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Л. С. ВЫГОТСКИЙ: ПУТЕШЕСТВИЕ НА ЗАПАД

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Аннотация. Л. С. Выготский оказал влияние не только на специалистов по психологии развития во всем мире, но и на исследователей из других областей науки, включая философов и когнитивных ученых. Его путешествие на Запад оказалось немного осложнено лингвистическими, методологическими и идеологическими проблемами. Западные специалисты по Выготскому отмечают неточности в английских переводах, вызванные как некомпетентностью переводчиков, так и ошибками советских изданий. Кроме того, большинство комментаторов сосредоточиваются на его теоретическом наследии, в значительной степени опуская солидный корпус его экспериментальных работ. И, наконец, западные читатели, привыкшие к академическим свободам, с трудом понимают места в тексте, в которых академический язык смешивается с идеологическим новоязом, обычно навязываемым исследователям недальновидными диктатурами. В этой статье основное внимание уделяется присутствию Выготского в западной и мировой когнитивной науке. Я надеюсь показать, что, хотя реакция первоначальных адептов символической когнитивной парадигмы не могла не быть отчужденной, более поздние разработки в этой

области, такие как коннекционизм, энактивистские подходы и предиктивные теории, сформировали более благоприятное русло для этого притока. Давняя критика Выготского Джерри Фодором, хотя подчас слишком спорная, раскрывает пару реальных проблем в привычной концепции ментального. Исследователи, которых часто называют неовыготскианцами, применяют методологические идеи мыслителя к практическим задачам обучения математике или языкам. «Радикальные» коннекционисты находят новые и интересные аспекты в доктрине интериоризации, в то время как теория обучения посредством практического взаимодействия становится мостом между энактивистами и теоретиками предиктивной обработки. В статье сформулированы два предложения, которые могут помочь в дальнейшем освоении наследия Выготского современными когнитивными школами. Во-первых, предлагается четко различать собственно теорию и онтологию. Это различие, более или менее очевидное в математизированном естествознании, обычно совершенно непрозрачно в качественных теориях, таких как теория Выготского. Между тем, оно могло бы помочь отфильтровать утверждения и гипотезы, которые могут быть операционализированы и проверены на основе экспериментов и вычислительных моделей. Второе предложение представляет собой онтологическую схему вложенных сетей, церебральных и социальных, понимаемых как метасеть, в которой осуществляются распределенные статистические вычисления. Этот взгляд может еще больше прояснить природу и функции человеческого языка.

Ключевые слова: Выготский, язык, мышление, интериоризация, обучение, когнитивная наука, коннекционизм, предиктивная обработка

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Memory of Culture

L. S. VYGOTSKY: JOURNEY TO THE WEST

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 **Abstract.** L. S. Vygotsky has influenced not only developmental psychologists all over the world, but also academicians from other research areas including, but not limited to, philosophers and cognitive scientists. His Western journey is a little hardened with linguistic, methodological, and ideological issues. Vygotsky scholars point out inaccuracies in English translations caused by both lack of competency in translators and fallacies in Soviet editions. Besides, most commenters focus on his theoretical heritage largely omitting the solid corpus of his experimental work. And, lastly, Western readers accustomed to academic liberties struggle to understand pieces where academic language is mixed with the ideological newspeak typically imposed on researchers by purblind dictatorships. This paper focus mainly on Vygotsky's presence in Western and global cognitive science. I hope to show that, while reaction of the initial symbolic cognitive paradigm adepts couldn't be but with a grain of alienation, later developments in the field, such as connectionism, enactive approaches, and predictive theories, have made up a more favorable riverbed for this inflow. Jerry Fodor's critique of Vygotsky from long ago although sometimes too contentious reveal a couple of real issues in the conventional conception of the mental. Scholars often referred to as neo-Vygotskians apply the thinker's methodological ideas to practical tasks of teaching mathematics or languages. "Radical" connectionists find new and interesting aspects in the doctrine of internalization, while the theory of learning through practical interaction becomes a bridge between enactivists and Predictive Processing theorists. Two proposals are put forward here that may help with further appropriation of Vygotsky's heritage by the present-day cognitive schools. First, one is advised to clearly distinguish a theory proper and an ontology. This distinction while more or less evident in mathematized natural science is usually quite opaque in qualitative theories like the one of Vygotsky. Meanwhile, it could help distill statements and hypotheses that may be operationalized and tested against experiments and computational models. The second proposal is an ontological scheme of nested networks, cerebral and social ones, understood as a meta-network accommodating distributed statistical computations. This view may further clarify the nature and functions of human language.

 **Keywords:** Vygotsky, language, thought, internalization, learning, cognitive science, connectionism, predictive processing

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"Nothing in the world is difficult,"
said the Patriarch;
"only the mind makes it so."
Journey to the West,
attributed to Wu Cheng'en

L. S. Vygotsky is a famous Soviet psychologist, who started as an art observer in the 1910s and shone as a prominent scientific school founder in 1930s. In the West, his name may compete in fame with another Russian thinker — Mikhail Bakhtin, the philologist — with some theoretical resemblances between the two. I hope it won't be a great stretch to say that both argued for dialogue as the proper form of the human thought — one while speculating out of literature and humanities, the other basing on empirical study of child development. Out of all the diverse heritage of the Russian/Soviet psychologist, the international academic community seems to have mastered two principal concepts: that of internalization and "zone of proximal development" (*ZPD*) — both heavily based on the "dialogue" idioms and strategies. In the first case, a child is supposed to firstly talk to someone and then to oneself to subsequently have the speech reduced to just predicates and, in the end, to transfer it completely into the interior to form what we refer to as "thought". The second concept represents an observable distance between a child competence on its own and its capability to finalize a task with the help of an adult trainer. This distance is bridged through the educating dialogue of both. The concept and the strategy based on it are widely used in educational psychology and philosophy of education. The most fundamental Vygotsky's introduction to the international audience has been the 1962's "Thought and Language" that impressed professionals and survived numerous reissues since the first edition [Vygotsky, 1986].

Nevertheless, some voices are heard saying that there are faults in the reception of Vygotsky by the anglophone international community. As is stated in [Veer van der & Yasnitsky, 2011], the works by Vygotsky translated into English, although numerous and comprehensive, may not be considered in any way exhaustive and accurate in all the details.

One of the main reasons for this are numerous inaccuracies in Soviet/Russian editions of his works, on which the principal English translations are based [Veer van der and Yasnitsky, 2011, p. 479]. Another one, as expected, is due to inaccuracies of the translations themselves. But there are also some biases in reception of Vygotsky's scientific contribution: thus, as is stated, commenters usually focus on Vygotsky the thinker while largely omitting the corpus of his experimental work. The latter might have, among all, bring his legacy closer to the modern scientific practice [Veer van der & Yasnitsky, 2011, p. 487].

A considerable difficulty for Western readers is also caused by the fact that "discursive practices of Soviet scientists were largely shaped by the need to merge scientific discourse with propagandist newspeak in pursuit of the support from the Bolshevik leaders of the state and the patrons of science" [Veer van der and Yasnitsky, 2011, p. 488], which makes their texts even less comprehensible for readers accustomed to the long-established academic independence.

With all this blur and bias, the English-language literature on Vygotsky is immense and monographs have been written on the subject [Daniels, Cole and Wertsch, 2007]. In my modest attempt, I would like to constrain the perspective with boundaries of widely conceived cognitive science of today, which is supposed by many to be ideologically hostile to the cultural-historical school, Vygotsky included, and all the approaches of the same vein. I see the situation a little more complex, since cognitive science has evolved from the first frontal attack with the notorious "computer metaphor" and the symbolic paradigm of the late 1950s, through connectionism of 1980–1990s, to which we owe present-day spectacular artificial neural networks, to the latest fashions of Bayesian, predictive, embodied-enactive-extended, and other "minds". No less important are recent AI achievements in the field of genetic and evolutionary algorithms, as well as agent-based models. Some of these novelties seem to allow for such seemingly archival doctrines as that of Vygotsky to be adapted and successfully translated into the language of calculi, algorithms, and models. The importance of this perspective relates to such huge philosophical theme as the nature of scientific explanation, on which I will briefly touch further.

A case of Fodor vs. Vygotsky

As long ago as in 1972, Jerry Fodor, the classic of the primordial symbolist language-informed cognitive science, paid attention to Vygotsky's "Thought and Language" to clarify his stance with developmental alternatives in psychology. That is why he has "chosen to treat it as a contemporary text rather than a period piece, both because many of Vygotsky's notions are still widespread in psychology, and because they seem to me intrinsically worth a run for their money" [Fodor, 1972, p. 83]. I would like to treat this old Fodor's text the same way, as ignoring the temporal distance and the evolution his views may have come through so far, for theories and conjectures may change, but the most fundamental assumptions, in Paul Simon's words, are "woven indelibly into our hearts and our brains".

Wittily, Fodor notices that psychologists "have not been able to stop doing philosophy, for no one can think seriously about mentation without eventually dealing with the sorts of issues that presented themselves to Locke, Hume, Berkeley, and Kant. But they have often managed to stop noticing when they are doing philosophy,

and from not doing it consciously, it is a short step to not doing it well" [Fodor, 1972, p. 84]. And he takes Vygotsky's works as an illustration thereof.

Fodor observes that "at every move Vygotsky's hand was forced by largely a priori assumptions about the nature of concepts; assumptions whose influence is evident both in the decisions Vygotsky makes about what experiments are worth running and in the conclusions he accepts on the basis of his experimental results" [Fodor, 1972, p. 84]. Besides, he confronts Vygotsky's inclination of equaling thought to problem solving and language to speech. At the very beginning of the discussion, Fodor proposes the principles of his own approach: (1) the known fact of intermodal perceptual interaction within cognition invokes the "mandatory" explanation positing the existence of a central processing language, rich enough to integrate all the multimodal perceptions, and (2) the natural language is one of the modal channels enjoying access to that internal computation. Holding these, as he believes, spares one from the obtrusive problem of thought and language, as well as from extra-scientific *ad hoc* hypotheses, such as Vygotsky's speculation on human speech as derivative from ape vocalizing. "If this is so," he continues, "then the production and comprehension of speech involve translating between this central code and a natural language" [Fodor, 1972, p. 85]. He likens this interaction of central code and natural languages in humans to the interaction of a machine code and programming languages in computers. Immediately, one could ask, why there is no convincing evidence of backward translation from this central code to perceptual modes if the natural language is just a mode alike, and speaking it, in Fodor's scheme, can't be but presented as a kind of backward translation from the innate cerebral code into the acquired skill of vibrating air with tongues, lips, and throats. Or are hallucinations such evidence? At least, at this point Fodor's conjectures seem no less speculative than those of Vygotsky.

A telling detail in his exchange of principles with Vygotsky is a footnote, in which he recalls Wittgenstein's remark on Augustine's "word-by-word" concept of language acquisition: as if a child already has a language, only not this one, Wittgenstein ironizes. Fodor rebuts: "Wittgenstein seems to suppose that the absurdity of that sort of view is self-evident. I have been arguing, on the contrary, that the Augustinian account is likely to be *precisely correct*" [Fodor, 1972, p. 86]. I should notice that Fodor is known, among other things, for his defense of productivity of human language against the associationist approach of connectionism [Fodor & Pylyshyn, 1988]. But how can a machine code, if it is taken for the ultimate solution for the problem of cognition, be itself productive? Meaning not *allow for* productiveness but *secure* it. And, moreover, if the objective of a child's linguistic development is to design a "compiler" [Fodor, 1972, p. 86] for translation of speech phrases into strings of the internal code and back, why does this development take decades instead of hours?

Naturally, the developmental issues get a special notice in the paper. Fodor strongly opposes Vygotsky's understanding of semantic differences in children and adults that boils down to the statement that these are differences in meanings but not in references. He objects that, according to Frege, a synthetic identity may be stated only intensionally, *i. e.* with meanings, not references, of the terms. If true, this entails, Fodor says, that Vygotsky's claim implies that children and adults speak different languages. Moreover, in this case you can't even tell a child that witches fly on broomsticks, because the reference of the term "witch" is a null set [Fodor, 1972, pp. 86–87]. Of course, one could have backlashed that this argument doesn't consider what Brentano called "intentional nonexistence", but that doesn't mean that we should not acknowledge a certain inaccuracy of Vygotsky's reasonings.

As before, the problem is that, to these unreliable conjectures, Fodor juxtaposes ones of his own that appear to be no less vulnerable. He resorts to the supposition that "adult concepts form a rich and elaborately interconnected network, of which the child's developing conceptual system is at best a sketch" [Fodor, 1972, p. 87]. And that is why a child misses those "resonances and ironies" available to an adult. I, myself, am sometimes countered with similar objections: language is not a series but a network. I am very curious to know where the Platonic kingdom exists that is home thereto. Because this view imposes a picture, in which we in fact pull threads of this mysterious web while speaking, making it resonate and ironize to our pleasure. Isn't it more plausible that all those semantic networks are no more than tools for methodological representation, or ontological schematization (more on which later), designed to interpret and visualize patterns and regularities in the serial flow of words? An adult who masters language may be likened to a die-hard football fan who has a whole "network" of meanings, reminiscences, and reactions opening before him as he watches a match on TV, while an uninitiated one passing by notices nothing but a mess of flashes and noises. To really join, the latter must watch the chaos day to day and talk to the more experienced. This is precisely what happens to any neural network being trained, be it natural or artificial. And the only networks relevant here are itself and the likes with all their weighed connections.

Fodor unexpectedly sums up this part of discussion by saying that "like most philosophical Empiricists, Vygotsky thinks that concepts are severally related to experience by necessary and sufficient conditions for their application" [Fodor, 1972, p. 87]. Thereby, Fodor claiming to do philosophy "good", unlike numerous psychologists, labels as an empiricist the author whose hand, in Fodor's own terms, is "forced by largely a priori assumptions about the nature of concepts" (see the reference above). I hope not to be mistaken in believing that empiricists are those who restrain their own studies to experience, but not only cognition of those under their examination.

Of course, being a Continental thinker with the Russian encumbrance, Vygotsky can in no way be considered an empiricist as he enjoys the mixture of Hegel and Marx in his methodological background. Looking back, this particular circumstance seems to be his most principal vulnerability, not his misperceived empiricism.

Then, Fodor attacks Vygotsky's theory as being "motivated almost entirely by his failure to find in children conceptual capacities which he assumes, on strictly a priori grounds (being an "Empiricist". — *I. M.*), are paradigmatic of the mentation of adults" [Fodor, 1972, p. 88]. But it should be acknowledged that, in his critique of Vygotsky's theory of conceptual development, Fodor hits the target. First, he offers a long quotation from *Conceptual Thinking in Schizophrenia* where an experiment is described tracing formation of some artificial nonexistent concepts with subjects during supervised sequential categorization of objects. The scenario is quite inventive but based on the empiricist (now it's true!) tradition of binding conceptualizing to the abstraction of observed properties. Rather fairly, Fodor draws our attention to the cases with concepts inexplicable in that vein, such as "tableware". Given Vygotsky's scheme of the hierarchy of abstractions where each higher abstraction is a function of lower ones, "you will hardly say that this defining property (being used for eating) is less abstractly related to sensory data than the defined concept (tableware)" [Fodor, 1972, p. 90]. That is, any such pragmatic criteria are themselves results of higher-level abstraction and thus can't be a ground thereof.

One more disproval is aimed at the technique of abstraction used in the experiment and presenting, in Fodor's belief, the essence of Vygotsky's treatment of conceptualization through abstraction — that is, what he calls "Boolean functions": at every step a subject must decide if an object relates to a made-up category or not. As it turns out, Fodor goes on, a child's development up to the adult level of mentation is just the progress in mastering Boolean functions [Fodor, 1972, p. 92]. As far as I can tell, these functions lie in the foundation of any computation, as at every step Turing Machine determines if a certain rule is applicable to this very input. They also permeate Deep Learning, especially supervised one with error backpropagation. Vygotsky's experiment cited by Fodor might have well occurred a nice algorithm of artificial neural network training. And still Fodor is right here: Boolean skills are important but not specific to formation of concepts, and theories linking it to abstraction of properties are obviously outdated.

As before, Fodor proposes an alternative, according to which a child's mentation differs from that of un adult not in simplicity, as children sometimes reveal capacities for cognitive processing of great computational power and complexity, but in specificity of their application. A young child can effect intense and costly computations in, say, mastering syntax but not in general problem solving. Thus, development, according

to Fodor consists in broadening the scope of tasks solved with those computations: “the young child differs from the adult not in the kinds of conceptual integrations it can effect, but rather, in the areas in which it can effect them.” And here also: “The mathematics required to characterize the structure of faces or the syntax of a language is presumably far more powerful than that required to characterize correct performances with Vygotsky blocks” [Fodor, 1972, p. 93].

Fodor’s suggestion was interesting and maybe promising but, again we got almost no arguments for why we should favor it over the contended one. And, still, if mental development is progressively broadening the scope of algorithms applications, then what drives the cognitive system in this direction?

He concludes his examination with the following: “Vygotsky is driven to this (cited above. — *I. M.*) conclusion less by his data than by some quite unreasonable philosophical convictions about what it is to think abstractly, logically, maturely, and so on” [Fodor, 1972, p. 94]. And this is the main complaint Fodor addresses to Vygotsky: the suspicion of metaphysics claiming a science. One can’t say that there are no reasons for this criticism considering the historical context and ideological background. But what Fodor contraposes is nothing less than a paradigmatic alternative of the second half of the century. It can hardly be commensurable to the historical-cultural standpoint of its first decades, long before the computer revolution shaped those later cognitive theories. That is why there is no real discussion: he might as well criticize Wundt or Watson for ignoring computational models and resorting to metaphysical assumptions instead.

As far as I can tell, this is quite common on both sides of the iron curtain — to condescend to the erroneous ones “before” from the position of a wise one “after”. Fodor believes that the “central processing language” is better than “internal speech” in the role of an explanatory scheme for language acquisition as well as increase in generality of computations is better than training of categorization as explanation for development. But why? Can we see facts that are easily explained by Fodor’s theory while Vygotsky struggles with them? Until we do, it is not “science vs. metaphysics”, but a battle of two very different philosophies watched by passionate fans of both. Of course, the paper we have read is rather small, but it quite allows for references to experimental inquiries.

Vygotsky in other cognitive paradigms

There are authors marked with a “neo-Vygotskian” label. They usually represent the historical-cultural school in psychology, but there may be variants. Those neo-Vygotskians may, for instance, treat development of quantification practices during children’s social interaction [Saxe, 2005], or interpret mathematics as social

elaboration of certain discursive symbolic practices aimed at solving problems [Sfard, 2002], or present theoretical knowledge as originating from mutual shaping of solving problems and developing tools for these solutions in a long-term process [Bussi and Mariotti, 2008]. Some of them, in the context of English language teaching, study pedagogical implications of the fundamental theoretical tenet of Vygotsky's sociocultural theory, according to which higher forms of human consciousness are semiotically mediated [Lantolf, 2000]. In the same context, some authors develop the methods of Dynamic assessment that integrates instruction and assessment, as a viable alternative to standard testing derived from Vygotsky's sociocultural theory [Daneshfar and Moharami, 2018]. As we see, the Vygotskian commitment reveals in their firm belief that learning, cognition, and thought are outcomes of social interactions mainly mediated with symbolic systems. This doctrine is, indeed, poorly compatible with classical Fodor-style cognitivism, but may be consistent with connectionist, predictive, and especially enactive, approaches.

Thus, proponents of "radical" connectionism, a doctrine that adopts "an analog conception of neural computation" and "a structural resemblance theory of representational content", which claims, "as against both classicism and ecumenical connectionism, that cognition never involves an internal symbolic medium, not even when natural language plays a part in our thought processes" [O'Brien and Opie, 2002, pp. 327–328]. O'Brien and Opie, therefore, agree with Vygotsky in that the external language gets internalized by children, but split with him because of his representational approach to language: "for Vygotsky, as for many later theorists (including those we are calling "ecumenical connectionists"), this process is one in which an external communicative scheme becomes an internalised *representational medium*: children learn to communicate with natural language, and then they learn to think in it" [O'Brien and Opie, 2002, p. 326]. In their view, language in the form of speech is produced when cerebral analog representations interact with motor systems for them to outwardly produce series of symbols in this or that physical form. The latter enter other communicator's brain to ensure that his/her token representations have become identical to those of the first communicator. The authors refer to their predecessors (Paul Churchland included) who believed that, thus, we need not ascribe any content to language seeing it as only a tool to manipulate other people's brains. But, as they say, Vygotsky adds an important aspect thereof: language being internalized continues to play the same role that it played outside — that is, being a tool for "recurrent self-manipulation." By internalizing language, the brain becomes "a powerful cognitive tool; one that can establish coherent, multi-modal representational states involving many brain sites, by facilitating communication among those sites; and one that can regulate the sequencing of thought, via the

constant interplay between networks that encode linguistic signals and those that encode thoughts" [O'Brien and Opie, 2002, p. 327].

"Radical" connectionism is generally consistent with Vygotsky, but even more so is its "ecumenical" version, as O'Brien and Opie reproach both them and Vygotsky in acknowledging representational nature of language, to which they oppose. In my view, the issue is just aspectual: one may say, following O'Brien and Opie, that an internal representation of a word causally interacts with an internal representation of a thought, or, alternatively, that one of them transmits content to the other — there will hardly be any observable parameter or event that will make one of these interpretations true, and the other false. Therefore, in this discussion, as in Fodor's case, we see clash of philosophies but not the triumph of science.

Some proponents of "the third wave of Extended Mind (*EM*)"[1] bring Vygotsky, among others, to witness that internalization "is thus not a matter of moving the forms of knowledge enacted in cultural practice inside of the head of an individual. It is instead to be understood in terms of a reconfiguring of the individual through the network of practices in which the individual participates" [Kirchhoff and Kiverstein, 2019, p. 17]. The same Michael Kirchhoff with other co-authors argues for the Free Energy Principle (*FEP*)[2] being a better and a more scientific tool for explaining and modelling "bodies–environment systems" that may include environmental cues, ecological information and cultural practices, naturally linking the latter to Vygotsky's heritage [Hesp *et al.*, 2019, p. 25].

A possible mode of Vygotsky's reception

The questionable relevance of Vygotsky's ideas for modern science and philosophy is not just a matter of superficial resemblances of his and nowadays authors' big pictures: for instance, the shared beliefs that an individual is brought up being dynamically shaped by socio-cultural forms and mechanisms. What is important is if his ideas formulated in a definite historical context are still capable of being operationalized to be used as rigor explanatory tools for the considerably extended corpus of recently acquired empirical knowledge consistent with recently elaborated computational models. To clarify the issue, I would propose a couple of ideas of my own to be used as a tool for analysis.

[1] *EM* stands for an ontological assumption that cognition stretches far beyond boundaries of the brain, thus embracing the body and the environment as well.

[2] *FEP* is at the core of the Predictive Processing Theory that states that cognitive and, more broadly, biological systems are statistical inference feedback engines that are designed to predict events in their environment. Another core concept of the theory, that of nested Markov blankets, allows for understanding boundaries between the internal and the external as definite, but moveable.

The first is a clear *distinction of a theory proper and an ontology*[3] [Михайлов, 2019; Mikhailov, 2022]. The latter is in fact a conceptual-perceptive scheme of typical objects and their relations posited as existent within a theory. An ontology thus conceived may generate statements that are typically and naïvely mistaken for being part of a theory proper[4]. But there is an important difference. A theoretical statement may be relevantly evaluated as true or false owing to its deductive or factual (in)consistency. As for assumed truth-values ascription to ontological commitments, it is the matter for discussion of scientific realism vs. what is referred to as instrumentalism by some. If you believe that ontological statements follow from principles of a true theory, this implies your belief that this theory has somehow rightly guessed the real composition of the world. And then there is no essential epistemic difference between a theory and its ontology. But, in this case, you may find yourself in conflict with the history of science that provides us with instances of a theory being interpreted on different inconsistent ontologies, as well as of an ontology being a fundament for inconsistent theories.

A more reliable understanding of the interrelation of theories and ontologies is not that of entailment, but that of interpretation in a kind of Tarskian sense [Tarski, 1983, pp. 416–417], which allows for a sentence being interpreted on various models, sometimes with different consequences for its truth-value. And here we should distinguish a sentence to be interpreted and a sentence that describes a model used in the interpretation. Obviously, they belong to different epistemic categories with different inferential and truth-conditional properties.

What is important furthermore, is that statements like “physical bodies are attracted to each other” may be taken as theoretical in some sense and not as purely ontological. In this case, all the observations of heavier-than-air objects falling onto the ground may be taken by some as their empirical verifications and, conversely, a statement of this kind may be taken as an explanation for the facts.

What is a problem here is that a principle of this form may explain why apples are attracted to the earth, but not the fact they are seemingly not attracted to each other while on the same branch of a tree. To explain the latter fact without dismissing the principle, we can but assume that the force of attraction may be lesser or greater and, therefore, quantifiable; and that the observations are relative to some measurable variables, such as mass and distance. And as soon as one comes to an equation sustainable against all measurements, one may be congratulated with authoring a theory proper built over an ontology. With this advancement, we obtain a theory

[3] The idea dates to later Wittgenstein, Quine, and some others, but I presumptuously believe to have added something thereto.

[4] Their examples may be “Physical bodies with mass exist in space and time”, or, more relevant hereto, “An individual appropriates historically developed forms of culture.”

with greater explanatory capabilities as compared to our previous proto-theoretical ontology, as it explains more facts, but a more vulnerable one at the same time: it may be falsified not only by a fantastic flight of an apple into the sky instead of its falling onto the earth, but with a sheer inconsistency of velocity or acceleration of its falling with those predicted by the equation. As a result, the theory composed of measurable variables appears to be less grand and omni-explanatory, while orders of magnitude more precise and practically seminal. Which means less metaphysical and more scientific.

The moral of the story may be this: if we encounter a purely qualitative attempt to explain facts with non-measurable concepts, it is either pure metaphysics eligible for any purposes other than those of scientific explanation, or a half-stuff of an explanation — a proposed ontology, just add some theory proper. I hope that it is possible to prove that Vygotsky's heritage is of the second kind, although at face value, it seems to be stuck at the transition.

The said proof may be probably obtained within my second proposal, for which I haven't yet invented a better label than once proclaimed *meta-network ontology for cognitive and social sciences* (not "hypernetwork" and not "theory" as in my earlier publications — a necessary self-correction) [Михайлов, 2015; Mikhailov, 2020]. This is a view on social-cognitive reality as nested networks: particularly, a brain inside social connections, but the ontology is supposed to be free from implementational details. It envisages only subordinate network-like connectomes of elements as some simple processors ready to execute some parallel distributed computations. The earlier versions of this ontology were inspired by the connectionist approach that is based on the concept of learning (or training) and is, therefore, consistent with Lockean and Humean philosophies of "tabula rasa" and associationism. Later, I moved somewhat closer to the Predictive Processing view in supposing that this meta-network does not just "learn" things but keeps optimizing some important variable(s) — be it the now famous "free energy" or anything else — to which end it loads its constituent elements with some tasks and constraints like, for example, morals and other social institutions [Михайлов, 2022]. Like any ontology, it anticipates being topped up with some quantitative theory and/or algorithmic calculus, so I still hope for somebody's professional input.

In connection with Vygotsky, it may occur prolific to use both of my proposals to update our understanding of language and, respectively, thought. Any learning and/or predicting network is essentially a tool for statistical computations, which are probably the only way to cope with unforeseeable environment. If it is a meta-network, a brain-in-a-society composition, connections between its primitive processors must be secured at all the levels. At the cerebral inter-neuronal level, we

have the observable synapses that transmit electrical spikes that are, in turn, attuned by transmitters and modulators. But if we step a level up and see brains as primitive units of a social network, we don't notice any physical conductors between the brains to secure the parallel processing at the societal level. Nodes of the meta-network must then elaborate communication carriers on their own, of which the evolution hasn't cared much so far. And, as it usually happens in spontaneously evolving systems, some previously developed organs assume the new required functions. In our case, vocal cords, tongues, and lips suddenly proved to be of use. Air vibrations produced thereby naturally turned into a kind of a network protocol[5]. This technical solution is slow and inefficient, but you can't do any better in the absence of the wise engineer behind this design.

In the same manner as prokaryotes come together to become organelles of eukaryotes [Hesp *et al.*, 2019, p. 202], colonies of the latter become organisms, within which cells compute by replicating DNA/RNA and by exchanging information via multiple endocrine and other chemical channels [Bhalla and Iyengar, 1999], those organisms connect to form higher order processing networks to share their cognitive (*i. e.* computational) capacities and thus increase their efficiency. But the network protocol they eventually bring about — *i. e.* the human language — differs substantially from their own network architecture: it is serial, not parallel, and substantially Boolean, not probabilistic. Still, it is the best they can afford evolutionary, and, subsequently, their brains get attuned to syntactical/semantical operations specific to this strange newly acquired medium.

This tuning is precisely what has been described by Vygotsky as the internalization of external speech, forming of the internal speech, which is eventually reduced to what we call "thought". Alternatively, we may picture the scene like this: the whole of a society induces new cognitive capacities in its nodes for them to better serve and support meta-network computations. Both explanatory strategies are holistic, but Vygotsky resorts to the usual Marxist axioms of *joint activity* as the necessary form interpersonal connection, for which language plays a role of informational support. The strategy I propose flips the explanation over, positing progressive computational complication of self-organizing multi-stable systems as the objective necessity making the collective labor of networking agents one of its possible but not strictly necessary outcome. The human history knew societies with rather individualistic modes of production, although none of them escaped at least some forms of producing symbols and narratives, which are collective ("dialogic") by definition.

[5] A sudden recurrence to the O'Brien and Opie's discussion: are network protocols representational?

Thus, "internalization" equals to formation of neuronal vehicles for linguistic operational capabilities, which matters primarily in the developmental context. These vehicles once being separated from vocalizing later underlie some specifically human ways of thought used in specific language games, speaking in Wittgenstein's terms. This linguistically informed way of thinking is not universal although, as multiple experiments show that humans mainly ignore regular inferential schemes prescribed by the logic of language, opting for probabilistic strategies in information searches and making decisions [Schooler, 2001] that relate us to our animal speechless ancestors. Which undermines the philosophical prejudice shared by such antipodes as Vygotsky and Fodor that language of any kind is the generative template for thought. Particularly, the AI developments of today, such as various GPTs, show that language itself must be subject of statistical manipulations to generate some human-like speech. Which also implies that philosophers should eventually break away from this Hegelian tradition of invoking "logic" every time they speak of "thought". "Thought" is about the intrinsic mathematics of living matter, not about the logic of discourses and proofs, which themselves are specific socially certified rituals.

The statistical and predictive nature of communication is revealed in Karl Friston's and Chris Frith's witty computer modeling of two tweeting birds based on similar generative models with shifting modes of "singing" and "listening" [Friston K. & Frith, 2015]. A theory aimed for the explanation was subsequently labelled "neural hermeneutics" by them [Friston K. G. & Frith, 2015].

If all the above said is true (and the truth is just a particular logical-linguistic category), then a winning Western, and not only, reception of Vygotsky's heritage should — as is envisaged in Fodor's developmental scheme — include elaboration of a "compiler" that would help convert Russian thinker's dialectical intuitions into modern processing jargons for them to be testable not only against experiments but against computational models as well. But, unlike Fodor's view of 1972, those models ought to be rather distributed and probabilistic than grammar inspired. This would make more of Vygotsky's ideas currently acceptable.

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