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MERIT RICKBERG

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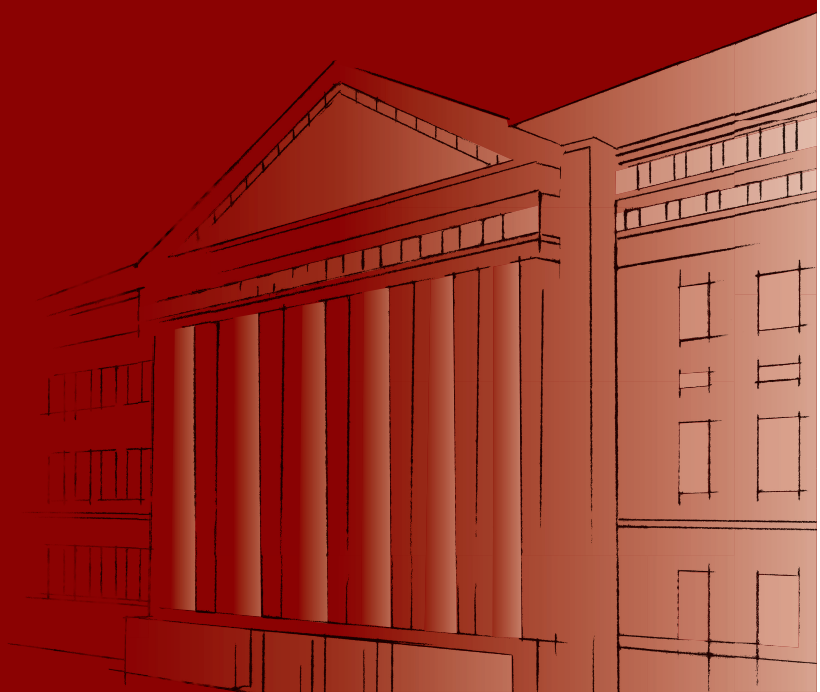

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Department of Semiotics, Institute of Philosophy and Semiotics, University of Tartu, Estonia

The council of the Institute of Philosophy and Semiotics of the University of Tartu has, on May 22, 2023, accepted this dissertation for the defense for the Degree of Doctor of Philosophy (in Semiotics and Culture Studies).

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The writing of this dissertation has been accompanied by constant doubt, fear and uncertainty. As the following thesis will argue, these experiences are not only inevitable but also appear necessary for such endeavours that are aimed at creating something new. At the same time, this process has not only taken place 'in the dark', but has also brought some wonderful moments of revelation, feelings of curiosity and surprise, and the bliss of discovery. Successfully navigating such turbulence between the ups and downs of doctoral research would not have been possible without some amazing people around me.

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I Rickberg, Merit 2017. Kahest vastandlikust tendentsist ajalooharidu ses. *Acta Semiotica Estica* 14: 46–68.

II Rickberg, Merit 2023. From avoiding uncertainty to accepting it: Semiotic modelling of history education at the limits of knowledge. *Sign Systems Studies* 51(1): 7–35.

III Rickberg, Merit 2022. Towards complexity thinking in education with Juri Lotman. *Lexia. Rivista di Semiotica* 39–40: 303–327.

IV Rickberg, Merit 2022. Lotmanian Perspective on Complexity in Cultural Systems. *Semiotika* 17: 77–109.

INTRODUCTION

Educational systems present a curious case for the study of cultural dynamics. On the one hand, they tend to be highly regulated and stable structures. At the same time, on the other, they are subject to endless political reforms and influences caused by rapidly changing cultural practices. In addition, societies tend to put a lot of hope and pressure on education to serve as a ground for initiating change and transformation towards collective goals. In most educational systems, we can find programmatic ideas according to which the education process is connected to developing the learner's capability to successfully participate in society and contribute to its development according to shared values. These aims are manifested in educational agendas on various levels and, from there, transmitted to curricula, educational materials, teacher training programs and classroom practices. From this regulatory perspective education process assumes a linear character, which means that a direct causal link is expected to lead from the educational agenda via teachers to the students and cause the anticipated behaviour, which in turn, on a higher level, accumulates into a movement towards the desired outcome in the form of societal change.

At the same time, it is possible also to take a rather different point of view, according to which the relations between the various levels of the educational process are entirely nonlinear. From such a perspective, each link in the chain we described above would react in its own individual and unique way to one and the same input. This reaction, in turn, could have a multidirectional effect on other parts of the system making the whole process inherently unpredictable. This view calls into question the idea of "managing" the learning process from the top down. If we cannot predict, at least to some extent, the outcome of the teacher–student interaction, then it is simply impossible to set goals or have any shared basis for measuring the results.

Both of these perspectives are inaccurate in a way. Educational systems are not governed by linear logic and thus cannot be managed through simple input-output logic. From a semiotic standpoint, the process of learning cannot be seen as a transfer of a static piece of information from one communication partner to another; it is always the act of generating a new message and thus entails unpredictability. However, educational systems are not chaotic in their behaviour either. Even though each part of this intricate system – whether we consider the students, the schools, or the textbooks – entails a vast variability in itself, the system as a whole can exhibit surprising stability and robustness while simultaneously facilitating processes of radical change on various operational levels (e.g., think of the transformation of an individual student progressing through the educational system). This dynamic can also be reversed, as significant structural reforms imposed upon the whole from the higher levels can encounter strong resistance to change in some lower parts of the system. Thus, there is a constant tension between partial predictability and unpredictability on various levels of such systems.

Considering this paradoxical nature of dynamics described above, one might wonder whether it is even possible to find a way to describe these kinds of processes of change accurately, let alone control or influence the trajectory of their development. However, as Paul Cilliers (2016[2000]: 64) has emphasised, the fact that there are limits to our understanding does not mean that scientists should not engage with those limits enthusiastically; it simply reminds us to let go of the strive of obtaining a perfect grip on reality in order to control it. The present thesis takes this stance as a starting point. It proposes that while we should discard the wish to manage educational systems to the full extent, there is a chance and a necessity to obtain a better understanding of the workings of cultural dynamics in education. For this purpose, Lotman's semiotics of culture can provide a suitable frame of thought. In this dissertation, I aim to propose a reading of Lotman's theory as a framework of complexity thinking. It will enable us to elucidate the particularity of culture among other complex systems and use this understanding to model the dynamics of change in education.

The gap in studying complex systems

Approaching educational systems from a complexity perspective emerged as a research trend at the beginning of the 2000s. The first international conference on complexity and education, titled *Complexity Science and Educational Research Conference*, was held in 2003 in Edmonton, Canada. In 2004, the first issue of the journal *Complicity: An International Journal of Complexity and Education* was published. Since then, many significant contributions explicating the complexity of education have been made (e.g., Davis, Sumara 2006; Mason 2008; Koopmans, Stamovlasis 2016; Hagger, Beckett 2019). In general, these approaches draw on the framework of complexity theory to envision ways how our thinking about education could break with "simple successionist cause-and-effect models, linear predictability, and a reductionist approach to understanding phenomena, replacing them with organic, non-linear and holistic approaches […] in which relations within interconnected networks are the order of the day" (Morrison 2008: 16).

The emergence of complexity research in education aligns with a broader scientific trend of the past decades, during which complexity-related investigations have gained wide popularity in various scientific fields. At the same time, it is impossible to talk of a unified theory or even a unified understanding of complexity. However, a common ground might be seen in the interest towards systems' (dis)ability to adapt to their ever-changing environments with attention on self-organisation, nonlinear change, emergence, nestedness, diversity and redundancy, processes happening at the 'edge of chaos' etc. While the complexity approach is broadly used in social sciences and the humanities, the majority of complex systems investigations are still conducted in the so-called hard sciences. Therefore, the frameworks for understanding complexity that are used in social sciences are mainly inspired by research conducted on physical or natural systems. Scott Page (2010: 3) from Santa Fe Institute has pointed out that while such transpositions between areas of research can be very fruitful and serve as a starting point, it is

essential to acknowledge that "they need refinement for the simple reason that electrons don't think. Thus, it's relatively easy to understand how their behaviors aggregate. People, on the other hand, do think. We base our behaviors on mental models, belief systems, and passion."

It is also important to note that method-wise, contemporary complexity research is primarily dominated by computational approaches such as cellular automata or multi-agent simulation. While computational methods enable to map broader trends and patterns in societies, their capacity is limited to specific aspects of culture. According to educational researchers Paul Hagger and David Beckett (2019: 164), in social and human sciences, such an approach has been confined to "more reductive areas of inquiry where individual persons can be treated as statistical variables." According to them, examples of such applications are:

> traffic flows; voting behaviour and patterns of disease, infirmity or infection across different localities. That is, […], in circumstances where neither humans as distinct individuals nor the nature of the specific interpersonal relations between individuals are relevant to the particular focus of the inquiry. (Hagger, Beckett 2019: 164)

Consequently, while such an approach produces eloquent results and undoubtedly has its merits, it is essentially unsuitable for describing some of the essential aspects that form the phenomenon of culture. The inter- and transdisciplinary research of complexity has led to an increasing need to differentiate between different types of complexity and pay attention to the specifics of various complex systems. While all complex systems seem to share some common ground, there also appears to be profound differences in how these systems behave depending on whether we observe complexity in physical systems or cultures.

Jüri Engelbrecht, a mechanics scientist, has addressed the need to take into account the particularity of the complexity in the case of various research objects. In his view, in the case of complex physical systems, "the interactions between the constituents are described by physical laws and can be measured at least with a certain degree of accuracy" (Englebrecht 2021: 83). At the same time, the situation in complex social systems is much more complicated because the interactions are based on "accepted rules, traditions, language, and governance, on economic and environmental conditions, and certainly on values. In addition, an important question in social systems is how its members interpret social problems" (ibid.). As such, in cultural systems, it is senseless to search for universal "laws" in the direct meaning of this word. This, however, does not mean that the structure of such systems would lack all regularities. It merely points to the fact that these regularities are much more fluid and characterised by multiplicity and thus, describing them necessitates search for models that can account for such variability and dynamics. Consequently, while searching for common ground between various disciplines for describing different types of complex systems is essential, it is equally relevant to move towards clarifying the distinguishing features of complexity in cultural systems and search for descriptive language that would allow us to elucidate their specificity.

Complexity thinking in Juri Lotman's semiotics

Lotman's view on the part–whole relations, his understanding of the emergent nature of semiotic processes and openness of the semiotic systems, his interest in nonlinear dynamics and various other aspects of his semiotic theory – all enable us to view Lotman's works in the context of complexity paradigm. In recent years, many works discussing Lotman's ideas in connection to complexity have been published (see Grishakova 2009; Gherlone 2013a, 2013b; Salupere 2017; Haidar 2019; Hartley et al. 2021a, 2021b; Ibrus et al. 2021). While the interest in explicating this connection is somewhat related to the growing relevance of the complexity paradigm, it is also grounded in the historical development of Juri Lotman's theory, which was greatly influenced by various scientific movements out of which contemporary complexity research emerged. Lotman's approach to the study of complex cultural phenomena was inspired by the works of cybernetician W. Ross Ashby, the geochemist Vladimir Vernadsky and the physical chemist Ilya Prigogine, among others. In these dialogues, however, Lotman was never in the role of a mere receiver of ideas but always a creative interlocutor. As has been pointed out by Edna Andrews:

> Lotman's work has often been read through the prism of other semiotic contributors of the twentieth century, resulting in what often appears to be an attempt to position Lotman as more of a borrower of ideas than an innovator of ideas. While it is certainly true that Lotman was deeply influenced by his own professors and some of the most outstanding intellectuals of his day, Lotman's work is unique in its achievement of a broadly-based metalanguage for the modelling of cultures, a system of systems. (Andrews 2009: xx–xxi)

While the connection between Lotman and complex systems theory is quite well recognised (though this recognition pertains primarily to Lotman scholars and the field of semiotics), what is yet to be clarified is how his approach differs from the universally accepted understandings of complex dynamics. Can Lotman's perspective on cultural dynamics tell us something new about the phenomenon of complexity? Could Lotmanian ideas about the workings of culture provide a suitable ground for delineating the specifics of complexity in cultural systems? The present work sets out to explore these questions by explicating Lotman's ideas from the perspective of complexity thinking.

The proposition to view Lotmanian ideas from the perspective of 'complexity thinking' needs some clarification. Among the scholars investigating complex systems, we can encounter various approaches to naming their field of work: complexity theory, complexity science, philosophy of complexity etc. The notion of 'complexity thinking' was first proposed by Richardson and Cilliers (2001) as a counter-reaction to reductionistic approaches to complexity, on the one hand, and the popular and metaphorical uses of complexity, on the other. Through this notion, the authors aimed to draw attention to the limits of our knowledge in the light of complexity (ibid., 7). However, this does not imply a purely epistemological view. This approach sees complexity as a property of systems while contemplating our

capacity to comprehend this phenomenon. Davis and Sumara have positioned complexity thinking somewhere between "a belief in a fixed and fully knowable universe and a fear that meaning and reality are so dynamic that attempts to explicate are little more than self-delusion. In fact, complexity thinking commits to neither of these extremes, but listens to both" (Davis, Sumara 2006: 4).

A foundational characterisation of what constitutes a complex thought has been elaborated by Edgar Morin (2008a). Morin distinguishes three principles that can help us to think of complexity. The first principle, what he calls dialogic, is grounded in the idea of our ability to associate two terms that are at the same time complementary and antagonistic and through that, it allows us to maintain duality at the heart of unity (Morin 2008: 49). He brings the example of order and disorder, which on the one hand appear to be enemies that abolish each other, but at the same time, they also collaborate and produce organisation and complexity (ibid.). The second principle is organisational recursion. By that, Morin (ibid., 49–50) implies the need to break away from the linear idea of cause and effect and focus on the recursiveness of the processes as self-constitutive, self-organising, and self-producing in the same way as a whirlpool is simultaneously a product and a producer. And thirdly, Morin names the holographic principle, according to which not only is the part in the whole, but the whole is in the part (ibid., 50). According to him, the idea of the hologram surpasses reductionism, which can only see the parts, and also holism, which only sees the whole (ibid.) and substitutes them with the understanding of the necessity to continuously consider the whole-part mutual implication (Morin 2007: 10). These principles are characteristic to Lotman's thinking as well. The attention towards the interdependence and unity of the opposing forces in the semiotic systems, the understanding of the multidirectionality of communicative processes and the ability to comprehend the paradoxicality of semiotic structure where every part is at once a whole, and every whole functions as a part – are all at the heart of Lotman's theory.

The scope, aims, and structure of the thesis

The thesis discusses complexity in cultural systems[1] and focuses explicitly on how the Lotmanian complexity thinking framework can model dynamics of change in educational systems. Limiting the scope of our research to the sphere of culture should not be understood as an attempt to imply that cultural systems are somehow disconnected from the physical world. However, the symbolic level of meaning-making, predominant for cultural systems, tends to close itself off from the extra-semiotic reality. While icons and indexes have their grounding in actual physical qualities and facts, symbols have no such purely physical grounding; they are not

[1] The notion of 'cultural systems' in this thesis follows Lotmanian line of thinking. By 'cultural systems' we imply either culture as a whole or systems that are nested within culture that are sufficiently complex in order to exhibit intellectual capacity, i.e., the ability to store information, communicate and produce new (non-trivial) messages (Lotman 2019[1978]). Lotman (2004 [1981]:585) distinguishes three classes of intellectual objects in culture that have these abilities: individual consciousness, artistic text, and culture as collective intellect.

pointing to a referent in the 'outside world' but to a cluster of other sign relations (Favareau 2015: 252). This feature has important implications for the dynamics of complex cultural systems and additionally validates the necessity to view cultural systems as a particular case of complexity. Nonetheless, as Kobus Marais (2014: 26) has emphasised, the complexity perspective is inherently ecological in that it sees the whole of reality as interrelated, having emerged from the physical. As such, complexity thinking can provide a common ground for us to learn to see the interconnectedness of various systems. This does not suggest an ambition for a grand unified theory of complex systems but merely points to the capacity of complexity thinking to serve as a platform for translation between different areas of knowledge. That is why, although the focal point of the present thesis is culture, we will occasionally step into dialogue with researchers investigating physical or natural complex systems as well.

As was mentioned, the thesis sets out to accomplish two interrelated aims:

- To explicate how Lotman's semiotic theory of culture can clarify the particularity of cultural dynamics in relation to other complex systems.
- To explore the possibilities provided by the Lotmanian framework of complexity thinking for modelling the dynamics of change in education.

In order to achieve these aims, the thesis will follow the subsequent steps:

- In the first part of the framing chapter (1.1.), I will give an overview of the historical roots of complex thought in Lotman's semiotics. Then in the next part (1.2.), I will delineate principles in Lotman's semiotics which appear central for describing the dynamics of complex cultural systems, and develop them in dialogue with the ideas of various authors from the complexity discourse. This way, it is possible to establish a common ground between Lotman's ideas and present-day understanding of complex systems as well as indicate already some ways in which Lotman's ideas diverge from the dominant discourse. Finally, in the third part (1.3.), I will concentrate on the aspect of constraints in complex systems. I will explore the idea that one of the main differences between complex cultural systems and physical or natural complexity lies in the functioning of constraints. Drawing parallels between Terrence Deacon's conceptualisation of constraints as an absence in the system and the role that absence plays in the Lotmanian model of semiotic systems allows me to explicate the particularity of cultural dynamics in relation to other complex systems.
- The second part of the framing chapter builds on the findings of the previous part and elaborates these ideas further in the context of education. In the first part of this chapter (2.1.), I will describe the process of learning in semiotic systems from the perspective of complexity. In the second part (2.2.), the focus will be on the possibilities that Lotmanian semiotics provides for modelling the complex dynamics in educational systems. More specifically, I will examine

how we can create analysability to study the relationship between the higher-order educational goals, the pedagogical models that guide learning and the meaning-making processes that occur in the context of real educational practice. In addition, I will discuss the limits of such modelling. In order to exemplify these claims, I will bring various examples, primarily from the articles that are included in this dissertation.

The dissertation includes four articles that contribute to achieving both of the aims in various aspects. Three articles (Rickberg 2017, 2022a, 2023) address different contemporary educational challenges and model the related processes of change in educational systems using the Lotmanian semiotic framework. One article (Rickberg 2022b) focuses on comparing Lotmanian semiotics and the contemporary complexity paradigm (for overviews of the articles, see Chapter 3.).

The thesis draws on research from various fields, especially on works on Juri Lotman's theory (Silvi Salupere 2015, 2017; Peeter Torop 2005, 2009, 2022; Laura Gherlone 2013a, 2013b, 2022a, 2022b; Edna Andrews 2003, 2009; Daniele Monticelli 2008, 2012a, 2019; Hartley et al. 2021a, 2021b), complexity research (Paul Cilliers 2008, 2016[2000]; Edgar Morin 1992[1982], 2008a; Terrence Deacon 2011; Kobus Marais 2014, 2019) and its applications in the field of education (Davis, Sumara 2006; Mason 2008; Hagger, Beckett 2019). There are also many important works that support this dissertation in the field of learning theory and pedagogy (among others, Kull 2014, 2018; Stables 2018; Semetsky, Stables 2014; English 2013; Tauritz 2012, 2019). In addition, many important insights on how Lotman's ideas can be applied in the context of contemporary education have been gained from the collaboration of Transmedia Research Group at the University of Tartu, to which the present author also belongs (Milyakina et al. 2020; Ojamaa et al. 2019, 2021; Ojamaa, Torop 2020).

1. COMPLEXITY THINKING IN JURI LOTMAN'S SEMIOTICS

Edgar Morin (2008b: 99) has described the capacity for complex thought in the following way:

> I've never been able to be resigned with parcelized knowledge, I've never been able to isolate a studied object from its context, from its antecedents, from its future. I have always aspired to a multidimensional thought. I have never been able to eliminate the internal contradiction. I have always felt that deep truths, antagonists with each other, were for me complementary, without ceasing being antagonists. I never wanted to reduce by force uncertainty and ambiguity.

These characteristics of thinking are mirrored in various aspects also in Juri Lotman's semiotic theory. The connection between Lotman and complexity has been elaborated from multiple perspectives. According to Peeter Torop, one of the first scholars to establish this connection was the director of Lotman's institute in Bochum, Karl Eimermacher, who in 1974 used the term "integrative culturology" to characterize Lotman's strive for a disciplinary synthesis (Torop 2014: 110–111; see Eimermacher 1974). More recently, Laura Gherlone (2013a) has written a comprehensive overview of how Lotman developed his complex thought through various influences. John Hartley et al. (2021b; see 2021a) have argued that Juri Lotman's theory of culture could provide a suitable groundwork for a systematic evolutionary-complexity model that would enable cultural science to describe and even, to some extent, predict complex-system causation in the semiosphere. Similarly, Ibrus et al. (2021) have proposed that a systematic approach to cultural data analytics could be rooted in the so-far unexploited resonance between cultural complexity science and Lotman's cultural semiotics, which provides a comprehensive framework for analysing complex and dynamically evolving cultural processes. In this chapter, we set out to further explore this resonance between complexity and Lotman's semiotics from various angles: by giving an overview of Lotman's connections with complexity ideas, elaborating main principles in his theory that account for complex dynamics, and discussing some aspects in which Lotmanian semiotics could help to specify the workings of cultural complexity.

To explore the relation between complexity paradigm and Lotman's theory, it is first necessary to reflect a bit on the meaning of the term "complexity". This task poses a challenge even for researchers who study complex systems. Providing a clear and comfortable definition of complexity is not the aim of this work and would, in fact, be in some ways contradictory to the phenomenon we are studying. So instead, let us take a moment to dwell on some of the challenges that arise when we set out to comprehend complexity. An excellent introductory insight into this challenge can be found in *Complexity: 5 Questions*, a book edited by Carlos Gershenson (2008). This volume consists of twenty-four short written interviews with the leading figures in complexity research. All of them were asked to share their understanding of the scientific field they are working in by answering five questions, including "How would you define complexity?". The published answers

paint a vivid picture of the inherent multiplicity of this research area. Most authors agree that there is no single correct definition to explain complexity (Gershenson 2008: 135), while some go as far as to claim that the main feature of complexity is that it resists all attempts to define it (Lloyd 2008: 87).

Why is defining complexity difficult? Here opinions diverge. For example, Melanie Mitchell (2009: 301) sees the problem primarily in the absence of scientifically rigorous vocabulary that could replace the various ill-defined terms currently used to describe complex systems. From another perspective, the difficulties seem to arise not because of the shortcomings of descriptive language but due to the ontological irreducibility of complex systems. As Paul Cilliers (2008: 28) has suggested, there is a certain performative tension between 'complexity' and 'definition' that comes from the fact that all definitions are inevitably reductionist. It is a well-worn truth that "all models are wrong", and according to the author of this famous phrase, George Box (1967: 792), what is important to consider is that "[s]ince all models are wrong the scientist must be alert to what is importantly wrong. It is inappropriate to be concerned about mice when there are tigers abroad." In the case of complex systems, however, the problem is that it is much more difficult to differentiate the mice from the tigers and predict which shortcomings of the model will become important. Cilliers (2016[2000]: 58) explains this peculiarity of complex systems in the following way: "Because of the nonlinearity of the interactions constituting a complex system, it cannot be "compressed". Any simplifying model will have to leave out something, and because of the nonlinearity, we cannot predict the significance of what is suppressed." However, this observation should not discourage us from trying to describe complexity. It merely points to the need to acknowledge this tension that arises from such attempts and proceed with caution and awareness of the limitations.

The problem of acknowledging these limitations brings us to one crucial divide in complexity research, which Edgar Morin has characterised using the notions of 'restricted complexity' and 'general complexity'. Restricted complexity is commonly understood as a phenomenon that emerges from rule-based interactions amongst simple elements (Byrne, Callaghan 2014: 5). Through modelling interactions among the parts of the system, it becomes possible to identify patterns of change in such systems. According to Morin (2007: 6), the problem with restricted complexity lies in the fact that it is oriented towards searching for the "laws of complexity" and, as such, is actually decomplexifying its object of study. However, the restricted complexity approach has enjoyed significant success. It is widely practised in the Santa Fe Institute, which since 1980 has become the world centre for complex studies and has had the opportunity to define the dominant understanding of complex systems. Kobus Marais (2014: 26) has asserted that although Santa Fe "brand" of complexity theory provides, to a large extent reductionistic view of complexity, it is possible to "argue in mitigation that many of the Santa Fe scholars do much work in natural sciences where reductionism has proved useful to some extent." After all, as Terrance Deacon (2011: 203) has reminded: "There can be little doubt that reductionistic science is fundamentally sound. It has provided unparalleled predictive power for explaining physical-chemical processes

across unimaginable ranges of scale and diversity of phenomena. It would be pointless to even imagine that it is somehow misguided." While I agree with this statement, it is possible to complement it by adding that although reductionism is not misguided, there are certain research objects and questions, especially in the social sciences and humanities, where it simply proves to be much less useful.

In these research areas, scholars are much more prone to turn to general complexity as an epistemological approach, which, while interested in the theoretical investigation of the properties of complex systems, recognises at the same time that the behaviour of a complex system cannot be fully formalised. As such general complexity simultaneously addresses the "self-organized and systemic nature of the world and the cognitive limits of human observers" while also calling into question "the deterministic, reductionist, and positivist principles of classical science" (Malaina 2015). Alvaro Malaina suggests that these two approaches to complexity have developed in deep separation from one another and would actually benefit greatly from reunification into a scientific paradigm, with one side establishing the "worldview" and the other side providing the "models of scientific realizations" (ibid.). A similar perspective of complexity research as a potentially unifying field of knowledge where natural sciences, social sciences and humanities could come together is presented by Engelbrecht, who sees general and restricted complexity as two sides of the same coin and emphasises that both need to be studied (Engelbrecht 2021: 84) and can be seen as mutually illuminating (ibid., 86).

The differences in defining what complexity means, its capabilities and scope of analysis are to some extent connected to the different paths of historical development that have led to the present-day multifaceted picture of complexity research. A vivid overview of the historical development of various branches of thinking that eventually led to today's overwhelming multiplicity in complexity research is given by Brian Castellani and Lasse Gerrits's ongoing project "Map of the Complexity Sciences" (2021)[2]. On the map, the history of the complexity sciences is developed along five major intellectual traditions: dynamical systems theory (Henri Poincare, Andrey Kolmogorov), systems theory (Ludwig von Bertalanffy, Margaret Mead), complex systems theory (Philip W. Anderson, Ilya Prigogine), cybernetics (Norbert Wiener, W. Ross Ashby) and artificial intelligence (Walter Pitts, Warren McCulloch). While we cannot find Juri Lotman's name on this map, then on closer observation, it is possible to note that there are many names of scholars and research areas on this map that have been important for the development of Juri Lotman's thought, as well as many topics to which he has significantly contributed. In this chapter, I will aim to fill this gap and put Lotman on the map of complexity research.

[2] The map was originally created in 2009 by Brian Castellani and various version of it have been published in different publications. However, as the map is constantly updated, then the most recent version is available at https://www.art-sciencefactory.com/complexity-map_feb09.html, last visited 04.07.2023.

1.1. Roots of complex thought in Lotman's works

In this subchapter, I intend to explore some of the scientific encounters throughout Lotman's academic path that nudged Lotman's thinking toward describing culture as a complex system. First, we need to pause on the problem of the periodisation of Lotman's works. Any in-depth inquiry into Juri Lotman's academic legacy cannot avoid the question of whether we can read his semiotic works as a holistic theory or not. How one answers this question can result in very different images of Lotman's scientific path and diverse evaluations of his ideas. The main point of divergence seems to be whether the early structuralist works of Lotman are theoretically reconcilable with his later dynamic, explosive and unpredictable perspective on culture.

The present work follows the line of thought of those who see continuity in the development of Lotman's semiotic thinking (see, e.g., Salupere 2017; Semenenko 2012; Avtonomova 2009; Kim 2003). I would even claim that the uniqueness and the potential of Lotman's semiotics in the context of complexity thinking lies exactly in this ability to merge these different sides of his semiotic theory of culture. By viewing Lotman's theory as a whole, I do not mean to imply that the shifts in Lotman's research focus, theoretical language and interests that took place over the course of his long academic path are insignificant. However, in most cases, these shifts did not cancel out the previous point of view. Instead, each new turn added another perspective to the bigger picture and stepped into a dialogue with the earlier viewpoints, sometimes creating creative tensions, sometimes paradoxical situations, but rarely unsolvable conflicts. In my opinion, it is the synthesis of these various perspectives that enables us to capture Lotman's legacy in all its diversity and allows us to achieve a genuinely stereoscopic understanding of his semiotics – without which, as Lotman himself often reminded his readers (Lotman 2019[1978]: 46) we cannot attain a life-like image of our object of study.

The unity of Lotman's thought has also been emphasised by Nataliya Avtonomova, who writes:

> In reality, the impression of the radical novelty of the late Lotman may arise from looking at him from the outside. If we immerse ourselves in Lotman's works themselves and follow his scientific biography step by step, then the image of the new Lotman [as] post-structuralist (or Lotman the communicationist or dialogist) will hardly be as convincing. Something that has been considered a radical change will appear more like a new accent, a shift in attention, occasionally, a new manner of expressing his thoughts, [that is] more familiar and more habitual to today's world (nobody ever talks about cybernetics anymore); in any case, however, not as abandoning his principles of work which were formed in the 1960s and developed throughout his entire life. (Avtonomova 2009: 217; trans. in Salupere 2017: 80)

The view presented by Avtonomova will also be affirmed if we follow the genesis of complexity thinking in Lotman's works. The development of complex thought in Juri Lotman's semiotics cannot be connected to a specific period or explained through one particular scientific influence. Various aspects of complexity thinking

emerged in Lotman's writings at different times, through dialogues with other authors and ideas which step-by-step added new aspects and layers of complex dynamics into his models of culture.

Describing Lotman's academic path[3] and choosing which moments are worthy of our attention inevitably depends on the concrete research goal. Related to the aim of the present thesis, we will focus on those aspects that are relevant from the point of view of complexity thinking. Here, Laura Gherlone (2013a) has already made a significant contribution. In her article "Lotman's Epistemology: Analogy, Culture, World", she demarcates four meaningful dialogues with different scientific fields in Lotman's works that also connect him to the complexity paradigm: Lotman's turn to cybernetics, Lotman's interest towards studies of the human brain, Lotman's dialogue with the works of Vladimir Vernadsky, and lastly his interpretation of I. Prigogine's works (Gherlone 2013a). This subchapter will follow Gherlone's line of thought but with a few changes. We will leave out the part about the asymmetry of cerebral hemispheres[4] and add structuralism as one of the steppingstones on Lotman's path to complex thinking.

These connections with complexity thinking which we are going to explore in this chapter entail many examples of what Gherlone (2013a) has called the use of external analogy – a method which was central for Lotman and was realised in his constant strive to step into dialogue with other scientific disciplines in order to find parallels with new models or methods from different areas of research. Lotman's interest towards various branches of "hard sciences" and his belief in the productivity of analogical reasoning in science reflects his understanding that not only is this dialogue possible, but it is also necessary. As expressed by Marina Grishakova (2009: 180): "Lotman's interest in semiotics and structuralism resulted from a sense of a deep bond between science and the humanities: both are part of human culture, and their radical separation and isolation as closed systems may have a deteriorating effect on both." In the present part, we will look at how Lotman advanced this bond between science and humanities in the context of his semiotic theory and how these connections provided ground for the emergence of complex thought in his writings.

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[3] There are various periodization's of the development of Lotman's theory; for a thorough overview of periodizations see Salupere 2017; for some examples, see e.g., also Pilshchikov, Trunin 2016; Levchenko 1996; Priimägi 2011).

[4] The impulse that Lotman received from the studies of cerebral hemispheres was without a question very significant in terms of the further exploration of the structural isomorphism of human mind and culture. However, Lotman had encountered similar ideas already in cybernetics and thus the neurological research just supported his point of view. The most relevant idea from this research area for Lotman was the distinction between discreteness and continuity (see e.g., Salupere 2017; Semenenko 2012).

1.1.1. Cybernetics: The first encounter with 'complex systems'

Silvi Salupere (2015: 63) has brought out that although cybernetics is usually mentioned in discussions regarding Juri Lotman's scientific background, it is rarely subject to in-depth analysis. There are some contributions that have elaborated the cybernetic influence in different aspects (see Rewar 1979, 1989; Semenenko 2012; Gherlone 2013a; Salupere 2015, 2017), but in general, the connection to cybernetic theory is usually perceived as something belonging only to the so-called theory. It seems that one of the reasons why the cybernetic context is often overlooked in contemporary research might be caused by the fact that the notion of 'cybernetics' is associated primarily with machines, computers, and technology and thus seems less relevant for Lotman's later thought where culture is often described as a living system. While the cybernetic language was certainly strongly influenced by mechanical vocabulary, its interests were not limited to studying machines but encompassed all systems with feedback and self-regulation capacity, including living organisms, society, and culture.

Cybernetics as a separate field of research was established through a series of interdisciplinary conferences in New York supported by the Macy Foundation and held between 1946 and 1953. The first meeting in 1946, titled "The Feedback Mechanisms and Circular Causal Systems in Biology and the Social Sciences", set out to "generate a new kind of link between engineering, biology, and mathematics on the one hand and psychology, psychiatry, and all the social sciences on the other" (Heims 1991: 17). As described by Mitchell:

> These meetings were organized by a small group of scientists and mathematicians who were exploring common principles of widely varying complex systems. A prime mover of this group was the mathematician Norbert Wiener, whose work on the control of anti-aircraft guns during World War II had convinced him that the science underlying complex systems in both biology and engineering should focus not on the mass, energy, and force concepts of physics, but rather on the concepts of feedback, control, information, communication, and purpose (or "teleology"). (Mitchell 2009: 296)

It was Wiener (1961[1948]: 11) who coined the notion 'cybernetics' denoting a field of communication and control theory and introduced it to broader audiences through his book *Cybernetics: Or Control and Communication in the Animal and the Machine* (1948). Among other conference participants were William Ross Ashby, Yehoshua Bar-Hillel, Gregory Bateson, Kurt Lewin, Margaret Mead, Oskar Morgenstern, Claude Shannon, John von Neumann, and J. Z. Young (see Leeds-Hurwitz 1994).

In the Soviet Union, the attitude towards cybernetics was initially very suspicious. The party-line stance towards cybernetics can be illustrated by the description provided in *A Brief Philosophical Dictionary,* published in 1954, where cybernetics is characterised as an ideological weapon of the USA and the rest of the capitalistic world that strives to transform the working class into a mere appendage of the machine that can be exploited in production and war (Rozental,

Iudin 1954: 236–237). Thus, any academic attempt for a dialogue with this research field was impossible in the USSR until Khrushchev's Thaw, which from the mid-1950s to the mid-1960s, brought some liberation from the restrictive policies to all parts of the Soviet system, including science. Slava Gerovich has described the path to acceptance of cybernetics in the USSR followingly:

> By the late 1950s, cybernetics was recognized as an innocent victim of political oppression and "rehabilitated" along with some of the political prisoners of the Stalinist regime. Soviet cybernetics emerged as a movement for radical reform of the Stalinist system of science. It gained wide popularity, and in the early 1960s it was written into a new Party Program and hailed as a "science in the service of communism. (Gerovich 2002: 4)

One of the first steps in this process was publishing the Russian translation of Norbert Wiener's *The Human Use of Human Beings: Cybernetics and Society* (1950) in 1958 in the Soviet Union. From this book begins the acquaintance of Juri Lotman with cybernetics.

As Boris Egorov, literary scholar and Juri Lotman's colleague and close friend, has recalled, the news about cybernetics had reached them in Tartu already from the mid-1950s, but primarily in the form of anti-cybernetic statements in the newspapers (Egorov 1999: 91). The first real encounter happened through the aforementioned Wiener's book whose ideas had a profound effect on them. Egorov writes:

> I was the first to buy and read Wiener's book, and it literally turned my soul upside down […] I immediately made a report in our department's philosophy seminar, outlining the content and possibilities of using the ideas of the American scientist in our field. What impressed Lotman the most was the principle of feedback […] and, in general, the whole range of central problems of information theory, which are the basis of cybernetics. (Egorov 1999: 92)

Gerovich (2002: 99) has pointed out that Wiener's description of society as a self-regulating device was meant to alert readers to the dangers of excessive control over the means of communication which could drive society out of equilibrium. As expected, such concerns were well appreciated in the Soviet Union.

However, as has been proposed by Salupere (2015: 71), the most important cybernetician for Lotman was not Norbert Wiener but William Ross Ashby. Ashby's book *An Introduction to Cybernetics*, written in 1956, was translated into Russian in 1959. Salupere (2015: 72) explains that the reason why Lotman was fascinated by Ashby's work may have been "that Ashby, who was a biologist, showed greater interest for "living" systems. His conception of the brain also falls in line with Lotman's – the society, the brain and living systems are all intricate, complex systems, but at the same time, they all share something in common". For Ashby (1957[1956]: 4) the potential of cybernetics lays in the ability to "provide the common language by which discoveries in one branch can readily be made use of in the others". Another advantage that he sees in the cybernetic approach is that

it can create means for analysing complex systems such as "the cerebral cortex of the free-living organism, the ant-hill as a functioning society, and the human economic system" (ibid., 5). Ashby criticises the scientific dogma of "varying the factors one at a time" as approach suitable only for systems that are either intrinsically simple or could be broken down into simpler components; according to him complex systems "just do not allow the varying of only one factor at a time – they are so dynamic and interconnected that the alteration of one factor immediately acts as cause to evoke alterations in others, perhaps in a great many others" (ibid.).

We can propose that it is through Ashby's writing that Lotman encounters 'complex system' [*сложная система*][5] as a distinct cybernetic notion for the first time[6]. In Lotman's writing, this notion appears[7] in the foreword to the second issue of *Trudy po znakovym sistemam* [Sign Systems Studies] (Editorial 1965: 8) where in a discussion regarding the secondary modelling systems, he distinguished between elementary, complex and ultracomplex cybernetic systems; where biological structures are seen as complex; systems that are simpler than biological are defined as elementary and systems more intricate than biological, including secondary modelling systems, are seen as ultracomplex. It is also possible to presume that Ashby's stance against such scientific enquiry that is based on separating the world into simpler components and thus reducing the inherent complexity of its research object was something that Lotman deeply empathised with and which he later on repeatedly proclaimed himself (see, e.g., Lotman 2005[1984]: 206; Lotman 2022[1967]).

Lotman does not often refer directly to Ashby's works; however, on a closer look into Ashby's *An Introduction to Cybernetics*, we can find many notions and ideas which later on acquire an important place in Lotman's semiotic theory of culture. For example, Ashby (1957[1956]: 94) discusses extensively the idea of isomorphism of systems which he defines broadly as "similarity in pattern"; he explicates the relation between invariants, constraints and predictability in a system (ibid., 130–132); we can also find a chapter about the concept of 'emergence' and emergent properties which especially in the case of larger systems can lead to a situation where the "properties of the whole are very different from those of the parts" (ibid., 111–112). An essential contribution to cybernetic theory is his law of requisite variety, also known as the First Law of Cybernetics (see ibid., 206–213). Rewar has noted that Ashby's' idea that in order to maintain itself and adapt to an ever-changing environment, a system must contain at least as much variety as there is in the environment to which it is adapting, is also echoed in Lotman's understanding of the adaptability of artistic text:

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[5] In Russian language the word 'сложный' is used for both complicated and complex.

[6] The word 'complexity' is used a couple of times by Wiener (1950) as well but does not appear as a specific cybernetic term in his text.

[7] The idea of complexity is also already present in his first monograph *Lectures on Structural Poetics* (1964) where Lotman uses the term 'complex structure' in a cybernetic sense for a couple of times in discussing the complexity of artistic text (see Lotman 1964: 90, 187).

> The poetic text is composed of levels disposed in hierarchical and spatial series. Transtextual structures are mobile, and they too are hierarchically disposed. Both the structures and the system of their dominants change in different periods of history. By establishing equivalences with hierarchies of the transtextual structures, elements of the object text are able to connect with elements belonging to the transtextual structures. Their ability to do so serves not only a hermeneutic function, but also the aims of longevity and survival. This is how we meet in Lotman's formulation Ashby's principle of requisite variety. (Rewar 1979: 289)

In addition to the above-mentioned, we can also find such concepts as mechanism, feedback, entropy, equilibrium, topological approach etc. An in-depth discussion of these connections does not fit into the goals of this study (for elaboration on some of these topics in relation to Ashby, see Rewar 1979 and Salupere 2015). We will be returning to many of these notions in the following chapters, but for now, I just want to note the extent of this overlap between Ashby and Lotman.

Lotman's exposure to cybernetic ideas extended beyond books. He was personally acquainted with Soviet cybernetician and mathematician Andrei Kolmogorov[8] whose name appears in several of his works (see, e.g., Lotman 1964, 1998[1970], 1972). Rewar (1979: 287–288) has pointed out that Lotman approaches Kolmogorov's ideas with reservations, as complexity in an artistic text cannot be measured in the same manner as proposed in his theory of information complexity[9]. A small but peculiar chapter in Lotman's interactions with the cybernetic field was his collaboration in the first half of the 1970s with Mikhail Ignatiev, head of the Department of Cybernetics and Technology at the Leningrad Institute of Aviation Instrumentation. The aim of this collaboration was to design robots for the Soviet space project of colonising the Moon, and literary scholars were involved in this project to explore the structural-semiotic approaches for designing communication between humans and machines and the topic of artificial intelligence (Egorov 1999: 206–209). The subject of artificial intelligence remained relevant for Lotman also in his later writings, but not in the form of technological innovation, but primarily as a heuristic figure, with the help of which to delineate the characteristics of thinking systems more broadly (see Lotman 2004[1981], 1979[1977]). He repeatedly discussed the idea that art as the most complex system known to humankind could serve as a model for developing artificial intelligence and even proposed that new branches of research could emerge: culturonics as cybernetics of culture and artonics as cybernetics of art, which both could open new ways of

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[8] As Silvi Salupere (2015: 81) has noted, they became acquainted through the mathematician Vladimir Uspensky in 1965, who was Kolmogorov's student and a good friend of Lotman (see also V. Uspenski 2010[1995]).

[9] Kolmogorov has proposed an algorithmic measure of complexity where the complexity of information is equated with the shortest computer program that is needed for generating it. However, for example in poetry, repetion cannot be reduced because "in poetry, rhythm is not a repetition of the same element. It is the repetition of different elements which are in similar positions. Repetition either equates the dissimilar or repeats the same in order to reveal dissimilarities in it" (Rewar 1979: 288; see also Lotman 1970: 45–46).

developing intelligent technology (Lotman 2005[1979]: 234; see also Lotman 2005[1976]; Torop 2010).

The encounter with cybernetics strongly influenced Lotman's metalanguage (see Salupere 2015), as well as planted seeds for ideas which will later become central features of his semiotic theory of culture. However, Lotman was not merely borrowing ideas, instead, it would be more accurate to frame his interaction with cybernetics (as well as with other fields) as a means to draw creative input. Gerovitch has pointed out that Soviet research differed significantly from Western cybernetics: "They viewed the works of Western cyberneticians as a point of departure, rather than as a theoretical canon' (Gerovitch 2002: 249)". According to Silvi Salupere, such a creative approach that used the conceptions of cybernetics mainly as a generator of individual ideas was also true for Juri Lotman's works (Salupere 2015: 65).

1.1.2. Structuralism: From individual elements to relations

Lotman's first encounters with structuralist views[10] date back to his student years at Leningrad State University when he got acquainted with the ideas of Ferdinand de Saussure already during the first year of his studies in 1939 (Egorov 1999: 103; on connections with Saussure see Velmezova 2022). Nevertheless, the structuralist approach did not appear in Lotman's own writings before the beginning of the 1960s. Such timing is connected to the fact that it was only in the late 1950s when structuralist studies finally gained some foothold in the Soviet Union. As Pilshchikov and Trunin write: "The structuralist thought spread all around the world after the Second World War when the emergence of cybernetics and computer science revived interest in mathematical methods in the humanities which became closely associated with structuralism and semiotics" (see Pilshchikov, Trunin 2016: 378). The belated arrival of structuralism to the Soviet Union was connected with the fact that structuralism shared, to a large extent, a similar fate to cybernetics, which means that it was deemed unsuitable from the point of view of the official ideology and labelled as 'reactionary pseudoscience'. According to Slava Gerovich (2002: 39), the structural approach in linguistics, together with the formalist movement in literary criticism, were painted as mortal enemies of Marxism and their intellectual flaws were seen as closely intertwined with their political errors.

The initial steps towards introducing structuralist ideas to Soviet academia were taken in the middle of the 1950s on the backdrop of Khrushchev's Thaw. One of the prominent advocates for structuralism at that time was Vyacheslav Ivanov, who later became one of the central figures of the Tartu-Moscow School of Semiotics. Boris Egorov (1999: 96) has written that Ivanov, who at that time was a young lecturer at Moscow State University, started actively propagating structuralism and machine translation in the mid-1950s. Among other things, he

[10] On Lotman and structuralism see e.g., M. Lotman 1998; Avtonomova 2009; Salupere 2017; Pilshchikov et al. 2018; Pilshchikov, Sütiste 2022; Trunin 2022; Velmezova 2022.

managed to create a platform for discussions about structuralism in one of the major linguistic journals of that time, *Voprosy Jazykoznanija* (Topics in the Study of Language), which was known to represent a rather conservative approach to science. It was through this journal that Juri Lotman came to learn about structural studies in the Soviet Union. As Egorov (1999: 103) writes: "The first structuralist ideas were introduced to him by Zara Mints, who followed the linguistic innovations and had read the discussion on structuralism in the *Voprosy Jazykoznanija*".

The following turn to structuralism marks a crucial turning point on Lotman's academic path. Semiotician Mihhail Lotman has even characterised it as one of the two major academic crises in his father's career:

> On two occasions, Juri Lotman decided that he had to change the object and method of his research substantially. Moreover, he was convinced that he had to essentially start from scratch. The first time was in the early 1960s, when he became definitively disillusioned with the prevailing literary methodology; the second time was in the early 1980s, when he took a decisive look at his own research methodology, which he had developed within the Tartu-Moscow School of Semiotics. (M. Lotman 2007: 143–144)

This crisis pushed Lotman on a quest for a new methodology for literary studies. He became a strong proponent of exact methods and verifiable results[11]. His first attempt at formulating his structuralist stance was in the form of theses published in 1962 for a scientific gathering in Gorky (presently Nizhny Novgorod) on the use of mathematical methods in the study of the literary language titled *The problem of the similarity of art and life in the light of a structural approach*[12]. According to Silvi Salupere (2017: 36), this text represents Lotman's first attempt at developing a new 'scientific' meta-language and turning literary studies into real science.

In the same year, the first conference in the USSR devoted to semiotics was organised in Moscow under the title 'Symposium on the Structural Study of Sign Systems'. Lotman did not participate in this conference, but the news about this symposium caught the attention of the scholars in Tartu and led Lotman to establish contact with the participants of this gathering, many of whom later became members of the Tartu–Moscow School of Semiotics (see, e.g., Rickberg, Salupere 2022). The structural-semiotic approach that emerged from this collabo-

[11] As we can read from Pilshchikov et al. (2018: 9-10) in this early period of fascination with structuralism, Lotman tended to formulate his ideas regarding the structuralism quite radically, deliberately sharpening some of the problems by absolutizing the tendencies and elevating extreme cases to the rank of a universal law. It appears, however, that as his views matured, his writings adopted a much more balanced tone and the initial optimism towards mathematical approach faded.

[12] These thesis titled in Russian as *Проблема сходства искусства и жизни в свете структурального подхода* are later included in Lotman's first semiotic monograph *Lectures on Structural Poetics* (1964) as a part of the first chapter.

ration combined two different directions of philological thought. According to Boris Uspensky (1987: 19), Juri Lotman and his closest colleagues in Tartu had all studied philology in Leningrad, which is why their educational background was linked to the tradition of literary studies in this city and the influence of the formalist movement of OPOJAZ (Society for the Study of Poetic Language)[13]; at the same time, the Moscow side of the school was more tightly connected to the other branch of Russian formalism movement – the Moscow Linguistic Circle. For Lotman, the structural approach merged with the theoretical insights he had gained through his contacts with cybernetic ideas (see Egorov 1999: 103), forming the next important step in his movement towards complexity thinking.

The idea that structuralism can be viewed as the cornerstone upon which Lotman started building his complex view of culture might seem paradoxical. Structuralism is often understood as an anti-historical, static and reductionistic approach. Thus, it appears to oppose the main focus of complexity thinking – i.e., explaining the phenomenon of change in systems. However, the indication that the structuralist approach eliminated the dimension of time is largely a misconception. Structuralism focuses on the synchronous context and stems from the idea of interconnectedness. This means that every element of a system acquires meaning only in relation to the other elements in the system and thus cannot be studied in isolation from the structural whole. As pointed out by Aleida Assmann, this, however, does not imply timelessness: "From its very start, the system was conceived of in terms of process and change. Structuralism, therefore, implies not a turning away from time but a new approach to time, looking not at isolated changes but at changes as sets of relations within a system and between systems" (Assmann 2010: 346). In this matter, Assmann (ibid.) bridges the structural point of view with complexity: "Temporal change is obviously affirmed, but it is not described in terms of a linear process: the new way to describe the temporal change is in terms of a systemic whole that constantly recomposes itself to maintain a state of balance".

A similar understanding of structuralism that does not exclude the diachronic axis was inherent to Lotman from the very beginning of his semiotic writings. In an article published under the title, "Literary criticism must be scientific"[14] in 1967, Lotman (2022[1967]: 488) argues that structuralism cannot be considered an opponent of historicism and claims that the "division between synchronic and diachronic (historical) analysis, despite being very important as a methodological device and having played a very positive role in the past, is now regarded as a heuristic rather than a foundational principle". In another article from the same period titled "On some principal difficulties in the structural description of a text", Lotman (1974[1969]: 57) points to the error of confusing a synchronic description

[13] Mikhail Trunin (2022: 47–48) has noted, that this connection should not be understood as a direct scholarly genealogy from Petersburg formalism to Lotman, because formalism fell into disrepute in the Soviet Union already during his studies; hence it would be more correct to speak about Lotman rediscovering the formalist legacy.

[14] The initial title proposed by Lotman was actually "On the principles of structuralism in literary studies" (see more on this in Pilshchikov et al. 2018).

with a static one. He refers to Roman Jakobson (1931: 264–265; trans. in Lotman 1974[1969]: 57) according to whom: "It would be a serious error to maintain that the words synchronic and static are synonyms. A static section is a fiction: It is but a useful scholarly method, and not a specific mode of existence." In this article, Lotman proposes that constructing a dynamic model of artistic work is one of the primary goals of the structural method. According to him, a dynamic structure will appear as some number of static models (a minimum of two) which are in a definite mobile relationship; while each of the structural aspects separately is described statically, it is their relationship with each other that gives the model a dynamic element (Lotman 1974[1969]: 58).

The centrality of relationships as the essence of the structural method is emphasised by Lotman repeatedly in his writings in the 1960s. For example, in his first semiotic monograph, *Lectures on Structural Poetics* (1964), he writes:

> The peculiarity of the structural study is that it does not involve considering individual elements in their isolation or mechanical connection, but rather determining the relationship of the elements to each other and their relation to the structural whole. It is inseparable from the study of the functional nature of the system and its parts. (Lotman 1964: 5–6)

We encounter a similar line of thought in his 1967 article:

> the artistic work is not a sum of features, but a functional system, a structure. The researcher does not list 'features', but rather builds the model of their relations. Each structure is an organic unity of elements, organized according to a given systemic type, and is in turn only an element of a more complex structural unity. Furthermore, it is possible to consider each element of the structure, taken separately, as a self-sufficient structure in itself. (Lotman 2022[1967]: 488)

In this text, he also brings out the problem of modelling complex systems: "When we have to deal with complex structures (such as art) whose synchronic description is in general troublesome, due to the countless factors involved, the knowledge of the previous states of the system becomes a necessary premise for a successful modellization" (ibid.).

The particularity of Lotman's structural approach has been characterised by Avtonomova (2009: 197) through the concept of 'open structure', a characteristic which, according to her, was already present in the early works of Lotman but which later on certainly became more prominent. As she has clarified, Lotman's models of culture do not describe one immanent structure. Instead, they are based on the idea of polyglotism, which always necessitates the process of translation between the various languages, resulting in the permanent search for new meanings and, thus, dynamics of the system (ibid., 198–199). While over the years, Lotman's scientific focus shifted from structuralism to semiotics[15], then, as Salupere (2017: 69) has noted, there is a paradoxical stability in Lotman's appreciation

[15] On the use and relations of these two concepts in Lotman's works see Salupere 2017: 58–69.

of the heuristic value of structuralism and its central concept – structure, even after his turn to the dynamic processes. As has been noted by Katre Pärn (2022: 176):

> The notion of structure allowed Lotman to integrate the issue of models and modelling with those of order and organization that were central in his concept of culture. Culture organizes/ orders/structures the world around people, models and modelling systems as structural and structuring phenomena therefore play a key role in the mechanism of culture.

To exemplify the relevance of 'structure' throughout Loman's works, let us look at how he describes what he sees as the next essential step for the discipline of semiotics expressed in one of his very last books, *The Unpredictable Workings of Culture,* written in 1991. There he writes that semiotics should move on to formulating a general theory of structures, a theory that links all forms of organisation in the world – from physical to cultural phenomena (Lotman 2010[1994]: 37). His own goal in this book is more modest: "to provide an outline for a general structural description of culture and tentatively to suggest the place of culture among broader and more general forms of organisation" (Lotman 2013[1994]: 53). As was insightfully noted by Salupere (2017: 65): "From this description, it turns out that Lotman actually never left structuralism." At the same time, this structuralist goal to search for a theory that could build a common ground for studying the organisational principle of various phenomena in the world also reflects the ambitions of complexity research.

1.1.3. Vernadsky: Towards spherical thinking

The term 'semiosphere' first appears in Lotman's works in 1984 in the article "On the Semiosphere" (2005[1984]). Through this notion, Lotman (1990: 125) manages to formulate one of the core principles of his semiotic theory, according to which: "The unit of semiosis, the smallest functioning mechanism, is not the separate language but the whole semiotic space of the culture in question. This is the space we term the semiosphere." For many authors, this marks a significant turning point in Lotman's thinking. According to Amy Mandalker (1994: 385), the transformation in the thinking of the Tartu–Moscow school that took place in the 1980s from a theory rooted in Saussurean linguistics and in mathematical procedures to a biological, organismic approach can be compared in its significance to the shift from Newtonian to relativistic physics. Edna Andrews (2003: 32) has observed that in his conceptualisation of the semiosphere, Lotman is "making a clear shift away from the level of individual signs and their functions in cultural space toward a higher level of network semiosis and system-level phenomena". In a similar line of thought, Bogusław Żyłko assesses this change as a movement from static to dynamic modelling:

> The shift, from the conception of culture as a bundle of primary and secondary modelling systems to the notion of semiosphere, is also a shift from static to dynamic thinking. If we took the former approach, culture would resemble a motionless unit

> made up of semiotic systems; whereas if we follow the semiospheric approach, culture takes the shape of a heterogeneous whole bustling with multiple rhythms of development and transient dominants. (Żyłko 2001: 400)

The model of semiosphere is without a doubt one of the most discussed ideas in Lotman's theory, and there exist a large number of substantial overviews from various perspectives (see, e.g., Mandelker 1994; Andrews 2003; M. Lotman 2002; Kotov, Kull 2011; Torop 2005, 2022b; Trunin 2017; Hartley et al. 2021) That is why in the current part, we will give just a brief overview of the development towards "spherical thinking" in Lotman's works in relation to elaborating his complex view on culture.

The primary source of inspiration for developing the concept of the semiosphere is without question the works of the biogeochemist and geologist Vladimir Vernadsky and his concepts of the 'biosphere' (biological life) and 'noosphere' (human cognition). The latter was viewed as the third stage in the development of the Earth after the geosphere when human thought drastically reshapes the biosphere (see Vernadsky 1989). At the same time, it is possible to trace many more relevant influences that, in various ways, had prepared the ground for the semiospheric approach to cultural systems.

For example, Peeter Torop focuses on the hierarchical structure of the semiosphere and proposes that from this aspect, it is possible to distinguish three authors whose research strategies were relevant for developing the understanding of how the semiosphere functions: "Tynyanov and the hierarchical treatment of the evolutionary process, Jakobson and the hierarchical treatment of communication process, and Bakhtin and the treatment of text as a chronotopical hierarchy" (Torop 2009: xxxv). The connection to Bakhtin in relation to the notion of semiosphere has also been noted by various other authors who have compared it with Bakhtin's idea of 'logosphere' (see, e.g., Mandelker 1994; Avtonomova 2009, Gherlone 2016). According to Mandelker (1994: 386–387), Lotman acknowledges his debt to Bakhtin's suggestive notion of the 'logosphere' which was also inspired by Vernadsky, and which was presented as the dialogic sphere where the word exists, and which can be viewed as a living space with a plenitude of unfinalizable meanings.

However, Lotman did not derive his ideas regarding the spheric structure of the semiotic space only via Bakhtin but stepped into a direct dialogue also with Vernadsky's works himself. The first time that the concept of biosphere is mentioned by Lotman in his writings is in 1971 in the article "On the semiotic mechanism of culture" co-written with B. Uspensky. They write:

> As a methodological abstraction, one may imagine language as an isolated phenomenon. However, in its actual functioning, language is molded into a more general system of culture and, together with it, constitutes a complex whole. The fundamental "task" of culture, as we will try to show, is in structurally organizing the world around man. Culture is the generator of structuredness, and in this way it creates a social sphere around man which, like the biosphere, makes life possible; that is, not organic life, but social life. (Lotman, Uspensky 1978[1971]: 213)

Although the authors do not mention Vernadsky's name, it can be assumed that Lotman was already aware of Vernadsky's ideas. M. Trunin (2017: 341) has written that Lotman knew of Vladimir Vernadsky early on, despite the fact that Lotman began a serious study of Vernadsky's works at the beginning of 1980. Among the Tartu–Moscow semioticians, Vernadsky's ideas were already present in the 1960s; for example, Vyacheslav Ivanov referenced him in a book *Slavic Modelling Semiotic Language Systems* (1965) co-written with V. Toporov as well as in an article published in 1967 in the *Sign Systems Studies* journal edited by Lotman (see Trunin 2017: 341–342).

Vernadsky first used the concept of 'biosphere' already in 1911 following Eduard Suess, a professor of palaeontology and geology at the University of Vienna, who was the first one to propose that biosphere could be interpreted in two ways: either as the sum total of living organisms or as a geosphere which is created and organised by the processes of life (Levit 2001: 53–54). In elaborating his theory, Vernadsky followed the latter definition. What is important from the complexity perspective, is that in Vernadsky's view, the biosphere as a geological envelope (Vernadsky 1997) was conceptualised as a self-regulating system. As George S. Levit (2001: 57) notes, Vernadsky discovered while studying the chemical compounds of different species that they do not reflect the compounds of their environment "but, on the contrary, living matter has determined the geochemical history of almost all the elements of the Earth's crust in the process of making the environment favourable to itself. Thus, living matter shapes the biosphere into a self-regulating system."

In relation to the idea of self-regulation, Vernadsky uses the concept of 'organisation' (*организованность*) to refer to the structure and regularities of the biosphere and, at the same time to differentiate it from the notion of 'mechanism' in the sense that '*организованность*' indicates that the parts of the whole are determined but not fully determined by the whole (ibid.). This structure is not static but can be described through the notion of dynamic equilibrium: "No single point of this system is fixed during the course of geological time. All points oscillate around some centre" (Vernadsky 1997: 225–227; see Levit 2001: 57). Hence, as Levit concludes: "the biosphere is a self-regulating system, which transforms the environment not chaotically, but in accordance with established regularities, which respond to the needs of terrestrial life" (Levit 2001: 58).

Kotov and Kull (2011: 186) have argued that the biosphere is what we might call an emergent phenomenon. This argument stems from one of Vernadsky's statements, which the authors deem to be the most relevant, i.e., "the impossibility of abiogenesis in biosphere; life presupposes life but also that life appears from the very beginning in the form of the biosphere" (ibid.). As Kotov and Kull (ibid.) explain, this claim is connected to Vernadsky's observations that living and inert natural bodies are connected only by a biogenic flow of atoms and that there are almost no transitional forms between living and inert matter. Thus, from this perspective, the phenomenon of living matter cannot be explained by reducing it to simple components. The idea that life can only emerge from life – was one of the central ideas that caught Lotman's attention when he started reading

Vernadsky's works at the beginning of the 1980s and which became one of the key principles of semiosphere (see also Kull 2015a: 7). In 1982 Lotman shared his impressions of Vernadsky's ideas in a letter to Boris Uspensky:

> While reading Vernadsky I was seized by one of his assertions. As you know, once in our Moscow seminar […] I dared to declare that a text can exist (e.g., can be socially comprehended as a text) if another text preceded it, and that any developed culture must be preceded by a developed culture. And now I have discovered in Vernadsky's writing a thought, deeply substantiated by his vast experience in studying cosmic geology, that life can only spring into existence from life, i.e., it is preceded by life. […] Only the pre-existence of a semiotic sphere makes a message become a message. Only the existence of consciousness explains existence of consciousness. (Lotman 1997: 630; trans. in Kull 2015a)

Another significant aspect in Vernadsky's work from the perspective of complexity, which resonated with Lotman, was the aspect of asymmetry. According to Mandelker, Vernadsky's model of the biosphere is based on the principle of specularity, or mirroring, on the interplay of symmetry and asymmetry, and on the reproduction of life by the union of enantiomorphic (mirror image) pairs. In this regard, Lotman was also already "primed" to perceive the relevance of Vernadsky's idea, as it resonated with his own model of communication as well as his interest in the functional asymmetry of the cerebral hemispheres (see, e.g., Lotman 1979[1977], 2019[1978], 1983). The mirroring principle becomes one of the bases of the semiosphere and serves as a model of its dialogical structure:

> Mirror symmetry creates the necessary relations between structural diversity and structural similarity, which allow dialogic relationships to be built. On the one hand, the systems are not identical and give out diverse texts, and on the other, they are easily converted, ensuring mutual translatability. We may say that, in order for dialogue to take place, the participants must be distinct and yet simultaneously contain within their structure a semiotic image of counter-agent […] thus enantiomorphism represents the primary "mechanism" of dialogue. (Lotman 2005[1984]: 220–221)

One other aspect of the biosphere, which nudged Lotman's semiotics towards complexity thinking, is connected to Vernadsky's view on boundaries. Laura Gherlone (2016: 8) has noted that during his studies on the mechanisms of chemical and molecular interpenetration among the various spheres of the planet, Vernadsky had worked for a long period on the functions of boundaries, which is why in his scientific vision the boundary has different meanings that can be represented through the following duality: "boundary as a line of demarcation that marks the unity and autonomy of each domain (of nature, of knowledge, etc.) and boundary as a filter through which the communication and exchange between different domains can happen." This duality and partial openness of the boundaries, which is also one of the key characteristics of complex systems, will be considered in more detail in part 1.2.3.

1.1.4. Prigogine: The laboratory of unpredictability

Lotman encountered Ilya Prigogine's theory of complex systems for the first time in 1986. As Marina Grishakova (2009: 179) has recalled: "In 1986, a discussion on Prigogine's work was organised by Lotman's semiotics research group, in which I worked at the time. My presentation on *Order out of Chaos* sparked a debate about the controversial aspects and invigorating impact of Prigogine's theory on the developments in science and the humanities." As Lotman (1989: 48) himself has recalled, this encounter left an extremely strong impression on him. What fascinated Lotman was that the ideas presented by Prigogine and Stengers, who were working primarily in the field of physical chemistry, in many ways supported his own conclusions from studying cultural processes and artistic texts.

As accounted by Tatjana Kuzovkina (2022: 35), in 1985, a year before he was acquainted with Prigogine's ideas regarding irreversible processes in chemistry and physics, Lotman had made a report at one of the semiotic seminars in Tartu, which was later published as an article "On the role of random factors in the evolution of literature" (О роли случайных факторов в литературной эволюции, 1989). In this report, he distinguished between two different types of process: "repetitive (reversible) and irreversible (with a 'historical, that is, temporary nature') […] In the latter process, chance plays a huge role, which Lotman associated with self-awareness and the act of individual choice" (ibid.). The dialogue with Prigogine's theory gave Lotman new ground and inspiration for exploring the mechanisms of unpredictability, choice, and creativity further. However, he always emphasised that the Tartu scholars had understood the importance of these aspects already from the very beginning of their semiotic project:

> When, at the dawn of the formation of the Tartu semiotic school, disputes flared up about whether it was necessary to put the analysis of the detective and other predictable art forms at the forefront or whether the foundations of scientific methodology should be honed on the uniqueness of the artistic worlds of Tolstoy and Chekhov, the dispute was really about whether the semiotic description of art is a platform on which methods of applying the simple to the complex will be tested (non-artistic to the artistic), or whether fundamentally new ways of science will be developed here, for which systems of extreme complexity are the basis of the search for a new stage of semiotics. (Lotman 2002a[1992]: 70)

Nonetheless, Prigogine's ideas introduced a completely new layer of complex thinking into Lotman's semiotics of culture. In their book *Order out of Chaos*, Prigogine and Stengers introduce the notion of 'dissipative structures', a concept that is opposed to the 'equilibrium structures' and is meant to capture the inner paradoxicality of complex dynamics. As the authors explain, this oxymoronic formation emphasises "the close association, at first paradoxical, in such situations between structure and order on the one side, and dissipation or waste on the other" (Prigogine, Stengers 1984: 143). Dissipative structures operate far for equilibrium conditions; as open structures, they interact with their surroundings, and through this interaction, new structures may originate spontaneously (ibid.). Such systems

do not follow the second law of thermodynamics, according to which the entropy of a system in spontaneous processes either remains the same or increases. That is, dissipative structures do not decay into chaos, but instead maintain their organisation by interacting with their environment (Marais 2014: 32); i.e., they are self-organising.

Prigogine and Stengers (1984: 13) emphasise that while the laws of equilibrium are universal and processes are characterised by repetitiveness, then processes happening in far-from-equilibrium conditions are specific and unique and can give rise to various new dissipative structures. The formation of dissipative structures can be described through the theory of bifurcations. As the authors explain:

> […] near-bifurcations systems present large fluctuations. Such systems seem to "hesitate" among various possible directions of evolution […] A small fluctuation may start an entirely new evolution that will drastically change the whole behavior of the macroscopic system. The analogy with social phenomena, even with history, is inescapable. Far from opposing "chance" and "necessity," we now see both aspects as essential in the description of nonlinear systems far from equilibrium. (Prigogine, Stengers 1984: 15)

The influence of Prigogine's ideas on Lotman (see, e.g., Grishakova 2009; Gherlone 2022; Kim 2014) is visible in his last monographs, *The Universe of the Mind* (1990), *The Unpredictable Workings of Culture* (2013[1994]) and *Culture and Explosion* (2009[1992]) as well as in various articles (e.g., Lotman (2019[1988], 2019[1989], 2019[1992]). For Lotman, the enormous contribution of Prigogine's work laid in the fact that he managed to introduce chance into the mechanism of causality and, through that, de-automatized our picture of the world (Lotman 2019[1989]: 89–90). Following his example, Lotman proceeded to "restore" the informativeness of historical processes in culture. Describing the process of historical interpretation, Lotman compares a historian to a fortune teller who, instead of predicting the future, "predicts backwards" – the main difference is that the retrospective gaze eliminates indeterminacy: "What in fact did not take place could not, in the eyes of the historian, have taken place. The historical process loses its indeterminacy, i.e., ceases to be informative" (Lotman 1990: 236). Modelling the historical process using the bifurcation theory allowed Lotman to recreate the past as an open and unpredictable process:

> If we look at the historical process as a time trajectory the bifurcation points are those historical moments when the tension between the opposing structural poles reaches a point of highest tension and the whole system leaves the state of equilibrium. At these moments the behaviour of individuals and of the masses ceases to be automatically predictable and determinacy recedes to the background. At these moments the movement of history should be pictured not as a trajectory but as a continuum that is potentially capable of resolving itself into any number of variants. (Lotman 1990: 233)

Prigogine and Stengers (1984: 176) have discussed that the role played by individual behaviour near the bifurcation points can be decisive. This aspect appears crucial for Lotman in the context of cultural processes. As he points out, it is in the time of cultural explosions[16], such as revolutions or other types of dramatic historical shifts, when the role of the individual is highlighted, as the possible path forward will depend not only on chance but also on the self-awareness of the people involved (Lotman 1990: 223). In this aspect, Lotman sees an important difference between the unpredictability of natural processes and cultural explosions. In cultural processes, the randomness which is present in the bifurcation points can be transformed into freedom, "which greatly complicates its relationship to causality because now, between cause and effect, there lies an act of intellectual choice, free from automatization" (Lotman 2019[1989]).

As Kim (2014: 21) has noted, Lotman's view regarding the aspect of choice in the moment of explosion is not only an elaboration on Prigogine's and Stengers' ideas but is connected to his previous theoretical investigations already from the early 1980s into the nature of 'semiotic personalities' and their ability for individual behaviour as well as original thought. However, the influence of Prigogine's ideas gives Lotman an impulse to reformulate the whole process of the emergence of new (original) meaning: "We will define meaning-making as the capacity of a culture as a whole or of individual parts to produce new, non-trivial texts. We will define new texts as those that arise as a result of irreversible (as Prigogine used the term) processes, that is, texts that are to a certain extent un-predictable" (Lotman 2019[1989]: 85). In such a way Lotman was able to rethink semiosis from the perspective of complex dynamics. In the following subchapter, we will examine how.

1.2. Principles of complexity thinking in Lotman's theory

Now that we have established the central frames of thought that nudged Juri Lotman's works towards complexity, we can move on to explicate in more depth how Lotman developed these ideas further in the context of his theory of culture. The aim of this part is to establish a common ground for dialogue between Lotman's semiotics and the ideas and notions relevant to the contemporary complexity paradigm. However, pinpointing the core aspects of the complexity paradigm is definitely not an unambiguous task. As was discussed at the beginning of the first chapter defining complexity is problematic in various ways. That is why many authors prefer to focus on delineating common properties or characteristics of complex systems instead of providing a concrete definition. Francis Heylighen (2008: 69) has reflected on some of the shortcomings of such an approach:

[16] Peeter Torop has proposed that Juri Lotman's concpet of explosion was inspired not only by Prigogine's works but also by Lev Vygotsky's idea of affective explosion (see Torop 2016).

> authors trying to characterize complex systems just provide extensive lists or tables of properties that complex systems have and that distinguish them from simple systems. These include items such as: many components or agents, local interactions, non-linear dynamics, emergent properties, self-organization, multiple feedback loops, multiple levels, adapting to its environment, etc. The problem here of course is that the different lists partly overlap, partly differ, and that there is no agreement on what should be included. Moreover, the properties are usually not independent. For example, self-organizing processes normally produce emergent properties, and include feedback loops, which themselves entail non-linearity...

Describing the properties as independent of each other inevitably distorts the object of study. Complexity as systems property can arise only from the inextricable and interwoven[17] relations that govern the system's dynamics. At the same time, such descriptions that divide the phenomenon of complexity into distinct features have a heuristic value as they create the possibility for analysis and comparison of different systems. Hence, it is essential to emphasise that although this subchapter will follow a similar approach of delineating the dynamics of complex systems into various aspects, we should constantly keep in mind that such partition is always artificial but unavoidable in the effort to grasp the phenomenon of complexity.

Giving an overview of the various attempts that have been made in listing complex systems properties (see, e.g., Érdi 2008; Cilliers 1998; Davis, Sumara 2006; Nicolis, Prigogine 1989; Serra, Zanarini 1990; Engelbrecht 2021; Emmeche 2004) goes beyond the aims of this dissertation. What is important, however, for us to note is that while most such attempts aim to delineate the general characteristics that would apply to all complex systems, the content of these lists still depends significantly on the type of complex system the researcher is interested in.

Jüri Engelbrecht has discussed such differences in the case of physical complex systems and social ones. As a mechanics scientist and a mathematical physicist, he has proposed that physical complex systems can be characterised through the following properties: (i) non-additivity and nonlinear interactions; (ii) deterministic unpredictability; (iii) sensitivity to initial conditions; (iv) various behavioural specifics like bifurcations, emergence, attractors, multiple equilibria, thresholds, coherent states, adaptability, self-organising criticality etc. (v) several rules which govern the processes: period doubling and Feigenbaum numbers, power laws, self-similarity, fractality of attractors, etc. (Engelbrecht 2021: 80–81). In addition to properties, Engelbrecht also distinguishes so-called structural cornerstones of a complex world – fractals, networks, and hierarchies (ibid., 81).

[17] Michel Alhadeff-Jones (2008: 63) has given an overview of the etymology of the word 'complex': "Adapted from the Latin expression 'complexus' (14th century) and adopted from the modern French, the term derives from 'cum' and 'plectere', meaning surrounding, encompassing, encircling, embracing, comprehending, comprising. Originally denoting 'embracing or comprehending several elements', its use in English tended to be akin to the sense of 'plaited together, interwoven'".

In comparison to his own list, he refers to a well-known list proposed by Paul Cilliers, which aims to distinguish the features of complex systems from philosophical and cultural perspectives. Cilliers names the following characteristics: (i) Complex systems consist of a large number of elements; (ii) in order to constitute a complex system, the elements have to interact, and this interaction must be dynamic; (iii) the interaction is fairly rich, i.e. any element in the system influences, and is influenced by, quite a few other ones; (iv) the interactions are nonlinear; (v) the interactions usually have a fairly short range (this does not preclude wide-ranging influence); (vi) there are loops in the interactions; (vii) complex systems are usually open systems; (viii) complex systems operate under conditions far from equilibrium; (ix) complex systems have a history; (x) each element in the system is ignorant of the behaviour of the system as a whole (Cilliers 1998: 3–4).

As Engelbrecht (2021: 85) points out, the main difference seems to lie in the aspect that "in physical systems, much attention is based on phenomena that could take place in complex systems and to the possible quantification of those phenomena" while in the case of Cilliers philosophical point of view, the attention is primarily on interactions. However, on a closer look and leaving aside the differences in terminology, we can see that there is still quite a significant common ground between these two views. An attempt to delineate a common ground from various lists of complex systems characteristics was published in 2018 by Rika Preiser, Reinette Biggs, Alta De Vos, and Carl Folke.

In their article, the authors propose six organising principles of CAS [complex adaptive systems] based on a comparison of leading scholars' classifications[18] of CAS features and properties (Preiser et al. 2018). As the authors explain, "the six principles provide a conceptual typology by which similar salient features, properties, and behaviors of CAS can be clustered together" (ibid.). The value of this attempt lies in the authors' aim to combine the works that present pretty different perspectives on complex systems and find common ground in this diversity. As such, this article gives a good representation of what can be considered a "shared understanding" of complex systems in the paradigm of contemporary complexity thinking. As a result, they arrived at the following list (Preiser et al. 2018:): (i) CAS are constituted relationally; (ii) CAS have adaptive capacities; (iii) CAS behavior comes about as a result of dynamic processes; (iv) CAS are radically open; (iv) CAS are determined contextually; and (vi) novel qualities emerge through complex causality[19].

In the present subchapter, I will not directly follow any of these existing lists of complex systems characteristics. Instead, I will take Juri Lotman's descriptions of semiotic systems as the starting point for delineating the principles that allow us to grasp the dynamics of complex cultural systems and develop them in

[18] Authors whose works were used in generating this typology: John Holland (1995), W. Brian Arthur, Steven Durlauf, and David Lane (Arthur 1988, Arthur et al. 1997); Simon Levin (1998, 2005); Paul Cilliers (1998), Dominique Chu, Roger Strand, and Ragnar Fjelland (2003).

[19] How these six properties proposed by Preiser et al. 2018 relate to Juri Lotman's semiotics is discussed in Rickberg 2022b.

dialogue with the ideas of various authors from the complexity discourse. I will focus on four types of relations which, throughout Lotman's works, are discussed as opposing tendencies occurring in the semiotic space and which, in my opinion, appear central for explicating the nature of dynamics in culture as a complex system.

For Lotman, describing cultural dynamics through binary opposition is common practice (as just one example, see Lotman 1977[1974]). However, this aspect of his semiotics seems to make researchers usually cautious as this way of modelling is structuralism in its purest form and appears overly reductive. At the same time, many researchers who have worked on Lotman's ideas find ways to reconcile such binarism with Lotman's more "explicitly dynamic" models of culture. For example, Edna Andrews (2003: 45) has written that the question of binarism in Lotman's semiotics is both complex and controversial; however, she stresses that Lotman is not reducing the structure of semiotic space to dyads alone, indicating that in his later works, Lotman defines binarism as "a principle which is realized in plurality since every newly-formed language is in its turn subdivided on a binary principle" (Lotman 1990: 124). Laura Gherlone has emphasised that, especially in later works, Lotman always speaks of "dynamic binariness" as a "tension that does not end in the conflict/synthesis between opposite poles, but always seeks a "complex unity" (сложная единица) or "higher unity" (высшее единство)" (Gherlone 2022b: 137).

In regard to this matter, Aleksei Semenenko has brought out that it is "important to distinguish between the two sides of this concept: binarism as, so to say, an intrinsic, ontological quality of any semiotic system and binarism as the principle of semiotic analysis and interpretation" (Semenenko 2012: 96) – for Lotman the value of such descriptions was connected with the latter. As Semenenko suggest, the binary approach in Lotman's works, as it is elaborated in the context of the "multidimensional character of culture, can therefore be represented by a diagram where each of the main oppositions is an axis with uncountable intermediate variants that in their turn can relate to other elements of the system" (Semenenko 2012: 97). Such a perspective allows us to perceive Lotmanian oppositions not as mutually exclusive but as simultaneously existing tendencies in culture. The contradictive and often paradoxical ways in which structuralism and dynamics merge in Lotman's thought is what actually makes his theories a suitable ground for developing complex thinking. The value of merging such contradicting lines of thought for the complexity paradigm has also been emphasised by Kobus Marais (2014: 22):

> It assumes that, in the case of all the typical binaries or conflicting concepts such as part and whole, mechanical and organical, universal and particular, culture and nature, both need to be conceptualized as constituting reality. None of these can be subsumed into their counter-concepts but need to be maintained in a paradoxical tension. Complexity is a philosophical stance that does not try to reduce either the one into the many or the many into the one. Rather it is a philosophy of paradox that maintains both one and many, universal and contingent, […] source and target, self and other as constituent parts of reality.

Following this line of thinking we will examine four paris of relations in Lotman's semiotics: (i) static and dynamic relations; (ii) whole and part relations, (iii) relations between internal and external space, and (iv) relations between continuous and discontinuous processes. The list is not exhaustive. The choice of these relations is made one the one hand by taking into account already existing characterisations of complex dynamics by other authors, and, on the other hand, by focusing on how Lotman, throughout his works, has attempted to describe the mechanism of change in culture. All these principles group together various other notions that are central to Lotman's semiotics. Such clustering can be done in different ways, and the proposed typology is not the only possible option.

Also, as was already emphasised, complex systems strongly resist any attempt to split them into discrete pieces, the same goes for Lotman's theoretical framework. The laws of the semiotic space constructed by Lotman are intricately intertwined, and each process is interrelated with the other parts of his theoretical model, which is why I would like to stress once more the connectedness of these principles proposed here and that they should be seen as different features of the same model. The aim of this subchapter is threefold: (i) to explain the role of each principle in the dynamics of semiotic systems; (ii) to establish a common ground for dialogue with the ideas and notions relevant to the complexity paradigm; (iii) to discuss some aspects of Lotman's theory of semiotics that differ from the generally accepted understanding of the dynamics of complex systems.

It is also important to note that various authors have already proposed ways how to delineate central principles for describing Lotman's semiotics, either holistically or some particular aspect of his theory. For example, Edna Andrews (1993: 33) distinguishes four fundamental concepts associated with the semiosphere: (i) heterogeneity, (ii) asymmetry, (iii) boundedness, (iv) binarity. In addition, she adds separately another defining characteristic of the semiosphere – its self-description, or the development of a metalanguage. Kalevi Kull and Timo Maran have described Lotman's semiotics through ten interconnected basic principles, which can be seen as the universal characteristics of a meaning-making mechanism. They propose the following list: (i) The principle of code plurality; (ii) The principle of incompatibility or nontranslatability; (iii) The principle of asymmetry; (iv) The principle of autocommunication or translation; (v) The principle of semiotic inheritance; (vi) The principle of the semiosphere; (vii) The principle of non-gradual (punctuated) evolution; (viii) The principle of modelling; (ix) The principle of boundaries; (x) The principle of unpredictability and choice (Kull, Maran 2022: 463–465; cf. Kull 2015a: 3–8).

In addition, I would like to point out some texts by Juri Lotman which provide a holistic examination of the aspect of dynamics of semiotic systems. An important example for the topic of the present thesis is his article "The Dynamic Model of a Semiotic System", in which Lotman (1977[1974]) states six aspects that should be taken into account when modelling a dynamic semiotic system which he presents in the form of oppositions: (i) static–dynamic; (ii) systematic–extrasystematic; (iii) monosemic–ambivalent; (iv) nucleus–periphery; (v) description–non-description; (vi) the necessary–the superfluous. Other significant texts concerning this topic

which I would like to highlight are his article co-authored with Boris Uspensky, "On the semiotic mechanism of culture" (Lotman, Uspensky 1978[1971]); "On the Semiosphere" (Lotman 2005[1984]); "Culture as a subject and its own object" (2019[1989]) and "On the dynamics of culture" (Lotman 2019[1992)]).

1.2.1. Static and dynamic relations: Adaptivity through self-organisation

According to Juri Lotman (2009[1992]: 1), one of the fundamental aspects of describing any semiotic system is its static and dynamic relations. Lotman formulates this as a question: "How can a system develop and yet remain true to itself?" This question connects Lotman's thinking about semiotic systems with one of the key-principles commonly attributed to all complex phenomena, namely that all complex systems have adaptive capacities. This implies that such systems change over time in response to feedback from interactions between system elements and between elements and their environment (see Preiser et al. 2018). The ability to adapt is explained in complexity sciences through self-organisation (e.g., Prigogine, Stengers 1984; Morin 1999; Levin 2005; Fox Keller 2008).

Cilliers (1998: 90) defines the capacity for self-organisation as "a property of complex systems which enables them to develop or change internal structure spontaneously and adoptively in order to cope with, or manipulate, their environment." He (ibid., 89) emphasises that the emergence of the structure, i.e., the internal organisation of the system – is neither a passive reflection of the outside nor a result of active, pre-programmed internal factors; instead, it is an intricate process that results from a complex interaction between the environment, the present state of the system and the history of the system. Another relevant aspect to note is that the occurrence of a structure is caused by limitations or, as Cilliers (ibid., 95) phrases it: "Boundaries, limits, and constraints are preconditions for structure"; thus, in the situation of unrestricted growth self-organisation would not occur.

Inspired by cybernetic ideas, Juri Lotman began exploring the idea that adaptivity is not only characteristic of living organisms but can also occur in semiotic systems already from his first semiotic monograph, *Lectures on Structural Poetics* (1964). There Lotman discusses the adaptive capacity of an artistic text:

> The feedback system that exists between all elements and levels of elements allows a work of art to acquire a certain independence after its creation and behave not as a simple sign system, but as a complex structure with feedback, significantly surpassing all known feedback systems created by man so far, and approaching, in a certain respect, living organisms: a work of art is in feedback with the environment and is modified under its influence. (Lotman 1964: 90)

The same type of comparison is repeated once more in the conclusion of this monograph: "Like a living cell, art appears as one of the most intricate structures with a complex system of internal self-regulation and feedback" (Lotman 1964: 187). In the following years, Lotman expanded the analogy between art and living

organisms to the sphere of culture (e.g., Lotman 1998[1973]: 645). In the article "On the Semiosphere", written in 1984, he claims that "all semiotic space may be regarded as a unified mechanism (if not organism)" (2005[1984]: 208). The parallels between the workings of culture and biological systems enable Lotman to propose that adaptability is one of the universal characteristics of all intelligent semiotic entities[20]; meaning systems that can store and transmit information; perform algorithmic transformations to decode information; and create new messages (Lotman 2019[1978]: 33–34). Lotman wrote in 1978 that an intelligent semiotic system has the capacity to "react flexibly and effectively to changes in its environment and to reorient itself in that environment by generating more effective models" (Lotman 2019[1978]: 45).

Systems' ability to generate more effective models is connected to two interrelated notions that are central to the understanding of self-organisation processes – memory and learning. In order to react flexibly and effectively to changes, the system has to be able to "learn" from past experiences. Cilliers (1998: 92) writes that in order to learn from experience, the self-organising system has to "'remember' previously encountered situations and compare them with new ones. If more 'previous information' can be stored, the system will be able to make better comparisons." This means that self-organisation is impossible without memory because, as Cilliers (ibid.) explains, without memory, a self-organising system could only mirror its environment.

The importance of memory in the process of cultural self-organisation is discussed in length in the paper by Juri Lotman and Boris Uspensky, "On the Semiotic Mechanism of Culture" (1978[1971]). Culture is defined there as the nonhereditary memory of the community (Lotman, Uspensky 1978[1971]: 213). The authors emphasise the role of collective memory in establishing the balance of static-dynamic relations in the mechanism of culture. According to Lotman and Uspensky, the search for balance between change and stability in a culture necessitates such a mechanism that, on the one hand, would "exhibit particular homeostatic functions to such a degree as to preserve the unity of the memory, to remain the same, and on the other, would continually renew itself, deautomatizing itself at every phase and thereby maximising its ability to absorb information" (Lotman, Uspensky 1978[1971]: 226).

While collective memory can be viewed as a stabilising force in the process of self-renewal of culture, it does not mean that Lotman would view memory as something static. Quite the contrary, memory, being isomorphic with culture, is itself a subject to constant adaptation and reorganisation. Lotman (1979[1977]: 95) noticed that "memory-procedures of culture have an exceptional power to reconstruct" which in turn leads to "the paradoxical situation: more can be taken from the memory of a culture than was put into it". Lotman and Uspensky (ibid.,

[20] As was mentioned before, in Lotman's works usually three classes of intellectual objects are distinguished: individual consciousness, artistic text, and culture as collective intellect (see Lotman 2004[1981]: 585).

215–216) describe various processes of organisation of the collective memory in the following way:

> First, a quantitative increase in the amount of knowledge-filling the various nodes of the culture's hierarchic system with various texts. Second, a redistribution in the structure of the nodes resulting in a change in the very notion of "a fact to be remembered," and the hierarchic appraisal of what has been recorded in the memory; a continuous reorganization of the coding system which, while remaining itself in its own consciousness and conceiving itself to be continuous, tirelessly reforms separate codes, thus ensuring an increase in the value of the memory by creating "nonactual," yet potentially actualizable, reserves. Third, forgetting.

Such a view coincides with Cilliers understanding of who also foregrounds the aspect of forgetting in self-organisation processes. However, Cilliers (see 1998: 92) argues that whether something is remembered or forgotten in complex systems is not a result of some form of decision-making activity; the "selection" follows the simple principle of "use it or lose it", meaning that information that is not used merely fades away. However, it is important to point out that in culture, the patterns formed in collective memory through repetition and remembering can at one point develop into a mechanism of "active selection", meaning that they can start constraining the processes of collective remembering[21]. According to Lotman (2019[1985]), "every culture defines its own paradigm for what should be remembered, that is, preserved, and what should be relegated to oblivion". While such paradigms are rarely absolute and are themselves subject to constant re-defining, their role in actively shaping cultural memory should not be downplayed.

Culture's ability to regulate collective memory brings us to another notion in Lotman's semiotics – self-description, a notion that is present throughout Lotman's works (e.g., Lotman 1971, 1979[1977], 1990, 2009[1992]; Lotman, Uspensky 1978[1971]; see also Madisson 2016). Lotman (1979[1977]: 197) considers the self-description of a semiotic system as a powerful means for the self-organisation of the system. He writes:

> The highest form and final act of a semiotic system's structural organization is when it describes itself. This is the stage when grammars are written, customs and laws codified. When this happens, however, the system gains the advantage of greater structural organization, but loses its inner reserves of indeterminacy which provide it with flexibility, heightened capacity for information and the potential for dynamic development. (Lotman 1990: 128)

[21] Lotman and Uspensky also consider situations in culture where the selection of what should be remembered and what should be forgotten is not only shaped by semiotic norms established through the process of self-organization but by obligatory demand. However, they note that in such cases what we are actually witnessing is not a process of forgetting as a part of normal self-organization, but instead, a "disintegration of culture as a unified collective personality, a personality possessing continued self-consciousness and accumulated experience (Lotman, Uspensky 1978[1971]: 216).

While, as a result of self-description, the potential for dynamism in the system decreases and, as such, concurrently reduces its adaptive capacity, there are, however, valuable aspects to this process. As Lotman explains, the need for such a process occurs as a response to the threat of too much diversity within the semiosphere. Without raising to the level of meta-description, the system might lose its unity and definition and disintegrate (Lotman 1990: 128). In the process of self-description, "one part of the semiosphere (as a rule one which is part of its nuclear structure) in the process of self-description creates its own grammar […] Then it strives to extend these norms over the whole semiosphere" (ibid.). As a result of this process, a reorganisation of cultural memory will take place, and as Lotman has described, whole layers of cultural phenomena, which from the point of view of the given metalanguage are marginal, will be declared to be 'non-existent' (ibid., 129).

While the notion of 'self-description' appears central to Lotman's complex perspective on cultural dynamics, it does not belong to the vocabulary of contemporary complexity research[22]. We can propose that one of the reasons for this lies in the fact that the key-terms used for describing complexity are primarily appropriated from the "hard sciences", while self-description as a part of the self-organising process is specific to culture. As Lotman (2019[1989]: 86) explains the capacity of a structure "to enter itself and, as a result, transform itself insofar as, from its own point of view, it is entering as a text among texts and, consequently, represents for itself normal semiotic "fare"" can be seen as a unique feature of cultural systems. The other possible explanation might be linked with the problematics connected to the active and passive organisation in complex systems. The idea of a central self-description, a meta-language which imposes its structure upon the whole semiotic space, seems to contradict the very bases of our understanding of the functioning of complex systems – the idea of decentralised control (see, e.g., Preiser et al. 2018; Cilliers 1998; Mitchell 2009).

However, the incompatibility of these ideas appears to be connected simply to the problematics of the level of description. That which on one level appears a self-description can, from another higher level perspective, appear as one description among many others. Such a multileveled perception of communicative processes is an inherent characteristic of Lotman's semiotics. As Peeter Torop has elaborated: "The description at one level of the semiosphere can be regarded as self-description at another level, and that is why we can say that processes of auto-communication are always present in communication processes" (Torop 2009: xxvii). Hence, while from the perspective of the self-description, the semiotic systems might appear as centrally unified, then, from a whole-system perspective, we get a very different picture. Lotman argues that while the metalevel might evoke an image of semiotic unity, then on the level of "the semiotic reality which is described by the metalevel, all kinds of-other tendencies flourish. While the picture of the upper level is painted in a smooth uniform colour, the lower level is

[22] However, the notion of 'self-description' has been used previously in some research areas connected with the development of complexity thinking, e.g., see N. Luhmann (1990).

bright with colours and many intersecting boundaries" (Lotman 1990: 130). Acknowledging this difference of perspectives and their simultaneity in cultural processes is essential for comprehending Lotmanian ideas in the framework of complexity.

One last aspect that needs to be mentioned in connection to self-organisation and adaptive capacity in complex systems is the problematics connected to the stability and instability of the system. For that, let us introduce one more notion used for describing the functioning of complex systems – attractors. Attractors can be understood as patterns towards which the system is moved by its long-term dynamics (Hager, Beckett 2019: 180). They can vary in their form. For example, the simplest form of an attractor is a point: "In some simple physical systems such as the swinging of an unforced pendulum under gravity, the ultimate steady state of the object is still at a point. Everything reaches an equilibrium and stays there" (Byrne 1998: 168). However, in social systems, we are dealing with "strange attractors", i.e., "a set of possible states of the complex system about which it moves without ever reaching these states. The result is an ongoing pattern of variations, which describes the complex system's limits" (Hager, Beckett 2019: 180). When in the case of simple attractors, the movement of the system is predictable, then in the case of strange attractors, we can, in the best-case scenario, merely indicate the set of possible states. According to Kobus Marais (2019: 59), the implication of strange attractors for humanities is that: "semiosis (and thus all of society and culture) gravitates (tends) towards particular trajectories without being as stable as to be predictable."

Coming back to the question of stability and instability, Cilliers (1998: 97) has explained that, in a very stable system, there will be only one or a few strong attractors, and as a result, "the system will quickly come to rest in one of these, and will not move to another one easily. […] On the other hand, in a very unstable system, there will be no strong attractors, and the system will just jump around chaotically." From the perspective of adaptability, both of these extremes are undesirable. A unique property of complex self-organising systems is that they tend to balance themselves at a critical point between rigid order and chaos by optimising the number of attractors without becoming unstable[23] (ibid.).

The search for such balance in semiotic systems, between the automatisation and deautomatisation of the system, is repeatedly emphasised by Lotman as well (e.g., Lotman, Uspensky 1978[1971]; Lotman 1977[1974], 2009[1992]). While on the one hand, semiotic systems strive towards stabilisation through self-description, then on the other hand, such systems also always contain means for disrupting existing patterns. Lotman has argued that a system in the state of equilibrium must do something to get out of that state: "If we were to translate this into the language of individual consciousness, then a sin, crime, or mistake must be committed, that is, some violation of the rules of conduct must take place, which excludes the "correct" symmetry of repetition" (Lotman 2019[1995]: 119).

[23] This idea is connected to the theory of self-organized criticality proposed by Per Bak and Kan Chen in 1987 in a paper titled "Self-organized criticality: An explanation of the 1/f noise".

In Lotman's works, the tension between stability and instability of the semiotic systems is often described also in terms of the symmetry-asymmetry principle. For example, in an article titled "Culture and organism", Lotman (1984: 218) writes that the need for such a structure, which would generate both symmetry (statics) and asymmetry (dynamics), gives rise to a very peculiar situation of structural saturation and variability. According to him, symmetry strives for economy, asymmetry for redundancy; the former seeks to limit and minimise all excess, and the latter constantly generates elements external to the system and transforms them into elements of new structures (ibid., see also Lotman 2005[1984]). The oscillation between these two tendencies can be seen as the main working mechanism of self-organization in semiotic systems that ensures their ability to change while maintaining their identity.

1.2.2. Whole and part relations: Emergence

In Juri Lotman's semiotic theory, culture and other functionally similar semiotic entities entail a unique structure "in which every part is at once a whole, and every whole functions as a part" (Lotman 2019[1983]: 74). The specifics of the relation between the whole and its parts also lies at the core of the complexity paradigm. While the phrase "the whole is greater than the sum of the parts" has been turned into a tagline of complex studies, the whole–parts relations in complex systems are much more multifaceted.

One way to approach these relations is through the notion of 'emergence'. This term can be used for describing quite distinct occurrences, which is why some researchers prefer to distinguish between different types of emergences (see Chalmers 2006; Bedau 2002; Deacon 2007). Nevertheless, it is still possible to determine the universal core of this concept, which, according to Mark Bedau, lies in two interrelated aspects. In his explanation: "All emergence involves macro-level phenomena that (1) arise from and depend on some more basic, micro-level phenomena, and yet (2) are simultaneously autonomous from that micro-level base on which they depend (Bedau 2010: 47).

Emergence can be seen as the trait that allows one to distinguish complex phenomena from complicated ones. As Cilliers (2016[2000]: 56–57) has written:

> Complex things have emergent properties, complicated things do not. Emergent properties are those we cannot predict merely by analysing the components of the system. Consciousness is an emergent property of the brain that cannot be predicted by examining a neuron. The behaviour of complicated things, however, is predictable – as it mostly should be. No one would fly in a jumbo jet with emergent properties.

Hence, the properties of any complex system as a whole result from the nonlinear relationships between its parts. However, while this distinction can be useful for illuminating the nature of complexity, it is not entirely unproblematic. Cilliers (2008: 29) points to the difficulty of distinguishing ontological complexity from epistemological complexity: "To what extent is the complexity of a system an

effect of our *description* of the system, and to what extent is it a characteristic of the system itself?" The same problem has been raised by Deacon, who writes that

> Phenomena that we cannot predict often reflect limitations of theory or of modelling and computing power. Something that is only novel with respect to current tools and theories is an artefact of science, not a feature of the world. Difficulty producing commensurate descriptions that are adequate at very different levels of scale is not evidence that the phenomena at these different levels are causally dissociated in some way. (Deacon 2007: 90)

Cilliers (2008: 29) brings an example that a piece of intricate technology that we are not familiar with can at first encounter appear to have emergent and unpredictable properties; however, once we get to know it well enough to understand its inner workings, it will turn out to be merely complicated. That is why it is impossible to say with complete confidence whether a system is irreducibly complex by nature or whether its "emergent" properties are just a reflection of our inability to comprehend the way the system functions. While the notion of emergence is problematic in many ways, and there are authors who see it as too vague to serve as a rigorous tool for scientific inquiry (see, e.g., Mitchell 2009: 301), then from the perspective of complexity thinking, it can have heuristic value for reimagining the relations between whole and parts.

A fascinating conceptualisation of the various ways the whole and its parts can relate in complex systems is given by Edgar Morin in an article "From the Concept of System to the Paradigm of Complexity" (1992[1982])[24]. In addition to acknowledging that the whole has properties that are not contained in any one of the individual parts, he adds that the relation between parts and the whole can also result in a state where "the whole is less than the sum of the parts since some of the qualities or properties of the parts are inhibited or suppressed altogether under the influence of the constraints resulting from the organization of the whole" (Morin 1992[1982]: 374). The whole–parts dynamics has been described in a similar way also by Terrance Deacon in *Incomplete Nature: How Mind Emerged from Matter* (2011: 43), who adds that not only is it the case that the "whole is less than the sum of its parts", but it is also "less than the interrelationships its parts can potentially realize". Kobus Marais (2019: 60), has expanded on this idea, explaining that: "Before there was a whole, the parts had unlimited potential. The moment a whole has been crystalised, the unrealized possibilities have a constraining effect on the whole and its future development, which means that the whole can only result in a more constrained next whole."[25]

Another aspect of the emergent processes that Morin draws our attention to is the interplay of upward and downward causation, which he formulates in the

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[24] The translator of this paper, Sean Kelly has noted that this paper titled "Le systeme, paradigme ou theorie?" was actually first read as the inaugural address to the Congres de l'A.F.C.E.T, Versailles, November 21, 1977.

[25] We will examine the role of constraints in the interactions between the whole and the parts in more detail in the subchapter 1.3.

following way: "The whole is greater than the whole, since the whole as a whole affects the parts retroactively, while the parts in turn retroactively affect the whole (in other words, the whole is more than a global entity – it has a dynamic organization)" (Morin 1992[1982]: 374). The back-and-forth dynamics circulating the complex system can sometimes also turn the process of emergence upside-down. This means that sometimes the parts can be greater than the whole; as Morin (ibid.) explains: "The most remarkable emergent phenomena within a highly complex system, such as human society, occur not only at the level of the whole (society) but also at the level of the individuals (even especially at that level – witness the fact that self-consciousness only emerges in individuals)." We can find confirmation for emergent processes that are directed from the whole to the individual also if we think about how emergence occurs in the sphere of art.

Through explicating various whole–part relationships in the emergent processes, Morin aims to critique the line of thought which equates the complex view with holism. As we mentioned before, holism which ignores the individuality of the parts, is, according to Morin, just a reversed version of reductionism. Hence, for a truly "complex" understanding of a system, one should view it through the antagonistic notion of *unitus multiplex,* which he explains in a subsequent manner:

> The whole is effectively a macro-unity, but the parts are not fused or confused therein; they have a double identity, one which continues to belong to each of them individually (and is thus irreducible to the whole), and one which is held in common (constituting, so to speak, their citizenship in the system). (Morin 1992[1982]: 373)[26]

Lotman's understanding of the whole–parts dynamics is certainly in line with Morin's *unitus multiplex* approach (see also Gherlone 2013b) as it acknowledges the multidirectional dynamics of semiotic systems. In Lotman's semiospheric model, the various levels of semiotic space can be seen as semiospheres nested[27] within each other in the manner of matryoshka dolls, making each individual "both a planet in the intellectual galaxy, and the image of its universum" (Lotman 1990: 273). However, the idea of the hierarchical structure of semiotic systems and the interrelatedness of these hierarchies in the process of meaning-making is present already in Lotman's earlier works. In his monograph, *Structure of the Artistic Text* he discusses the syntagmatics of the artistic text not in the form of a chain of signs, but as a hierarchy where the signs fit together like *matreški*, with each doll inserted into another (Lotman 1977[1970]: 23).

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[26] Whether such statement is true for all cases of emergence is debatable. See, e.g., Paul Humphrey's (1997) approach to emergence, where he proposes the idea of fusion according to which in some cases the process of emergence of higher-order phenomena the lower-level components are transformed and merged together in such a way that it is no longer possible to distinguish them as separate parts. However, this is one aspect where the particularity of cultural emergence is revealed, as the processes of fusion on one level will not lead to disintegration of the structural whole on the level of the parts.

[27] On nestedness in complex systems see e.g., Preiser et al. 2018; Davis, Sumara 2006; Adolfsson, Alvunger 2017; Ludlow et al. 2017.

In Lotman's works, the relation of the whole to its parts is connected to the principle of "vertical isomorphism of culture", referring to the "analogy of the principles of structure and functioning, as well as mutually exchangeable functionality" (Lepik 2008: 17) of semiotic entities at different levels. However, the principle of isomorphism does not imply the identity of these levels or direct mirroring. If that would be the case, no complex dynamics could occur. However, it is precisely the isomorphic relations in culture that constitute a mechanism which leads to ever-increasing complexity in semiotic systems. The explanation for why this occurs can be found if we take a closer look at how Lotman explains the workings of the whole–parts dynamics. Typically to Lotman, he describes this through two opposing and simultaneous tendencies: on the one hand, the movement of each semiotic entity towards greater autonomy and on the other hand, the constant integration of separate parts into higher-order structures (Lotman 2019[1983]: 74; see also, e.g., Lotman et al. 2013[1974]: 76). The movement towards autonomy leads to the emergence of semiotic individualities on various levels which concurrently enhances the heterogeneity of the system. While it might be logical to assume that this tendency might weaken the coherence of the system, it can actually have the opposite effect. This is because the movement towards autonomy of the parts simultaneously stimulates the ability of the individual parts to form various contacts with different parts of the system. Hence, this may increase the flow of information in the system and, through that, facilitate better connectivity. Lotman describes this process in the following way:

> The tendency to increase semiotic diversity within the organism of culture has the result that each meaning-bearing node of its structural organization begins to show a tendency to turn into a peculiar 'cultural personality', a closed immanent world with its own internal structural-semiotic organization, its own memory, individual behaviour, intellectual capacities, and procedure for self-development. As a result, culture as an integral organism represents a combination of structural-semiotic formations, constructed according to the model of separate personalities, and the systems of connections (communications) between them. (Lotman 1979[1977]: 91)

Such structure, where every whole consists of individualities that are symmetrical on the vertical axis but asymmetrical on the horizontal axis (Lotman 1984; see Gherlone 2013a: 329), also implies that every such semiotic entity is inherently dialogical. The emergence of new meaning in semiotic systems, according to Lotman, can occur only through dialogue. Consciousness is inoperative without a partner (Lotman 2004[1981]: 589), without another perspective on the external reality.

Concerning whole–parts dynamics and how it enables the process of emergence in semiotic systems, it is important to note that semiotic systems are structured in a way that the possibility of dialogue occurs on both the vertical and horizontal axis of the system. On the vertical axis – the symmetry axis governed by the principle of isomorphism – the partner is located as a sub-entity within the "I" or, on the contrary, the "I" is part of the partner (Lotman 2004[1981]: 589). In this case, the dialogue is made possible, i.e., the mutual understanding between the

dialogue partners is ensured due to the similarity between the whole and its part. However, this type of dialogue is not redundant. The capacity to generate new information from such interaction is connected to partial asymmetry, which in this case can come from the fact that the part is an individual in itself and thus has characteristics that are not entailed in the higher level and/or that the part belongs simultaneously to various other higher-order systems leading to a multiplicity of identities. On the horizontal axis – the axis of asymmetry, heterogeneity and polyglotism – the informational value of the dialogue lies in the incompatibility and mutual untranslatability between the semiotic individuals, while the dialogue is made possible by the fact that both individuals are isomorphic to the higher-level system (see, e.g., Lotman 2019[1989], 2005[1984]).

Therefore, due to the constant process of forming new connections and integrating into new unities while simultaneously disintegrating into separate semiotic individualities necessitates dialogue on various levels and on different axes of the semiosphere. As the dialogue always takes place in the condition of partial untranslatability (Lotman 2009[1992]: 2), it consequently enables the emergence of new (unpredictable) meaning on all levels of the system. That is why, according to Lotman, the structural paradox where every part is at once a whole, and every whole functions as a part, results in the richness of inner conflicts and "ensures the exceptional flexibility and dynamism of Culture as collective intelligence" (Lotman 2019[1978]: 47).

1.2.3. Relations between internal and external space: Radical openness

According to Lotman (1990: 131) "Every culture begins by dividing the world into 'its own' internal space and 'their' external space. How this binary division is interpreted depends on the typology of the culture. But the actual division is one of the human cultural universals." The relation between internal and external space is manifested in the notion of the boundary of semiotic systems. Explaining the nature and function of boundary is closely related to the previous two points and inseparable from the processes of self-description as well as being integral to understanding the whole–parts dynamics. The way Lotman describes boundary dynamics in his theory of semiotic systems has many interconnections with how boundaries are conceptualised in complex systems discourse.

Complex systems are open systems which means that there is an exchange of energy, information, and matter between the system and its environment (Preiser et al. 2018), unlike in isolated systems that exchange neither energy nor matter; or closed systems that exchange only energy (Byrne, Callaghan 2014: 25–26; cf. Bertalanffy 1968). Such distinction between various types of systems is related to differentiating between systems that are equilibric, close to equilibric or far from equilibric (see Byrne, Callaghan 2014: 25); in the latter type, which contains complex systems, change can occur rapidly due to the boundary characteristics of such systems.

The so-called "radical openness" of complex systems is caused by the difficulty of defining the boundaries of complex systems, for they "interact with their milieu in such a way that it becomes almost impossible to discern which components belong inside the system and which belong to the broader environment" (Preiser et al. 2018; see also Juarrero 2002; Chu et al. 2003). That is why the boundary of a complex system is simultaneously a function of the activity of the system itself and a product of the strategy of description involved (Cilliers 2001: 141). Hence, defining the boundary of a complex system is inevitably, to some extent, always connected to the perspective of the observer (Preiser et al. 2018). The difficulty of defining the boundary is also linked to the whole-part relationship aspect – not only is every system a part of a higher-order system, but it can also simultaneously belong to various systems leading to a multiplicity of boundaries in all complex systems. Explaining the difficulties of delineating the boundaries of complex systems, Cilliers has written:

> in a critically organised system, we are never far away from the boundary. If the components of the system are richly interconnected, there will always be a short route from any component to the "outside" of the system. There is thus no safe "inside" of the system, the boundary is folded in, or perhaps, the system consists of boundaries only. Everything is always interacting and interfacing with others and with the environment; the notions of "inside" and "outside" are never simple or uncontested. (Cilliers 2001: 142)

Cilliers has also noted that in the framework of complexity perspective, it would be more beneficial to think of a boundary as something enabling rather than as confining[28] (Cilliers 2001: 141). In Lotman's works both of these aspects of boundary are deemed relevant. As he stresses, the notion of boundary is an ambivalent one and implies both the function of separating as well as uniting (Lotman 1990: 136). However, more attention is paid to the latter. A thorough description of the nature of boundary occurs in Lotman's text in relation to elaborating the semiosphere model. Lotman presents the "porous" boundary as a bilingual/polylingual mechanism that transforms "external" into what is "internal" and vice versa, making it the "hottest spot" of the semiotizing activity in the semiosphere (Lotman 1990: 136–137). Only through boundary can the semiosphere establish contact with non-semiotic and extra-semiotic spaces (Lotman 2005[1984]: 210). Borrowing an analogy from Vernadsky, Lotman writes: "The function of any boundary or filter (from the membrane of the living cell, to the biosphere which according to Vernadsky is like a membrane covering our planet, and to the boundary of the semiosphere) is to control, filter and adapt the external into the internal" (Lotman 1990: 140). However, Lotman emphasises that such a view of a boundary is only the minimal simplified model of a semiotic space, and in order to provide a more

[28] In complexity discourse the boundary is sometimes discussed in terms of 'autopoiesis' (Maturana, Varela 1972; see also Luhmann 1995). However, the focus of the notion of autopoiesis is on the aspect of closure, which is relevant for complex systems as well, but is not the dominant characteristic of their boundary functioning (see Cilliers 2008:31).

"accurate" picture of the semiotic boundaries a much more complex description is needed. In the *Universe of the Mind*, he aims to provide one:

> [T]he entire space of the semiosphere is transected by boundaries of different levels, boundaries of different languages and even of texts, and the internal space of each of these sub-semiospheres has its own semiotic 'I' which is realized as the relationship of any language, group of texts, separate text to a metastructural space which describes them, always bearing in mind that languages and texts are hierarchically disposed on different levels. These sectional boundaries which run through the semiosphere create a multi-level system. Certain parts of the semiosphere may at different levels of self-description form either a semiotic unity, a semiotic continuum, demarcated by a single boundary; or a group of enclosed spaces, marked off as discrete areas by the boundaries between them; or, finally, part of a more general space, one side of which is demarcated by a fragment of a boundary, while the other is open. (Lotman 1990: 138)

From this description we can see that the idea of 'radical openness' is inherent to the model of semiosphere. Discussion of the function of boundary stays relevant for Lotman's later works in relation to describing the semiotic monad – the invariant model of meaning-making entity that not only represents the functioning of culture as a whole but also explains the functioning of any other sufficiently complex text in that culture. According to Lotman, such a model (2019[1989]: 85) "assumes, first and foremost, its definitive delineation and self-sufficiency, and the presence of a border between it and the semiotic space outside it." However, Lotman again highlights that "the "isolation" (within certain limits) of such a monad assumes not only the presence of a border and of a latent structure but also of an "entrance" and an "exit" (ibid.). For Lotman, the uniqueness of cultural semiotic entities lies in their ability to maintain their boundaries (their wholeness) on some level, even when stepping into direct interaction with other monads. He brings a comparison of biological systems, saying that when a cat eats a mouse, the latter ceases to exist physically as a separate biological structure; however, when an artistic text is used to create a fundamentally new text, neither the physical nor the semiotic existence of the initial text is annihilated, it remains in its original form and can enter into new relationships with its own transformation (Lotman 2019[1989]: 87–86).

While the explicit discussion regarding the notion of 'boundary' belongs predominantly to the later period of Lotman's semiotics, the topic of boundary[29] is also relevant to Lotman's early works. As has been argued by Puumeister et al. (2022: 115): "The notion of borders is […] central to any and all structural understandings of the text […] since the concept of the text is of central importance to the semiotics of culture, it is uncontroversial to state that the notion of the border has been implicit in cultural semiotics since the beginning." It is noteworthy that

[29] It is relevant to note that in Russian language the word "граница" can be translated as either border or boundary, hence using these words here do note denote different concepts but are merely used as synonyms.

already in Lotman's earlier works from the "structuralist" period, the notion of boundary entails aspects that will become central for the semiosphere model, like the multiplicity of boundaries or the role of the perspective or function in delineating a boundary. For example, in the *Structure of the Artistic Text*, Lotman (1977[1970]: 51–53) describes demarcation as one of the three central aspects through which it is possible to define 'text' (the other two being the aspect of 'expression' and 'structure') and writes that the "hierarchism of the text, the fact that its system can be broken down into a complex construct of subsystems, entails that the series of elements which belong to the internal structure serve as boundaries in subsystems of different types (the boundaries of chapters, strophes, lines, hemistiches)."

The flexibility of the textual boundaries is also present in the "Theses on the Semiotic Study of Cultures" (Lotman et al. 2013[1974]: 58), where 'text' is conceptualised as the primary element (basic unit) of culture and a carrier of integral meaning and function, while at the same time, it is noted that "on different levels, the same message may appear as text, part of a text, or an entire set of texts." The Theses also notes the importance of the distinction between internal and external space in defining 'culture'. The authors argue that while the mechanism of culture is, on the one hand, oriented towards transforming the outer sphere into the inner one and thus turning disorganisation into organisation, entropy into information, it simultaneously also defies this opposition of the outer and the inner spheres "by moving from one sphere to the other, it does not only struggle against the outer "chaos" but has need of it as well; it does not only destroy it but continually creates it" (Lotman et al. 2013[1974]: 54).

If we compare how the border areas of semiotic systems are described in Lotman's earlier works and in his later writings, then the main difference appears to be that in relation to the semiosphere model, the notion of boundary obtains a twinned concept – periphery. The difference between these two spatial descriptions in Lotman's works has been clarified by Daniele Monticelli, who writes that the "boundary imagined as a line between two spaces may be understood both as an instrument of delimitation and separation and, alternatively, as an instrument of connection and place of transition" (Monticelli 2020: 430; see Monticelli 2009, 2012b). In this respect, the boundary is created by the semiotic system's self-description, which, concurrently with the demarcation process, establishes the relation between the internal and external.

According to Monticelli, the periphery, on the other hand, could be understood as a multidimensional border space "which functions as an instrument of internal differentiation within a given semiotic space (centre VS periphery) or an instrument of indifferentiation between different semiotic spaces – something in between that does not belong to either of the two spaces or belongs to both of them at the same time (Monticelli 2020: 430). In relation to self-description periphery appears as non-existent; it is the place of refuge for everything that, from the perspective of the meta-description, appears either irrelevant or meaningless. Monticelli has described the Lotmanian notion of periphery as the "no man's land" characterised by non-actuality, unpredictability, and indeterminacy; it is a place of "suspended

(insignificant and unidentifiable) existences or of potential significance without fixed meanings, where all may be significant precisely because there is no more/not yet meaning in place" (Monticelli 2012a: 70). The role Lotman assigns to the borderlands in the wider dynamics of semiotic space corresponds in the discourse of complex systems to the notion of 'the edge of chaos' which is "the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive, and alive" (Waldrop 1992: 12).

1.2.4. Continuity and discontinuity: Nonlinear dynamics

In the *Unpredictable Workings of Culture*, Lotman (2013[1994]: 130–131) poses the following question:

> Does cultural evolution take place gradually and principally as a process devoid of the unexpected, or as a chain of unpredictable explosions? It is worth formulating the question in this way so as to make the error of this formulation readily apparent. Before us lie two aspects of one inseparable unity. They can be separated only in pure abstraction or as a result of illness in a dying society. Neither a system made up of explosions alone nor a system devoid of explosions can exist as a healthy organism. This has never been possible. […] Gradual evolution and shifts to unpredictability must form a complex whole.

The interdependency of continuity and discontinuity as a necessary characteristic of complex dynamics can be observed on various cultural levels, from meaning-making to broader social processes and is one of the universal principles of Lotmanian culture theory. A similar dynamic duality is also represented in the work of Prigogine and Stengers (1984: 170) through the notions of 'necessity' and 'chance', which together constitute the history of the system. Chance as a mechanism of discontinuity plays its role at or near the point of bifurcation, after which deterministic, i.e., gradual, processes take over once more until the next bifurcation (cf. Toffler 1984: xxvi). At the same time, Prigogine and Stengers (1984: 14) emphasise that such a point of view should not be perceived as opposing "chance" and "necessity", but instead, they propose that both aspects are essential in the description of nonlinear systems far from equilibrium.

Nonlinearity is one of the central properties that characterise complex systems. According to Preiser et al., the interactions that constitute complex systems and their relations with the environment are nonlinear, "which means that the magnitude of a system's outputs cannot be measured in direct proportionality to the magnitude of its causes" (Preiser et al. 2018; see also Prigogine, Stengers 1984; Holling 2001). The rich repertoire of systemic behaviour, meaning that there are multiple trajectories of possible development, results from "non-linear feedback loops that can either dampen or amplify perturbations both internally and between the system and its environment", which in turn results in complex systems being inherently unpredictable and uncertain, which makes the control of such systems particularly difficult (Preiser et al. 2018).

From a complexity thinking perspective, Helena Knyazeva has proposed that the idea of nonlinearity entails the following aspects: (i) the idea of the multiplicity of evolutionary paths, the availability of alternative paths of evolution […]; (ii) the idea of choice between these alternative paths of evolution; (iii) the idea of tempo of evolution, that is, the speed of course of evolutionary processes in an open nonlinear system; (iv) the idea of the irreversibility of evolution (Knyazeva 2004: 392). These aspects are featured in various ways in Lotman's semiotic thinking as well (see also Chapter 1.1.4.).

In relation to cultural dynamics, Lotman distinguishes between cyclical and directed forms of dynamism, and according to him, "the latter can, in turn, be divided into slow dynamism, which occurs according to consolidated laws and, as a result, is characterised by a high degree of predictability, and catastrophic dynamism, characterized by a sharply lowered level of predictability" (Lotman 2019[1992]: 97). While from a diachronic perspective, these processes might appear as two phases alternating with each other, then Lotman (2009[1992]: 12) stresses that from a synchronic point of view, they are simultaneously operative, and although they can be perceived as being counteractive towards one another, then, in reality, this "hostility" can actually stimulate the development of the opposite tendency. As Lotman writes:

> Complexity is increased by the fact that, in reality, we never have a stable, consecutive, rhythmic shift from dynamic (catastrophic) to normative stages of development. In actual history, many dynamic, though non-synchronized and unrelated, processes possessing different temporalities of development co-occur, along with simultaneously occurring processes that are experiencing a period of stability in different spheres of development. (Lotman 2019[1992]: 97)

Edna Andrews (2003: 38) has asserted that in regard to continuous and discrete dynamic forces, what is most important for Lotman is the intertwined reactivity of these two types of dynamic change, "where the strength of change in one area evokes an equally powerful change in another, distinct area: the inextricable relationship between continuous and discrete (or discontinuous) phenomena, where the existence of one is dependent on the existence of the other." What is relevant is that both continuity and discontinuity in semiotic processes have an important role to play, and one should not be regarded as inferior to the other. As Lotman (ibid., 12) states, one ensures succession and the other innovation. At the same time, it is important to note that one without the other is not possible, so it might be even more accurate to say that both innovation and succession can only result from the reciprocity of these forms of dynamism.

In relation to information processes, Lotman distinguishes a similar duality that can be seen as isomorphic with the processes of continuous and discontinuous development on cultural levels. According to him, we can observe two fundamentally different forms of information processing. One process is founded on the mechanism of memory and is oriented towards the preservation and accumulation of information (Lotman 2019[1995]: 116). As Lotman (ibid.) writes, such quanti-

tative accumulation is built on the basis of consecutive and symmetrical structures, and when reversed, these structures return us to the initial starting point. In this sense, they correlate with the gradual processes. The other information processing type is oriented towards the generation of fundamentally new messages, which cannot be generated automatically from a pre-existing repository of messages, and as such, Lotman (ibid.) explains this process in terms of explosion. The consequences of explosions "are unpredictable due to the many factors involved and the extraordinary complexity of their interconnection" (ibid.). In this sense, the emergence of new meaning, i.e., meaning that arises as a result of irreversible (as Prigogine used the term) processes, and is therefore to a certain extent unpredictable (Lotman 2019[1989]: 85), always follows the model of explosion to some degree.

However, Lotman (2019[1995]: 124) has emphasised that while creating the new requires a 'leap across paradox', it is impossible without the mechanism of memory. Reflecting on Pushkin's ideas on the development of new ideas, Lotman writes that not only does an "explosion" fail to negate the gradual development that preceded it; it is impossible without it (ibid.). As such, any creative activity in culture is, in some sense, located along an axis uniting predictable and unpredictable processes (ibid., 123) and emerges from their mutual tension.

1.3. On constraints in complex systems

The four realtions discussed in the previous sub-chapter highlighted the common ground between Lotman's work and the complexity paradigm. These four aspects of Lotman's semiotic thinking are relevant to all complex systems. In the present part, I would like to move on to explicating the specifics of culture as a complex system and ask how cultural complexity differs from complexity in physical or natural systems? My focus will be on the nature of constraints as one way how to clarify the particularity of complex cultural systems. To explain the phenomenon of constraints first in general terms, let us go back to the works of W. R. Ashby, who emphasised the centrality of this concept for the cybernetic theory. Ashby defines 'constraint' in a negative way. According to him: "It is a relation between two sets, and occurs when the variety that exists under one condition is less than the variety that exists under another" (Ashby 1957[1956]: 126). Ashby brings a simple example to illustrate this definition: "The variety in the human sexes is 1 bit[30]; if a certain school takes only boys, the variety in the sexes within the school is zero; so as 0 is less than 1, constraint exists." Hence, a constraint can be observed if only some states occur out of all the possible states of a particular system. Another way how Ashby (ibid., 130) proposes to discern constraints is in connection to invariants: "The existence of any invariant over a set of phenomena implies a constraint, for its existence implies that the full range of variety does not occur." In

[30] The unit 'bit' (contraction of "BInary digiT") is the logarithmic form of the measurement of variety (see Ashby 1957[1956]: 126).

this sense, every law of nature is a constraint as it always implies the existence of an invariant (ibid.). The importance of constraints for understanding how the systems behave lies in their connection with predictability. As Ashby (ibid., 132) stresses: "That something is "predictable" implies that there exists a constraint.

In complex systems, the relation between constraint and predictability is usually not so straightforward. Nevertheless, understanding the constraints under which the system operates is still central to the process of modelling the dynamics of complex systems. It is important to note that constraints can differ significantly in their degrees of freedom or restriction, i.e., in the number of possible states they enable. If most physical laws do not leave room for much choice, then constraints imposed by cultural traditions usually entail alternatives. For Jüri Engelbrecht, one of the major differences between dealing with complexity in physical systems and complexity in social systems lies precisely in the nature of constraints that limit the behaviour of these systems. According to him, in physical systems, it is often the thermodynamical considerations that constrain the possible path of development of a complex system, and this allows for some consistency and possibility of measuring, while there are no stable and clearly definable constraints in social systems (Engelbrecht 2021: 53). However, the inability to provide clear-cut definitions for constraints operating in social and cultural systems, should not discourage us from examining the central role they play in cultural dynamics.

In this chapter, I will elaborate on how a complexity thinking perspective stemming from Lotmanian semiotic theory could enable us to model constraints in complex cultural systems. The aim of such modelling activity is not to predict or to gain control over the processes taking place in culture but to move towards a more intricate understanding of the multidirectionality of these processes. I will start by discussing how the nature of constraints has been viewed from the perspective of semiotics. The main focus will be on Terrence Deacon and his conceptualisation of constraints as absences that enable change to occur in a system. Then I will give an overview of how the idea of absence, i.e., what has been constrained, is presented in the context of Lotmanian scholarship and elaborate on how merging these two perspectives allows us to define the peculiarity of constraints in culture. Finally, I will discuss how this peculiarity influences cultural dynamics.

1.3.1. Semiotic perspectives on constraints

The notion of 'semiotic constraints' first appeared in an article by A. J. Greimas and F. Rastier in 1968. The article titled "The interaction of semiotic constraints" sets out to investigate the question of how the human mind constructs complex cultural objects (literary, mythical, pictural) from simple elements and how this process entails constraints as well as some freedom of choice (Greimas, Rastier 1968: 86–86). The authors propose the "semiotic square" model to represent how the possibilities of meaning-making are constrained to certain combinations of relations. In the field of semiotic study of culture, the idea of constraints is also relevant, for example, to the structural approach of Claude Levi-Strauss on mythical forms of thinking as well as cultural prohibitions (Levi-Strauss 1971[1949],

1983[1964]; see Rossi 1973). However, it is in the field of biosemiotics where the topic of constraints in semiotic processes has been elaborated most extensively. From the biosemiotic perspective, "semiotic constraints" have been defined by Donald Favareau in the following way:

> Semiotic constraints refer to the notion that the behavior of animals (including humans) is organized at least in part by what the things that they encounter in the world signify, or "mean" to them. […] such "meanings" do not refer to self-conscious mental processes but to naturally evolved patterns of behavior wherein a given stimulus has come to indicate, or point to, something other than itself for the members of a species. (Favareau 2018: 7012)

As Favareau (ibid., 7013) explains, these patterns of meaning-making that guide sign processes in living organisms have been shaped by both evolutionary and material constraints. Such understanding of semiotic constraints connects it to an adjacent notion of 'semiotic scaffolding'. Semiotic scaffolding[31] was introduced to biosemiotics by Jesper Hoffmeyer (2007: 156), who has claimed that: "The primary mechanism behind semiotic emergence is semiotic scaffolding, the key to nature's tendency to take habits in the biological realm." Kalevi Kull has specified the connection between semiotic scaffolding and semiosis:

> semiotic scaffolding is a general result and function of semiosis. Semiosis as an active meaning-seeking-making process results often with the building of some relatively static or even quite solid structures that somehow embed in themselves the findings of that active searching-event of semiosis. The resulting structure is a scaffolding. It canalizes further behavior. It is the frame for habits. (Kull 2014: 116)

In addition, Kull (ibid.) accentuates that scaffolding is always a reduction of degrees of freedom: it is essentially "a constraint – and this is how scaffolding works, the reason it is useful." From this perspective, semiotic scaffolding and semiotic constraint can be seen as synonyms. The way constraints relate to "usefulness" as the ability to do work and to freedom is a question that is closely observed by Terrance Deacon in the *Incomplete Nature: How Mind Emerged from Matter* (2011).

In this book, Deacon does not focus on semiotic constraints but gives a holistic account of the role of constraints on various levels of dynamic processes[32] and their causal relations that lead from non-life to life. While on each level, the nature of the processes involving constraints varies significantly; there are still tendencies which can be seen as universal for all levels. The present overview will focus on the invariant aspect of Deacon's description of constraints. Giving a proper overview of the multifaceted treatment of the nature of constraints presented in

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[31] The concept of 'scaffolding' was already used in Lev Vygotsky's works and later developed by Jerome Bruner (Vygotsky 1986[1934]; Wood et al. 1976; see Kull 2014: 116).

[32] Deacon (2011) distinguishes three levels: homeodynamics (e.g., thermodynamics), morphodynamics ("self-organization") and teleodynamics (life, information).

this book goes beyond the aims of this dissertation. Thus, the following representation of his ideas manages to communicate only a fraction of Deacon's broad conceptualisation of this topic. However, including this short overview is relevant because it will allow us to reflect on the specifics of constraints in cultural systems in the following subchapter. Bringing Deacon's ideas into a discussion revolving around Lotman's semiotics is also justified by the fact that both of these authors are influenced by W. Ross Ashby's ideas, which can be perceived in the parallels regarding their view on constraints. The connection between Lotman's theory and Deacon's approach to constraints has also been made previously by Tyler Bennet (see Bennet 2021: 207–208). In what follows, I will demarcate some of Deacon's ideas that are relevant for elaborating this connection further.

Deacon (2011: 193) defines constraint as a negative property, as a way of referring to what is not exhibited but could have been, at least under some circumstances. Hence, "constraint is the fact of possible states not being realized" (ibid., 203). In proposing a negative definition of constraints, Deacon is inspired by W. Ross Ashby, whose view on constraints was introduced at the beginning of chapter 1.3. What seems to be essential for Deacon's approach is that Ashby managed to reverse the perspective of viewing organisation or order in systems as something "extra" and, instead, grasped the possibility of looking at it from the point of view of something missing – as a restriction or constraint (see Ashby 1962: 257; Deacon 2011: 192). What can we gain from this negative way of assessing order or organisation? A significant benefit according to Terrance Deacon is the possibility of obtaining an adequate understanding of the process of emergence:

> By recasting our understanding of habit and order in negative terms, we can begin to disentangle ourselves from the "something more" fallacy of traditional emergence theories, and give new meaning to Peirce's "law of habits." Emergent properties are not something added, but rather a reflection of something restricted and hidden via ascent in scale due to constraints propagated from lower-level dynamical processes. (Deacon 2011: 203)

Deacon draws on Peirce's "law on habits", i.e., the idea of habits begetting habits in order to explain constraint propagation and consequently clarify the idea that something that is absent can still have a causal effect on the development of dynamic processes. As he explains, if not all states of a process are realised, or if there is a bias in the probability of their occurrence, there is a habit[33] (Deacon 2011: 202). Furthermore, states that are not realised or that occur only improbably in a given process can play a critical causal role in forming further constraints at higher levels (ibid.), i.e., constraints begetting constraints. The way constraints can create new constraints is explained by Deacon through the idea that where there is

[33] Deacon defines Peirce's notion of 'habits' as a behavioural bias or predisposition that may or may not be overtly expressed but is always a tendency (Deacon 2011: 183). In this sense, a habit can be described as an expression of constraint (ibid., 202).

no difference, it can cause no difference[34]; hence if there is a quality or a state that a system does not exhibit, it cannot impose it on something else via interaction (ibid., 198). However, Deacon (ibid.) stresses that while it might appear that in such cases where a variation that is absent leaves no trace during the interaction, we cannot speak of any causality, it is actually not that simple because:

> the nature of the constraint (and therefore the absent options) indirectly determines which differences can and cannot make a difference in any interaction. This has two complementary consequences. Whenever existing variations are suppressed or otherwise prevented from making a difference in any interaction, they cannot be a source of causal influence; but whenever new constraints are generated, a specific capacity to do work is also generated.

The connection between constraints and the system's ability to do work[35] is crucial for understanding self-organising processes. Let us try to unpack this relationship. Deacon (2011: 223) differentiates between spontaneous change, i.e., change that happens without external interference, and non-spontaneous change, i.e., change that must be extrinsically forced because it runs counter to spontaneous tendencies[36]. At the same time, the system's ability to "run counter to so-called "natural" or unforced processes should not be seen as an "unnatural" occurrence. As Deacon explains (ibid.), what on one level appears as non-spontaneous change, is actually the result of the lower-level interaction between two opposing tendencies of spontaneous processes. In this reciprocal interaction, the spontaneous tendencies of the systems impose constraints on the total variability that was present before the coupling. As a result of the interaction, the variability is decreased while the total energy of the processes remains the same, therefore initiating a change towards a direction that, without this connection, would not have occurred "naturally" (see Deacon 2011: 340–341). Such production of non-spontaneous change is what Deacon calls work (ibid., 337). He writes: "How the interactions are constrained is a critical determinant of the nature of the work that results, because ultimately all such transformations involve a change in the dimensions and degrees of freedom (i.e., mode of dynamics and constraints) while the total energy remains unchanged" (ibid., 341). Hence, work is made possible by imposing specific forms of constraint, and the way this channels spontaneous change, via the expenditure of energy (ibid., 479).

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[34] Here Deacon is referring to Gregory Bateson's (1972: 453) description of information as a "difference that makes a difference".

[35] Deacon discusses the nature of work on various levels and emphasises that "the relationship between these different dynamical paradigms of work is complex. In one sense, they are but analogues of one another, and it is important that they not be confused. They involve very different substrates and conceptions of what is spontaneous or not, very different conceptions of what constitutes the differences that generate spontaneous change" (Deacon 2011: 342), however the basic mechanism of this process is isomorphic on all levels that he describes, which is why we will limit ourselves to describing the general model.

[36] Deacon names the spontaneous change orthograde and non-spontaneous contragrade.

To illustrate the process of work, Deacon brings an example of reading. For us to be able to comprehend the meaning of the words in front of us, we have to intentionally interfere with the spontaneous processes that take place in our mind without much effort and instead counteract them by focusing our attention on the cognitive task of reading (ibid., 360). This is achieved by coupling the constraints imposed through the written text and our internalised capability to read. He describes this in the following way:

> A passive source of cognitive constraints is potentially provided by the letterforms on a page. A literate person has structured his or her sensory and cognitive habits to use such letterforms to reorganise the neural activities constituting thinking. This enables us to do teleodynamic[37] work to shift mental tendencies away from those that are spontaneous (such as daydreaming) to those that are constrained by the text. (Deacon 2011: 360)

So, what is important for us here is that for a change to occur in systems, the variability of possible options (or states) available has to be decreased (constrained), so the released energy can be channelled towards the available states resulting in a fundamental shift in the system. As Deacon (ibid., 419) notes, "Constraints don't do work, but they are the scaffolding upon which the capacity to do work depends".

On each level of the organisation, new constraints are imposed, which build upon the previous absences caused by the non-spontaneous changes that have occurred on the lower levels. As a result, on the higher level of organisation, we can encounter systems that entail increasingly complex forms of constraints – absences – that give rise to evermore varied ways to impose constraints on the world with respect to their internal constraints (Deacon 2011: 480). Deacon (ibid.) points out that, in this sense, agency can be seen as directly connected to generating and maintaining constraints that, in turn, maintain the system. He admits that defining self-agency in terms of constraints may appear counterintuitive at first due to our conviction that the development of higher forms of life and the emergence of mind "has increased, not decreased, our degrees of freedom (i.e., free will). Increasing levels and forms of constraint do not immediately sound like contributors to freedom. In fact, however, they are essential. What we are concerned with here is not freedom-from, but freedom-to" (ibid.). As such, what Deacon (ibid.) means by agency is the system's ability to run counter to how things would have spontaneously proceeded without such intervention. It is this ability to oppose spontaneous change through constraints that generate the ability to self-organize and maintain itself. For Deacon, this is how constraints paradoxically lead to generating more freedom:

> The evolution of our higher-order capacities to create and propagate ever more complex and indirect forms of constraint – from the self-organizing processes that

[37] Deacon (2011: 552) defines teleodynamics as a form of dynamical organization exhibiting end-directedness and consequence-organized features that is constituted by the co-creation, complementary constraint, and reciprocal synergy of two or more strongly coupled morphodynamic processes.

> build our bodies to the production of scientific theories that guide our technologies – has in this way progressively expanded the capacity to restrict sequences of causal processes to certain very precise options. The ability to produce highly diverse and yet precise constraints – absences – thus makes possible a nearly unlimited capacity for selves to intervene in the goings-on of the natural world. (Deacon 2011: 480)

While Deacon's take on the nature of constraints enables us to describe the invariance of dynamic processes on various levels, it also leaves room for further elaborations regarding specific levels of dynamics. For example, Joseph Bracken (2017: 151) has proposed that while Deacon interprets constitutive absence as something missing or left behind, i.e., options no longer available for use within the workings of the cosmic process, then in the case of animate entities, the constitutive absence could be seen instead as referring to "subjectivity as the hidden potentiality for change within a given entity, its ability to adopt new and still untried options for the future". In the following subchapter, we will continue to explore this line of thought in order to examine the possibility that absence in cultural systems participates in processes of change in various ways.

1.3.2. On peculiarities of constraints in cultural systems

In this part, I aim to explicate the particularity of the functioning of constraints in complex cultural systems. We will follow the line of thought presented in the previous part, which conceptualises constraints through the absence in the system. Similarly, to other systems, constraints in culture enable change towards some directions by suppressing certain possible variations in the system. Yet, in cultural systems, the role of constraints in generating systems dynamics has a dual nature which stems from the fact that in a culture what is being excluded[38], is never wholly absent from the system; its ability to "make a difference" is partially preserved. Lotmanian semiotics can provide us with the necessary ground for making sense of the specifics of the role of constraints in cultural dynamics.

The topic of constraints is present in Lotman's earlier works regarding the limitations imposed on the structure of the artistic text. When the increase of constraints in physical systems leads to a higher level of predictability, then such a correlation does not automatically hold for cultural systems. Lotman (1977[1970]: 74) notes that because of the "multidirectional quality of structural levels, predictability […] does not increase, but may even decrease despite the large number of additional limitations which an artistic structure imposes on a natural

[38] It is important to note, that the process of exclusion in Lotmanian semiotics can indicate two types of exclusion. In one case, what is excluded is opposed to culture, but actually belongs to the self-description. Another type of exclusion is that which is absent from description altogether and ends up in cultural periphery. In the present part, we are primarily interested in the exclusion that causes absence.

language text". By this 'multidirectional quality', Lotman appears to point to a fundamental aspect which allows us to comprehend the uniqueness of the functioning of constraints in cultural systems. According to him, one of the most profound distinctions between the structure of art in comparison to other models lies in the fact that when in most modelling systems, extra-systemic material is "eliminated", then in art, both systemic and non-systemic material conveys meaning (ibid., 70). What is important, though, is that their meaning-making capacity is connected to counter-directional processes. If one of them is oriented to subordinate all elements of the text to the system and transform them into an automatised grammar, then the other strives to destroy this automatisation (ibid., 72). Another peculiarity of artistic texts in this relation is that what appears to be "extra-systemic" is, as Lotman (ibid.) notes, in reality completely systemic, but just belongs to another structure which from the point of view of this particular level of the system goes 'unnoticed'. Hence, we can see already here the idea that what is constrained on a specific level of a cultural system does not really cease to exist but continues to participate in the process of meaning-making.

Around the same time, Lotman discusses the topic of constraints in culture in the article "On the semiotic mechanism of culture", co-written with Uspensky. There they define culture in the following way: "We understand culture as the non-hereditary memory of the community, a memory expressing itself in a system of constraints and prescriptions" (Lotman, Uspensky 1978[1971]: 213)[39]. Expanding on this idea, they continue:

> the definition of culture as the memory of a community raises the question about the system of semiotic rules by which human life experience is changed into culture: these rules can, in their own turn, be treated as a program. The very existence of culture implies the construction of a system, of some rules for translating direct experience into text. (Lotman, Uspensky 1978[1971]: 213)

How are these rules created in culture, and how are they manifested? Here we have to note first that culture, when viewed from different levels, can appear as a "hierarchy of particular semiotic systems, as the sum of the texts and the set of functions correlated with them, or as a certain mechanism which generates these texts" (Lotman et al. 2013[1973]: 68). This means that while cultural memory is fixated in texts, these texts are not only a collection of past knowledge but can turn into an active principle for creation – i.e., the texts themselves can transform into rules for creating new texts. Rules in this context should not be perceived as explicitly phrased regulations of what is allowed and what is forbidden in culture. Instead, they could be viewed in relation to the notions of 'semiotic scaffolding'

[39] Around the same time in 1970 Lotman publishes a short thesis about the concepts of "shame" and "fear" as two central constraints in culture (Lotman 1970: 98) where he writes that the understanding that culture can be seen as system of constraints has become generally accepted in spheres of ethnology and sociology after the works of Claude Lévi-Strauss.

or ‘habit’ discussed in the previous subchapter, i.e., as relatively static patterns or structures that canalise the meaning-making processes in culture.

How can we explain the occurrence of such patterns in culture? This relates to an essential aspect in Lotmanian semiotics, according to which a text is not merely a manifestation of language as a set of rules; instead, text can also generate its own language (see Torop 1995: 228; M. Lotman 1995, 2019). Hence, when a new text, such as a piece of art or literature, emerges in culture, it creates a particular set of relations, or patterns of meaning, that while following the existing “rules” in some respect, also transgresses the pregiven boundaries of the existing language. These transgressions can in turn, become a part of the language in the future or serve as a basis for creating a new system of rules. The more this text is “repeated” in various ways in culture, the more the meaning relations inherent to this particular text automatise. Eventually, the pattern that first occurred spontaneously can become a rule-like structure acting as a ‘strange attractor’ towards which meaning-making in culture gravitates (cf. Marais 2019: 59).

While attractors exhibit a tendency towards particular trajectories in culture, such a tendency entails the presence of constraint, that is, the absence of a variety of possible states. In Lotman’s semiotics, the aspect of absence becomes most vivid in the context of the centre-periphery dynamics we examined in Chapter 1.2. A relevant explication of this dynamics for our present discussion has been provided by Daniele Monticelli (2012a; see also 2008) in the context of political totalization and emancipation. He discusses the peculiar role of the periphery in broader cultural processes in dialogue with the political thought of G. Agamben, A. Badiou and J. Rancière (ibid.). Monticelli views the tension between the cultural self-description and the remainder as the result of the process of exclusion of everything that, from the perspective of the metalanguage, appears insignificant or irrelevant. As we discussed previously, the process of self-description, which necessitates declaring a large part of the semiotic system as non-existent, in Lotman’s view, does not actually permanently abolish the semiotic variety; it merely “exiles” it to the periphery of semiotic space (see Lotman 1990: 128). What is relevant for us is that Monticelli highlights the active role of the remainder, which continues to interrupt the strive towards self-descriptional closure. He writes:

> Absence is never absolute (alterity destroyed) just as presence (totalization without residuum) never is; and the border-zone is precisely this in-between place of non-actualization/holding in reserve. Through the hospitality granted to pieces of otherness by the periphery, a “reserve of polyglotism” and “indeterminacy” is constituted at the border of the semiotic space (Lotman 1999: 20; 1990: 398). The border-space as periphery enters therefore into tension and collision with the center of the system that it makes vulnerable to non-systemic elements thus contesting the privileged position of the dominating self-description. (Monticelli 2012a: 70)

This perspective allows us to move on to formulating more clearly the difference in the nature of constraints in cultural systems. First, let us recall that Deacon

explained the causal efficacy of constraints through their relation to the system's ability to undergo some fundamental shift or transition towards a new state:

> the presence of constraint – the absence of certain potential states – is a critical factor in the capacity to perform work. Thus, it is only because of a restriction or constraint imposed on the release of energy (e.g., the one-directional expansion of an exploding gas in a cylinder) that a change of state can be imposed by one system on another. It is precisely by virtue of what is not enabled, but could otherwise have occurred, that a change can be forced. (Deacon 2011: 198)

In the context of cultural dynamics, the process of self-description, which can occur on various levels of culture, constrains a large part of the variety of the semiotic system. By this act of exclusion, it enables significant changes to occur, resulting in the emergence of new structural organisation and movement towards certain trajectories of development. Without imposing constraints, self-organisation and adaptation do not occur – structure results only from limitations. Hence, in this aspect, the relevance of constraints in cultural systems dynamics coincides with Deacon's description. However, in culture, what is absent has another way to participate in generating change in the system due to the specificity of cultural space, where, as Monticelli phrased it, "absence is never absolute". As Lotman (1990: 127) himself has noted, this is the reason why the evolution of culture is quite different from biological evolution and why even the word 'evolution' can be quite misleading:

> Biological evolution involves species dying out and natural selection. The researcher finds only living creatures contemporary with him. Something similar happens in the history of technology: when an instrument is made obsolete by technical progress it finds a resting place in a museum, as a dead exhibit. In the history of art, however, works which come down to us from remote cultural periods continue to play a part in cultural development as living factors. A work of art may 'die' and come alive again; once thought to be out of date, it may become modern and even prophetic for what it tells of the future. What 'works' is not the most recent temporal section, but the whole packed history of cultural texts. The standard evolutionary point of view in literary history comes from the influence of evolutionary ideas in the natural sciences.

What is declared absent from the perspective of the higher level of the system maintains its presence on the lower level creating a situation of incompatibility between the semiotic reality and the higher-order description. The tension arising from this incompatibility can become a source which initiates further change in the system. Gherlone (2022: 132) has proposed that the centre-periphery oppositional dynamics can be viewed as "original tension" – a primary energy that drives the semiosphere. According to her, one of the most prolific insights of Lotman "is to have grasped that this conflict between dominant and peripheral semiotic forms is an energy that is deposited in culture and remains actively latent in its depths" (ibid., 133). Hence, in culture, while constraining part of the information in the

process of self-description enables a release of energy that empowers certain transformations, the excluded parts of the system are maintained in the form of residual energy. In this way, culture has a built-in mechanism of dynamics which means that its ability to change is not solely dependent on "external" influences.

At the same time, it is essential to accentuate that the tension between the centre and periphery should not be viewed as a zero-sum game between two forces in the semiosphere that are simply exchanging places with each other[40]. The results of this tension are inherently unpredictable. In order to comprehend the complexity of the dynamics we are discussing, one should envision the semiotic space not as a two-dimensional surface area divided between centre and periphery but instead evoke the image of the hierarchical structure of semiotic systems. As we described before (see Chapter 1.2.1.), Lotman depicted culture and other isomorphic entities built in a way that every part is at once a whole, and every whole functions as a part" (Lotman 2019[1983]: 74). In such a structure, every new whole that emerges, is a result of some constraints imposed on the lower level. As such, the tension between the emerging structure and the excluded remainder is simultaneously present throughout the semiotic system encompassing all its centres and various border areas and results in complex multilevel dynamics. While it can trigger rapid change on some occasions, on others, it can also serve as a mechanism of balance which paradoxically stabilises the system, ensuring more continuous development. Without counterbalance tendencies occurring on other levels, the system would exhaust its meaning-making potential rapidly.

This tendency for such "counterbalancing" is reflected in another peculiar feature of cultural systems: the aspects that are constrained and are absent from one level might actually become more accentuated on the lower level. Lotman (2019[1989]: 87) has described that as soon as two monads enter into a relationship, forming a single semiotic mechanism on a higher level, they shift from a state of mutual neutrality to one of mutual supplementarity and structural autonomy and begin to cultivate their own particularity and mutual contrasts. This increases the conflict between different levels of the system; however, from the perspective of system's ability to generate new information and maintain its dynamicity, the increased asymmetry is not necessarily a deficit, but rather a value in itself. As Lotman explains:

> A monad, which as a part is subjected to the strict laws of determinism, as a whole or an "individual," possesses the possibility of choice and a specific reservoir of unpredictability that is, autonomy from the whole and from its semiotic context. […] The more complex the organization of the monad, the more autonomous its behavior and the more unpredictability it introduces into the system as a whole. Such organization possesses an enormous information load and, in fact, unlimited possibilities for development. (Lotman 2019[1989]: 90–91)

[40] See Lotman's (1989) reflection on Tynyanov's ideas regarding the centre – periphery dynamics in relation to art forms as a useful albeit too simplistic model. He argues that centre and periphery do not just switch places, but from this tension always a multitude of new forms of art occur.

To summarise, what is absent can participate in cultural dynamics in different ways. On the one hand, through the act of exclusion – of some variability being constrained, it enables the system to go through fundamental change towards particular directions. On the other hand, by remaining present on the lower level of the cultural system after being excluded, it can participate in the cultural dynamics by generating tension in the system. According to Edna Andrews (2003: 48), "Lotman's notion of tension and explosion is at the heart of not only the semiosphere itself but also any individual act of human communication". As Andrews (ibid., 49) brings out, one aspect of this tension is the long-term mechanism for dynamic change in cultural systems characterized by two different mechanisms for change: gradual and explosive (see Lotman 2009). The tension created through absences in culture can function as a catalyst for both of these. In some cases, it can serve as a mechanism of gradual processes by providing a counterbalance and ensuring the continuity of the system's ability to produce new meanings. And at other cases, when such balance is broken, this tension can also lead to new fundamental shifts in the system, i.e., to cultural explosions.

1.3.3. Modelling absence in culture

There are various possibilities for how to approach the question of modelling absence that results from the process of exclusion. For instance, in describing the process of exclusion in culture, Juri Lotman and Boris Uspensky illustrated this idea with two examples of forgetting. One takes place as an exclusion of concrete text from cultural memory, and the other type of forgetting is through a selection process of real-life events, facts etc., distinguishing which of these deserve to be translated into cultural texts (collective memory) and which can be cast aside as non-essential (Lotman, Uspensky 1978[1972]). Another possibility of how such an exclusion process can be modelled is by using the concept of narrative. For example, Selg and Ruutsoo (2014) propose a view of teleological historical narratives that, according to them, can play the role of the centre of a meaning system and serve as national master narratives that exclude other possible meanings and views. Hence, in the context of Lotman's theory, this exclusion is usually thought about as the exclusion of some concrete semiotic entity – information, text, social groups etc.

However, there are other ways how we can model this process. For example, we can propose that the dynamics between a description and what has been left out could alternatively be described using the opposing relations that function as organising principles of the dynamics of semiotic systems, which we discussed in Chapter 1.2. If a higher-order self-description exhibits a tendency towards one side of these relations, this means that movement towards the other direction is inevitably absent. All cultural models exhibit tendencies towards particular forms of semiotic activity, simultaneously constraining processes that tend in the other direction. For example, if a model strives to establish one unified meaning, then inevitably, the movement towards plurality on that level of semiosis cannot be present on the same level and vice versa. Or a model that deliberately aims to

disrupt the meaning-making process is constraining the semiotic strive towards the continuity of existing semiotic patterns. It is important to emphasise that what we mean here is the 'dominant tendency'. We have to take into account that if we are dealing with complex structures such as artistic texts, then various levels of the same model can exhibit independent tendencies from the whole. As discussed before, the absence on one level of culture can amplify this tendency on the other level. Hence, what is constrained on one level enables the process of semiosis to proceed in a particular direction while simultaneously remaining present on the lower level and generating creative tension with the higher-level meaning process.

As was highlighted already previously, modelling cultural dynamics through opposing tendencies should not be seen through the logic of "one or the other". Complexity thinking allows us to perceive that they are always simultaneously present on different system levels and intricately interrelated. As Marais (2014: 22) has argued, in the complexity perspective these conflicting relations "need to be maintained in their paradoxical tension". Viewing cultural dynamics through the perspective of constraints and the effect they have simultaneously on various levels of culture can help to clarify the workings of this paradoxical tension in cultural systems.

Let us bring a few examples of such dynamics starting with Lotman's own ideas. In *The Structure of the Artistic Text*, Lotman discusses the compensatory mechanism between various structural levels of artistic texts, which can be characterised as tension on the static–dynamic axis:

> It has long been noted that within the confines of certain poetical structures, when fewer limitations are imposed on the rhythm, greater demands are put on rhyme; the freedom to improvise in the general structure of a commedia dell'arte text is accompanied by the rigid standardization of masks, style of behaviour, situations, and so on. (Lotman 1977[1970]: 74–75)

A similar mechanism of "compensation" can appear in culture between various texts that belong to the same art form. In his conceptualisation of tropes as rhetorical figures that function as mechanisms of meaning-generation, Lotman (1990: 44) brings an example of how "the artlessness of a neo-realist film […] contains a latent rhetoric, activated against the background of the worn-out rhetoric of pretentious pseudo-historical epics and high society comedies, a rhetoric which has ceased to 'work'." Hence, if, on the higher level of culture, the trope as a mechanism for producing semantic diversity and indeterminacy is overused to the extent that it becomes part of the neutral store of the language, then to counterbalance this tendency and pertain system's ability for dynamic meaning-generation, the tendency towards generating "anti-rhetorical" texts emerges and creates a situation of tension with the dominant semiotic patterns (see, ibid.).

Similarly, it is possible to find analogous multilevel dynamics occurring inside the human mind. Fascinating examples of such counterbalancing between opposing tendencies can be found in the works of psychologists Travis Proulx and Steven J. Heine. Building on Jean Piaget's (1960) idea of reducing disequilibrium

and Leon Festinger's (1957) theory of cognitive dissonance, among others, they investigate how contradictions, confusion and indeterminacy affect our meaning-making processes. The idea that 'meaning threats' lead to an increased need for affirmation is a well-established research topic (see Proulx, Heine 2009: 1125). What Proulx and Heine have aimed to contribute to this field of knowledge is that being exposed to a meaning threat and the following search for a stable meaning need not happen in relation to the same information[41].

In an experiment conducted in 2009, the scientists asked the subjects of the study to read Franz Kafka's short story *A Country Doctor* (1919), in which a "rural dentist sets out during a snowstorm to help a young boy with a toothache; as the story progresses, the narrative gradually breaks down and ends abruptly after a series of non-sequiturs" (Proulx, Heine 2009: 1127). Being exposed to the fundamental ambiguity and discontinuity of Kafka's narration leads the subjects of the study to demonstrate superior accuracy in learning new patterns of associations (ibid.). Kafka's story exhibits the tendency towards disruptive meaning-making and thus simultaneously constrains the subject's ability to maintain cohesive semiotic patterns. In order to be able to follow the artistic structure of *A Country Doctor*, the subjects need to constrain the semiotic orientation towards unity and continuity on one level. At the same time, as Proulx and Heine show, the very tendency that was constrained by the text will actually simultaneously increase in relation to some other meaning-making activity, like, for example, enhancing the ability to notice patterns. As such, a tension between discontinuity and continuity on various levels enables to maintain balance in the system (mind) as a whole.

At the same time, the tendency described in the previous example can occur in reversed direction. Humans are not only seeking stability and coherence in the world. Eelco Runia provides thought-provoking discussion regarding the movement in the contrary direction in culture in relation to "humans' inordinate ability to spring surprises on themselves" (Runia 2006: 7). Runia examines the question of discontinuities in culture:

> I would like to propose the counterintuitive thesis that discontinuities, mutations, and historical landslides – for example, the French Revolution, the First World War, and the Holocaust – are not "rooted" in what came before, but are the result of an irresistible urge to cut ourselves loose from our moorings. From this perspective, discontinuity is not a regrettable side effect of our ambition to attain some desirable goals. No, from this perspective discontinuity is in a very real sense precisely what we are after. (Runia 2010: 5)

For Runia, the necessity for creating discontinuities in culture appears to be connected to the tendency of culture to exhaust its meaning-making potential, i.e., its ability to generate new information. It seems to occur when historical knowledge, that what we learned from previous discontinuity, has become too common to be

[41] To conceptualise their findings Proulx and Heine have proposed the meaning maintenance model (see, Heine et al. 2006; Proulx, Heine 2006).

recognised as knowledge (Runia 2010: 20). He quotes Robert Musil (1995[1930]: "Somehow or other, order, once it reaches a certain stage, calls for bloodshed". As Runia explains "the need to through ourselves headlong into the new" (ibid., 5) emerges from the danger of getting to know ourselves to the full extent (ibid., 18). This can be understood as the loss of the internal dialogism. We can recall that for Lotman such inherent dialogism resulted from the fact that each semiotic individuality always consists of individualities and thus is to a certain extent asymmetrical in relation to itself (see, e.g., Lotman 1979[1977]). There has to be something within us that we don't fully understand. Otherwise, the autocommunicative processes will be redundant.

Runia proposes the idea that on the level of culture, this "something" in ourselves of which we are not fully aware, which "ways us down" and, in a paradoxical sense, keeps us grounded and holds us from making the leap into the new – is trauma. Trauma is, by definition, absent. It resides on the level of cultural "subconscious" as something for which we do not have a language, and thus, it cannot be expressed in the cultural self-description. It is the remainder of culture's previous act of "committing history". While excluded from the centre, it continues to haunt the presence of peripheral areas of the semiotic structures. This asymmetry ensures the necessary indeterminacy of semiotic processes in culture and, through that, works against a culture's tendency to exhaust its meaning-making potential. The idea that culture's ability to produce new meanings is connected to its disability to fully understand itself has been highlighted by Lotman as well. According to him: "Life must necessarily not understand itself; it must come into conflict with itself all the time" (Lotman 2005[1993]: 85). Lotman argues that living culture and everyday life can never be grasped in its entirety because it cannot be translated into one language, there are always plurality of languages at work, that step into conflict with each other and consequently help to maintain the endless semiosis.

It is also worth noting that Runia's example supports the idea that the tension between the centre and periphery, between the absence and the self-description, is not always aimed towards creating a new explosion; it can actually be the source of maintaining continuity of the broader system. What is intriguing is that it also shows that radical explosions in culture can be caused not only by an increased conflict between that which was excluded and the centre. Sometimes the exact opposite might serve as a cause. If the tension between the absence and the self-description is completely exhausted, a rupture in the continuity, which leads to unpredictable change, might be created by the culture as a means to save itself from reaching equilibrium, which for complex systems means death (cf. Cilliers 1998: 4).

Hence, as the previous examples have illustrated, the dual nature of constraints in cultural systems creates a paradoxical structure which, on one level, channels meaning-making and dynamic processes towards the predetermined path while simultaneously, on another level, what has been excluded remains, creating a 'reserve of indeterminacy' (cf. Lotman 1990: 134). This reserve can either enable gradual development of the system by working against the self-descriptional

tendency to exhaust its meaning-making potential; or if this tension goes off balance, it can eventually lead to explosive developments. At this point, a question may arise how can we take into account these particularities of complex cultural systems in modelling their dynamics? The next chapter will discuss this question in the context of educational change.

2. COMPLEX DYNAMICS IN EDUCATION

Educational systems provide a fascinating example of complex dynamics in culture. On the one hand, the whole idea of education is, at its core, rooted in the principle of guiding the process of learning towards a predictable outcome. From this perspective, education appears as a stabilising force in cultural dynamics. On the other hand, from another perspective, education as a system that guides the learners seems to take on the role of the student itself, constantly evolving and changing in dialogue with all the participants in the learning processes. In the context of Lotmanian semiotics, such simultaneity of learning and teaching in culture has been clarified by Peeter Torop in the following way:

> Culture is a system of teaching and learning (self-improvement) at the same time, and accordingly, everything that happens in culture has two dimensions. What is teaching on one level becomes self-education on another level; in every act of cultural communication, the specific nature of culture's communication with itself is reflected. (Torop 2022a: 368)

The reciprocity of these processes will be the focus of this chapter.

Juri Lotman's semiotic works rarely explicitly touch upon the topic of learning, teaching, or education. One text where this topic emerges as central is "The problem of "acquiring a culture" as typological characteristic" [Проблема «обучения культуре» как типологическая характеристика], where Lotman differentiates between cultures oriented towards grammar and cultures where learning happens through texts (Lotman 1971). In most other cases, the topic of education occurs primarily in the role of examples. This, however, does not mean that the problem of education was of low importance for Lotman. The centrality of this matter is evident in his many non-academic texts and interviews (see Lotman 2005) where he often discussed the ethical side of teaching and emphasized the utmost importance of the role of education in the development of culture. As a professor of Russian philology whose work was, among other things, devoted to preparing teachers for public schools, he also dedicated a large part of his time to developing educational materials – publishing handbooks for literature teachers (Lotman 1972, 1980; Lotman, Neverdinova 1984, 1988) as well as textbooks for school students (Lotman 1982; Lotman, Neverdinova 1982; Lotman et al. 1989).

While Lotman did not explicitly deal with education in his theoretical works, the applicability of his ideas for educational contexts has been thoroughly examined in both theoretical and practical works of the Transmedia Research group at the University of Tartu, to which the present author also belongs. The research group develops open-access online materials[42] for supporting the teaching of humanities-related subjects in secondary schools, and "the overarching goal of the educational platform is to support cultural coherence and autocommunication by cultivating literacies necessary for holding meaningful dialogues with cultural

[42] See Education on Screen webpage: https://haridusekraanil.ee/.

heritage" (Ojamaa et al. 2019: 152). The group's work is predominantly focused on the transmedial aspect of education and elaborates various of Lotman's notions like 'text', 'language', 'modelling' and 'autocommunication' in both theoretical and practical dimensions of education (Milyakina et al. 2020, Ojamaa et al. 2019, 2021). This approach presents a view of culture as education, referring "to the understanding that acquiring a cultural identity presumes learning cultural languages" (Ojamaa et al. 2019: 153–154).

At the same time, Lotman's ideas have not found much resonance in the field of edusemiotics, which, being primarily rooted in the Peircean tradition, explores the process of learning and education with a focus on the notions of sign and semiosis (see Deely, Semetsky 2016; Semetsky, Stables 2014; Semetsky 2017). Alin Olteanu and Cary Campbell (2018: 245) have emphasised that "edusemiotics does not mean semiotics applied to education, as a pedagogical aid or teaching/research tool, but is rather, "thinking" semiotics as the foundation for educational theory and practice at large." Edusemiotics, which is process-oriented and views learning as semiosis, provides a possibility for "liberating the concept of learning from the domain of education, and rethinking education as a system or a program that works in the service of learning" (Olteanu, Campbell 2017).

At first glance, it may seem that the Lotmanian theory of culture, where 'text' is the focal point of analysis, offers an opposing approach to the edusemiotics view, which tends to give "priority to process over product" (see Deely, Semetsky 2016: 3). However, in my view Lotmanian semiotics can address both the process and the product in their mutual conditionality without prioritising either. Semiotics of culture provides a unique perspective for analysing the relation between cultural dynamics and the structural organisation of culture. On the one hand, it focuses on how semiotic models materialised in texts on various levels of culture guide the processes of meaning-making. On the other hand, it describes how unpredictable semiosis, in turn, shapes these cultural models. In the first part of this chapter, we will describe the process of learning in semiotic systems from the perspective of complexity.

In the second part, the focus will be on how Lotmanian semiotics can allow us to model the complex dynamics in educational systems. In order to exemplify our claims, we will discuss various examples, primarily from the articles that are included in this dissertation. As such, the primary goal of this short chapter is to bridge the theoretical discussion about Lotman's complexity thinking with the educational context discussed in the publications.

2.1. Learning systems

All complex adaptive systems have the ability to learn (see, e.g., Cilliers 1998; Preiser et al. 2018). As complex systems are characterised by nested structure and radical openness, then the learning process should not be viewed as confined to only one system but can simultaneously involve lower and higher-order structures. This means that drawing a clear boundary of who is the 'learner' in a particular

process is not possible. Instead, it is more accurate to talk about learning as a co-emergent process that is happening on various levels simultaneously. From this perspective, the role of the learner can be assumed not only by an individual student but instead, as Davis and Sumara (2006: 14) note, the term 'learner' can include "social and classroom groupings, schools, communities, bodies of knowledge, languages, cultures, species – among other possibilities. One might also move in a micro direction, extending the list to include organs and bodily subsystems, cells, neurons, and so on." Such a view is quite foreign in the context of formal education, where it is presumed without much hesitation that the individual is the correct unit of analysis for assessing learning processes (Hagger, Beckett 2019: 87). As Hagger and Becket (ibid., 88) have argued, this has far-reaching consequences for our conception of learning:

> the assumption that individuals are the focus of learning is closely aligned with the notion that what is learnt is a product or commodity that can be acquired, possessed and transferred by individual learners. Linked to this is a further influential assumption that this product, that is, the learning, is a thing that is relatively stable and enduring. That learning should exhibit relative stability and endurance is a vital practical matter for formal education arrangements. These require that learning (what is to be learnt) has the kind of stability that enables it to be encapsulated in curriculum, libraries and textbooks.

The complexity perspective opposes this view in many aspects. First, it argues against the unitary concept of learning or of a general theory of learning, claiming that there is no one level or type of explanation that could cover all sides of this phenomenon, and thus, different theories are needed to account for different kinds of learning situations and different aspects of learning (ibid., 120). Second, it conceptualises learning as a dynamic and relational process. Hagger and Beckett (ibid., 98) frame it as a "relational web that is in a process of change, where learners have a sense of their (individual) self-directedness, typically embedded in socio-material practices. This relational web connects the whole that is the learner and the surrounding world in an evolving way." In a similar line of thought, Davis and Sumara (2006: 93) have defined learning as "a process through which a unity becomes capable of more flexible, more creative activity that enables the unity to maintain its fit to its ever evolving context."

In the context of Lotman's semiotics (2019[1978]: 45), the capability to "react flexibly and effectively to changes in its environment and to reorient itself in that environment" is connected to the process of generating more effective models for interpreting the surrounding world. In this aspect, Lotmanian ideas can be connected with the notion of adaptation[43] as well as with the notion of scaffolding. As we have already mentioned in Chapter 1.3. scaffolding results from semiosis and functions as a relatively stable structure for channelling further behaviour of an organism (see Kull 2014: 116). The connection between semiosis, scaffolding and

[43] See also, how this connection has been elaborated in edusemiotics (Gough, Stables 2012; Olteanu, Stables 2018; Pikkarainen 2018; Campbell et al. 2019).

learning is multidirectional. As Kull (ibid.) states: "Semiosis is a learning process that produces scaffolding". However, at the same time, the process of learning takes place "through the scaffoldings of previous experiences and previous generations (at biological, cultural and personal levels)" (Campbell et al. 2019: 369). From this follows that memory is crucial for learning to occur, because, as we have discussed earlier, without memory, a self-organising system could only mirror its environment, and for it to be able to learn from experience, a self-organising system has to 'remember' previously encountered situations and compare them with new ones (Cilliers 1998: 92). Campbell et al. (2019: 356) propose to define memory as "the semiotic scaffolding established by learning" or in other words: "learning is the process of building and of modifying memory" (Kull 2018: 457). Memory as semiotic scaffolding is not limited to the concrete learner (see ibid., 485) but also entails the "external" memory, which for example, in the context of cultural systems, can mean memory preserved in texts. Hence, the scaffolding being built out of previous experience can provide direction and channel learning adaptively (Campbell et al. 2019: 370).

This does not mean that scaffolding determines the outcome of learning. In order for us to define some process as learning, the "learner" has to, at least to some extent, transgress these existing scaffolds or models. As Kull (2018: 457) has proposed: "The semiotic concept of learning describes learning as a process that starts with behavioural indeterminacy (describable also as a situation of incompatibility, confusion, logical conflict, problem-situation, ambiguity). This is a situation in which there are options to choose from." While the scaffolding structures can, to some extent, support the act of making this choice, they do not predetermine it. The reason why the choice remains, to some extent, unpredictable lies in code plurality as the essential feature of semiosis. Kull (2015b: 227) writes: "Semiotic scaffolding provides direction, while code plurality provides incompatibility for choice." In this aspect, the semiotic conceptualisation of the learning process and Juri Lotman's understanding of the occurrence of a new (i.e., non-trivial) message in culture, which requires a minimum of two languages which are two some degree incompatible (see, e.g., Lotman 2009, 2019[1978]) – overlap (see also Kull 2015a).

Drawing on the previous discussion, we can propose that the relationship between learning and education in culture can be viewed on the axis of static–dynamic tension and reflected in one of the central questions for Lotman, namely: "How can a system develop and yet remain true to itself?" (Lotman 2009: 1). As Kaie Kotov (2002: 53) has noted, in Lotman's view semiosis is both the stabilising as well as the destabilising mechanism of the (human) universe. From this perspective, learning can be seen as non-linear meaning-making oriented towards generating new information. At the same time, the process of learning is guided by various educational models that direct meaning-making along particular trajectories. These models provide stability against the backdrop of the overwhelming indeterminacy that learners can experience. However, as the process of learning in culture is happening simultaneously on various levels and involves a multitude of different models, a situation of incompatibility arises, due to which the learner's

choices in meaning-making become unpredictable. Thus, the process of learning, which is channelled by the existing models, in turn, is continuously transforming the models themselves. The essence of this process is insightfully captured by James Gleick's (1987: 24) phrase that the "act of playing the game has a way of changing the rules."

2.2. From educational models to cultural dynamics

In this part, I will discuss how we can create analysability to study the relationship between the higher-order educational goals, the pedagogical models that guide learning and the meaning-making processes that occur in the context of real educational practice and bring some examples how this approach has been used in the articles. As was discussed previously, on the one hand, educational models channel semiosis in the process of learning towards particular trajectories by constraining the variability of the possible states of meaning-making. At the same time, what is excluded will continue to participate in dynamic processes. The particularity of semiotics of culture is that due to the multilevel modelling, it enables us to turn our attention simultaneously to the higher-level structures as well as the absences which have remained present on the peripheries and unveil the resulting incompatibilities and tensions that ensure the dynamic development of the system.

The multilevel modelling in the framework of the semiotics of culture, is connected to the principle of vertical isomorphism of semiotic systems. The analogy of the principles of structure and functioning (see Lepik 2008: 17) is what allows to create analysability of the dynamic processes in semiotic systems through various levels. The principles of structure and functioning in Lotmanian semiotics are often modelled using dynamic oppositions. In this thesis, we have focused on four such types of relations: static-dynamic relations, whole-part relations, relations between internal-external space, and the interrelatedness of continuity and discontinuity – as the most central for describing the dynamics of complex systems.

What is important here in the context of learning is that the openness of the semiotic system towards its boundaries, the ability to take in new information and the capacity to adapt to changes, etc., can differ depending on the type of the model that is channelling the semiotic processes. Different types of modelling systems[44], exhibit different tendencies for organising the semiotic environment of the learner in various ways and through that also guide the meaning-making processes in relation to this environment[45]. By examining the universal relations mentioned

[44] That is, a structure of elements and rules of their combination, existing in a state of fixed analogy to the whole sphere of the object of perception, cognition, or organisation (Lotman 2011[1967]: 250).

[45] In this aspect, it relevant to bring out a view on teaching and learning that has been presented by psychologist Aaro Toomela, who understands learning as getting to know the organization of the environment and constructing knowledge about the environment, and accordingly has defined teaching as the purposeful organization of the environment for the student by the teacher (Toomela 2020: 372).

above, we will be able to describe the link that connects educational agendas, pedagogical models, learning processes and anticipated societal change. This creates a framework for mapping out the ways in which different pedagogical approaches or educational models relate to various higher-order educational goals.

Let us observe a couple of concrete examples that will allow us to demonstrate the potential of the semiotics of culture in enabling us to model such multilevel dynamics of educational systems. One educational challenge that I have analysed by using Lotman's descriptions of these relations and the principle of vertical isomorphism is the challenge of growing uncertainty in today's world and the need to find new ways in which education can help students to manage uncertainty in their daily lives (see Rickberg 2023). I have proposed that the way various semiotic systems deal with uncertainty, i.e., "the epistemic state at the limits of knowledge" (Wakeham 2015: 716), can be modelled as the relation between a semiotic system and its boundary. The nature of this relation can differ depending on how the division between the internal and external space of the semiotic entity is constructed by the educational models that guide the process of learning.

Therefore, by analysing how different pedagogical approaches generate this relation between what belongs to the system and what remains outside its boundaries will allow us to model the possible paths of meaning-making under the condition of uncertainty. This means that when in the process of learning, students have to face the limits of knowledge and experience uncertainty; they can, to some extent, rely on the models that scaffold this learning experience and make use of the particular strategies for dealing with uncertainty that these semiotic models enforce. These strategies practised in concrete educational contexts can, later on, translate into generalised semiotic habits of meaning-making, which in turn start affecting cultural processes on a broader scale and determine to what extent uncertainty is tolerated and how it is handled in a society. In the context of this particular study, I was examining different approaches to teaching history and how they construct the internal–external relation. I delineated three different semiotic strategies resulting from the processes of learning: avoiding uncertainty in the case of the collective memory approach, addressing uncertainty in the case of the disciplinary approach, and accepting uncertainty in the case of the post-modern approach to teaching history.

Another example of modelling isomorphic relations between cultural dynamics, pedagogical models and meaning-making has been presented in a collective paper on digital reading practices (see Ojamaa et al. 2021). In this paper, we discuss one of the biggest problems related to digitalisation in culture and its impact on humanities education, i.e., the pulverisation of texts and meanings in an overwhelming information overload. We argued that the main challenge it creates for students is connected to the ability to generate cohesive knowledge – a systemic understanding of this fragmented multiplicity of their cultural environments.

We propose that the semiotic process of moving from informational multiplicity to comprehending the meaningful unity of this variety in learning can be channelled in different ways. This channelling depends on the structural organisation of the learning process expressed through these materials. In some cases, the

coherence of an information field can be achieved by providing the students with a set of rules which allows them to describe the relations between various texts or fragments of texts. Or in other cases, the modelling potential of the learning material is realised through the principle of sameness, which organises the informational variety according to the idea that different texts can be viewed as variations of the same story. While there are many other possibilities, what is important here is that the experiences gained from the interaction with the learning material can again create long-term meaning-making strategies for handling the information overload of our contemporary culture. The more various models we can introduce in educational contexts, the more adaptive students can become in tackling this challenge.

While we can expect that the trajectory of semiosis in learning can follow the direction provided by the educational models to some extent, we should also pay attention to the aspects that are constrained by these models and which, as we discussed earlier (see Chapter 1.3.), often play an equally important role in guiding dynamic processes in semiotic systems. To account for this aspect, we can again make use of these structural relations to observe, how constraining a tendency on one level, can create an amplification of the other side of this relational axis on the lower level of the system.

An example of such a situation where what is being constrained on one level will continue to participate on another and counteract the tendency that is enforced in the higher-order model is discussed in the article "On two contradictory trends in history education" (Rickberg 2017)[46]. This article follows how educational politics in the EU uses history education as a platform for enhancing social cohesion and observes how such policies affect the emergence of certain tendencies in teaching history in Estonia. In addition, the article also addresses how these tendencies, in turn, generate a response among the Estonian Russian-speaking minority. In this way, the modelling entails three different cultural levels. The central focus of this paper is on a multiperspective approach to history education which the EU has promoted since the 1990s as a way how to deal with national history narratives which are deemed to cause conflicts in the globalising world. The idea behind promoting multiperspectivity is that including multiple points of view about the past in history classes should lead to understanding that every perspective is limited in its own way, and this, in turn, should reduce tensions that arise in multicultural societies due to the collisions of different historical narratives existing side by side. Concurrently, this should allow us to achieve a more peaceful, tolerant, and integrated society.

If teaching national history aims towards unification through one dominating narrative, then in the case of multiperspectivity, the goal is quite the opposite. Multiperspectivity works against the unifying power of one central narrative (self-description) by revealing its "myth-like" nature. It brings out the other texts that

[46] This article "Kahest vastandlikust tendentsis ajalooharidusest" which is a part of the dissertation is written in Estonian which is why I will give longer overview of the main idea here in English as well.

were cast to the periphery or beyond the border and reminds us that the self-image doesn't reflect the whole complexity of the semiotic world around us. Through that, it aims to achieve social cohesion by erasing the borders of us and them that are created on the basis of different historical narratives. By disintegration on the lower level of culture, cohesion on the higher level should be achieved.

While the concept of multiperspectivity has been incorporated into most school curricula around Europe, in many countries, it did not lead to the anticipated effect, but instead, an increase in national approaches to teaching history was observed (see van der Leeuw-Roord 2009a). The reason for that can be explained through the fact that the tendency towards plurality, which undermines the uniting power of the narrative in history, does not consider the possibility that, in some cases, the cultural self-image, and thus social cohesion, can be very strongly connected to historical narratives. For example, countries that "by virtue of their geographical location, have been annexed, occupied, fought over and absorbed into various Empires throughout history" give a lot more value to the role of national history (Stradling 2011: 5). In those cases, the multiperspective approach that undermines the authority of those narratives by involving other historical perspectives as equal can lead to a situation where this diversity is seen as a threat. This, in turn, can lead to defensive strategies. Such reactions have been observed in the context of Estonia as well.

While history education in Estonia followed the overall trends represented in EU policies regarding implementing multiperspectivity to history education, at the same time, the desire to preserve the national perspective of the past remained. The question about the correct interpretation of the past that stems from memory conflicts with Russia is at the core of Estonian national identity. That is why recognising the Estonian national history narrative, along with speaking the Estonian language, is seen as one of the primary requirements for integrating into Estonian society. Therefore, teaching the national narrative to local Russian-speaking minorities was seen as a primary way to enhance social cohesion. However, it has been shown (see Karjahärm 2008) that teaching the Estonian national history narrative to the Russian-speaking minority can actually increase the contrary historical views among students. What has been excluded from the official government narrative is not erased from the information filed of the minority, and the resulting contradiction between these various levels can make what is absent even more significant and, consequently, the society even more separated.

Hence, while in their own way, both multiperspective history education as well as history teaching that is based on national narrative are oriented towards enhancing social cohesion, in certain cultural contexts, they may simultaneously enhance the opposite effect. As this example demonstrates that while it is possible to model how certain pedagogical models channel meaning-making, learning is always grounded in real semiotic contexts that have their own history, which can be, to some extent, constrained but never fully erased. While learning, we are constantly using multiple and, to some extent, incompatible models of meaning-making and thus, the process taking place simultaneously on various levels can never be fully controlled or predicted.

From the point of view of the dynamics of complex systems, the conflicts between various levels of educational systems do not appear as shortcomings. On the contrary, this feature, in many ways, functions as a guarantee for the adaptability of the system. Or, as Lotman has emphasised, the richness of inner conflicts is what "ensures the exceptional flexibility and dynamism of Culture as collective intelligence" (Lotman 2019[1978]: 47). Cultural systems, including education, are self-regulating, and the dominant tendencies on one level will be, in one way or another, balanced out through dynamic processes on other levels. At the same time, the price of such self-regulatory processes can, at times, turn out to be extremely high. That is why it is only natural to wish to search for ways how to ensure that the mechanisms responsible for cultural self-regulation work as "smoothly as possible", so as to avoid defusing rising tensions with explosions. This raises the question, can the complexity perspective in education also inform our decisions in managing the processes of learning so as to enhance the adaptability of educational systems?

This question is examined in a paper (see Rickberg 2022a) which discussed the potential of Lotmanian complexity thinking to make sense of how present-day education systems can become more adaptable in the face of the enormous pressure to keep up with the increasing speed of processes in socio-ecological systems. In such cases, adaptability may not necessarily result from better planning or more intricate measurement systems. Instead, it can sometimes require the opposite. Adaptive education requires, first and foremost, diversity. According to Lotman, the only way to act in a state of ignorance, growing complexity and unpredictability is to compensate for the insufficient information with stereoscopicity – "that is, by producing a completely different projection of reality – a translation into a completely other language" (Lotman 2019[1978]: 46). Hence, rethinking education from the perspective of greater adaptability would give preference to educational models characterised by greater variability and freedom of choice, which in turn can accommodate more flexible and creative responses to the changing environments.

The article also examines some initial thoughts on how Lotman's ideas of artistic modelling could be applied to the sphere of education for the purpose of modelling learning in a non-linear way. Such models would be oriented towards disruption of the pre-existing meaning; they would engage with indeterminacy, uncertainty and unpredictability in a non-defensive way and explore the creative potential of such phenomena; and they would accept the existence of a plurality of possible meanings while not giving up on the search for a truth not yet given.

3. OVERVIEW OF THE ARTICLES INCLUDED IN THE THESIS[47]

(I) Rickberg, Merit 2017. Kahest vastandlikust tendentsist ajaloohariduses. *Acta Semiotica Estica* 14: 46–68.

The article "On two contradictory trends in history education" discusses the ambition of history education to serve as means for increasing social cohesion. The article looks at two very different approaches to history classes, one based on teaching the national history narrative and the other that can be titled multi-perspective approach. The tension between these two opposing trends in the European cultural space and the impact of this tension on social cohesion is explicated using Lotman's dynamic model of culture and viewed as the search for balance between the mechanisms of cultural unity and cohesion and, at the same time, diversity, and pluralism. The article discusses the effects these strategies can have when immersed in a concrete cultural context using the example of history education in Estonia and particularly its reception among the Russian-speaking minority.

(II) Rickberg, Merit 2023. From avoiding uncertainty to accepting it: Semiotic modelling of history education at the limits of knowledge. *Sign Systems Studies* 51(1): 7–35.

The article sets out to investigate the problem of the growing experience of uncertainty in the contemporary world as an educational challenge. The article explicates how different approaches to teaching history can enforce diverse strategies for dealing with uncertainty. The paper argues that the connection between pedagogical approaches and uncertainty, as an experience that occurs at the limits of knowledge, can be modelled as the relation between a semiotic system and its boundary. The nature of this relation can differ depending on how the division between the internal and external space of the semiotic entity is perceived. Different modelling systems impose distinct patterns to deal with the indeterminacy of the borderland area.

(III) Rickberg, Merit 2022. Towards complexity thinking in education with Juri Lotman. *Lexia. Rivista di Semiotica* 39–40: 303–327.

The paper examines how educational systems can adapt to the accelerating pace of change in modern societies. As a starting point, it places Lotman's question, "How can a system develop and yet remain true to itself?" in the context of edu-

[47] The articles are listed according to the order in which they were written.

cational systems, which allows us to discuss the problem of change as the dynamics between two different orientations of semiotic activity in Lotman's semiosphere. On the one hand, learning can be viewed as non-linear meaning-making oriented towards generating new information; on the other hand, the process of learning is guided by various educational models that serve as stabilising mechanisms that, in turn, are continuously transformed by the learners' unpredictable choices. The tension between these two tendencies allows learning systems to develop while maintaining their identity. In the last part of the article, Lotman's unique take on artistic modelling, in which he sees the potential for making sense of extremely complex systems, is considered a means for addressing educational change and channelling learning towards greater adaptability.

(IV) Rickberg, Merit 2022. Lotmanian Perspective on Complexity in Cultural Systems. *Semiotika* 17: 77–109.

The last article represents the first attempt to provide a reflection on the investigations undertaken in the previous three articles. In that sense, this article also serves as the preliminary version of what has been elaborated further in Chapter 1. of this dissertation. The article discusses the potential of Juri Lotman's semiotic theory to serve as a ground for a new perspective on cultural complexity. The article compares Juri Lotman's ideas with a generally recognised understanding of complexity to delineate a common ground. Next, the paper addresses the issue of how studying complexity differs in physical and cultural systems, focusing on how this matter has been discussed in semiotics. And in the final part, the article proposes some initial lines of thoughts regarding how Lotman's ideas could be advanced further to grasp the phenomenon of complexity in culture.

4. CONCLUSION AND FUTURE DIRECTIONS

In his paper devoted to discussing the core principles of Lotman's semiotics, Kalevi Kull (2015a: 1) posed a question regarding the potential of semiotics to help us make sense of the infinite diversity of the meaning-making processes:

> Sign processes can do literally everything; mind is almost almighty – the art of text is limitless; life's evolution is open-ended; there are 'no limits in learning'. While physical reality is limited by physical laws, and the mathematical realm as based on formal logic is restricted by the necessity of avoiding contradictions, the realm of imaginations and meaning-making has no such limits. We must ask whether the science of signs, semiotics, can tell us anything general at all about this vast diversity. Paradoxically, it can. (Kull 2015: 1)

The present work followed this line of thought to elaborate further on the potential of Lotmanian semiotics of culture to grapple with complex phenomena. The dissertation had two closely related aims. The first aim, addressed in Chapter 1. and in article IV (Rickberg 2022b) was to explicate how Lotman's semiotic theory of culture can clarify the particularity of cultural dynamics in relation to other complex systems. The second aim, which we addressed in Chapter 2. and articles I–III (Rickberg 2017, 2023, 2022a) was to explore the possibilities provided by the Lotmanian framework of complexity thinking for modelling the dynamics of change in education.

To achieve the first aim, I started by giving an overview in Chapter 1.1. of the development of complex thought in Lotman's works by focusing on four main influences which, in various aspects, nudged Lotman's semiotics towards complexity: cybernetics, structuralism, the works of V. Vernadsky and I. Prigogine. This enabled to show historical connections with the contemporary complexity paradigm and set the ground for explaining how Lotman developed these ideas further in the context of his theory of culture. The second step was to delineate particular principles in Lotman's theory which appear central for describing the dynamics of complex systems. Chapter 1.2. focused on four pairs of relations (i) static and dynamic relations; (ii) whole and part relations, (iii) relations between internal and external space, and (iv) relations between continuous and discontinuous processes; and developed them in dialogue with the ideas of various authors from the complexity discourse. This allowed to establish a common ground between Lotman's ideas and present-day understanding of complex systems as well as indicate already some ways in which Lotman's ideas diverge from the dominant discourse. From there, in Chapter 1.3. I moved on to the problem of constraints which can be seen as one of the main aspects in which complex cultural systems differ from physical or natural complexity. Drawing parallels between Terrence Deacon's conceptualisation of constraints as an absence in the system and the role that absence plays in the Lotmanian model of semiotic systems made it possible to explicate the particularity of the functioning of constraints in complex cultural systems.

Similarly to other systems, constraints in culture enable change towards particular directions by suppressing certain possible variations in the system. Thus, following Ashby's and Deacon's line of thought, we can say that self-organisation is always also self-simplification. In the context of cultural dynamics, the process of self-description occurring on different levels of meaning-making constrains a large part of the variety of the semiotic system. By this act of exclusion, it undergoes significant changes resulting in the emergence of new structural organisation and movement towards certain trajectories of development. Yet, in cultural systems, the role of constraints in generating systems dynamics is not limited to this one function as in the case of physical systems. Instead, it has a dual nature which stems from the fact that in a culture, what is being excluded, is never wholly absent from the system; its ability to "make a difference" is partially preserved. The relationship between the system dynamics and constraints in culture can be described using the Lotmanian model of the tension between the self-description (centre) and periphery.

By remaining present on the lower level of the cultural system, what has been excluded can continue to participate in the cultural dynamics by generating tension in the system. This tension, in turn, can serve as a catalyst for two different types of dynamic processes. In some cases, it can serve as a mechanism of gradual processes by providing a counterbalance to the "higher level" dynamics. This means that, by creating a situation of incompatibility, this tension ensures the system's ability to produce new meanings and thus guarantees continuous development. In other cases, when the tension between the self-description and what is "absent" from the system goes off balance, it can also lead to new fundamental shifts in the system, i.e., to cultural explosions. Due to the structure of complex entities where every part is at once a whole, and every whole functions as a part, this tension can be simultaneously present on every level of the system and should not be viewed in terms of a two-dimensional zero-sum game between centre and periphery. Hence, the dual nature of constraints in cultural systems creates a paradoxical structure which, on one level, channels semiotic processes towards the path which has emerged from the self-organising process of the system while simultaneously, on another level, what has been excluded remains, and participates in maintaining the system's capacity for various forms of dynamic development.

The importance of elaborating Lotmanian view on the nature and specifics of the dynamics of complex cultural systems lies in the fact that it provides a qualitative alternative to the computational methods currently dominating in establishing the general understanding of complex systems. The discussion presented in this thesis is not aimed at opposing the quantitative approach to studying complexity but merely to help to clarify and explain the limits of modelling dynamic processes in culture. Lotmanian framework exemplifies that while culture, through its ability to generate structuredness, takes on relatively stable and predictable forms, the unaccounted absences in cultural models can, in some cases, lead not only to significant and unexpected transformations but also to radical discontinuities.

The ideas that were elaborated in relation to the first aim of the dissertation were then used to accomplish the second aim, which was describing the dynamics of change in educational systems drawing on the Lotmanian framework of complexity thinking. I argued that, as the semiotics of culture provides a unique perspective for analysing the relation between cultural dynamics and the structural organisation of culture, it can thus offer valuable insight for the field of education where the question regarding the capacity of various models to initiate the desired change is of critical importance.

In Chapter 2.1. my first step was to define learning systems in terms of complex dynamics. I then moved on to establishing the relationship between learning and education, connecting it with one of the central questions Lotman posed, namely: "How can a system develop and yet remain true to itself?" (Lotman 2009: 1). From this viewpoint, learning can be seen as non-linear meaning-making oriented towards generating new information. At the same time, the process of learning is guided by various educational models that direct meaning-making towards particular trajectories and, through that, provide stability against the backdrop of the overwhelming indeterminacy that learners can experience. However, as the process of learning in culture is happening simultaneously on various levels and involves a multitude of different models, a situation of incompatibility is created, due to which the learner's choices in meaning-making become unpredictable. Thus, the process of learning, which is channelled by the existing models, in turn, is continuously transforming the models themselves.

In Chapter 2.2. I discussed how the framework of the semiotics of culture could allow us to examine the relationship between various levels of educational systems and model how educational structures on one level can be "translated" into meaning-making processes or cultural dynamics on other levels. More specifically, I discussed how we can create analysability to study the relationship between the higher-order educational goals, the pedagogical models that guide learning and the meaning-making processes that occur in the context of real educational practice.

By using the universal structural relations in semiotic systems, which I described in Chapter 1.2., to model the isomorphic relations between mind–text–culture, we can describe the link that connects educational agendas, pedagogical models, learning processes and anticipated societal change. While we can expect that the trajectory of semiosis in learning can follow the direction provided by the educational models to some extent, we should not ignore what is left out of these models and which, as we discussed earlier, can often play an equally important role in guiding dynamic processes in semiotic systems. Therefore, while a pedagogical model can channel meaning-making in a particular direction, learning is always grounded in real semiotic contexts that have their own history, which can be, to some extent, constrained but never entirely erased. To account for this tension, we can observe, how constraining a tendency on one level, can create an amplification of the other side of this relational axis on the lower level of the system. In the process of learning, we are constantly using multiple and, to some extent, incompatible models of meaning-making and thus, the process taking place simultaneously on various levels can never be fully controlled or predicted. The

particularity of semiotics of culture is that due to the multilevel modelling, it can simultaneously describe the higher-level structures as well as the as well as the absences which have remained present on the peripheries and help to reveal the resulting incompatibilities and tensions that ensure the dynamic development of the system.

The second chapter also provided various examples from concrete educational cases discussed in the articles and thus helped to bridge the frame of the dissertation with the publications included in the thesis. Furhtermore, this part examined a question posed in one of the articles regarding whether the complexity perspective, in addition to allowing us to describe the dynamics of educational systems, can also provide guidance and inform our decisions in managing the processes of learning to enhance the adaptability of educational systems. I concluded with the idea that rethinking education from the perspective of greater adaptability using a complexity framework would give preference to educational models characterised by greater variability and freedom of choice, which in turn can accommodate more flexible and creative responses to the changing environments.

The relevance of introducing the Lotmanian perspective into the discourse of complexity research in the field of education is valuable in its balancing stance. The complexity approach in education has been positioning itself against the mainstream contemporary formal education, which is characterised by the pervasive wish to control, measure, and predict every aspect of the learning process. However, in providing a counterpoint to the status quo, the complexity researchers, in some cases, seem to overcompensate by giving too much priority to the dynamic, nonlinear, and unpredictable side of learning and leaving aside the fact that in addition to the ability to change, systems are also capable of remaining relatively stable. Not every flap of a butterfly's wings will set off a tornado. This bias towards unpredictability has caused doubts about whether complexity thinking is at all a suitable frame for informing or guiding educational practices. As asserted by Keith Morrison:

> Though it offers an explanation for change and evolution in particular instances and circumstances, it is essentially a post hoc explanation […] in the very notion of unavoidable unpredictability, complexity theory undermines its own power to guide behaviour with any certain future in mind. It is a theory for the here and now. (Morrison 2008: 25–26)

The complexity thinking approach stemming from Juri Lotman's semiotics of culture manages to maintain the static–dynamic dimension of educational processes in paradoxical tension and, through that, has the potential to address both linear developments as well as unexpected bifurcations and view them as mutually conditional.

The present thesis sets the ground for continuing research in various directions. However, it appears that one of the most crucial paths to explore further in relation to the question of what complexity thinking could contribute to the field of education is connected to the ongoing planetary crisis. Addressing the various crises

humanity is currently facing cannot be achieved by merely adding more environmental or global education lessons to the curricula. It also requires a critical examination of the educational models we use to make sense of the world and a better comprehension of how these models shape our relationship with the environment in the broadest sense of the word. The practitioners of an educational movement called 'wild pedagogies' have phrased this necessity in the following way:

> Beneath what appear as crises, such as climate change and species extinctions, a more profound crisis lies in the way that many humans relate to the world – that is the dominant modernist way of being in the world. A renegotiated and renewed vision of education must include structures, curricula, and pedagogies that are fundamentally disruptive to these ways of being. (The Crex Crex Collective 2018: 67)

Complexity thinking has the capacity to fundamentally disrupt existing educational practices, but what is even more important is that in its theoretical versatility, it can also provide various approaches to rebuilding education. As an inherently ecological perspective (cf. Marais 2014) that prioritises relations, co-emergence and radical openness, the complexity approach can help to nudge our educational systems towards more diverse, creative, and adaptive ways of being together with the world.

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SUMMARY IN ESTONIAN

Kompleksse mõtlemise poole koos Juri Lotmaniga: kultuuridünaamika modelleerimine haridussüsteemides

Doktoritöös uurin Lotmani kultuurisemiootika potentsiaali komplekssüsteemsete nähtuste käsitlemiseks. Tööl on kaks omavahel tihedalt seotud eesmärki. Esimene eesmärk on selgitada kultuuridünaamika eripära võrreldes teiste komplekssete süsteemidega Juri Lotmani semiootikateooriast lähtuvalt. Töö teine eesmärk on rakendada Lotmani kultuurisemiootikal põhinevat kompleksse mõtlemise raamistikku muutuste dünaamika modelleerimiseks hariduses.

Esimese eesmärgi saavutamiseks annan kõigepealt peatükis 1.1. ülevaate kompleksse mõtlemise arengust Lotmani töödes, keskendudes dialoogidele erinevate teadusharudega, mis Lotmani semiootilist teooriat komplekssüsteemide paradigmaga seovad. Käsitlen nelja olulisemat mõjutajat: küberneetika, strukturalism, V. Vernadski sfääride teooria ja I. Prigogine'i teadustöö dissipatiivsete struktuuride uurimisel. Selle kaudu on võimalik näidata ajaloolisi seoseid Lotmani ja tänapäeva komplekssüsteemide uuringute vahel ning luua alus järgmisele alapeatükile, kus selgitan, kuidas Lotman nendest dialoogidest võrsunud ideid oma kultuuriteooria raames edasi arendas. Järgmise sammuna toon peatükis 1.2. välja need printsiibid Lotmani teoorias, mis võimaldavad kirjeldada kultuuriliste komplekssüsteemide dünaamikat. Keskendun neljale erinevale semiootiliste süsteemide kirjeldamise aspektile Lotmani töödes, mis esindavad vastassuunalisi tendentse kultuuri dünaamikas: (i) staatilised ja dünaamilised suhted; (ii) terviku ja osa suhted, (iii) sise- ja välisruumi vahelised suhted ning (iv) järjepidevate ja katkendlike protsesside vahelised suhted. Nende suhete kirjeldamisel võrdlen Lotmani ideid ka teiste komplekssüsteeme uurivate autorite käsitlustega. See võimaldab ühelt poolt luua ühisosa Lotmani ideede ja komplekssüsteemide paradigma vahele ja teiselt poolt tuua välja ka mõningaid aspekte, mis Lotmani töödes teiste arusaamadest eristuvad.

Sealt edasi liigun peatükis 1.3. kitsenduste [constraints] küsimuse juurde, mida võib pidada üheks peamiseks aspektiks, mille poolest kultuurilised süsteemid erinevad füüsikalistest või looduslikest komplekssüsteemidest. Kitsenduste olemuse selgitamisel lähtun Terrence Deaconi ideedest, kes W. Ross Ashby eeskujul mõtestab kitsenduste toimimist süsteemis millegi puudumise kaudu. Uurides, kuidas omavahel suhestuvad puudumine ja semiootilise süsteemi enesekirjeldus Lotmani töödes, on võimalik selgitada kitsenduste toimimise eripära kultuurilistes komplekssüsteemides.

Sarnaselt teiste süsteemidega on ka kultuuris muutused võimalikud tänu kitsendustele, mis võimestavad arengut teatud suundades võimalike variatsioonide hulga vähendamise kaudu. Ashby ja Deaconi mõttekäigust lähtudes on eneseorganiseerumine alati ka süsteemi eneselihtsustus. Kultuuridünaamika kontekstis kitsendavad tähendusloomet kultuuri enesekirjeldusprotsessid, mille käigus jäetakse kõrvale suur osa semiootilise süsteemi mitmekesisusest. Kitsenduste kaudu teeb süsteem läbi olulisi muutusi, mille tulemuseks on uue struktuurilise korrastuse

tekkimine ja teatud arengusuundade võimestamine kitsenduste arvelt. Kuid oluline on see, et erinevalt füüsikalistest süsteemidest ei piirdu kultuuris kitsenduste roll süsteemi dünaamika tagamisel ainult sellega, et miski jääb süsteemist välja. Kitsendustel on kultuuri dünaamika kujunemisel kahetine funktsioon, mis tuleneb asjaolust, et kultuuris ei jää see, mis on süsteemist välja arvatud, siiski päris lõplikult arenguprotsessidest kõrvale. Süsteemi dünaamika ja kitsenduste vahelist suhet kultuuris võib kirjeldada Lotmani mudeli abil, mis käsitleb pinget enesekirjelduse (tsentri) ja perifeeria vahel.

Jäädes alles süsteemi perifeeriasse, võib see, mis on kultuuri enesekirjeldusest välja jäetud, jätkuvalt osaleda kultuuridünaamikas, astudes kõrgema järgu mudelitega pingeseisundisse. See pinge võib omakorda olla katalüsaatoriks kahte tüüpi dünaamilistele protsessidele. Osadel juhtudel võib see toimida järjepidevate protsesside mehhanismina, pakkudes vastukaalu "kõrgema tasandi" dünaamikale. Sellisel puhul tagab vastuolu enesekirjelduse poolt loodud mudelitega süsteemi võime luua uusi tähendusi ja see omakorda on garantiiks järjepidevale arengule. Teistel juhtudel aga, kui pinge enesekirjelduse ja süsteemist "puudu oleva" vahel läheb n-ö tasakaalust välja, võib see viia ka täielike katkestuste tekkimiseni süsteemis, s.t. kultuuriliste plahvatusteni. Komplekssete süsteemide struktuuri tõttu, kus iga osa on korraga tervik ja iga tervik toimib osana suuremast tervikust, võib see pinge esineda samaaegselt süsteemi igal tasandil ja seda ei tohiks vaadelda tsentri ja perifeeria vahelise üheplaanilise võimuvõitlusena. Seega loob kultuurisüsteemide kitsenduste kahetine olemus paradoksaalse struktuuri, mis ühel tasandil suunab semiootilisi protsesse süsteemi eneseorganiseerumise käigus võimestatud arenguteedele, kuid teisel tasandil jääb see, mis kitsenduste kaudu süsteemi enesekirjeldusest kõrvale jäi, siiski alles ning tagab süsteemi dünaamilisuse selle eri vormides.

Lotmani vaate olulisus komplekssete kultuurisüsteemide olemuse ja dünaamika eripära mõtestamisel seisneb selles, et see pakub kvalitatiivset alternatiivi praegusel ajal domineerivatele kvantitatiivsetele lähenemistele komplekssuse modelleerimisel. Sealjuures ei soovi ma kuidagi pisendada kvantitatiivsete uurimiste väärtust ja informatiivsust komplekssüsteemide käsitlemisel, kuid oluline on ka mõista kultuuris toimuvate dünaamiliste protsesside modelleerimise piire ning selles aspektis võib Lotmani semiootikal olla oluline roll. Lotmani raamistik näitab, et kuigi kultuuris, mille oluline funktsioon on struktuursuse genereerimine, on tähtsal kohal stabiilsed ja prognoositavad vormid, võib see, mis meie mudelitest välja jääb, viia mõnel juhul mitte ainult ootamatute muutuste, vaid ka totaalsete katkestuste tekkimiseni. Seega, kuigi kultuurisemiootika annab meile väärtuslikke mudeleid kultuuri struktuurilise korralduse ja sellest tuleneva mitmetasandilise dünaamika kirjeldamiseks, võimaldab see samal ajal pöörata tähelepanu ka sellele, mis neist mudelitest välja jääb.

Doktoritöö esimese eesmärgi täitmisel kirjeldatud Lotmani komplekssе mõtlemise ideestikku kasutan seejärel teise eesmärgi saavutamiseks, milleks oli haridussüsteemide muutuste dünaamika modelleerimine. Kuna kultuurisemiootika pakub ainulaadset perspektiivi kultuuridünaamika ja kultuuri struktuurilise korralduse vahelise seose analüüsimiseks, võib see pakkuda väärtuslikku sisendit haridus-

valdkonna jaoks, kus küsimus erinevate mudelite suutlikkusest kutsuda esile soovitud muutusi on kriitilise tähtsusega. Peatükis 2.1. annan n-ö õppivate süsteemide määratluse kompleksse dünaamika vaates. Kultuurisemiootika raamistikus on kultuur vaadeldav korraga nii õpetamise kui ka õppimise süsteemina ja see, mis ühel tasandil näib õppimisena, võib teiselt tasandilt vaadatuna paista hoopis enesekasvatusena (Torop 2022a: 368). Seega ei ole kultuurisüsteemides võimalik anda selgepiirilist vastust küsimusele, kes on ühes või teises olukorras õpilase rollis.

Õppimise ja hariduse vahelist seost saab siduda ühe Lotmani jaoks keskse küsimusega, nimelt "Kuidas saab süsteem areneda, säilitades samas oma identiteedi?" (Lotman 2009: 1). Semiootiline vaatepunkt õppimisele võimaldab seda defineerida kui mittelineaarset tähendusprotsessi, mis on suunatud uue teabe genereerimisele. Samal ajal on see protsess juhitud mitmesuguste haridus- või ka laiemalt kultuurimudelite poolt, mis, kitsendades tähenduse loomise variatiivsust, suunavad õppimist kindlate trajektooride poole ja pakuvad seeläbi stabiilsust selle ülekaaluka määramatuse taustal, mida õppijad uue tähenduse otsimisel kogeda võivad. Kuna aga õppimisprotsess kultuuris toimub samaaegselt erinevatel tasanditel ja hõlmab korraga paljusid erinevaid mudeleid, tekib selles paljususes paratamatult n-ö kokkusobimatuse (tõlkimatuse) olukord, mille tõttu muutuvad õppija valikud tähenduste loomisel siiski ettearvamatuks ning uued tähendusrajad kalduvad ettemääratud trajektooridelt kõrvale. Seega on õppimisprotsess, mida haridusmudelid suunavad, omakorda suunatud olemasolevate mudelite muutmisele.

Peatükis 2.2. selgitan, kuidas kultuurisemiootika raamistik võimaldab meil modelleerida haridussüsteemide erinevate tasandite vahelisi suhteid ja uurida hariduslike struktuuride mõju tähendusloomeprotsessidele ja kultuuri dünaamikale. Lähtudes Lotmani vertikaalse isomorfismi printsiibist teadvuse–teksti–kultuuri vahel ja kasutades semiootiliste süsteemide universaalseid struktuurseid suhteid, mida kirjeldasin peatükis 1.2., on võimalik modelleerida haridusprogrammide, pedagoogiliste mudelite, õpiprotsesside ja oodatavate ühiskondlikke muutuste vahelist dünaamikat. See omakorda võimaldab kirjeldada, millist mõju erinevad pedagoogilised lähenemised või haridusmudelid avaldavad kõrgemate hariduslike eesmärkide saavutamisele.

Kuigi võime eeldada, et tähendusloome õppimises järgib teatud määral haridusmudelite poolt etteantud suunda, ei saa eirata ka seda, mis jääb neist mudelitest välja ja mis võib sageli mängida sama olulist rolli semiootiliste süsteemide dünaamiliste protsesside kujundamisel. Seega, kuigi me võime luua kirjeldusi selle kohta, kuidas teatud pedagoogilised mudelid suunavad semioosiprotsessi, on õppimine alati mõjutatud reaalsete semiootiliste kontekstide poolt, millel on oma ajalugu, ning mille variatiivsust saab küll mingil määral kitsendada, kuid mitte kunagi lõplikult süsteemist eemaldada. Õppimisprotsessis kasutame me paralleelselt erinevaid ja mingil määral kokkusobimatuid tähenduste loomise mudeleid, ning kuigi kitsenduste loomise kaudu saame anda jõudu teatud trajektooride kujunemisele, jääb erinevate tähendusloome tasandite vastuoluline koosmõju siiski alati mingis ulatuses ennustamatuks ning kontrolli alt välja. Kultuurisemiootika eripära seisneb selles, et tänu mitmetasandilisele modelleerimisele suudab see korraga

kirjeldada nii kõrgema tasandi struktuure kui ka seda, mis antud kirjeldusest välja on jäetud, kuid süsteemi madalamal tasandil siiski edasi eksisteerib ning kaardistada tasandite vahelisi vastuolusid ja pingeid, mis tagavad süsteemi dünaamilise arengu.

Teises peatükis toon ka erinevaid näiteid artiklites käsitletud konkreetsetest haridusjuhtumitest ning arutan, kas kompleksse mõtlemise vaatepunkt võimaldab lisaks haridussüsteemide dünaamika kirjeldamisele anda ka juhiseid otsuste tegemiseks õppeprotsesside suunamisel. Kuigi kompleksne mõtlemine ei paranda ennustatavust, võib see aidata selgitada üldisemaid arengutrende ning hinnata süsteemide kohanemisvõimelisust. Kohanemisvõimelisuse eesmärgist lähtuvalt oleks edukamad taolised haridusmudelid, mida iseloomustab suurem mitmekesisus ja valikuvabadus, mis omakorda võimaldavad paindlikumat ja loovamat reageerimist muutuvale keskkonnale.

Lotmani perspektiivi sissetoomise olulisus komplekssüsteemsete hariduskäsitluste valdkonda on väärtuslik oma tasakaalustava hoiaku poolest. Komplekssüsteemne lähenemine hariduses on positsioneerinud end kaasaegse formaalse peavooluhariduse vastu, mida suuresti iseloomustab läbiv soov kontrollida, mõõta ja ennustada õppeprotsessi iga aspekti. Kuid selle vastasseisu tulemusena kipub komplekssüsteemne lähenemine vahel ise teise äärmusesse kalduma, pannes liiga palju rõhku õppimisprotsessi dünaamilisusele, mittelineaarsusele ja ettearvamatusele ning jättes kõrvale asjaolu, et lisaks võimele muutuda on kõik n-ö õppivad süsteemid võimelised ka erakordseks püsivuseks. Mitte iga liblika tiivalöök ei vallanda tornaadot. Selline kallutatus ettearvamatute protsesside poole on tekitanud kahtlusi selles, kas komplekssüsteemne vaade on üldse sobiv raamistik haridustegevuse mõtestamiseks või juhtimiseks, sest vältimatu ettearvamatuse printsiip õõnestab komplekssusteooria võimekust suunata käitumist kindlat tulevikku silmas pidades (Morrison 2008: 26). Juri Lotmani kultuurisemiootikast tulenev komplekssuspõhine lähenemine suudab hoida haridusprotsesside staatilis-dünaamilist mõõdet paradoksaalses pinges ning selle kaudu käsitleda ühtaegu nii lineaarseid protsesse kui ka ennustamatuid arenguid haridussüsteemides, vaadeldes neid üksteist vastastikku tingivatena. Juri Lotmani ideede rakendatavust kaasaegse haridusmaastiku muutuste mõtestamiseks ilmestavad kolm käesoleva doktoritöö neljast artiklist.

I artikkel (Rickberg 2017) käsitleb ajalooõpetuse sotsiaalset funktsiooni ühiskondliku sidususe tagamisel. Euroopa Liidu haridusmaastikul on arvamused selle kohta, kuidas ajalugu kõige efektiivsemalt ühiskondliku sidususe tagamiseks rakendada, jagunenud suures plaanis kahte leeri. Euroopa Liidu hariduspoliitika propageerib mitmeperspektiivilist lähenemist. Selle suuna lähtepunktiks on oletus, et erinevaid vaatenurki kaasav analüüs kui õppemeetod aitab kujundada avatumat ja sallivamat suhtumist teistesse kultuuridesse ning toimib seetõttu pingete maandajana globaliseeruvas maailmas. Sellele vastandub rahvuslik ajalooõpe, mis osana kultuuri enesemudelist kinnitab ühtse ajaloonarratiivi kaudu rahva terviklikkuse ja järjepidevuse ideed. Nende kahe vastandliku suuna vahelist pinget Euroopa kultuuriruumis ning selle pinge mõju ühiskondlikule sidususele saab mõtestada lähtudes Juri Lotmani kultuuri dünaamilisest mudelist. See võimaldab

käsitletava probleemi taandada küsimusele kultuuri ühtsuse ja terviklikkuse ning samas mitmuslikkuse ja paljukeelsuse mehhanismide vahelisest tasakaalust.

II artikkel (Rickberg 2023) otsib vastust küsimusele, kuidas erinevad lähenemised ajaloo õpetamisele kujundavad erilaadseid strateegiaid ebakindluskogemusega toimetulemiseks. Vaatluse all on kolm pedagoogika suunda ajalooõppes, mis põhinevad erinevat tüüpi modelleerivatel süsteemidel. Lotmani kultuurisemiootilistest ideedest lähtuvalt eristatakse müütilist modelleerimist, teadmuslikku modelleerimist ja mängulist modelleerimist. Tekstis käsitletakse pedagoogiliste lähenemisviiside ja ebakindluse kui teadmiste äärealadel tekkiva kogemuse vahelist seost, modelleerides seda kui semiootilise süsteemi ja selle piiri vahelist suhet. Sõltuvalt loogikast, mida kasutatakse semiootilise üksuse sise- ja välisruumi vahelise suhte konstrueerimiseks, kujunevad semiootilistel süsteemidel ka erinevad lähenemised, kuidas tulla toime piiriala kui määramatuse reservi poolt tekitatava ebakindlusega. Õppeprotsessis võib neid lähenemisi vaadelda kui semiootilisi strateegiaid, mida erinevad pedagoogikad jõustavad olukordades, kus informatsiooni määramatus võib tekitada õpilastes ebakindlust. Ajalooõppe kontekstis käsitletakse artiklis kolme erinevat strateegiat: ebakindluse vältimine rahvusliku ajalooõppe puhul, ebakindluse vähendamine distsiplinaarse pedagoogika puhul ja ebakindluse aktsepteerimine postmodernses ajalooõppes.

III artikkel (Rickberg 2022a) võtab vaatluse alla Juri Lotmani kultuurisemiootika teooria võimalused kaasaegse haridusmaastiku mõtestamisel, mille üheks suuremaks väljakutseks on kultuuriruumi üha kiirenevast muutumisest tingitud vajadus suurendada haridussüsteemi paindlikkust ja kohanemisvõimelisust. Lotmani semiootika, mis oma lähtealustelt paigutub komplekssе mõtlemise paradigmasse ning on suunatud staatika ja dünaamika vahekorra selgitamisele, pakub sobivat raamistikku praeguse kultuurisituatsiooni analüüsiks. Samal ajal võib see kirjelduskeelena osaleda ka haridussüsteemi kujundamises ning püstitab küsimuse süsteemisiseste protsesside teadlikust suunamisest. Artiklis kirjeldan seda, kuidas mõista kompleksset lähenemist haridusele, ja selgitan, millistel alustel on võimalik Lotmani kultuurisemiootikat vaadelda komplekssuskäsitlusena. Seejärel visandan kultuurisemiootilise kirjelduse haridussüsteemist, mille areng kulgeb kahe vastassuunalise protsessi vastastikmõjus, olles ühelt poolt seotud õppimise kui mittelineaarse tähendusloomega ja teisalt haridusmudelite kui seda tähendusloomet suunavate ettekirjutuste süsteemiga. Artikli viimases osas kirjeldan Lotmani ainulaadset vaatepunkti kunstilisele modelleerimisele, milles ta näeb võimalikku vahendit äärmiselt keerukate süsteemide mõtestamiseks, ja arutlen võimaluse üle, kuidas kunstiliste mudelite rakendamine hariduses saaks suurendada kultuuri paindlikkust muutustega kohanemisel.

IV artikkel (Rickberg 2022b) on seotud doktoritöö esimese eesmärgiga ja otsib vastust küsimusele, kuidas selgitada kultuuridünaamika eripära võrreldes teiste komplekssete süsteemidega Juri Lotmani semiootikateooriast lähtuvalt. Antud artikkel on esmaseks mõttearenduseks doktoritöö esimesele peatükile. Artiklis võrdlen Juri Lotmani ideid üldtunnustatud arusaamadega komplekssetest süsteemidest, et piiritleda ühisosa. Järgnevalt käsitlen küsimust, kuidas erineb komplekssuse uurimine füüsikalistes ja kultuurilistes süsteemides. Viimases osas pakun

välja mõned esialgsed mõttekäigud selle kohta, kuidas Lotmani ideede kaudu modelleerida kultuurilisi komplekssüsteeme.

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Käesolev doktoritöö võimaldab jätkata alustatud uurimistööd erinevates suundades. Siiski näib, et üks olulisemaid radasid, mida mööda siit edasi liikuda, on seotud küsimusega, kuidas saaks kompleksset mõtlemist haridusvaldkonnas rakendada käesoleva planetaarse kriisiga kohanemiseks. Mitmete kriisidega, millega inimkond praegu silmitsi seisab, ei saa tegeleda pelgalt keskkonna- või maailmahariduse tundide lisamisega õppekavadesse. See nõuab ka laiemalt nende haridusmudelite kriitilist uurimist, mida me kasutame maailma mõistmiseks ja paremat arusaamist sellest, kuidas need mudelid kujundavad meie suhteid keskkonnaga selle sõna kõige laiemas tähenduses. "Metsiku pedagoogika" nimelise haridusliikumise praktikud on selle vajaduse sõnastanud järgmiselt:

> Selle taga, mida me mõistame kriisina, nagu kliimamuutus ja liikide väljasuremine, peitub tegelikult hoopis sügavam kriis, mis on seotud sellega, kuidas paljud inimesed suhestuvad maailma – ehk sellega, milline on meie modernistlik domineeriv viis maailmas olla. Uus nägemus haridusest peab sisaldama struktuure, õppekavasid ja pedagoogikaid, mis on suunatud selliste olemisviiside katkestamisele. (The Crex Crex Collective 2018: 67)

Kompleksne mõtlemine suudab olla selliseks jõuks, mis katkestab olemasolevaid haridus*praktikaid*, kuid veelgi olulisem on see, et oma teoreetilises mitmekülgsuses võib see pakkuda ka erinevaid lähenemisviise mitte ainult olemasoleva "lõhkumiseks", vaid ka hariduse ümberehitamiseks. Kuna kompleksne mõtlemine põhineb ökoloogilisel vaatel maailmale (vt Marais 2014), mis seab esikohale suhted, koosmõju ja radikaalse avatuse, võib see aidata suunata ka meie haridussüsteeme mitmekesisemate, loovamate ja kohanemisvõimelisemate maailmaga koosolemise viiside suunas.

PUBLICATIONS

CURRICULUM VITAE

Name: Merit Rickberg
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Education:

2016–2023	University of Tartu, doctoral studies, Semiotics and Culture Studies
2014–2016	University of Tartu, master's studies, Semiotics and Culture Studies, MA
2009–2014	University of Tartu, bachelor's studies, Semiotics and Culture Studies, BA
2006–2009	Nõmme Gymnasium in Tallinn, secondary education

Study visits at other universities:

06/2021–08/2021	Vilnius University, A. J. Greimas Centre, Visiting PhD Student
02/2013–06/2013	Saint Petersburg State University, Russian Philology, B.A. exchange student
09/2012–01/2013	Moscow State University, Russian Philology, B.A. exchange student

Career:

2021–…	Tallinn University, Head of Juri Lotman Semiotics Repository
2019–2020	University of Tartu, Junior Research Fellow in Semiotics

Research-related managerial and administrative work:

2021–...	Member of the editorial board of "Bibliotheca Lotmaniana" (Tallinn University Press)
2019–2022	Member of Juri Lotman 100 organizational committee
2018–...	Estonian Semiotics Association, board member (2018–2022)
2017–...	Literature on Screen NGO, board member
2016–...	Member of Transmedia Research Group, University of Tartu

Research topics:

semiotics of culture, education studies, semiotics of conflict, complexity theory

Acknowledgements:

2022	Juri Lotman stipend for developing a complexity approach to education
2019	Award for best lecturer from the student council of the Institute of Philosophy and Semiotics
2018	Annual award of Estonian Semiotics Association "Semiootiline jälg"

Selected publications:

Rickberg, Merit 2023. From avoiding uncertainty to accepting it: Semiotic modelling of history education at the limits of knowledge. *Sign Systems Studies* 51(1): 7–35.

Ventsel, Andreas, Hansson, Sten, Rickberg, Merit; Madisson, Mari-Liis 2023. Building Resilience Against Hostile Information Influence Activities: How a New Media Literacy Learning Platform Was Developed for the Estonian Defense Forces. *Armed Forces & Society*: 0095327X231163265.

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Rickberg, Merit 2017. Kahest vastandlikust tendentsist ajalooharidus. *Acta Semiotica Estica* 14: 46–68.

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Haridus:

2016–2023	Tartu Ülikool, doktoriõpe, Semiootika ja kultuuriteooria
2014–2016	Tartu Ülikool, magistriõpe, Semiootika ja kultuuriteooria, MA
2009–2014	Tartu Ülikool, bakalaureuseõpe, Semiootika ja kultuuriteooria, BA
2006–2009	Tallinna Nõmme Gümnaasium, keskharidus

Õppetöö teistes ülikoolides:

06/2021–08/2021	Vilniuse Ülikool, A. J. Greimase keskus, külalisdoktorant
02/2013–06/2013	Peterburi Riiklik Ülikool, vene filoloogia eriala, B.A. vahetusüliõpilane
09/2012–01/2013	Moskva Riiklik Ülikool, vene filoloogia eriala, B.A. vahetusüliõpilane

Teenistuskäik:

2021–…	Tallinna Ülikool, Juri Lotmani semiootikavaramu juhataja
2019–2020	Tartu Ülikool, semiootika osakond, nooremteadur

Muu teadusorganisatsiooniline ja -administratiivne tegevus:

2021–...	Raamatusarja “Bibliotheca Lotmaniana” toimetuskolleegiumi liige (TLÜ Kirjastus)
2019–2022	Juri Lotman 100 korraldustoimkonna liige
2018–...	Eesti Semiootika Selts, juhatuse liige (2018–2022)
2017–...	Kirjandus Ekraanil MTÜ, juhatuse liige, asutaja
2016–...	Tartu Ülikooli transmeedia uurimisrühma liige

Uurimisvaldkonnad:

kultuurisemiootika, haridusteadus, konfliktisemiootika, komplekssüsteemide teooria.

Tunnustused:

2022	Juri Lotmani stipendium hariduse komplekssüsteemse mõtestamise eest
2019	Filosoofia ja semiootika instituudi õpilasesinduse poolt parima õppejõu tunnustus
2018	Eesti Semiootika Seltsi aastaauhind "Semiootiline jälg" teadustöö eest

Olulisemad publikatsioonid:

Rickberg, Merit 2023. From avoiding uncertainty to accepting it: Semiotic modelling of history education at the limits of knowledge. *Sign Systems Studies* 51(1): 7–35.

Ventsel, Andreas, Hansson, Sten, Rickberg, Merit; Madisson, Mari-Liis 2023. Building Resilience Against Hostile Information Influence Activities: How a New Media Literacy Learning Platform Was Developed for the Estonian Defense Forces. *Armed Forces & Society*: 0095327X231163265.

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