotsky 1983a; Vygotsky and Luria 1994).

Let us go beyond Vygotsky now. To command stimuli implies, I think, a possibility of choice. Indeed – action becomes voluntary when we have a choice. We saw above that with emergence of cultural signs, we become able to conceptualize differently events identical for senses; we can also conceptualize similarities of very different for senses events. Thus with the use of cultural signs, the possibility for choice emerges. In any situation we can interpret the situation by different mechanisms and together with it discover that the situation becomes open for possibilities: we can decide whether to behave at all or not and if we decide to behave, we can choose different courses of actions depending on the particular interpretation we chose as a basis of our behaviour. This is the essence of voluntary action, which emerges as an essential characteristic of HPFs.

HPFs are Active Forms of Adaptation to the Environment

Vygotsky suggested that specifically human forms of adaptation to the environment are qualitatively different from other animals; human way of adaptation is *active* whereas other animals surrender to the nature passively (e.g., Vygotsky 1960b; Vygotsky and Luria 1930). The active nature of the human mind is reflected in two complementary perspectives. Vygotsky, following Engels' ideas here, mentioned:

> […] in the sphere of the human psychological development. Also here it is possible to say that an animal only uses its own nature whereas a human forces it to serve his own goals and rules over it; that also he owes to work. Process of work requires humans to some degree command over one's own behavior. This command over oneself, in essence, is based on the same principle, as the command over nature. (Vygotsky and Luria 1930, p. 51)

Thus, with the development of sign-mediated mind, humans can adapt actively to their environments by planning differently their activities towards the world *and* by taking control over their own mental processes. These changes characterize not only behavioural phylogenesis but also ontogenesis:

> Two facts seem remarkable in the transformation undergone by practical operations through the inclusion in them of speech. First of all, the practical operations of a child that can speak become much less impulsive and spontaneous than those of the ape that makes a series of uncontrolled attempts to solve the given problem. Due to speech, the child's activity is divided into two consecutive parts: the first consists of the solution of the problem in the field of speech, achieved through speech-planning, while the second is the simple motor realization of the prepared solution. […] on the other hand – and this is of decisive importance – among the different objects open to the child's transformation, speech introduces *the child's own behaviour*. Words directed toward the solution of the problem pertain not only to objects belonging to the external world, but also to the child's own behaviour, to its actions and intentions. (Vygotsky and Luria 1994, pp. 110–111, emphasis in original)

Here, again, we need to leave Vygotsky behind and make a step further. Otherwise we would be open for two misunderstandings about the sign-related changes in the ways humans adapt to their environments. First, it is important to realize that all living organisms are active; what changes with the emergence of HPFs is the nature of active adaptation. And second, Vygotsky seems to suggest that there is a gradual – quantitative – change from animal to human mind and corresponding behaviour. Even if some developmental changes may seem quantitative, all changes in the mind related to the emergence and development of HPFs are qualitative. Next I will discuss each of these questions in a little more details.

In order to understand how human active adaptation to its environment might be different from that of other animals, we need to define, what life is, or, what it means to be alive. Shortly, following and elaborating Anokhin's ideas (cf. Anokhin 1978;

Konstantinov et al. 1978; see also Toomela 2010a), I think *Life is a form of organization of matter that is able on the basis of the anticipatory reflection of the reality to prevent the destructive effects of the environment by purposefully changing either itself or its environment and thereby preserve its holistic qualities* (Toomela 2015a). This formal and abstract definition can be translated into humanese. Thus, first, life is a form of organization – it characterizes certain forms of matter. Second, these living forms of matter preserve their holistic qualities even when their environment changes beyond tolerable level at any given moment. How it is possible to survive when environment changes too much, over limit? There are, third, two possibilities – living organisms change themselves (we sweat in sauna, for instance) or they change their environment (we use clothes, build houses, etc.). As a rule, when the environment changes over limit, then it is too late to change anything. Living bodies must act before the environment changes – this is done on the basis of what Anokhin called anticipatory reflection of the reality. Each and every living organism is, thus, able to "foresee" (some) future changes of the environment (see Toomela 2010a for discussion of this issue).

In sum, all living organisms are able to act purposefully and actively change either their environment or themselves before their environment changes. Thus, in that sense, no living organism is passive. Rather, there are qualitative differences in how exactly the active adaptation is achieved. This subject is too complex to be discussed in full details here. So just one thought – I think what distinguishes human and nonhuman ways of adaptation most is what was also suggested by Vygotsky – only humans work (cf. Vygotsky and Luria 1930, p. 52). And what makes work different from other forms of purposeful acting is the content of planning. In "just" acting, the aim of the actions, the satisfaction of a need, is guiding the actions. So the content of the thought and planning that underlies actions is fully covered by trying to figure out how to change the environment, in which way to affect it. In the process of work, however, an important aspect is added to thinking and planning – these processes include now thoughts about *how* one's own body (and, in more advanced stages of the HPF development, own mind as well) should act. Thus, in the world of lower psychological processes, the focus is on how *things* should be done; with the emergence of HPFs, another question is added – how *I* should do those things.

Another possible misconception should also be avoided. Vygotsky mentioned that with the emergence of the HPFs, children become *less* impulsive and spontaneous, animals make *more* uncontrolled attempts to solve a problem. In a certain sense perhaps differences related to the emergence of the HPFs can be reflected in quantitative terms indeed. Yet the underlying mental changes are qualitative; the sign either is or is not included into the mental structure. Therefore quantitative description of developmental changes can only be superficial and therefore useless if the aim is to understand what and how is changing. I think all such changes in external behaviour are essentially qualitative. In the course of development of the HPFs, certain qualities of the environment as well as certain qualities of one's own acts and thoughts are not taken into account whereas others are added into sensemaking of the world and planning of behaviour. Thus behavior becomes "more" organized, "less" spontaneous because it is based on qualitatively different thoughts and plans.

HPFs are Dynamically Changing in Development

So far it may seem that there are only two steps in the development of mind – sensory-based thought becomes sign-mediated. Vygotsky made it clear that the whole process is much more complex:

> However, that structure [of cultural psychological operations] does not remain unchanged. That is the most important point of all we know concerning the cultural development of the child. […] A new method of behaviour does not simply remain fixed as a certain external habit. It has its internal history. It is included in the general process of the development of a child's behaviour, and we therefore have a right to talk of a genetic relation between certain structures of cultural reasoning and behaviour, and of the development of the methods of behaviour. This development is certainly of a special kind, is radically different from the organic development and has its own definite laws. (Vygotsky 1994, p. 62)

Vygotsky put a lot of effort in understanding better the processes of development. He was well aware that both lower and higher psychological functions develop. Even more, he could distinguish three stages of development in each of them (cf. Vygotsky 1934, 1935a, b, 1984a; Vygotsky and Luria 1930). The development of lower psychological processes he discussed mostly in animals; in their evolution he distinguished three general stages: inborn reactions, conditioned reflexes, and intellect. In humans, both in their historical development and in ontogenesis, he distinguished three stages of word meaning development (syncrets, everyday concepts, and scientific concepts), which correspond to the general developmental stages of HPFs. Several of his studies also went beyond general stages and demonstrated important qualitative changes within those stages as well.

Vygotsky's theory of developmental stages remained unfinished; he did not discuss in details the structural characteristics of each of the stages, he did not demonstrate how all distinguished stages are related one to another (and thus there was no theory to explain why these stages must develop in a certain order). Several other questions about development remained without answer as well. At the moment, it seems, more stages of HPFs can be distinguished and the structural relations of all of them can be understood as well (cf. Toomela 2000b, 2003b, c). Yet one Vygotsky's principle of utmost importance comes forward in more advanced theory as well – development of word meaning and corresponding development of HPFs follows principles that are different from the development of lower psychological functions indeed. We have discussed the main differences already – the development of HPFs is historical and consists internalization of sign meanings in psychological co-operation.

Ontogeny of HPFs Recapitulates Cultural History

As it was just described, the historical and ontogenetic lines of development of HPFs were, according to Vygotsky, parallel. Today it seems to be generally accepted that

there is no such recapitulation in mental development.[14] Yet, I think there are several reasons to connect cultural history with cultural ontogenesis. Before providing these reasons, let us see one quote from Ernst Haeckel, who observed parallels in biotic lines of development[15]:

> These two branches of our science—on the one side ontogeny or embryology, and on the other phylogeny, or the science of race-evolution—are most vitally connected. *The one cannot be understood without the other*. It is only when the two branches fully co-operate and supplement each other that "Biogeny" (or the science of genesis of life in the widest sense) attains the rank of a philosophic science. *The connection between them is not external and superficial, but profound, intrinsic, and causal.* This is a discovery made by recent research, and it is most clearly and correctly expressed in the comprehensive law […]: "The history of the foetus is a recapitulation of the history of the race" (Haeckel 1905a, pp. 4–5, my emphasis)

So, Haeckel, who posited parallels between ontogenesis and phylogenesis, suggested that the developmental parallels he was discussing are not superficial but intrinsic and causal. Therefore, indeed, one cannot be understood without the other. We may still think that such recapitulation characterizes only biotic line of development; no such intrinsic parallels can be found in mental genesis. However, Haeckel made a very important for our purposes observation:

> We started from the simplest facts of ontogeny […] The first and most important of these facts is that every man, like every other animal, begins his existence as a simple cell. (Haeckel 1905b, p. 859)

Indeed, if the beginning of developmental lines is the same, certain parallels must emerge by necessity. If in the beginning of life – be it beginning of a species or an individual – is a single cell, then the next developmental step can be some simple multicellular organism composed of a few cells. Differentiation of organs can only follow the emergence of a simple multicellular whole.

[14] In fact, there is almost no developmental psychology as well. Mental development, according to structural-systemic view, is hierarchical reorganization of mental structures. If a mental structure is hierarchically reorganized, the way how mind operates becomes different as well. True mental development is reflected in two parallel changes. On the one hand, qualitatively novel ideas can be understood, qualitatively novel problems and tasks can be solved, qualitatively novel goals can be achieved through behavior. On the other hand, externally similar things, ideas, problems, etc. become internally different. The same tasks, for instance, will be solved by different psychic operations. More generally, the kinds of relationships of units of thought change in the course of psychic development. So-called developmental psychology today with extremely rare exceptions is aimed at describing what humans can do at different ages and not how, by which psychic processes external behavior is organized. No wonder the idea of recapitulation disappeared from "developmental" psychology – because what is recapitulated is not necessarily *what* is done by humans at different stages of their development but *how*.

[15] It is worth mentioning that Haeckel did not think that ontogenesis recapitulates phylogenesis exactly. On the contrary, he made a clear distinction between what he called *paligenetic* processes, i.e., ontogenetic recapitulations, and *cenogenetic* processes, i.e., embryonic variations (cf. Haeckel 1905a, Chapter I, esp. p. 8). Thus finding unparalleled changes in two lines of development is obviously no reason to reject the idea of recapitulation.

This principle alone is in my opinion sufficient to look for recapitulation in the genesis of mind. As I have mentioned before (Toomela 2003c, p. 201; see also Toomela 2003a), both phylogenesis and ontogenesis of the mind begin from the structurally identical state, an ability to respond to individual sensory attributes. Thus there is already sufficient reason to look for recapitulation in mental genesis. But there are actually more reasons. Second, not only the initial state is the same but also the basic mechanism of development – mental representations, constructed from those sensory attributes, develop on the basis of active interaction of an organism with its environment. And third, all phylogenetic changes, both in biotic and psychic lines of genesis, are realized exceptionally through individual organisms. In other words, in order to pass over some structural properties of organisms to next generations, those organisms themselves have to change first. This principle applies both to organic and to cultural evolution. In the latter case all cultural novelty has been introduced by single individuals. Here we see, how phylogenesis and history indeed cannot be understood without understanding ontogenesis and vice versa. All phylogenetic-historical changes result from changes of single individuals first and therefore genesis of individuals must be necessarily understood. At the same time, structural properties of individuals, both of their organisms and of their neural networks of individual memories that change in the psychic interaction with the environment, reflect biotic and psychic history of them. Without knowing phylogenesis and history, we cannot understand all aspects of individual structures also. Thus denial of the principle of recapitulation is not a secondary issue – with the denial of it neither individual nor the species can be understood in principle.

Final Thoughts on HPFs

I began this article with two questions – whether there is a reason to suggest that HPFs exist and what, theoretically, characterizes HPFs. As the answer to the second question logically precedes the answer to the first – we cannot decide whether something exists before defining what that something should be – I discussed in details the main characteristics of HPFs. In this final part of the article I look shortly for an answer to the first question and then summarize more important ideas from the discussion of the second.

On the Reality of HPFs

Mainstream psychology[16] today has arrived at the verdict regarding the existence of HPFs in Vygotskian sense – they do not exist. Even though there might be a couple of (mostly, if not only, nonmainstream) scholars, who disagree, the way how psychology students are taught, reflects the situation best. We learn, for example, from one very popular psychology textbook:

[16] "Mainstream psychology is an approach to the science of mind accepted by majority of psychologists and defined by ontological and epistemological qualities questioned by representatives of non-mainstream psychology." (see *Mainstream Psychology* in Toomela 2014a, for the definition and discussion of it)

> The use of language influences us and guides us, and surely this is no surprise: This is one of the essential functions of communication. But this is quite different from Whorf's suggestion that language acts as a kind of mental straitjacket limiting how we can think or what we can think. The bulk of the evidence seems to point the other way: Language is a bright, transparent medium through which thoughts flow, relatively undistorted, from one mind to another. (Gleitman et al. 2011, p. 421)

The central defining characteristic of HPFs is the fact that they are sign mediated, i.e., a communicative sign is included in the structure of the mind as a whole. Thus, according to that theory, internal, psychic use of language grounds fundamental reorganization of mind and allows humans to think thoughts not available for any other known animal. This psychology textbook teaches us the opposite – language is a nice human invention useful for communication but otherwise quite unimportant.

I am not going to discuss in details, where and how the mainstream psychology has gone wrong with denial of the central role of language in the emergence of specifically human forms of mentality. There are too many fundamental epistemological, ontological, and methodological flaws in it (cf. Toomela 2007a, b, 2008b, c, 2009, 2010b, c, d, 2011, 2012, 2014a, b, c; Toomela and Valsiner 2010) to take any such theoretical statement without doubt. So I mention only three obvious shortcomings of studies on the basis of which denial of the role of language has been reached.

First, there is no way to determine the role of anything – including language – if the studies are conducted only when the phenomenon or thing in question is present. Studies must be taken into account where organisms (be it young children or members of other species) with no language are compared to humans with language.

Second, the conclusion in question is based on irrelevant arguments. For instance, in support for the idea that language use is not related to qualitative changes in mind, it is said that "infants who know no language seem [sic!] able to think relatively complex thoughts"; "some [sic!] of our adult thought takes the form of nonlinguistic mental images"; and some wasps and birds "are able to find their way from place to place across great distances without the benefit of words like *north* and *left*" (Gleitman et al. 2011, p. 421). Many similar arguments can be found in the literature – and all of them are not connected to the question, because thought obviously exists without language and many forms of organized behaviour are even not based on thought but on biologically grounded inherited properties of the structures of organisms. If *some* thoughts are image-based, then there is no logical way to conclude that therefore *all* thought is image-based as well.

Finally, truly relevant studies are extremely rare; the scholars ask, what problems or tasks are solved but not how the solutions have been achieved, by which mechanisms. There is no question in mainstream psychology, what are the units of thought that underlie organization of the behaviour and how these units are organized and reorganized in acts of thought. So a bird finding a way to another continent and a child becoming surprised when observing unexpected events, become identical (perhaps one being only quantitatively "smaller" than the other) in mind to those, who are able to do things absolutely not attainable by other but humans with advanced language. Can a bird fly to the Moon? Should we think that humans who have done it were supported by essentially the same forms of thought as the birds? Can young

infants know that stars in the sky are bigger than Earth? Should we think that astronomers, who *discovered* this fact, rely on the same form of thought as infants who understand that big things do not fit into small containers? And why this discovery has been so hard to make, if all we need is just to look to the sky and make conclusions in the image-based thought?

I think certain forms of knowledge about the world are not possible without language. I just mention two realms of thought that, in my opinion, are impossible without sign-mediation, without HPFs. First is all our knowledge about the oversensory world, the world that is not available for our senses. I think it is not trivial to realize that *all* our theories about such world – with no exception – are formulated in communicative cultural signs with all four characteristics I provided above (most important among them being the possibility to use the sign differently from its referent). Language is not only for reflecting, language use is essential for realizing that identical for senses world can be different in oversensory aspects and vice versa. Without such a possibility, we would not even be able to discover that oversensory world might exist.

Second, we learned that HPFs are conscious. And that consciousness can be structural-systemically explained as a result of the emergence of the sign-mediated thought. Nonhuman animals never report what they *feel*, whether they *remember*, what they *think*, etc. Today the consensus seems to be that they do not do it because they do not have tools for communicating the states of their minds. Yet there is also no conclusive evidence that they experience their mental states as such. There is actually no need to communicate the state of mind in order to reveal whether it has been experienced by an organism or not. Sufficient and conclusive would be observation of situations where animals without language take command over their mental states – they control their emotions (through meditation or psychotherapy, for instance), they use techniques to enhance remembering of facts independently of the content, they distinguish forms of thought operations and can chose to rely on better ones (such as logical thought). I think organisms who do not report their mental states – and who also, without any known to me exception, cannot take command over them – have these limitations for the simple reason that they are not conscious, they cannot experience their own mind as distinguished from experiencing the external world.

On the Necessary Characteristics of the HPFs

Vygotsky described 11 characteristics of HPFs, if not more. Now the question is, whether his early definition should be revised by removing and/or adding characteristics. As you see, I already do not ask whether HPFs exist; the evidence for the existence of special forms of organization of the human mind is strong enough to support the idea. Thus the question is, how to characterize HPFs. Can we keep Vygotsky's defining characteristics? Partly I have already answered that question as well; the answer is – no, we cannot proceed by relying on him alone. In my discussion above, Vygotsky's ideas have been modified, clarified, elaborated and developed. In the first place, Vygotsky did not list the characteristics of HPFs, as I did; these needed to be picked from his different works. Thus there was also no discussion whether each of the characteristics is individually necessary, whether it adds to understanding the whole of HPFs. Next I also modified and extended Vygotsky's ideas. For instance, he did not provide the defining characteristics of signs, he did not explain why HPFs must be social, he did not explain

how consciousness and voluntary activity emerge on the basis of HPFs – even his definitions of consciousness were confusing, and finally he did not explain why ontogeny of HPFs must recapitulate history of them.

Now, from another perspective, I think there are all reasons to keep all the 11 characteristics of HPFs, discussed first by Vygotsky. I am not going into details any more and provide just some general thoughts how each of the characteristics is necessary. First, the systemic nature of HPFs is the ground that allows to distinguish characteristics of parts from the characteristics of the emerging whole and get a coherent understanding of what HPFs are and what follows from their emergence. Second, the fact that HPFs develop from natural processes helps us to realize how cultural organization of the environment is necessary and yet insufficient for the development of HPFs – without natural processes there would be no individual cultural development. Thus we are also pushed to create a theory of development where the nature of natural processes is explicitly taken into account. Third, sign-mediated nature of HPFs obtains another meaning when we put it explicitly into structural-systemic theory and also look for natural roots of signs and sign-mediated thought. Definition of signs with four complementary characteristics grounds also understanding how and why the structure of psyche changes with the emergence of the HPFs. We would not be able to understand why signs can be used differently from their referents unless we take into account the fourth characteristic of HPFs – they are forms of psychological cooperation. Fifth, the internalized nature of HPFs is necessary to understand how exactly culturally organized environment is related to the development of individual cultural mind – there is no unidirectional flow from "out" to "in" but rather structural reorganization of the individual in the process of his or her active sense-making of the environment. Sixth, the historical nature of meanings of signs is necessary to understand how cultural and individual innovations of cultural meanings are related one to another. From yet another perspective, seventh and eight, the conscious and voluntary nature of HPFs reveals the qualitative changes of the individual mind that take place with the emergence of HPFs. We realize that consciousness and voluntary action does not follow from HPFs but rather reflects the nature of them. This, in turn – and ninth – helps us understand how changes in individual psychic organization are related to qualitative changes in the ways the individual is related to his/her environment. Only humans can harmonize their relationship with their environment by taking command over their own bodily and mental functioning. Tenth, from the fact that HPFs develop along the hierarchy of structural changes in sign meaning we discover the whole complexity of the problems we have if we want to understand human mind. This characteristic alone would be sufficient to keep consistently in mind that without knowing *how* exactly thought is organized we cannot understand the human behaviour. We learn that externally similar behaviours can emerge on the basis of internally different psychic structures and vice versa. Thus by knowing only what humans do, we will never achieve understanding of the human psyche. And finally, we found a strong requirement for the theory of HPFs – if the theory is not able to fit into a coherent whole the cultural-historical and individual lines of development, the theory has failed.

Here I would like to add a final thought. As I also mentioned above, while discussing the characteristics of HPFs, some of them are secondary, they follow logically from others. At the moment, I think, we should keep in mind all the 11

realizing at the same time that some of them should be taken more as reminders or ideas of heuristic value whereas others are necessary for the definition of the HPFs. Tentatively, I would say that the first four are individually necessary – and collectively sufficient. In addition, recognition of the developing nature of HPFs – the theory of stages of development and the principle of recapitulation – should be added as empirical facts. These developmental stages cannot be deduced from the first four characteristics but need to be discovered through studies of HPFs, through truly psychological studies, the studies that answer the question how external behaviour has been psychically created. The rest of the characteristics follows from the first four.

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