



The early history of the scaffolding metaphor: Bernstein, Luria, Vygotsky, and before

Anna Shvarts & Arthur Bakker

To cite this article: Anna Shvarts & Arthur Bakker (2019) The early history of the scaffolding metaphor: Bernstein, Luria, Vygotsky, and before, *Mind, Culture, and Activity*, 26:1, 4-23, DOI: [10.1080/10749039.2019.1574306](https://doi.org/10.1080/10749039.2019.1574306)

To link to this article: <https://doi.org/10.1080/10749039.2019.1574306>



© 2019 The Author(s). Published with license by Taylor & Francis Group, LLC.



Published online: 27 Feb 2019.



Submit your article to this journal [↗](#)



Article views: 1211





View Crossmark data [↗](#)



OPEN ACCESS



The early history of the scaffolding metaphor: Bernstein, Luria, Vygotsky, and before

Anna Shvarts ^{a,b} and Arthur Bakker ^b

^aLomonosov Moscow State University; ^bUtrecht University

ABSTRACT

Given the growing interest in the scaffolding process, it is worthwhile to address competing accounts about the origin of this term. The concept was empirically introduced by Wood, Bruner, and Ross in 1976 and has often been associated with the “zone of proximal development” in the writing of L.S. Vygotsky. We trace the origins of it in instances of the term being used by Nikolai Bernstein and Alexander Luria, as well as in Vygotsky’s notebooks. Our historical search helps to highlight the theoretical connection between this metaphor and the teaching/learning versus development opposition, and its relation to motor control development.

The aim of this article is to share our discoveries about the history of the scaffolding metaphor, which we found in Russian psychology, in particular in the work of Nikolai Bernstein (1947, 1991/1996) and Luria (in Luria & Vygotsky, 1930/1992) and in Vygotsky’s recently translated and published notebooks (Zavershneva & Van der Veer, 2018). We included in our search for historical antecedents those scholars who are acknowledged sources for Vygotsky, Luria, and Bruner’s ideas, as well as the political discourse of early Soviet years.

By showing how Bruner was inspired by Bernstein’s work and by correspondence and conversations with Luria, we intend to clarify the extent to which the metaphor began as Vygotskian and the extent to which different properties of the metaphor were introduced by Wood, Bruner, and Ross (1976). With this history at hand, we use the historical observations to highlight aspects of the metaphor that are worth emphasizing to preserve the richness and specificity of the original ideas behind scaffolding. Pea (2004) argued that the concept of scaffolding has become a proxy for many sociocultural ideas and that “this is surely too much complexity to take on at once” (p. 423). We propose how scaffolding can be related to Vygotskian ideas such as the zone of proximal development (ZPD) and Bernstein’s ideas about motor development, so as to contribute to a “more differentiated ontology” (p. 423).

In the first section, we explicate the intricate situation around origins of the scaffolding metaphor in the contemporary literature. In the second section, we expose the historical occurrences of the metaphor and their interrelations. The third section is dedicated to the conceptual and factual transition from scaffolding in Bernstein’s conception of motor skill development to scaffolding in Wood, Bruner and Ross’s (1976) article. The fourth section is a theoretical discussion of the historical findings, and the final section provides conclusions and suggests future directions for the development of the scaffolding concept.

CONTACT Anna Shvarts  a.y.shvarts@uu.nl  Faculty of Science, Utrecht University, Princetonplein 5, Room 367, Utrecht 3584 CC, The Netherlands

Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/hmca.

© 2019 The Author(s). Published with license by Taylor & Francis Group, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The debates on the history of scaffolding

Over the past decades, interest in the concept of scaffolding—temporary adaptive support—has grown (see Figure 1). However, although the use of the word is spreading around the discipline, its meaning is becoming vague and polysemic (observed by, e.g., Pea, 2004). The threat of losing any specific innovation in the educational and developmental science which this concept may convey is especially strong due to the controversial history of this concept.

As Renshaw (2013) and Smagorinsky (2018) observed, there are several persistent myths about the concept of scaffolding. The most obvious first myth is that the concept could be attributed to Vygotsky. A quick search in Google Books on “scaffolding Vygotsky” yields a surprising number of publications in which Vygotsky (1962 or 1978) is cited when authors use the term *scaffolding*. However, some experts in Vygotsky’s heritage claim that this term does not appear in Vygotsky’s publications or in the work of his followers:

Although the term ‘scaffolding’ has a long history in the West of being associated with Vygotsky’s paradigm (Wood et al., 1976), it is not a term used either by Vygotsky himself or by the post-Vygotskians (Bodrova, Leong, & Akhutina, 2011, p. 19).

Some authors highlight the diversity in treatment of origins of this term. For example, Roth and Jornet (2017) pointed out that

in the sociocultural literature, authors might use the term [scaffolding] synonymously with the *zone of proximal development*, whereas in other literatures it has arisen from the observations of tutoring, where the term has arisen independently from Vygotsky’s work (e.g. Wood et al., 1976). (p. 122)

What might explain the first myth on the supposedly Vygotskian origins of the term is that the concepts of scaffolding and ZPD are closely associated. This strong association was explicitly stated by Cazden (1979) and may explain the tendency of many authors to relate scaffolding to Vygotsky’s heritage. However, several authors point out the differences between these concepts (Griffin & Cole, 1984; Smagorinsky, 2018): Smagorinsky raises the issue of long-term influence of learning on the development that is supposed by Vygotsky’s ZPD ideas, and Griffin and Cole (1984) noted that the scaffolding metaphor supposes a predefined system of goals and leaves little space for a child’s creativity.

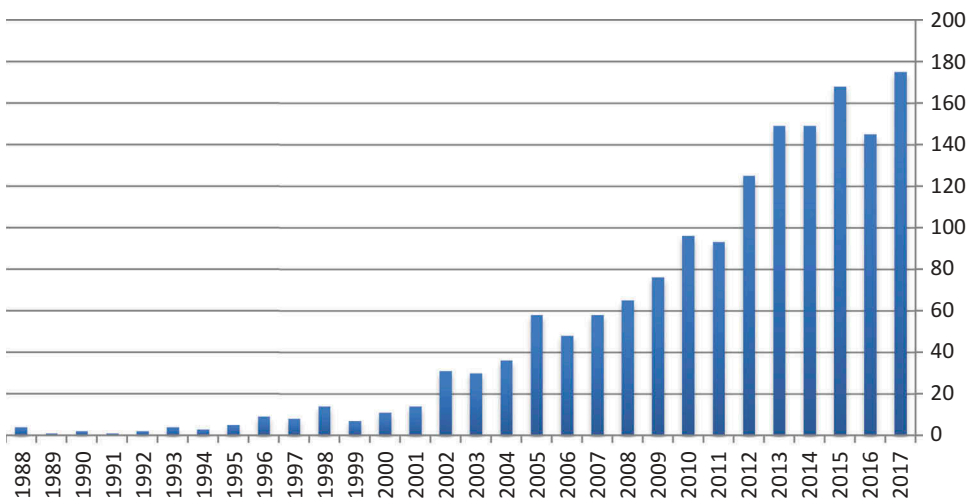


Figure 1. The number of publications that use the term *scaffolding* in their title or keywords according to the Scopus database. Note. The search was limited to social science and psychology subject areas.

Another persistent myth is that the concept of scaffolding was first introduced by Wood et al. (1976). However, Bakker, Smit, and Wegerif (2015) and Renshaw (2013) observed that it can be found earlier in the literature on educational and developmental psychology. For example, Ausubel (1963) used the phrase “ideational scaffolding” at least six times. However, Ausubel did not define scaffolding or work out this idea; he used it only metaphorically as a temporary support system.

Investigating the history of the particular article by Wood et al. (1976) and the possible authorship of the term, we found an earlier version of this article, written no later than by March 1973, in Jerome Bruner’s archive (Wood, Bruner, & Ross, 1973). Wood and Middleton (1975) described the phenomenon of scaffolding, though without using this term, whereas Bruner did use this term in the other articles of that period (Bruner, 1975a, 1975b). David Wood¹ did not remember who used the term first (see also “Entretien avec David Wood,” 2017). Given also a recollection by Gail Ross,² we assume that it was Jerome Bruner who came up with this term—an assumption we verify later in this article.

Later, Bruner mentioned scaffolding strategies when he discussed the ZPD within the broader context of Vygotsky’s ideas (Bruner, 1987, 1997). Bruner’s (1986) own words may have caused researchers to think that the metaphor of scaffolding was introduced by Vygotsky:

How can the competent adult “lend” consciousness to a child who does not “have” it on his own? What is it that makes possible this implanting of vicarious consciousness in the child by his adult tutor? It is as if there were a kind of scaffolding erected for the learner by the tutor. But how?

Nowhere in Vygotsky’s writings is there any concrete spelling out of what he means by such scaffolding. But I think I can reconstruct his intentions from two sources, one of them philosophical-historical and in Vygotsky’s own hand, so to speak, the other from research on such “scaffolding” that I undertook myself, better to grasp what this intriguing concept might mean. (p. 74)

Given the variety of opinions concerning the history of the metaphor and rather vague references to the sources by Wood, Bruner, and Ross, we now delve into the historical investigation.

Re-viewing the history of the scaffolding metaphor

The sources

We traced the origins of the scaffolding metaphor in educational and developmental psychology literature by backtracking the references in key publications, talking to experts in the field (their names can be found in the acknowledgments), searching in Google and Google Books, analyzing biographical materials, searching in personal archives of the prominent Russian researchers and in Jerome Bruner’s archive at Harvard University,³ and exploring the possible sources of their inspiration in the literature step-by-step. Another valuable resource to go further back than Vygotsky proved to be the marxists.org website. Taking into account the polysemy of the metaphor and the “perils of translation” (Cole, 2009; Roth, 2018) between Russian and English as well as other languages, we provide the italicized original word in parentheses in case other languages are involved.

Vygotsky and earlier

In light of the aforementioned controversies, the most obvious question about the relation of scaffolding to the thoughts of Vygotsky is whether Vygotsky himself used the term anywhere. According to the experts we consulted,⁴ there is only one place in print where Vygotsky himself used the term, namely, in his *Notebooks* (Zavershneva & Van der Veer, 2018). This note was presumably written in 1929, the year that he and Luria wrote “Tool and Symbol in Child Development” (Vygotsky & Luria, 1930/1994) as well as *Essays in the History of Behavior* (Luria & Vygotsky, 1930/1992), fundamental texts that represented the development of the first, “instrumental psychology” phase of Vygotsky’s career (see the latest periodization of his work in the introduction

to *Vygotsky's Notebooks*, Zavershneva & Van der Veer, 2018). Later, he turned from instrumental psychology toward the theory of dynamical and semantic organization of consciousness that was essentially based on the concept of functional systems. In 1929, Vygotsky was still searching for a correct name for the approach that he intended to elaborate.

Not instrumental, not cultural, not signifying, not constructive, etc. Not just because of the mixing up with other theories, but also because of its intrinsic obscurity: For example, the idea of the analogy with an instrument = just scaffolding, more essential is the *dissimilarity*. (Zavershneva & Van der Veer, 2018, p. 121)

Thus, the old analogy between the role of a sign and an instrument is considered as “just scaffolding” (*песа*, Russian) toward the future theory. We may note that two essential aspects of the scaffolding metaphor are present in this note: (a) It focuses on some substance under construction, a transitional, unfinished quality, and (b) it highlights the imprecise quality that needs further elaboration.

What are the possible sources for Vygotsky to use this metaphor? One source is dialectical philosophy, which was a great inspiration for Vygotsky and particularly for his studies on method (Derry, 2013; Roth & Jornet, 2017; Van der Veer & Valsiner, 1991). The word *scaffolding* (*Gerüst*, German) appears seven times in Hegel's (1812/2010) *Science of Logic* and further in Marx (e.g., 1847/1885). However, the German word *Gerüst* may mean not only a temporary support for the workers who construct a building, but also a skeleton. Hegel (1812/2010) wrote,

It cannot be denied that, especially with the aid of the fog of the infinitely small, much has been accepted as proof in this field for no other reason except that the result had already always been known to be true and the proof, deliberately devised to reach that result, created at least the illusion of a scaffolding of proof—an illusion which was still preferred to mere belief or to knowledge from experience. The empty scaffolding of such proofs was erected in order to prove physical laws. (p. 234)

In this text, the phrase “a scaffolding of proof” refers to a construction (a skeleton) of categories that may lead to false or limited knowledge due to their illusionary argumentation and reliance on sensory experience. At the next stage of dialectical spiral, which is the core of the method introduced by Hegel, this scaffolding would fail in the process of sublation⁵ yet function as a ground of overcoming the controversy in a new synthesis.

Involvement of the scaffolding metaphor in the description of dialectical methods continues in Marx's texts. For instance, the term *scaffolding*⁶ appears in *The Poverty of Philosophy*, one of the most important methodological books by Marx (1847/1885, translation from French, Fifth Observation):

In the absolute reason all these ideas ... are equally simple, and general In fact, we attain knowledge only by a sort of scaffolding of our ideas. But truth in itself is independent of these dialectical symbols and freed from the combinations of our minds (Proudhon, Vol. II, p. 97). ... Indeed, from the moment the process of the dialectic movement is reduced to the simple process of opposing good to bad, and of administering one category as an antidote to another, the categories are deprived of all spontaneity; the idea “ceases to function”; there is no life left in it. It is no longer posed or decomposed into categories. The sequence of categories has become a sort of scaffolding.

In this passage, taken from the chapter entitled “Method,” Marx claimed that Proudhon lost the essence of the dialectical method in pure categorical reasoning and stresses that categories without “life left in” become a mere skeleton (a scaffolding). Like in Hegel's work, where the scaffolding was considered empty, in Marx's view the scaffolding of categories is imprecise or even wrong unless they are immersed in practice.

Although in Marx's text there is no future potential, no development left for scaffolding of categories, the philosophy of Hegel suggests potential growth of knowledge toward truth by sublation of contradictions at previous levels. The themes of a possible approximation of truth as well as of an imprecise grasp of the target idea are consonant with Vygotsky. Apart from these philosophical materials, he might also have been influenced by another source of the metaphor.

The metaphor of scaffolding (*строительные леса* or, in short, *леса*, Russian) was highly popular among socialists and Marxists (e.g., de Leon, 1899), including Russian revolutionists and politicians

at the beginning of the 20th century who used it in their writings (e.g., Lenin, 1901/1961; Trotsky, 1923/1957) and official speeches (Stalin, 1917/1954) when talking about building Communism and spreading propaganda. Trotsky stressed the temporary nature of the Soviet regime in 1922 by this metaphor: “The revolutionary regime is only the scaffolding for the new culture. In order to build the new culture we need to learn how to erect the new edifice stone by stone, brick by brick” (Trotsky, 1924/1981, Listen and Get Ready, Red Army).

To understand the Soviet connotations of this metaphor in the revolutionary texts, one needs to be aware that everything was under construction at that time and constructivist metaphors mostly meant strong determinacy of the future by current efforts based on socialist politics. According to the utopian ideas of the time, not only the political system but also individual consciousness and thoughts were expected to be determined by society, especially starting from the 1930s. However, despite the presence of this metaphor of construction in the state discourse, we should not attribute the deterministic connotations to Vygotsky’s or Bernstein’s ideas. On the contrary, their research programs contributed to the understanding of freedom, and they themselves suffered from political prosecution.⁷

The aforementioned sources illustrate the popularity of the scaffolding metaphor in Russia and elsewhere in Vygotsky’s time. Vygotsky himself mentioned this term only in a metaphorical meaning of a temporary and insufficient approximation as he was rethinking the essence of his approach. To understand how it made its appearance at Harvard and in Oxford in the early 1970s, in the next sections we use historical evidence and draw a dashed line from Vygotsky toward the appearance of the term in the article by Wood et al. (1976).

Alexander Luria

The next occurrence of the scaffolding (*леска*, Russian) metaphor was found by Van der Veer and Valsiner (1991) in Chapter 3 of the *Ape, Primitive Man, and Child: Essays in the History of Behaviour* (Luria & Vygotsky, 1930/1992). As this book was finished no later than by the summer of 1929 (Akhutina, 2003), this appearance of the metaphor matches the time of the aforementioned occurrence in *Vygotsky’s Notebooks* (Zavershneva & Van der Veer, 2018). However, we also know from many sources that it was Luria who wrote this chapter of the joint monograph. Luria’s use of the metaphor clearly points to the process of ontogenetic development:

... the child has started to walk. The transition to walking is usually not clear-cut. At first the child makes use of external objects, by holding on to them: he makes his way along holding onto the edge of the bed, an adult’s hand, a chair, pulling the chair along behind him and leaning on it. In a word, his ability to walk is not yet complete: it is in fact still surrounded, as it were, by the scaffolding of those external tools with which it was created. Within a month or two, however, the child grows out of that scaffolding, discarding it, as no more external help is needed; external tools have now been replaced by newly formed internal neurodynamic processes. (Luria & Vygotsky, 1930/1992, p. 145)

As Van der Veer (2007) pointed out, this occurrence of the scaffolding metaphor went mostly unnoticed due to the problematic translation in the more popular version of this book by Golod and Knox, who translated it as “as it were, ‘to the woods’ of external tools” (Vygotsky & Luria, 1930/1993b, p. 207). A literal word-by-word translation is “his walking is not ready yet, it is still ‘in scaffolds’ [in the woods] of those external tools with help of which it is being created.”⁸ These external tools appear to be a variety of possible auxiliary means that may help the child to stand steady, the adult’s hand being one of those tools. Notably, the word “scaffolding” is written in quotation marks in the original Russian text, indicating that the word is used metaphorically.

Much later, Luria elaborated on principals of neuropsychology demonstrating the systemic organization of each function and stressing the significance of auxiliary means. Under the right conditions, the damaged psychological function can be compensated by providing auxiliary means for the patients in accordance with each one’s particular brain damage and with the demands of the target task. For example, when asked to complete a puzzle involving blocks, a patient with damage to

the frontal lobes is supported by a series of organizational questions, such as, “What is the next block?” whereas a patient with parieto-occipital deficit is oriented in space (Luria, 1973).

At present, Luria’s neuropsychological approach is being developed toward compensating an asynchrony of a child’s development that may emerge as a relative lag in development of one psychological function within the system. Auxiliary means (cf. “external tools” in Luria’s quotation earlier) serve as a temporary external support that is provided by a neuropsychologist while the lagging psychological function is developing. Although, to the best of our knowledge, Luria never used the term *scaffolding* in his neuropsychological writings, his successors find that the idea of providing an appropriate auxiliary means matches well with the contemporary concept of scaffolding (Akhutina & Pylaeva, 2012; Bodrova et al., 2011).

Nikolai Bernstein

Although he has been rarely referred to in conjunction with the concept of scaffolding, the Russian scientist who has most clearly inspired Wood, Bruner, and Ross is Nikolai Bernstein. As we argue next, the vehicle for this influence was Alexander Luria.

Born in the same year as Vygotsky, Bernstein in his “Physiology of Activity” radically reconsiders the principles of motor action construction and development (Reed & Bril, 1996). At present, he is acknowledged as the founder of motor control studies that developed mostly in the theoretical perspective of dynamic systems theory (e.g., Thelen, 2000).

One of the central terms of Bernstein’s theory of active movements construction is the concept of *degrees of freedom*, which Bruner (1975b) used in this article on speech ontogenesis:

One form is an interpretation of the infant’s behavior as an intention to carry out some action. In such instances, mothers most often see their role as supporting the child in achieving an intended outcome, entering only to assist or reciprocate or “scaffold” the action. “Scaffolding” refers to the mother’s effort to limit, so to speak, those *degrees of freedom* [emphasis added] in the task that the child is not able to control —holding an object steady while the child tries to extract something from it, screening the child from distraction, etc. (p. 12)

Bruner characterized scaffolding as the help that is provided by caregivers as they are limiting the children’s movements or protecting their attentional focus from distraction. The characteristic of this process involves the mathematical term *degrees of freedom* from Bernstein’s discourse that here is used rather metaphorically.

The Wood et al. (1976) paper refers to Bernstein’s (1967) book, the only one that was published in English at that time. In the chapter “Biodynamics of Locomotion,” which is the translation of Bernstein’s paper from 1940 on the development of walking ability (cf. Luria’s mention of scaffolding), Bernstein (1940/1967) did indeed write about reduction of degrees of freedom in mastering a new skill in sport or music when the learner “rigidly, spastically fixed and holds the limb involved, or even his whole body, in such a way as to reduce the number of kinematic degrees of freedom which he is required to control” (p. 108). He thus considered this stage as necessary before the movement would be regulated smoothly and a person could manage to coordinate all degrees of freedom.

The aforementioned quotation illustrates the beginning of Bernstein’s interest in the genesis of motor skills. Later, in 1947, he presented a more detailed description of the stages of the process of achieving mastery. About the early stages he wrote,

At the beginning, he [the learner] still has to execute the new movements almost entirely under the control and correction of the leading level. ... As a consequence, the movement is executed at the beginning by means of *surrogate corrections* similar to temporary wooden scaffolds by means of which the future stone construction will be built. In the whole central nervous system only cortical sensorimotor systems in the level C2 and above⁹ have sufficient differentiation for the possibility of constructing new motor combinations ad hoc. (Bernstein, 1947, p. 178, translation by Anna Shvarts)

The scaffolding metaphor is used in the description of a motor action development at an early stage, when the higher levels of the action regulation serve the fulfillment of the action's goal. This scaffolding allows elaboration of *genuine corrections* at the lower levels of action control that will maintain more fluent and automatized performance later in the process of mastering.

The same thought is repeated in a book that was written by Bernstein a couple of years later but had not been published in the USSR until 1991 due to political reasons (Bernstein, 1991/1996)¹⁰:

The movement is first performed clumsily, as if “on crutches,” and the sensory mechanisms available to the leading level play the role of wooden scaffolding used temporarily for building a brick house. And indeed, while the movement is performed on these surrogate props, the lower levels have time to elaborate actual appropriate background corrections or automatisms. (p. 186)

Although in the previous quotation Bernstein used the term *scaffolding* for the process of movement regulation by the leading level, now he describes this regulation with the help of two metaphors. The movement itself is performed “on crutches,” whereas scaffolding serves only as a sensory feedback and further corrections of the movement.¹¹ Indeed, a building is not supported by scaffolding and typically stands without it, whereas the crutches serve the role of support without which the patient would fall. In contemporary literature, these two functions are subsumed in the concept of scaffolding.

What is the role of sensory feedback in the development of motor actions according to Bernstein? Each motor action is considered as a solution of a motor problem, thus making the process of movement construction creative each time as it is performed. Any movement unfolds not as a direct run of a program but as a recurrent cycle of central effector impulses, the sensory feedback from the periphery that serves as a correction of the program after comparison of the current state with the anticipation of the target movement. The sensory corrections allow the learner to adjust the movement to the particular situation. In Bernstein's prototypical example, even the hammering movements of a skilled carpenter vary from one action to the next as the initial program is corrected to the peculiarity of each iteration.

So the function of the sensory corrections at the leading level, which are metaphorically explained as scaffolding, is to provide feedback about the fulfillment of the required action. In so doing, the leading level lets the action be somehow conducted by accessible means and by “crutches” (cf. Luria's auxiliary means), whereas the background, subsidiary levels of movement regulation develop more appropriate and stable corrections:

For example, when learning the skills of filing or mowing as well as the fine finger skill of playing the piano, during the first stages, the correctness of movements of the file, the mower, or one's own fingers is checked by vision, by one's staring intently at them. The ability to perform the movements more or less correctly under such surrogate control directs and accelerates the elaboration of genuine correction. (Bernstein, 1991/1996, p. 186)

Thus, for a solution of a motor problem a new functional system is established at the beginning through a scaffolding process (e.g., under visual control), and later, the same function is fulfilled by mechanisms at the background levels.

Summing up the early occurrences of the scaffolding metaphor

Although Bernstein employed the scaffolding metaphor in his analysis of motor skill development, the widespread meaning of scaffolding refers to the situation of teaching and learning, as it was elaborated by Wood, Bruner, and Ross. Before we clarify in the next section the transition from Bernstein's theory to the current understanding of scaffolding, we use [Table 1](#) to summarize aforementioned scaffolding occurrences.

Following the table, one may see how the scaffolding metaphor traveled from philosophical and political discourse to Soviet psychology and physiology. Keeping the property of a temporary construction throughout history, it was transformed from a skeleton of a proof to a supportive construction for either workers or buildings as it was serving the building of communism and then to a temporal way of a new motor action's performance.

Table 1. The main examples of the scaffolding metaphor that allow reconstruction of its possible history.

Author, year	Original word	Context (interpretation)	Metaphorical connotations
Hegel, 1812	<i>Gerüst</i> (German), in English translated as <i>scaffolding</i>	Categorical consequences of sensory experience as an illusion of scaffolding of a physical laws' proof. It falls away at the next turn of scientific endeavor, but its core may be preserved due to the peculiarity of sublation (see footnote 4).	<ul style="list-style-type: none"> – Skeleton of a building – Temporary construction
Marx, 1847	<i>Échafaudage</i> (French) (in Russian translated as здания, строительные леса)	A skeleton of categories as a scaffolding of ideas that is empty and arbitrary unless the categories have immersed in practice and obtained from there in the analysis.	<ul style="list-style-type: none"> – Skeleton of a building – Temporary construction
Lenin, 1901, and other revolutionaries	Строительные леса	Support for the process of ideology spreading or of establishing of communism. The revolutionary means are temporary until the building of communism will stand on its own.	<ul style="list-style-type: none"> – Temporary construction – Support of the workers or of the building
Vygotsky, 1929	леса	An analogy between a word and an instrument as the scaffolding of the future theory. Approximation of the future theory by previous theoretical construction.	<ul style="list-style-type: none"> – Temporary construction – Approximation of a future building
Luria, 1929	“в лесах”	A description of walking skill at the early stages of development: a child is supported by external objects and a parent's hands while walking, and later this function is replaced by internal neurodynamic processes.	<ul style="list-style-type: none"> – Temporary help by external tools – Replacement of a scaffold by the built construction
Bernstein, 1947 and approximately 1949	Строительные леса	A metaphorical description of the development of motor control functional system that consists of a leading level and lower levels. The leading level plays a role of scaffolding for the background levels. In 1949 this process is explained by two metaphors: “crutches” take part in realization of the action and “scaffolding” provides the sensory feedback about the action fulfillment.	<ul style="list-style-type: none"> – Temporary help by external tools – Replacement of a scaffold by the built construction

From early history to elaboration of the scaffolding metaphor in 1976

Scaffolding in Bernstein and in Wood, Bruner, and Ross: A comparison

We now compare Bernstein's scaffolding by the leading level of a motor action's regulation (such as visual control and corrections in learning to play the piano) with the scaffolding concept as it was introduced by Wood et al. (1976). We suggest that Bernstein describes the *intrasubjective* process of new skill mastery, whereas Wood et al. (1976) talk about *intersubjective* process of teaching and learning. However, we explain next that these two scaffolding processes match quite well as soon as we consider the leading level of movement regulation as an independent entity, such as an adult.

Wood et al. (1976) summarized their findings in terms of six “scaffolding functions” (p. 98), namely, *recruitment*, *reduction in degrees of freedom*, *direction maintenance*, *marking critical features*, *frustration control*, and *demonstration*. The functions of *recruitment*; *direction maintenance*; and, partially, *frustration control* correspond to an adult's activity of introducing the target task and then keeping the child focused on it. In Bernstein's system, it would correspond to maintenance of

practicing this particular skill without distraction by any other activity. This deliberate focus is the responsibility of the leading level of activity in the process of self-regulation. The importance of this sustainment of goal-oriented activity corresponds to the idea that any motor action emerges as a solution of a motor problem, as a bridge from the current state to the required future.

The *marking critical features* corresponds to the situation when tutors provide “information about the discrepancy between what the child has produced and what he [the tutor] would recognize as a correct production” (Wood et al., 1976, p. 98). Comparing with the Bernstein system, this scaffolding function is similar to an essential mechanism of movement control: The sensory feedback from the environment about the action fulfillment (e.g., visual information), the factual state (*Istwert*, as Bernstein, 1967, called it in German), is further compared with an anticipation of the movements, an expected state (*Sollwert*, German) (cf. “a correct production”), and then the further movement is adjusted according to discrepancy between them. This mechanism unpacks the target solution of a motor problem as a system of anticipations at all levels of motor control, as a *model of the desired future*. In the case of teaching, the tutor holds this model of the future, whereas the child should constitute it within his system of regulation.

The *reduction in degrees of freedom* is explicitly adopted from Bernstein and interpreted by Wood et al. (1976) as “simplifying the task by reducing the number of constituent acts required to reach solution,” while the tutor “fills in the rest” (p. 98). Indeed, as we have already mentioned, one way in which the leading level controls an action is “spastic fixation” of a movement to acquire better control of it (Bernstein, 1967). For example, in the early stages of practice, a pianist would hold the fingers in tension to prevent uncontrolled movements and thus simplify the motor problem that needs to be resolved.

The last scaffolding function according to Wood and colleagues is *demonstration* or “modeling” of the task solution for the child, who is supposed to imitate it.

However, “the only acts that children imitate are those they can already do fairly well” (Wood et al., 1976, p. 99). This finding is consonant with the possibility of imitation, which according to Vygotsky (1978) can take place only within the ZPD. Continuing our parallel between Bernstein and Wood, Bruner and Ross, we notice that the background levels of motor action regulation are unable to repeat (to imitate) the task that is performed under the leading level of regulation until they would form an ensemble of a functional system, which is oriented toward this task competency. Then, the background levels of movement regulation develop the “genuine corrections” (Bernstein, 1947) and motor skill development moves to the next stage.

Our analysis reveals the functional similarity of scaffolding terms in Bernstein’s theory of motor skill development and in Wood et al. (1976) despite the diverse domains: The meaning of scaffolding keeps its essential properties, namely, a temporary quality of support and creation of a new functional system by contingent interaction between a leading level and the background levels or between an adult and a child. Moreover, this similarity between *intrasubjective* and *intersubjective* processes was noticed by Bernstein (1991/1996):

Then in some time corrections in an appropriate background level mature and strengthen. The background level breaks free from the leading one, which has been supporting it (like the hand of an adult supporting the child who is trying to learn to swim), and takes entire responsibility for the new automatism. (p. 192)

As the conceptual similarity of the scaffolding concept in Bernstein (1947, 1991/1996) and in Wood et al. (1976) has been explicated, we now show how this concept transferred from the Soviet physiologist to the authors of the article that was written by Bruner and colleagues in the 1970s. To keep the intrigue, we note that Bernstein’s text on scaffolding was not translated into English until 1996.

Friendship behind the history of scaffolding

The final part of our historical endeavor should be interpreted as archive-based reconstruction of the possible events that led to the transfer of the metaphor over the ocean.

At the outset, we mention that there is contradictory evidence. David Wood, in a recent interview (“Entretien avec David Wood,” 2017), recalls that around 1971 they were discussing the results of their tutoring research at the laboratory seminars conducted by Bruner. At that time, they were considering several terms, such as “interface,” “framework,” “supporting structure,” and “eventually, we decided that the term ‘scaffolding’ might be suitable” (p. 6). Bruner, who had previously described the scaffolding metaphor as related to Vygotsky’s heritage (Bruner, 1986, 1987, 1997), later commented that this metaphor was “just one of those ‘labeling intuitions’ that came out of the blue!” (R. Lake, correspondence with Jerome Bruner, June 6, 2016).

Although these memories do not show any connection of the scaffolding metaphor with the previous history we have just sketched (Bernstein, 1947, 1991/1996; Luria & Vygotsky, 1930/1992), we introduce the oral history of the metaphor to shed light on this connection. Particularly, our investigation of biographical materials and the analysis of Bruner’s and Luria’s archives revealed the friendships among the protagonists of our story as an essential part of the idea’s transfer.

Vygotsky, Luria, and Bernstein were working together in the Institute of Psychology from 1925 to 1927 (Sirotkina, 1996) and were helping each other in their scientific projects. Although they were contributing to different disciplines, Luria and Bernstein later became close friends (Feigenberg, 2014). They shared the same, broad theoretical commitments, and despite differences in their research program they discussed many ideas, which were later incorporated into Luria’s cultural-historical neuropsychology and Bernstein’s physiology of activity.

Remarkably, in the late book *The Working Brain*, Luria (1973) many times acknowledged Bernstein as a prominent researcher, as well as Vygotsky (see also Akhutina, 2003), as they both played essential roles in elaboration of the fundamental principles that Luria employed in his neuropsychology. We would even speculate that this book by Luria merges Vygotsky’s ideas on social development of voluntary actions (Vygotsky, 1978) and Bernstein’s clarification of the systemic organization of motor action’s construction (Bernstein, 1947). The concept of scaffolding, as presented in Wood et al. (1976) and in Bruner (1975a, 1975b), appears to be a detailed and well-elaborated synthesis of these ideas toward the issues of learning in interaction with a more knowledgeable peer (see Section *Cognitive skills mastery and motor development: Building on both Vygotsky and Bernstein* for further elaboration).

It is known that Luria and Bruner were close friends for many years. Bruner referred to Luria as a father figure (see a quotation from Bruner in the biographical book by E. A. Luria, 1994, and interview with Michael Cole about Luria¹²). They met in person several times, and rich correspondence between them over almost 20 years has been preserved.

Working at Luria’s family archive,¹³ we figured out that in November 1968, Luria strongly recommended Bruner to read Bernstein’s work that had just been published in English (Bernstein, 1967). Bruner highly appreciated this recommendation: “First let me tell you that the Bernstein volume is absolutely superb” (letter to Luria, December 1967; copy provided by Luria’s Family archive). In the letter dated January 1968, Luria briefly described Bernstein’s main ideas, including the system of different levels of motor control and the idea of comparison of actual fulfillment of motor action (*Istwert*) and its anticipated form (*Sollwert*). Just a bit later, Bruner in an article about the development of infants’ early motor skills (Bruner, 1970) dedicated a few pages to Bernstein’s system of reafferentation and comparison between an actual fulfillment and the planned action. Bruner also adopted the idea of reducing the degrees of freedom in the development of a new motor skill from Bernstein.

We suggest that Luria may have mentioned the scaffolding metaphor in their conversations, which sometimes were so engaged that doctors would not allow Luria to continue (E. A. Luria, 1994). For example, they met in 1969 at a conference in London, when Bruner was thinking about the development of skilled movement in infancy and about Bernstein’s research. Later, they met in

Liege in July 1971; these meetings happened at the time when both of them were studying children's abilities at an early age.¹⁴

From the Luria–Bruner correspondence, we know that their discussions influenced Bruner's writing. For instance, sending a draft of a paper (Bruner, 1975b) in which he mentioned scaffolding to Luria, Bruner wrote in a supplementary note: "I am enclosing my new paper, 'Ontogenesis of Speech Acts.' You will find familiar echoes of part conversations in it!" (letter to Luria, July 19, 1974; copy provided by Luria's Family archive)

Analyzing the unpublished materials and Bruner's correspondence in the Harvard University Archives, we found an early version of a Feitelson and Ross (1973) article that was written under Bruner's supervision no later than November 29, 1971. This version already included the word *scaffold* a few times as an expression for the tutor's function:

The tutor works with the child at accomplishing the task. She serves as a scaffold. If there are aspects of the task the child cannot yet perform for himself, she fills in the gaps until he can do so. In this way, the child sees that the behavior is effective toward reaching the goal even if he can not yet complete the whole task himself, and he is, therefore, encouraged to learn the means by which he can eventually reach the goal independently. ([Ross, 1971?], p. 28, unpublished manuscript)

In this manuscript, the scaffolding function is already considered as covering the gap or bridging the current child's abilities and the target task. As the paper unfolds further, it provides us with the analysis of gradual transfer of initiative, decrease of the provided help and encouragement of responsibility during the scaffolding process (cf. with transfer of responsibility and fading of scaffolding in Van de Pol, Volman, & Beishuizen, 2010).

Bruner liked the description of the tutoring process in this manuscript ([Ross, 1971?]) in particular and intended to make a chapter for a monograph from it. Perhaps a part of it became the basis for a text by Wood et al. (1973) that was also found in the archive and that was referred to by Bruner (1973) as a chapter in press. Unfortunately, the monograph was never published, and the chapter was transformed into a journal article by Wood et al. (1976).

Although this earlier version (Wood et al., 1973) does not clearly point to the Vygotsky–Luria circle, there are some traces of the possible ongoing discussions with Luria. Introducing the "scaffolding function," the authors begin with the concept of "the reduction of degrees of freedom" (a Bernsteinian term) and elaborate this property of scaffolding more than others. Moreover, the description of this process starts from an example of how the parents reduce the degrees of freedom for a child who has just started to walk that exactly matches the way Luria used the scaffolding metaphor early in his career (Luria & Vygotsky, 1930/1992).

According to the archives, at some stage of writing, the Wood et al. (1976) article also had a clear connection with the teaching/learning¹⁵ versus development opposition (Vygotsky, 1978): "And it may well be that a closest inspection of the nature of comprehension and production would lead to a reconciliation of differences in studies of the impact of 'instruction' on the course of development" (Wood et al., 1973, p. 24).¹⁶

Later, Bruner intended to give a talk in January 1973 on "the theory of the tutors." However, his possible future research plans on this topic were not fulfilled due to a change in his university position. It was the summer of 1972 when he moved from Harvard to Oxford to start his new lines of research, mostly on early childhood motor and language development.

Taken as a whole, these archival findings suggest that it was as a consequence of personal contacts, oral discussions, and correspondence that the scaffolding metaphor traveled from the USSR to Europe and the United States and from movement control development studies to educational theory, research, and practice. Perhaps Bruner himself did not have clear memories of how this transfer happened but was aware of tight relations between the scaffolding metaphor and Vygotsky's circle (Bruner, 1986, 1987, 1997).

Discussion: From the historical investigation to future theoretical elaboration

Why do these details of the history of the concept of scaffolding matter? In this section, we propose the key ideas that analysis of early instances of the scaffolding metaphor may bring to contemporary understanding of the scaffolding process. We argue that appropriation of these historical connotations would allow keeping the term congruent to the tradition of cultural-historical approaches in educational and developmental studies and their philosophical roots, and thus help to avoid watered-down meanings of scaffolding as any kind of support.

Cognitive skills mastery and motor development: Building on both Vygotsky and Bernstein

In their commentary to Bernstein's (1991/1996) *Dexterity and Its Development*, Reed and Bril (1996) expand Bernstein's theory of motor development to include the cultural development of the appropriate motor actions. Following Rogoff (1990), the authors approach the term *scaffolding* as an adult's activity of "bridging" the current state of the child's abilities with the future, required state, which is known by the adult. From their perspective, the culturally appropriate way of acting appears at first in a form of co-action with an adult, and development of the independent culturally appropriate action requires a discovery of "dynamically stable solutions" (Reed & Bril, 1996, p. 438) of a motor problem. In this type of pedagogy, direct instructions are considered as constraints (Newell & Ranganathan, 2010) that the developing skill needs to fit, and scaffolding activity of the teacher, including the reduction of degrees of freedom, could be considered as another type of constraint. The stable solution, which needs to be found by the learner, is not determined by the cultural strategy but emerges as an embodied discovery within the teaching constraints. The same approach of nonlinear pedagogy is proposed in other learning domains, such as sports (Chow et al., 2007) and mathematics (Abrahamson & Sánchez-García, 2016; Abrahamson & Trninic, 2015).

However, the role of the teacher (or *more knowledgeable other*) cannot be diminished to a constraint independent from the learner, because the teacher in her scaffolding does interact with the student as a dynamical system (Bakker, 2018) and they together form an intersubjective perception-action system (Shvarts & Abrahamson, under review). Thus, the scaffolding process is already a reorganization within the functional system of the child's ability, which is considered as a crucial transformation in ZPD (Griffin & Cole, 1984).

It is the preceding anticipation of the future by the adult that contingently influences the ongoing activity in a true cooperation with the child's emerging abilities; in cultural approaches, it has been referred to as *prolepsis* (Cole, 1996; Stone, 1998). The prolepsis, or anticipation of the future, distinguishes a functional system, as proposed by Bernstein as well as by Vygotsky and Luria, from a self-organizing process of a complex dynamical system, because the functional system finds its stable solution within the functionally anticipated outcome from broader historical and societal systems. At the microembodied level, this anticipation is realized by Bernstein's *model of desired future*¹⁷ that in the case of scaffolding is constituted at the leading level of motor control but later is distributed between different background levels.

In Bernstein's system, the leading level of motor regulation can sustain a motor act only as it scaffolds the background levels, but it could never "instruct" them, as each level of regulation has its own system of sensory corrections. For example, the visual control of the pianist's fingers does not form anticipations and feedback within the proprioceptive system; moreover, the involvement of the background levels of motor or cognitive action regulation "are not seen from outside" (Bernstein, 1996, p. 185). It is an intrinsically creative process of a new functional system constitution that would realize the action of playing piano and what earlier needed to be scaffolded (corrected and controlled) visually will not be attended any more as soon as automatization takes place.

Transferring this theoretical scheme to the *intersubjective* scaffolding of a learner by a teacher, we look at the teacher's role as establishing conditions in which the learner may sense the required future state and creatively constitute her own system of action control and a system of sensory

corrections. Moreover, in some cases, the learner may become aware of her own system of regulation only after sufficient *repetitions without repetitions*¹⁸ (Bernstein, 1996, p. 204) in cooperation with the teacher—the practice establishes some regulative pattern that only later surfaces for the student as an articulated strategy (Trninic, 2018).

The process of *transfer of responsibility* (Van de Pol et al., 2010) matches with Vygotsky's idea of interiorization (*ingrowing*) when a child appropriates the *intersubjective* function that has manifested in the scaffolding process. The child's regulative processes form a new functional system, which fulfills the adult's function but does not repeat the structure and mechanisms of the adult's support and corrections: “*Only in the beginning, ingrowing fully repeats the instrumental act internally, then abbreviations, a short circuit, and profound changes*” (Zavershneva & Van der Veer, 2018, p. 121). The appropriation of a new function is not the end of the mastery process, because a long development of internal mechanisms follows the very first accomplishment of the new action. This development was investigated by Bernstein in his studies of motor control when he proposed the scaffolding metaphor to refer to an *intrasubjective* process at the early stages of this mastery. Thus, *intersubjective* scaffolding transforms into *intrasubjective* scaffolding, the self-scaffolding that is fulfilled by one person toward herself until the development of a fluent and automatized competency is reached and no scaffolding is needed. Thus, we suggest that in this theoretical perspective the term scaffolding will naturally fit both Vygotsky's and Bernstein's broad theoretical systems.

The self-scaffolding after the fading of scaffolding: From teaching/learning to development

In the introduction, we suggested that myths about scaffolding being a Vygotskian term promote the tendency to merge the ideas of scaffolding and ZPD, which is a specific zone of the tasks that can be accomplished by a child with the help of a more mature peer or adult but lies beyond the capabilities of this child alone. Much has been written about the comparison of ZPD and scaffolding (e.g., Cazden, 1979; Smagorinsky, 2018; Stone, 1998) and in some cases (e.g., Belland, 2017; Bruner, 1986; Holton & Clarke, 2006) these terms are considered as a natural continuation of each other. In contrast, Smagorinsky (2018) notices that unlike ZPD, which was introduced in the heart of Vygotsky's analysis of development versus teaching/learning process, the term *scaffolding* is often used to address a very short time of a particular teaching episode that is finished with the fading of scaffolding. Yet some authors stress the importance of long-term scaffolding processes until independence is achieved (e.g., Smit & Van Eerde, 2013).

Taking into account the historical and functional congruency between educational *intersubjective* scaffolding and Bernstein's *intrasubjective* scaffolding in the development of motor action, we suggest that scaffolding, as a process of teaching within a ZPD, exactly evokes the developmental processes. Wood et al. (1976) also mentioned this broader impact that the scaffolding process may have “in development of task competence by the learner at a pace that would far outstrip his unassisted efforts” (p. 90).

As previously mentioned, from our theoretical perspective that builds on Vygotsky and Bernstein, a period of self-scaffolding follows the fading of external support. At first, the learner consciously regulates the acquired skill, whereas later, when the new skill would be initiated many times in a variety of internal and external conditions (*repetition without repetition*), internal mechanisms may elaborate their own system of regulation, the skill becomes automatized and self-scaffolding will not be needed any more.

There is some literature on self-scaffolding (Bickhard, 2005; Holton & Clarke, 2006; Valsiner, 2005), which we argue needs further elaboration. In these publications, self-scaffolding is mostly considered as a metacognitive process when a child deliberately functions as an adult in relation to his own behavior. This is congruent with Vygotsky's prominent example of egocentric speech that “in-grows” and transforms into internal speech by which a child regulates her own behavior.

However, scaffolding by the leading level of motor control does not require speech. The vision helps a novice pianist to hit appropriate keys and careful attention is required for the movements of

our legs on the car's pedals when we are just beginning to learn. In the same way, we may observe the traces of nonverbal self-scaffolding that follow distributed accomplishment of a task between a child or a student and a more knowledgeable other in empirical research: These are self-regulatory gestures that allow a child (Rodríguez, Estrada, Moreno-Llanos, & de los Reyes, 2017; Rodríguez & Palacios, 2007; Saxe & Kaplan, 1981) or a student (Shvarts, 2018) to regulate her own activity.

From this perspective, the fading of scaffolding does not mean the removal of the provided support but an appropriation of this function by the child and, according to late (not before 1933) notes by Vygotsky (Zavershneva & Van der Veer, 2018), “differentiation” of the child from the child–adult system, as she is capable now to resolve the new problem independently. However, “when teaching according to the program had ended, development began” (p. 354). Per Vygotsky, the just learned scientific concept needs “the *run inward*” (p. 355) and to become a spontaneous one. In this process, we may expect the self-scaffolding to take place.

As soon as we consider a transfer of the scaffolding function from external help into an internal process, scaffolding in teaching becomes exactly the mechanism that “awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment” (Vygotsky, 1978, p. 90). In the case of motor development, this internal process of honing the new skill may take many years until the initial scaffolding by the leading level of control, including the limitation of degrees of freedom, is removed and replaced by “genuine corrections”; by this time our pianist does not need to look at the fingers (nor even at the written score of the music), and an adolescent's walking has become smooth and flexible as the levels of motor regulation co-act in harmony (Bernstein, 1991/1996). The same long process of development toward a qualitative change after the teaching/learning within the ZPD is anticipated by Vygotsky concerning scientific concepts (Zavershneva & Van der Veer, 2018).

Scaffolding: An ambiguity of metaphorical meanings and a request for a definition

Finally, as we come to judge the history of the scaffolding metaphor into developmental and educational psychology, we claim that the metaphor was indeed borrowed by Bruner and his colleagues from Vygotsky's circle, and first of all from Bernstein. This metaphor was barely elaborated in Soviet psychology and physiology, where it was originally applied to motor development rather than to education. However, the tradition of culture-historical approach appears to be the relevant source for this metaphor that Wood et al. (1976) insightfully transferred to the description of a teaching/learning process.

Despite the clear historical ground that now is established, we have to acknowledge that the metaphor itself is rather problematic. If we consider scaffolding as a contingent collaboration between a child and an adult as they form a functional system, in which a child is capable of solving a problem that she is incapable of solving alone, the parallel of constructing a building is complicated and ambiguous. The scaffolding metaphor has different interpretations, depending on whether it is the building that is supported, or the workers (see Figure 2).

This ambiguity became one of the factors in blurring its meaning. For example, Griffin and Cole (1984) interpreted it as a support for the workers, not for the developing skill (the erected building). This interpretation is, perhaps, the closest to Vygotsky's description of teaching/learning within ZPD as it leads “the child to carry out activities that force him to rise above himself” (Vygotsky, 1987, p. 213). Holton and Clarke (2006) thought of a scaffolding as something that allows “learners to reach places that they would otherwise be unable to reach” (p. 129), whereas another meaning of the metaphor is the temporary support of the building being erected (e.g., Bakker et al., 2015) or of a bridge (see also footnote 10).

Figure 2a–2c provide the diverse images that people may have as they think of scaffolding. Whereas Figure 2a represents the ordinary scaffolding of these days, in Figure 2b the scaffolding looks merged with the *framing* that was used to form a skeleton of a building (cf. with the meaning of scaffolding in Hegel's writings, with *framework* as a possible term for the scaffolding according

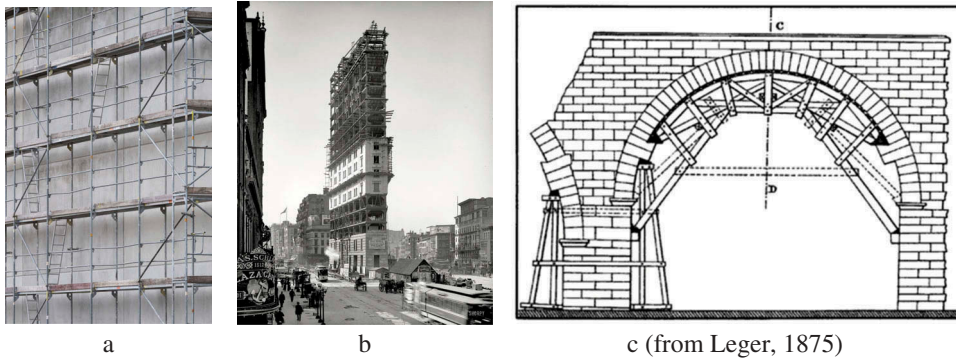


Figure 2. Diverse constructive contrivances that may be referred to as scaffolding.

The image (a) was retrieved from <https://pixabay.com/en/scaffold-scaffolding-site-build-2710842/>

The image (b) was retrieved from https://fr.m.wikipedia.org/wiki/Fichier:One_Times_Square_under_construction_1903.jpg

to David Wood, and with *format* that emerged in memories of that period of time by Pea, 2004). Figure 2c illustrates the construction of arches in Roman time, and this version corresponds to the “crutches” part of the Bernstein’s metaphorical explanation: an arch cannot stand on its own until it is finished and the final stone is put in (see Lancaster, 2005, for the technical details of Roman arches). When the arch is ready, the scaffolding may be removed.

In our opinion, the last example fits best to the description of a temporary adaptive support that is provided until a student or a child is capable to solve the task for herself. Indeed, the goal is shared since the direction of the bridge span is determined by the environment, and then the scaffolding helps to construct the bridge until the arc is able to stand on its own: “If there are aspects of the task the child cannot yet perform for himself, she [the tutor] fills in the gaps until he can do so,” and thus functions as a scaffold ([Ross, 1971?], unpublished manuscript). The arch in Figure 2c itself serves the same function of going over the gap as the previous scaffolding did. However, none of these interpretations clearly reflects the idea of a functional system that emerges between a child and an adult, as they both iteratively and contingently adapt to each other while solving a particular learning task and reaching a more general aim of learning.

Our position on the scaffolding metaphor corresponds to the positions that have been articulated earlier (e.g., Bakker et al., 2015; Stone, 1998; Van de Pol et al., 2010): Whereas scaffolding obviously grasps some important phenomenon in the teaching/learning process, it is important to keep scaffolding as a term with a clear definition or, at least, stick to its particular characteristics, rather than purely as a metaphor that may trigger different associations. This process of transfer from metaphorical meaning to a scientific term is currently happening in Russia where this term is usually phonetically written as “скаффолдинг” without translation (e.g., Akhutina & Pylaeva, 2012; Kotliar & Safronova, 2011); in other cases it is translated as “система опор” (“a system of supports”; White, 2010) or “опоры” (“supports”; Tsukerman, Obukhova, Ryabinina, & Shibanova, 2017).

We acknowledge that the concept of scaffolding should be allowed to travel (Bal, 2009) and expand to other learning systems (such as whole-class scaffolding; e.g. Smit, Van Eerde, & Bakker, 2013) or computer-based scaffolding (e.g., Belland, 2017). However, in any case we expect to find the characteristics of a temporary adaptive support that forms a functional system with the learner.

Conclusions

In our historical endeavor, we investigated if the scaffolding concept can be attributed to Vygotsky and can be incorporated into the theory of ZPD. Our historical research showed that there are rare instances of this metaphor by Vygotsky and his colleagues Luria and Bernstein. We also speculated on possible earlier origins of the metaphor in Hegel’s and Marx’s methodological works and in communist revolutionary texts. Following the history of oral communications between Russian researchers, including the friendship

between Luria and Bruner, and having investigated their intensive correspondence, we propose that all these mentions of scaffolding are interrelated. However, neither Vygotsky nor Luria or Bernstein used this metaphor in an educational context.

We elaborated on Bernstein's usage of the metaphor and claimed that Bernstein influenced Wood, Bruner, and Ross's promotion of scaffolding in educational psychology. In particular, we argued that it is worthwhile to consider the similarity between *intrasubjective* scaffolding in motor control development (Bernstein) and *intersubjective* scaffolding in teaching-learning situations (Wood, Bruner, and Ross and their followers). This theoretical parallel enriches contemporary understanding of scaffolding as *a temporary adaptive support* in a historically congruent way by the idea of teacher–student or adult–child *functional system* that is constituted in an accomplishment of some task, thus bridging current state of the student's abilities with an *anticipated future state*.

In this article, we developed an understanding of scaffolding as a concept that entails the heritage of both Bernstein and Vygotsky and sketched theoretical consequences of this bridging of two theories, which need further investigation. We introduced an idea of *intrasubjective* self-scaffolding as self-regulation that follows the fading of *intersubjective* scaffolding by an adult. Currently, there are limited empirical evidences of such process beyond the classical example of egocentric speech. We also claim that scaffolding within ZPD may trigger the developmental process and lead to qualitative change much later, when a skill or a concept acquired through teaching/learning would undergo a further developmental change. However, broad literature review and empirical research are needed to clarify possible postponed transformations, their conditions, and interrelations with scaffolding.

We do hope that our historical analysis serves in retaining the richness and specificity of this important educational and psychological concept and contributes to its further theoretical development.

Acknowledgments

We thank many people who helped us on the way of this historical endeavor by pointing to the possible sources, providing the materials, or helping with their interpretations and memories: Shaaron Ainsworth, Angelika Bikner-Ahsbabs, Tatiana Akhutina, Anatoly Chusov, Mike Cole, Jan Derry, Maria Falikman, Thomas Janßen, Anatoly Krichevets, Nadezhda Plungian, Aleksandra Radkovskaya, Gail Ross, Irina Sirotkina, Dragan Trninic, René van der Veer, David Wood, Ekaterina Zavershneva, and the staff of Harvard University Archive, who were very responsive and helpful.

Notes

1. Personal communication, May 1, 2018.
2. Personal communication, March 26, 2018.
3. The permission to work and to cite materials from Jerome Bruner's personal archive was granted by Whitley Bruner.
4. René van der Veer (personal communication, February 4, 2018); Ekaterina Zavershneva (personal communication, November 20, 2017).
5. *To sublate* is an English translation of German *aufheben* that has “a twofold meaning ...: it equally means ‘to keep,’ ‘to preserve,’ and ‘to cause to cease,’ ‘to put an end to’” (Hegel, 2010, pp. 81–82). Hegel used this word as a core concept in the description of the dialectical method as a contradiction between the thesis and antithesis is overcome in the synthesis.
6. Originally, Marx wrote this in French, and the word was *échafaudage*; it was translated into Russian as *здания* (buildings; Marx, 1919) and *строительные леса* (constructions for building erection; Marx & Engels, 1955).
7. Starting from ideological pressure in 1931 and strongly continued in 1936, the political campaign against Pedology—the general science of children development and learning—led to a ban on Vygotsky's books, as a main theorist of this science until the middle of the 1950s (Yaroshevskiy, 1991). Bernstein was also not allowed to publish between 1949 and the early 1960s due to his independence from official Soviet science ideas (Sirotkina, 2018) and Jewish origins (Talis, 2015).
8. The Russian text is “его ходьба еще не готова, она еще ‘в лесах’ тех внешних орудий, с помощью которых она создается” (Vygotsky & Luria, 1930/1993a, p. 196).
9. According to Bernstein, each motor action is regulated at a few levels of control: Level A sustains appropriate tone and equilibrium, Level B serves the muscular-articular links and synergies and fulfills kinematic coordination, Level C is responsible for the movement in space, Level D performs actions with objects and artifacts, and

Level E is responsible for intellectual and symbolic actions. In each motor act, there is the leading, highest level of regulation that fulfills the required action together with the other background, subsidiary levels that provide necessary corrections. All levels work as an ensemble and compound a functional system. Level C2 is the sublevel of Level C that is responsible for precise movements, such as reaching for something and throwing at the target. This sublevel Bernstein distinguishes as the lowest level, which may control a new motor skill development while it stays under voluntary control.

10. The book was ready for publishing by the summer of 1949 but was stopped due to the repression against Bernstein, who did not acknowledge Pavlov as a prominent Soviet physiologist (Sirotkina, 2018) during an anti-Semitic campaign “against cosmopolitanism” (Talis, 2015).
11. It is interesting to note that Bernstein’s hobby was the construction of bridges. His brother became an engineer of bridges (Levin, 2005), and he himself had published a few popular articles on bridge construction (e.g., Bernstein, 1965). The bridge’s scaffolding is a rare case of scaffolds that support an erected construction as they help to reach the next column and to support the span of a bridge until it will be locked and can stand on its own (see Figure 1c).
12. http://luria.ucsd.edu/AudioVideo/DVD_Luria4.mp4 transcribed here: <http://www.psyanima.su/journal/2013/1/2013n1a3/2013n1a3.1.pdf>.
13. The permission to work and to cite materials from Alexander Luria’s family archive was granted by Elena Radkovskaya
14. See Bruner (1973) for a review and the studies with Subbotsky on voluntary control by speech (Luria, 1979).
15. We use “teaching/learning” as a specific translation for Russian *obuchenie*, aiming to stress the interactive process between a teacher and a student as it was essential for Vygotsky. This contrasts with an interpretation of *obuchenie* as instruction (Cole, 2009).
16. The published version of the paper (Wood et al., 1976) refers to this discussion as well, but in a less explicit way: “We assume, however, that the process can potentially achieve much more for the learner than an assisted completion of the task. It may result, eventually, in development of task competence by the learner at a pace that would far outstrip his unassisted efforts” (p. 90).
17. Sometimes it can also be referred as “forward model” (e.g., Rahaman, Agrawal, Srivastava, & Chandrasekharan, 2018). From a phenomenological theoretical perspective (Merleau-Ponty, 2002; Zagorianakos & Shvarts, 2015), this embodied form of future anticipation would be conceptualized as *operative intentionality*.
18. According to Bernstein, a real exercise is happening with iterative transformations of the movements as it is getting better and better coordinated within the environment, thus despite the repetitive actions, there is no exact repetition.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Anna Shvarts  <http://orcid.org/0000-0001-6556-0058>

Arthur Bakker  <http://orcid.org/0000-0002-9604-3448>

References

- Abrahamson, D., & Sánchez-García, R. (2016). Learning is moving in new ways: The ecological dynamics of mathematics education. *The Journal of the Learning Sciences*, 25(2), 203–239. doi:10.1080/10508406.2016.1143370
- Abrahamson, D., & Trninic, D. (2015). Bringing forth mathematical concepts: Signifying sensorimotor enactment in fields of promoted action. *ZDM Mathematics Education*, 47(2), 295–306. doi:10.1007/s11858-014-0620-0
- Akhutina, T. V. (2003). L.S. Vygotsky and A.R. Luria: Foundations of neuropsychology. *Journal of Russian and East European Psychology*, 41(3–4), 159–190. doi:10.2753/RPO1061-0405410304159
- Akhutina, T. V., & Pylaeva, N. M. (2012). *Overcoming learning disabilities*. Cambridge, England: Cambridge University Press.
- Ausubel, D. P. (1963). *The psychology of meaningful verbal learning*. New York, NY: Grune & Stratton.
- Bakker, A. (2018). Discovery learning: Zombie, phoenix, or elephant? *Instructional Science*, 46(1), 169–183. doi:10.1007/s11251-018-9450-8
- Bakker, A., Smit, J., & Wegerif, R. (2015). Scaffolding and dialogic teaching in mathematics education: Introduction and review. *ZDM Mathematics Education*, 47(7), 1047–1065. doi:10.1007/s11858-015-0738-8
- Bal, M. (2009). Working with concepts. *European Journal of English Studies*, 13(1), 13–23. doi:10.1080/13825570802708121

- Belland, B. R. (2017). *Instructional scaffolding in STEM education*. Cham, Switzerland: Springer International Publishing.
- Bernstein, A. N. (1965). Kak byl postroen syzranskiy most [How a bridge in Syzran was built]. *Nauka i Zhizn* (5), 146.
- Bernstein, A. N. (1967). *The co-ordination and regulation of movements*. New York, NY: Pergamon press.
- Bernstein, N. (1996). *Dexterity and its development* (M. L. Latash & M. T. Turvey, Eds.). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Bernstein, N. A. (1947). *O postroenii dvizheniy* [On the construction of movements]. Moscow, USSR: Medgiz.
- Bickhard, M. H. (2005). Functional scaffolding and self-scaffolding. *New Ideas in Psychology*, 23(3), 166–173. doi:10.1016/j.newideapsych.2006.04.001
- Bodrova, E., Leong, D. J., & Akhutina, T. V. (2011). When everything new is well-forgotten old: Vygotsky/Luria insights in the development of executive functions. *New Directions for Child and Adolescent Development*, 2011, 11–28. doi:10.1002/cd.v2011.133
- Bruner, J. S. (1970). The growth and structure of skill. In K. J. Connolly (Ed.), *Mechanisms of motor skill development* (pp. 62–94). New York, NY: Academic Press.
- Bruner, J. S. (1973). Organization of early skilled action. *Child Development*, 44(1), 1–11. doi:10.2307/1127671
- Bruner, J. S. (1975a). From communication to language - A psychological perspective. *Cognition*, 3(3), 255–287. doi:10.1016/0010-0277(74)90012-2
- Bruner, J. S. (1975b). The ontogenesis of speech acts. *Journal of Child Language*, 2(1), 1–19. doi:10.1017/S0305000900000866
- Bruner, J. S. (1986). *Actual minds, possible worlds*. Cambridge, MA: Harvard University Press.
- Bruner, J. S. (1987). Prologue to the English Edition. In R. W. Rieber & A. S. Carton (Eds.), *The collected works of L. S. Vygotsky. Volume 1. Problems of general psychology* (pp. 1–16). Boston, MA: Springer US.
- Bruner, J. S. (1997). Celebrating divergence: Piaget and Vygotsky. *Human Development*, 40(2), 63–73. doi:10.1159/000278705
- Cazden, C. (1979). Peekaboo as an instructional model: Discourse development at home and at school. *Papers and Reports on Child Language Development*, 17. Retrieved from <https://eric.ed.gov/?id=ED191274>
- Chow, J. Y., Davids, K., Button, C., Shuttleworth, R., Renshaw, I., & Araújo, D. (2007). The role of nonlinear pedagogy in physical education. *Review of Educational Research*, 77(3), 251–278. doi:10.3102/003465430305615
- Cole, M. (1996). *Cultural psychology: A once and future discipline* (Vol. 37). Cambridge, MA: Harvard University Press.
- Cole, M. (2009). The perils of translation: A first step in reconsidering Vygotsky's theory of development in relation to formal education. *Mind, Culture, and Activity*, 16(4), 291–295. doi:10.1080/10749030902795568
- de Leon, D. (1899, January 22). Goodbye, new party, goodbye. In *The people*. New York, NY. Retrieved from https://www.marxists.org/archive/deleon/pdf/1899/1899_jan22b.pdf
- Derry, J. (2013). *Vygotsky: Philosophy and education*. Oxford, England: John Wiley & Sons Ltd.
- Entretien avec David Wood pour le numéro spécial «L' aide en contexte numérique d' apprentissage»*. (2017). Retrieved from <https://journals.openedition.org/dms/1908?lang=en>
- Feigenberg, J. M. (2014). *Nikolai Bernstein: From reflex to the model of the future* (E. Loosch & V. Talis, Eds.). Zurich, Switzerland: LIT Verlag.
- Feitelson, D., & Ross, G. S. (1973). The neglected factor – play. *Human Development*, 16(3), 202–223. doi:10.1159/000271276
- Griffin, P., & Cole, M. (1984). Current activity for the future: The Zo-ped. *New Directions for Child and Adolescent Development*, 1984(23), 45–64. doi:10.1002/cd.23219842306
- Hegel, G. W. F. (2010). *The science of logic* (G. di Giovanni, Ed.). New York, NY: Cambridge University Press.
- Holton, D., & Clarke, D. (2006). Scaffolding and metacognition. *International Journal of Mathematical Education in Science and Technology*, 37(2), 127–143. doi:10.1080/00207390500285818
- Kotliar, I. A., & Safronova, M. A. (2011). Tri ponyatiya o realnosti detskogo razvitiya: Obuchaemost, zona blizhayshego razvitiya i skaffolding [Three concepts reflecting the reality of child development: Ability to learn, zone of proximal development and scaffolding]. *Cultural-Historical Psychology* (2), 74–83. Retrieved from <http://psyjournals.ru/en/kip/2011/n2/>
- Lake, R. (2016). *Re: Sad news – Jerry Bruner has died*. Retrieved from <http://lchc.ucsd.edu/MCA/Mail/xmcamail.2016-06.dir/msg00078.html>
- Lancaster, L. C. (2005). *Concrete vaulted construction in Imperial Rome: Innovations in context*. New York, NY: Cambridge University Press.
- Leger, A. (1875). *Les travaux publics, les mines et métallurgie aux temps des Romains*. Paris, France: Dejeu & C.
- Lenin, V. I. (1961). Where to begin? In *Lenin collected works* (Vol. 5, pp. 13–24). Moscow: Foreign Languages Publishing House. Retrieved from <https://www.marxists.org/archive/lenin/works/1901/may/04.htm#fwV05E001>
- Levin, V. (2005). Chelovek, razadvshij tainu zhivogo dvizhenia [A person who has guessed the mystery of an alive movement]. *Nauka i Zhizn* (10). Retrieved from <https://www.nkj.ru/archive/articles/2099/>
- Luria, A. R. (1973). *The working brain. An introduction to neuropsychology*. London, UK: Allen Lane.
- Luria, A. R. (1979). *Language and consciousness* [Yazyk i soznanie] (E.D. Khomskaya, Ed.). Moscow, USSR: Moscow University.

- Luria, A. R., & Vygotsky, L. S. (1992). *The child and his behavior*. In *Ape, primitive man, and child: Essays in the history of behaviour* (E. Rossiter, trans.). New York, NY: Harvester Wheatsheaf. Retrieved from <https://www.marxists.org/archive/vygotsky/works/1930/man/index.htm>
- Luria, E. A. (1994). *Moi otets A. R. Lurii* [My father A. R. Luria]. Moscow, Russia: Gnozis.
- Marx, K. (1885). The method. In *The poverty of philosophy*. Retrieved from <https://www.marxists.org/archive/marx/works/1847/poverty-philosophy/ch02.htm>
- Marx, K. (1919). *Nischeta Filosofii* [The poverty of philosophy] (V. Zasulich, Trans). Peterburg, USSR: Literaturno-Izdatskiy Otdel Narodnogo Komissariata po Prosvescheniyu. Retrieved from http://publ.lib.ru/ARCHIVES/M/MARKS_Karl_ENGEL'S_Fridrih/_Marks_K.,_Engel's_F.html
- Marx, K., & Engels, F. (1955). *Nischeta Filosofii* [The poverty of philosophy]. In *Collected works* (2nd ed., Vol. 4). Moscow, USSR: Politizdat. Retrieved from http://publ.lib.ru/ARCHIVES/M/MARKS_Karl_ENGEL'S_Fridrih/_Marks_K.,_Engel's_F.html
- Merleau-Ponty, M. (2002). *Phenomenology of perception*. London, England: Routledge.
- Newell, K., & Ranganathan, R. (2010). Instructions as constraints in motor skill acquisition. In G. Savelsbergh, K. Davids, & I. Renshaw (Eds.), *Motor learning in practice: A constraints-led approach* (pp. 17–32). London, England: Routledge.
- Pea, R. D. (2004). The social and technological dimensions of scaffolding and related theoretical concepts for learning, education, and human activity. *Journal of the Learning Sciences*, 13(3), 423–451. doi:10.1207/s15327809jls1303_6
- Rahaman, J., Agrawal, H., Srivastava, N., & Chandrasekharan, S. (2018). Recombinant enaction: Manipulatives generate new procedures in the imagination, by extending and recombining action spaces. *Cognitive Science*, 42(2), 370–415. doi:10.1111/cogs.2018.42.issue-2
- Reed, E. S., & Bril, B. (1996). The primacy of action in development. In M. L. Latash & M. T. Turvey (Eds.), *Dexterity and its development* (pp. 431–451). Mahwah, NJ: Lawrence Erlbaum Associates.
- Renshaw, P. D. (2013). The social cultural and emotional dimensions of scaffolding. *Learning, Culture and Social Interaction*, 2(1), 56–60. doi:10.1016/j.lcsi.2013.01.002
- Rodríguez, C., Estrada, L., Moreno-Llanos, I., & de los Reyes, J.-L. (2017). Executive functions and educational actions in an infant school: Private uses and gestures at the end of the first year. *Estudios de Psicología*, 38(2), 385–423. doi:10.1080/02109395.2017.1305061
- Rodríguez, C., & Palacios, P. (2007). Do private gestures have a self-regulatory function? *Infant Behavior and Development*, 30(2), 180–194. doi:10.1016/j.infbeh.2007.02.010
- Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York, NY: Oxford University Press.
- Ross, G. (1971). *No title*. Unpublished Manuscript. (HUG 4242.55 Box 1). Jerome Seymour Bruner Papers: Research Project 1970s. Harvard University Archives.
- Roth, W.-M. (2018). Translation and its consequences in qualitative social research: On distinguishing “the Social” from “the Societal”. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, 19(1), Art. 12. Retrieved from <http://dx.doi.org/10.17169/fqs-19.1.2988>
- Roth, W.-M., & Jornet, A. (2017). *Understanding educational psychology: A late Vygotskian, Spinozist approach*. Dordrecht, the Netherlands: Springer.
- Saxe, G. B., & Kaplan, R. (1981). Gesture in early counting: A developmental analysis. *Perceptual and Motor Skills*, 53(3), 851–854. doi:10.2466/pms.1981.53.3.851
- Shvarts, A. (2018). A dual eye-tracking study of objectification as student–Tutor joint activity appropriation. In E. Bergqvist, M. Österholm, C. Granberg, & L. Sumpter (Eds.), *Proceedings of the 42nd Conference of the International Group for the Psychology of Mathematics Education* (pp. 171–178). Umeå, Sweden: PME.
- Shvarts, A., & Abrahamson, D. (under review). Dual-eye-tracking Vygotsky: A microgenetic account of a teaching/learning collaboration in an embodied-interaction technological tutorial for mathematics. *Learning, Culture and Social Interaction*.
- Sirotkina, I. (1996). Vydayushijisa psyziolog. Klassik psichologii? (K 100-letiju so dnja rozhdeniya N. A. Bernstejna) [An outstanding physiologist. The classic of psychology? (To the 100-th anniversary of N.A.Bernstein)]. *Psichologicheskij Zhurnal*, 5, 116–127.
- Sirotkina, I. (2018). *Mir kak zhivoe dvizhenie: Intellektual'naja biografija Nikolaja Bernshtejna* [World as alive movement: Intellectual biography of Nikolay Bernstein]. Russia, Moscow: Cogito-Centre.
- Smagorinsky, P. (2018). Deconflating the ZPD and instructional scaffolding: Retranslating and reconceiving the zone of proximal development as the zone of next development. *Learning, Culture and Social Interaction*, 16, 70–75. doi:10.1016/j.lcsi.2017.10.009
- Smit, J., & Van Eerde, D. (2013). What counts as evidence for the long-term realisation of whole-class scaffolding? *Learning, Culture and Social Interaction*, 2(1), 22–31. doi:10.1016/j.lcsi.2012.12.006
- Smit, J., Van Eerde, H. A. A., & Bakker, A. (2013). A conceptualisation of whole-class scaffolding. *British Educational Research Journal*, 39(5), 817–834. doi:10.1002/berj.3007
- Stalin, J. V. (1954). Blacklegs of the revolution. In *Works*, Vol. 3, March–October, 1917. Moscow: Foreign Languages Publishing House. Retrieved from <https://www.marxists.org/reference/archive/stalin/works/1917/10/15-2.htm>

- Stone, C. A. (1998). The metaphor of scaffolding. *Journal of Learning Disabilities, 31*(4), 344–364. doi:10.1177/002221949803100404
- Talis, V. L. (2015). New pages in the biography of Nikolai Alexandrovich Bernstein. In M. Nadin (Ed.), *Anticipation: Learning from the past. cognitive systems monographs* (Vol. 25, pp. 313–327). Cham, Switzerland: Springer.
- Thelen, E. (2000). Motor development as foundation and future of developmental psychology. *International Journal of Behavioral Development, 24*(4), 385–397. doi:10.1080/016502500750037937
- Trninic, D. (2018). Instruction, repetition, discovery: Restoring the historical educational role of practice. *Instructional Science, 46*(1), 133–153. doi:10.1007/s11251-017-9443-z
- Trotsky, L. (1957). *Literature and revolution*. New York, NY: Russell & Russell. Retrieved from https://www.marxists.org/archive/trotsky/1924/lit_revo/
- Trotsky, L. (1981). Listen and get ready, Red Army! Speech at the ceremonial meeting of the Moscow Soviet devoted to the Fourth Anniversary of the Red Army, February 23, 1922. In *The Military Writings and Speeches of Leon Trotsky how the Revolution Armed, Volume V: The years 1921–23*. London, England: New Park Publications. Retrieved from <https://www.marxists.org/archive/trotsky/1922/military/ch08.htm>
- Tsukerman, G. A., Obukhova, O. L., Ryabinina, L. A., & Shibanova, N. A. (2017). Introducing basic concepts: In search of the missing scaffolds. *Cultural-Historical Psychology, 13*(4), 4–14. doi:10.17759/chp.2017130401
- Valsiner, J. (2005). Scaffolding within the structure of Dialogical Self: Hierarchical dynamics of semiotic mediation. *New Ideas in Psychology, 23*(3), 197–206. doi:10.1016/j.newideapsych.2006.06.001
- Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher-student interaction: A decade of research. *Educational Psychology Review, 22*(3), 271–296. doi:10.1007/s10648-010-9127-6
- Van der Veer, R. (2007). *Lev Vygotsky*. London-New York: Bloomsbury.
- Van der Veer, R., & Valsiner, J. (1991). *Understanding Vygotsky. A quest for synthesis*. Oxford, England: Basil Blackwell.
- Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.
- Vygotsky, L. S. (1978). Interaction between learning and development. In M. Cole, V. John-Steiner, S. Scribner, & E. Soubberman (Eds.), *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press, pp. 79–92.
- Vygotsky, L. S. (1987). *Collected Works of L.S. Vygotsky (Volume 1): Problems of general psychology* (R. W. Rieber & A. S. Carton, Eds.). Boston, MA: Springer US.
- Vygotsky, L. S., & Luria, A. R. (1993a). *Etudy po istorii povedenija: Obezjana, primitiv, chelovek* [Essay in the history of behaviour: Ape, primitive man, and child]. Moscow, Russia: Pedagogika-Press.
- Vygotsky, L. S., & Luria, A. R. (1993b). *Studies on the history of behavior: Ape, primitive, and child* (V. I. Golod & J. E. Knox, Eds.). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Vygotsky, L. S., & Luria, A. R. (1994). Tool and symbol in child development. In R. Van der Veer & J. Valsiner (Eds.), *The Vygotsky reader*. Wiley-Blackwell. Retrieved from <https://www.marxists.org/archive/vygotsky/works/1934/tool-symbol.htm>
- White, M. (2010). *Karty narrativnoy praktiki* [Maps of narrative practice]. Moscow, Russia: Genesis.
- Wood, D., Bruner, J. S., & Ross, G. (1973). *The role of tutoring in problem-solving*. Unpublished manuscript. (HUG 4242.55 Box 2). Jerome Seymour Bruner papers: Research project 1970s. Cambridge, MA: Harvard University Archives.
- Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem-solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100. doi:10.1111/jcpp.1976.17.issue-2
- Wood, D., & Middleton, D. (1975). A study of assisted problem-solving. *British Journal Of Psychology, 66*(2), 181–191. doi: 10.1111/bjop.1975.66.issue-2
- Yaroshevskiy, M. G. (Ed.). (1991). *Repressirovannaya nauka* [The oppressed science]. Leningrad, Russia: Nauka.
- Zagorianakos, A., & Shvarts, A. (2015). The role of intuition in the process of objectification of mathematical phenomena from a Husserlian perspective: A case study. *Educational Studies in Mathematics, 88*(1), 137–157. doi:10.1007/s10649-014-9576-9
- Zavershneva, E., & Van der Veer, R. (Eds.). (2018). *Vygotsky's notebooks. Perspectives in cultural-historical research* (Vol. 2). Singapore: Springer.