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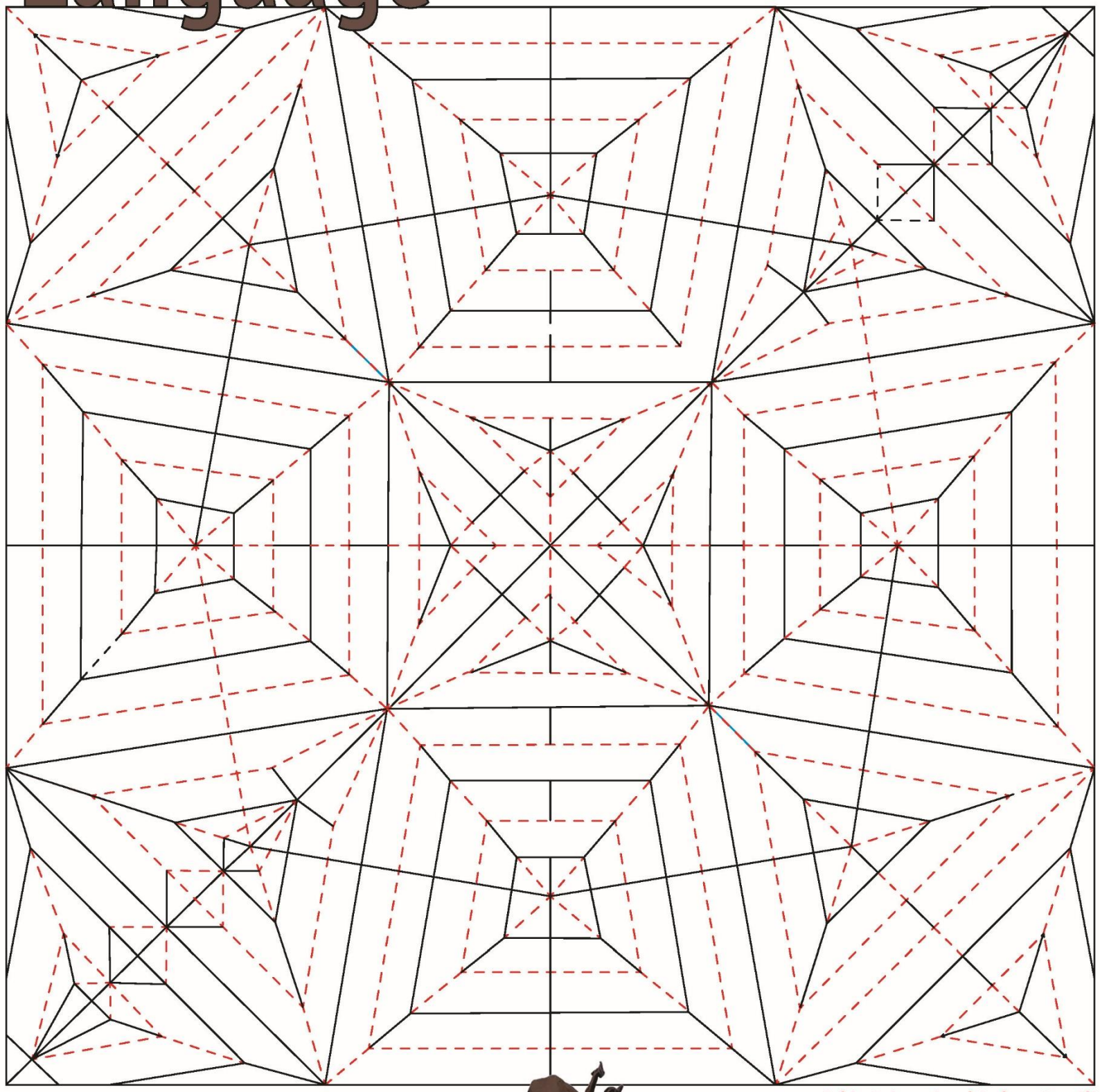

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Research article

Techniques of Presence: A Way to Interpret Technoscience Starting from Ernesto De Martino's Theory of Magic

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Abstract

Ernesto de Martino developed in the 1940s a theory of magic on philosophical grounds, while engaging a critical dialogue with the anthropology of his time. The central category of his study is that of the "crisis of presence". Through it, the magical is interpreted as a historical response to an existential and permanent predicament of the human condition. The role of the shaman and the ritual are interpreted in an original way as countermovements against the risk of losing one's individual consistency (presence). Magic, from this perspective, reveals itself not to be primarily a way of dominating the natural world and making it function according to our needs and desires. While it does not lose this operative character, it proves to be initially born out of an inner condition of existential crisis. The purpose of this paper is to delineate the De Martino's theory of the relationship to magic and to trace its connection to modern technosciences. Regarding the underlying need to which they respond and the way in which its procedures are conducted: In magical thinking there is no intention of developing a description of the world, instead a willingness to dominate its irregularities. Magic operates through recomposing human presence when it is threatened by forces outside its dominion. In our hypothesis, magicians appear as a kind of techno-scientists who succeed in obtaining a representation of the world only insofar as their interventions prove effective on it.

Keywords: Ernesto De Martino; Magic; Technoscience; Anthropology; Presence; Technology and Magic

Acknowledgment*:* The work of the two authors can be divided as follows: Andrea Gentili wrote the "Introduction" and the first two sections ("De Martino's Theory of Magic" and "Reintegration of Presence and Dehistorification"), Fabio Grigenti wrote the third section ("How Techno-Magic Works") and the "Conclusions."

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Научная статья

Техники присутствия: Способ интерпретации технонауки, начиная с теории магии Эрнесто де Мартино

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Аннотация

Эрнесто де Мартино разработал в 1940-х годах теорию магии на философских основаниях, ведя при этом критический диалог с антропологией своего времени. Центральной категорией его исследования является «кризис присутствия». Через него магическое интерпретируется как исторический ответ на экзистенциальное и постоянное затруднение человеческого существования. Роль шамана и ритуал интерпретируются оригинально как контрдвижения против риска потери индивидуальной состоятельности (присутствия). Магия, с этой точки зрения, оказывается не в первую очередь способом доминировать над миром природы и заставить его функционировать в соответствии с нашими потребностями и желаниями. Хотя он и не теряет этого оперативного характера, он оказывается первоначально рожденным из внутреннего состояния экзистенциального кризиса. Цель этой статьи состоит в том, чтобы обрисовать теорию Де Мартино об отношении к магии и проследить ее связь с современными техническими науками в отношении лежащей в их основе потребности, на которую они реагируют, и того, как проводятся ее процедуры: намерение разработать описание мира, а не готовность доминировать над его неровностями. Магия действует, восстанавливая человеческое присутствие, когда ему угрожают силы, находящиеся за пределами его владений. В нашей гипотезе маги предстают своего рода техно-учеными, которым удается получить представление о мире только в той мере, в какой их вмешательство в него оказывается эффективным.

Ключевые слова: Эрнесто Де Мартино; Магия; Технонаука; Антропология; Присутствие; Технологии и магия

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INTRODUCTION1

"Magic" is an object of study as intriguing as it is embarrassing to the history of thought. The Western world's self-interpretation proclaims its detachment from the magical. The modern subject, that uses his reason and lives in a world written in mathematical characters, no longer sees any use in an explanation of things that does not also obey stringent logics of reason. The world is no longer inhabited by incomprehensible entities, nor by dark forces plotting for or against his life, according to inhuman laws of reward and punishment. One looks upon magic as a relic of a childlike past, from which one is now safely and completely emancipated.

When European anthropology began its travels and was confronted with "magical civilizations", its first discoveries only confirmed what the European modernity already ascribed to herself, to be the pinnacle of rational development. And this development was matched and confirmed by the growth and refinement of her scientific and technical apparatus. The latter demonstrates, as if there were still a need, the extent to which the modern world is now freed from the obscurity of the natural world, its secrets, and its constraints. Anthropology, by tracing a primitive and primordial humanity, which has not yet obtained the means of progress and lives in a world of superstitions, spirits, and irrational beliefs, could thus become a science worthy of the highest interest, that of observing an origin that would otherwise have vanished altogether.

Certainly, this reconstruction has, over the years, seemed less and less convincing. Western rationality not only found its critics, but had to question its genesis, finding in it remnants of that neglected heritage, perhaps never fully eradicated. Why, despite everything, does human behavior continue to respond to logics that are not entirely transparent? Why does it fail to really conduct itself according to that absolute freedom which also, so it seems, is its distinctive mark which separates it from nature? Can we be entirely confident that we have completely emancipated ourselves from that childlike past of magic and other primitive beliefs?[2]

This brief inquiry aims to relate the theoretical results realized from the investigation of magic by Ernesto De Martino (1908-1965),[3] an Italian anthropologist and thinker, to the field of technical action, which is based on the manipulation of objects. The underlying thesis of this paper is that in magical thinking there is no intention of developing a description of the world, instead we discover the willingness to dominate its irregularities following a regular code of action and intervention. The way magic operates, through those that we will see as procedures of a genuine technical matrix, is recomposing the peculiar human presence when threatened by forces outside its

[1] This paper complements several papers on "Technology and Magic" which appeared in *Technology and Language* 3:4, 2022. It also originated as part of the 2022 Padova Summer School on Philosophy and Cultural Studies of Technology, associated most closely with the papers by Natascha Adamowsky (2022), Benedetta Milani (2022), Federico Monaro (2022), and Mareike Smolka (2022).

[2] It is precisely in the Renaissance that one finds, alongside the great propulsion toward the scientific method, still irruptions of the magical thinking, not antithetical to said method, but integral to the history of its development (for instance, we can look at Paracelsus, Girolamo Cardano, or Giovanni Pico della Mirandola).

[3] For an English-language introduction to De Martino's work see Ferrari, 2012 and Geisshuesler, 2021.

dominion. In our hypothesis, the magician appears as a kind of techno-scientist *ante litteram*, that is, as a subject who succeeds in obtaining a representation of the world only insofar as his or her intervention proves effective on it. Thus, the possibility of knowledge is subordinate to obtaining a practical result through the deployment of a correct procedure.

The relationship between magic and technology, as we aim to show, is not as much of a stretch as one would initially be led to believe. The paradoxical comparison between what is the so-called primitive mentality and what is the peak of contemporary progress, will lead us to question even the categories of "primitive" and "progress". We will try to show the similar underlying structures between magic and the most advanced form of Western technology. That may reveal to us the proximity of the magical, at least in the consideration of it that we are about to outline.

DE MARTINO'S THEORY OF MAGIC

De Martino's arguably most famous work, *Il mondo magico* (*The Magical World*), was written during World War II and came out in 1948. To introduce the theory of magic displayed therein, it is necessary to give an account of the author's argument against the ethnological and anthropological sciences of his time.

Previous theories drew two conclusions that, for De Martino, could not be accepted: 1) that all the phenomena of magic are the residue of a civilization that is primitive and inferior in its degree of development (Tylor, 1871), or that at least is characterized by being pre-logical (Levy-Bruhl, 1910; 1949); 2) that magic as a whole has to do with the domain of the irrational and belongs to it (Frazer, 1911), therefore even the result of a magical practice has to be completely irrational, incomprehensible. If, for example, magic has some power in influencing social cohesion and ensure the stability of a community, this will be only due entirely to psychological reasons, such as mass-manipulation or self-suggestion.

De Martino's *first* move is to counter the idea that "primitive" coincides with "archaic" (in a chronological sense) and with pre-intellectual or irrational. There is no definition of "primitive" that can encompass all human societies, from the Egypt of the pharaohs to the Eskimo community. It is a category that turns out to be dependent solely on the observer's point of view. Therefore, "primitive" is a characterization entirely relative to one's culture of reference, not an absolutely valid designation. *Second*, if we take the magical (or paranormal) as an object, it is not true that its explanation in so-called "primitive societies" is always tied to an irrational belief. For example, whether the phenomenon of lightning is explained with the notions of modern meteorology, or whether one considers it the apparition of a divinity or the descent on Earth of a mythical hero, in both cases one is applying an order function to an event which manifests itself first and foremost as something unknown (De Martino, 1941, p. 94).[4] Either way, reality is given an order. The "primitive" world is not an illogical or pre-logical world, it

[4] All translations from De Martino's works are by the authors.

possesses a logic of its own, and we understand nothing of its culture and development unless we make the effort to penetrate that logic.

This brings us to the second point: the body of knowledge that makes up *magism* (*magismo*) is not a merely psychological content. The foundation of the effectiveness of magic is not to be found in the conviction of the subject performing the act or in the social group to whom the act is destined. This is evident when highlighting a character of magic that is usually marginalized: magic works. It *does* something, it has its own specific operation. If in fact the magical ritual did not work, which means that it did not arrive at any result, we would be right to consider its practice completely irrational. It is after all a banal question: If magic had no effect, if the ritual always failed, wouldn't magical civilizations be absolutely incomprehensible?

De Martino's question is then: where does magic come from? What triggers the creation of a system that we can call a system of practices, rituals, rules, arrangement: a magic system? Magic is something that exists in its cultural world, as an historically determined expression of a community. It is not simply something that one believes in, it is something that is part of that way of life and one's own everyday reality. "The problem of magical powers", says De Martino, "involves not only the subject of judgment but also the judging category itself, the category of *reality*" (De Martino, 1948/2022, p. 54; s. a. Cherchi, 1998).

So, the magical does not have to do with the not real, but with the aspect of reality that remains impenetrable, which cannot be investigated, but which must be acted upon. The domain of the irrational and of the unknown are not one and the same. If the purpose is to "determine the *Weltanschauung* of magism and the historical function of that *Weltanschauung*" (De Martino, 1941, p. 74), one obscures the understanding of magic by dismissing it as *a priori* non-rational. Magic should be, at first, given the dignity of a way to *deal with the unknown* by incorporating it into a rational scheme of interpretation and practices. Like every historical world, ours as well has ways of dealing with the unknown. The comparison between what is known to us and unknown to other worlds is not fruitful. Quite different is the case if we shift the focus, and we consider our manners of dealing with the unknown compared to theirs. It is then a matter of broadening the field of inquiry and, first of all, assessing *against what* magic is employed, from what inescapable necessity it emerges as a determined historical concretion.

According to De Martino, magic comes from a structural condition of the human, around which *magism* as a historical world develops. Referring to Heidegger's early philosophy, De Martino says that the culturalization of nature, its ordering into a functional system of practices, is the result of the manifestation of *Angst*. As it is well known, being-there, the human's *Dasein*, does not only have to deal with the condition of fear (*Furcht*). Fear is always fear of something, fear in face of a concrete danger or a depiction of it. *Angst*, on the other hand, does not turn to an outside, but to the inside. It is the consciousness of "nothingness as nothingness", as annihilation of one's own presence. In a way, we can say it is fear without an object, a being-there that is stricken with the anticipation of the possibility of not-being-there-anymore, the end of every further possibility. This occurrence – the moment when *Angst* confronts a human with his most radical possibility, the impossibility of being there – is called by De Martino "crisis

of presence" (*crisi della presenza*). We can follow here a description by the author himself:

> The crisis of presence is felt as an occult force, as a malevolent influence. The crisis of the objectivity of the world is experienced as if everything acquires the ductility of wax, and as if things lose resistance and become sag in their contours. The world falls apart, collapses, loses relief and dignity, it becomes sordid. (De Martino, 1948/2022, p. 151)

De Martino, at this point, filters Heidegger through his Italian reception and his own neo-Hegelians background.[5] Contrary to Heidegger, there is for De Martino a content of *Angst* that is somehow *determined*, precisely in the sense that Hegel gave to that process as *bestimmte Negation*.[6] Even in the most radical negation we must be able to find a residuum, something that remains from that negation, and from which we can start again and, one more time, build something on top of what has been negated.

This determined content is for De Martino the same invariant structure that manifests itself in the phenomenon of *Angst*. The crisis of presence, triggered in the moment of breakdown, configures a human tension to respond, to do something in order not to succumb to a total loss of identity. Again, this is an original point, as it moves us away from the naive consideration of the "primitive" world as one that does not know the individual and the person and would live in a kind of "community with all things," cloistered in an ontological and social monism that would prevent the arising of a qualified form of self. But it is not just that, for the individual confronting its own crisis of presence is in fact not only faced with the loss of self as singularity, but simultaneously faced with the loss of its own historical world. So we already have in *magism* the affirmation of a interrelationship between *Dasein* and *Welt*, on the one hand,our "presence at the world" (*presenza al mondo*), on the other, "the world becoming present" (*il mondo che si fa presente*).

When this interrelationship is challenged, the response is not that of an isolated individual, alone with oneself, but is a collective response, and the individual becomes part of the public, collective drama (De Martino, 1948/2022, p. 154). In this collective dimension of crisis, the properly magical drama is distinguished from delirium and mental pathology, which remain solely in the private sphere of the individual. Faced with *Angst*, with the "nothingness that advances," cultural formation can and will respond, by creating ways for recovering the presence in the world that is going to fade.

> the *supreme principle* of the transcendental unity of self-consciousness entails a *supreme risk* for the person, namely, the risk of losing the supreme principle that constitutes and grounds it. This risk arises when the person, in place of preserving its autonomy over content, abdicates its task, allowing content to assert itself outside the synthesis, as unmastered *elements*, as *data* in absolute sense. But when

[5] For an overview of De Martino's philosophical background see Barbera, 1990, Sasso, 2002, and Berardini, 2013.

[6] Where for Heidegger *Angst* is only in the face of what is and remains completely indeterminate ("das Wovor der Angst ist völlig unbestimmt" Heidegger, 1927/1967, p. 186).

> such a threat unfolds it is the same person who is at risk of dissolving, disappearing as presence, *precisely because its presence is not assimilable to elements and data.* (De Martino, 1948/2022, p. 161)

What happens in the crisis is thus a radical disruption of the *a priori* forms of subjectivity. The world is not put into form, it escapes the ordering instance of the individual, and becomes for it a formless, incomprehensible and imposing mass. Faced with the weight of the datum, the self fails to give itself a determined shape and breaks down. In front of such a force of indetermination, the cultural response involved by the magical practice is instead always determined and determinant. It is *determined* insofar as it takes the form of a certain ritual, a certain rule, the observance of a certain prohibition or *taboo*, and that's because magic is systematic, always ordered, not anarchic or improvised. It is *determinant* insofar it has the ultimate purpose of reintegrating presence against the risk of disappearance. In this conflict, which is played out on the dual level of a procedure (ritual) and the result related to it (reintegration of presence), we have the *drama* of the magical world and its internal dynamic.

Also, from this point of view, De Martino can criticize the individualistic framework of existentialism, i.e., its attachment to the individual as singular (thus, the impossibility of understanding the crisis of the individual outside the pathological, as abnormal consciousness). Inside the procedure of the magical drama, we surely see a struggle for the singularity of the individual, but it takes the organized form of a communal endeavor for the "the elementary being there, or presence, of the *persona*" (De Martino, 1948/2022, p. 165) which is not abstracted in isolation, but is instead part of a surrounding social structure. Only in the context of a social world, which follows communal logics, then the presence of the individual can be saved thanks to an external intervention, that of the mage or shaman figure. And the rescue occurs at the level of an everyday practice, which is magical rituality.

REINTEGRATION OF PRESENCE AND DEHISTORIFICATION

As we have seen, for De Martino, the reaffirmation of presence is a reaffirmation of an existence, of a singularity, inside a community. Magical rituality acts as his refuge and as a social shield or, in Shirokogoroff's (1923) term: the mage or shaman has the role of society's "*safety valve*". If we have outlined what the origin of the magic ritual is and have come to understand why it is necessary and how the intervention of an outsider is incorporated, it is therefore appropriate to see how the shaman is formed and what is the very essence of his practice.

In the very training of the shaman, we see the confirmation of the operative function of magic. To become a mage, one must undergo through an initiation that involves one's personal regaining of selfhood. In the ritual pattern of initiation into the role, the following elements are almost always present:

1) The first stage consists in isolation. The shaman will go to the forest, the desert, or some other place distant and disconnected from the community, where the initiation begins. We can identify this stage as one of existential solitude;

2) The second stage is conducted through the consumption of drugs, or otherwise the induction of altered states. This ritual has a specific meaning: the shaman has to deal with the risk of uncontrolled possession by spirits. This is the most important passage, the one in which the shamans themselves run the risk of losing their presence;

3) Lastly, if the shaman manages not to succumb to the altered state, then it's possible to finally return to the native community. At this point the training is over, the shaman's own presence is been reintegrated and he can return in the world that will receive his intervention. This theme is generally interpreted as "second birth", or "rebirth", and is the deciding qualification for the shaman role

In short, only because the shaman has run and exorcised the risk of loss of presence, can be the director of the magical drama. The mage has faced "chaos", "the indeterminate" or "the nothingness", and succeeded in reemerging victorious, as again an individual unit, is now entitled to become the guardian of communal order.

> through the sorcerer's redemption, the whole community opens itself to redemption, can have access to "salvation." In this sense, the sorcerer is configured as a true *magical Christ*, a mediator for the whole community of being there in the world as redemption from the risk of not being there. On the other hand, this redemption is cultural in the sense that the individual experiences connected to the existential drama proper of magism do not remain isolated and unrelated to each other, but are shaped in tradition, and as tradition they provide the ideological and institutional expressions within which the new individual experiences will move, and by virtue of which the vicissitude of risks, daring, debacles and victories that characterizes the magical world will receive a unity of development. (De Martino, 1948/2022, pp. 99-100)

We can at this point take a closer look at what this movement of redemption and reintegrating of presence consist of on a conceptual level. We might say that the original disruption, the shock provoked by the risk of losing one's presence, is indeed a negative movement, and cultural constructions, including magic and religion, consist of making up an opposition to that danger. Magic is a countermovement to the negative: "an experience, a drama, a problem, an unraveling" and also, finally, when it works, "an achievement" (De Martino 1948/2022, p. 74). That which is achieved is the re-integration of presence. But then we have to consider magic as a positive, as *positum*, a specific cultural construction made to keep the negative at bay. When it fades away in time, the trouble, the original negative, does not dissipate as well. That means that the risk of self-loss is not necessarily something that belongs only to distant civilizations: it is always there. As a response to this problem, magic is, in itself, entirely rational, because the truly irrational and incomprehensible is the concrete mass of the data when it exceeds the ordering function of subjectivity. And the magical practice is also a way of ordering the economy of presence and rebalancing the relationship with the original negative.

In *The Magical World*, however, De Martino still seems to tie this risk to the specific unfolding of a certain cultural world, precisely that of *magism.*[7] Only later, returning to these questions, will he recognize the general scope of his theory: the loss of presence is not just a "magical risk," but a "product" of the "vital sphere" itself (De Martino, 1953-1954/1995, p. 72 note). As such, it is constantly addressed, regardless of the historical civilization of reference. If *Angst* has to do with the loss of reality in a given historical moment, the countermovement will have to be characterized by being the positive removal of that problematic piece of reality, which manifests itself in an indeterminate threat. As we have seen briefly in the three phases of the shaman's training, we can trace each stage back to a broader meaning that can be further ascribed to other social figures, not just that of the mage, as its vector of realization. By this route we access the final characterization of the idea behind the interpretation of *magism*, a general theory of *dehistorification*.

The human, the being who in Marxian terms "makes history", must "dehistoricize" its own production of history (De Martino, 1953-1954/1995, p. 62), that is, de-realize its reality. The reintegration of presence thus shifts from being an exclusively magical practice to being characterized more extensively as a "technique of presence toward itself" (*tecnica della presenza verso se stessa*; De Martino, 1953-1954/1995, p. 60). The sense of "technique" here, De Martino points out, is not the usual one of dominance over the external object, whether natural or artificial, but of inner (re)appropriation of a "vital good", that is presence itself.

Certainly, however, as a technical mechanism, the mythical-ritual device that removes human historicizing activity is configured as a process of "alienation," in the precise sense of removing an element of activity from its owner. And, nevertheless, this process is necessary to receive something back, the confirmation of presence. However, its necessity is not given as this or that historically determined form (be it magic or a specific religious practice), which is and remains contingent. The inevitability is that such a process *needs to materialize itself*, insofar as it responds to an immutable human necessity that continues to present itself in history, regardless of its particular configurations. Angst, strictly individual, is reconfigured into the anticipation of the end of an entire historical world, and the figure that triggers the process of reintegration and dehistorification becomes that of the apocalypse.[8] The end of the world, the collapse of one's "mundane order," the oblivion of its reality, is thus configured as a "permanent anthropological risk" (De Martino, 1977, pp. 14-15).

[7] That led him to speak of a "return" to *magism* when forms of reintegration of presence appeared in his contemporary world (in the case of the countryside population of Italy or in the new "spiritualistic" trend),: "Everything in the life of the spirit, can be called back into question, even those achievements that seemed to be sheltered from any risk, and thus also the fundamental achievement of being-there in the world. In a situation of peculiar suffering and deprivation, as during a war, a famine, etc., the being-there may not withstand the exceptional tension and open itself again to the existential drama of magic" (De Martino, 2022, p. 131 note).

[8] These are precisely the themes that will employ De Martino's research from the 1960s onward, research that unfortunately he will not be able to finish in a systematic work and of which we are left with only a considerable amount of semi-organized notes.

But again, these conclusions need further justifications. Might it not, even now, be a matter of a certain historical conviction that is also destined to be outdated? This, if we turn once more to De Martino's reflection, stems from a specificity of Western culture, where "specificity does not mean primacy, or superiority. De Martino's attitude has always been one of "critical ethnocentrism" (see Saunders, 1993), that is to say: the anthropologist cannot approach other cultures in a completely pure and unprejudiced way but only as one that belongs to a certain culture at a certain moment in its historical shaping. However, one cannot help but admit that it is precisely that relativization and perspectival distance that permits an analysis. Certainly, the magical world would never understand itself through the problem of the crisis of presence. But we can understand it as such precisely because we are distant and that distance is what we have gained in the course of history itself.[9] The modern subject has not found a solution to the fundamental problem, but has found a way to face it. We have found historicity itself, understood – and here we can certainly diverge from De Martino's analysis – as the categorical content that can be applied to the analysis of a world.

The use of historical categories is clearly subject to historicity (in the sense that every given social world has its own), but precisely the intrinsic historicity of our categories is something that cannot be refuted, otherwise a history would not be conceivable in general. In this discovery of historicity therefore consists the specificity of Western culture, and its difference from all the others:

> Humanity has always lived in history, but all human cultures, except for the Western one, have expended treasures of creative energy to mask the historicity of existence. It could be said that human cultural history is the history of the masquerades of the historicity of existence, the history of the ways in which humans have pretended to be in history as if they were not in it. (De Martino, 1977, p. 354)

In this would consist the only form of progress we have gained, namely the historical awareness of its drama and the necessity of its mechanisms. If the underlying structure of the problem, the crisis and the need for countermovement, remains unchanged, it will therefore have to be possible to apply this hermeneutic gaze to the contemporary as well, to see if our own techniques of presence actually respond in the same way.

HOW TECHNO-MAGIC WORKS

Now, De Martino's thesis which we have just described in its philosophical terms has an important techno-practical aspect. The magical drama of risk and redemption is always accomplished through the mastery of a technique. In all forms of magical practice, the magician's first act is to fall into a particular state of consciousness, which is an

[9] Therefore, De Martino can confidently say: "the meaning of a historical epoch always lives within the movement of historiographical consciousness, and its problem only lies for posterity" (De Martino, 1948/2022, p. 170).

obvious reminder of the experience of losing Self. This *enchantment*[10] () takes place according to a precise sequence of steps:

(a) a process of disintegration of the person, loss of the self;

(b) extreme concentration on a single object, which entirely occupies what remains of consciousness;

(c) vision and dialogue with supra-entities, that takes the place of a direct relationship between one's self and magical spirits;

(d) progressive domination of vision, which is interpreted as an invitation to become a mage from an adjuvant spirit.

These elements, masterfully described by De Martino (1948/2022), can represent the first stage of a magical practice in the moment they become "the dominant end, voluntarily pursued" (p. 87) by the mage or shaman. Namely: magical enchantment, which is the first professional skill of a mage, is nothing more *than the deliberate repetition of the loss of self*. At this stage, through this willingness to undergo a repetition of a traumatic event, the danger of becoming absent is not only dissolved, but actively mastered, and this mastery is power socially recognized. As De Martino (1948/2022) points out in several points of his work, in magical practices the risk of dissolution becomes part of a technique based on repetition:

> The technique employed by the *selk'nam* sorcerer appears entirely appropriate for the purpose of weakening the unitary presence: it proposes itself to the presence by iteration again and again of the same content, thereby compromising the condition of any presence, which – as a *unification of the manifold* – is never compatible with the *repetition of the identical.* (p. 88)

Voluntary *enchantment* techniques have unified elements that are clearly recognizable in all cultures. First, they use behaviors and tools, which are employed according to a precise ritual protocol. Solitude, darkness, fasting, dancing, monotonous chanting, drum-rolling and the use of narcotics configure the professional equipment of the mage. Through these paraphernalia, he artificially re-enacts the original experience of the self-dissolution (the possibility of not being present) but removes from them their element of danger. This happens because – if the "not being here" by its essence would be definitive and unrepeatable – the fact that it *can be repeated* willingly and according to a technique makes it controllable and available. The *identical repetition of the unrepeatable* is really the beginning of magic in its technical and professional meaning. Therefore, the magical ritual is not an end in itself, but produces a result, which is precisely the repositioning of a self, which the situation of *Angst* would otherwise have dissolved.

Facing the most extreme danger – the loss of consciousness as the faculty of knowing (unification of the manifold) – the magical attitude does not seek a theoretical explanation, but *goes further* (*va oltre*) with the establishment of a techno-practical order. In this technical protocol there may be knowledges, but they are arranged around the

[10] I prefer this expression to the more technical one of *trance*, because it better expresses the specificity of the phenomenon.

practical existential fact of being able to voluntarily repeat – *and therefore respond*– to the possibility of dissolution.

This structure of the magical world is confirmed by the more specific techniques that the mage uses in his professional activity: *spells* and *mimesis*. The shaman's art consists mainly in rendering ineffective the malign influence of dangerous entities. Diseases, for example, are traced back to external influences, i. e. to a hostile being, also a magical user, that wants to cause the death (loss of presence) of another individuality. The mage is therefore called to counter the insurgent lability in the various nuances that this assumes in the daily life of a community. But the mage must also fight against other mages, who intentionally arouse the risk of the loss of presence. If it is in fact clear that the magician plays a role of social cohesion, magic cannot be but central in the struggles against the enemies of the community. In this scenario, where the mage is configured as a professional figure opposed to other mages, the movement of "going further" the risk of not being s attended by ever more technical rigor. Thanks to the practice of the spell:

> now the human being controls all moments of magical drama. (…) The risk is no longer a demonic snare, which arises beyond human control, during solitary wanderings, during the gloomy night, in the presence of a dead body (...). The fact that one mage can intentionally *make* the spell and another mage can *unmake* it gives the existential magical drama the character of a competition in which the presence of the strongest will claim victory (De Martino, 1948/2022, p. 111).

The circumstance that a subject can intentionally implement a spell based on a controllable and repeatable protocol and that another subject can implement a *counter-spell*, endows the magical agon with the character of a professional practice based on competence. Precisely because magic follows a specific procedure, it can be recognized by another practitioner, and then deconstructed. Even in this case it is to be noted that, if magic had a completely arbitrary character, no "counter-spell" would be possible, which instead makes sense only because it recognizes that a certain state derives from the application of certain practices (the rules of the opposing magic).

The same dynamic that we observed in the spell procedure can also be found in the mimetic processes implemented by the mage. Imitating animals, invoking atmospheric phenomena, copying other human beings, it's not a way to represent them (as a metaphor or a symbol), neither to becoming identical with them, because that would just result in a loss of one's own presence. The shaman imitates the bison to hunt it, the mage imitates the rain to make it fall, and imitates another human for the purpose of injuring or killing. Every mimetic practice is part of a protocol that aims to produce a result on the object of imitation:

> Those who imitate the rustling of the leaves for ecokinesis do not perform imitative magic: they will do so only when, becoming the center of imitation, they will imitate the rustling of the leaves in order to produce the wind. Only within this resistance and this redemption of the "I am there" threatened by ecokinesis can magical imitation be constituted (De Martino, 1948/2022, p. 113).

Indeed, a mimesis that sought to reproduce the object or natural phenomenon would be nothing more than a form of crisis, in which the self is lost in the givenness of the world. Magic is exactly the opposite of an "indiscriminate koinonia" (De Martino 1948/2022, p. 224) with the natural world, indeed that unity with the natural is precisely the supreme risk. Imitation becomes properly magical only when it is purposeful, when it assumes a precise poietic aim. In the example: the procedure imitates leaves not to join nature, but to produce wind.

Here we must consider two aspects, which can make us finally appreciate the closeness between magical practice and contemporary technoscience.[11] On the one hand, there is no real distinction between the technical object employed by the practice and the theory of the practice itself: ritual, or magic, is both the means and the specific object of magical knowledge. On the other hand, more broadly speaking, there is no autonomous theory of magic inside the magical world, but rather an essentially productive practice from which the conceptual element cannot be abstracted. The pure element of knowledge, separated from its application and experiment – the *scio* contained in *scientia* – becomes here inseparable from practice and the necessity of his performance.

There is, in short, no purely theoretical shaman.

Magic aims at a production, which takes on, as we saw earlier, the character of dehistorification (when historicity presents itself in the form of a problem). What the magical wants to produce is always a concrete self, a presence in the world, of which the shaman is a kind of original imprinter. The shaman's command over the process of production is first and foremost applied reflexively. Precisely because the shaman dominates it, a reproductive practice is made possible. But every reproduction eschews the seriality of the result, since each subject is a person in a peculiar sense. What remains reproducible and serial is practice itself. Magic is thus a rigorous procedure that oversees a general production of subjectivity. Its primordial genesis, the *Angst* of self-loss, somehow determines its outcome (that always aims to a reintegration of one's own self), but leaves the process indeterminate. The way in which the procedure is determined, that *positum* of which we spoke previously, will then depend on the configuration of the historical world to which it refers.

Perhaps, this determination of content is bilateral, and it is through this process that the historical world too comes into existence. However, this never fully unburdens it from its basic need, as we have learned from De Martino: is the opposition to the givenness and immediateness of the world, not yet historically understood, that presents us with the task of replacing these with the result of a human, artificial praxis, thus a mediation.

CONCLUSIONS: TECHNOSCIENCE AS A REPRODUCTION OF PRESENCE

Contemporary common sense is inclined to consider its distance from a past civilizations, or even present ones that are perceived as distant, primarily in terms of scientific progress. De Martino himself would not have said otherwise. And yet, when we

[11] For a more detailed analysis of the term, see e.g. Nordmann, 2010; 2011.

compare our ways of confronting the unknown we find conceptual similarities that are not insignificant. Magic, as we have seen, is something rationally and socially instituted, which has a specific function and is trusted only on the basis of its ability to fulfill that function – thus, its practical efficacy. As we have seen, the magical or "primitive" world does not stand in striking antithesis to the modern world. And this is perhaps the most unsettling result of De Martino's research. Progress is neither envisioned as a triumphant march toward constant improvement, neither is it the emergence in history of new, more complex problems, that nevertheless holds the promise that the problems of the past are now fully solved. There is, instead, an invariant foundation, a fundamental problem that determines the human being to create adequate procedures of reintegration. Hence the comparison with modern technoscience becomes possible.

Technoscience does not operate in accordance with reality, but as a recomposition of it. Reality is interrupted, suspended, and then returned as modified, technicized. At the moment of crisis, the real is de-realized. This intermittence of reality, which is held and then released, is made possible by mediate and operative forms of technical intervention, even if only in the form of information or entertainment. In the face of *Angst*, technoscience offers a response, and that response works. As with magic, the main focus is not to offer a general theory of reality and its processes, but a toolset that allows its more dangerous side, in an existential sense, to be kept at bay. The result is a production of reality, a surplus of the real (see Grigenti, 2019), which can certainly be again a cause for *Angst*, but it is indeed a result. Magic is not first and foremost an active form of dominance over the real (Malinowski, 1925/1948), but arises as a reaction, culturally situated. Technoscience, as it has developed, performs the same function in contemporary society.

What changes, evidently, are the forms through which the result is achieved (no longer the ritual, but the technical operation). Also, the mode of reintegration changes, but in a more subtle way. In fact, magic reintegrates presence as it was, before the crisis, interrupting the historical flow that would lead to its disappearance, and leading the individual's singularity back to its stability. The technoscientific model, on the other hand, interrupts the flow in the same way, but reconfigures presence as novelty, as invention. Presence is reintegrated into its status of being, but it is no longer the same as before. Presence immediately runs again the risk of not finding itself and not recognizing itself as such. Therefore, technoscience constantly offers ways of reintegration which are always new and different through a constant production. These, however, never succeed at permanent reintegration. The singular magical ritual thus breaks down into the recursiveness of a procedure that must be renewed all the time. The economy of presence, removed from the resolving intervention of the mage, thus becomes a pervasive, multifaceted, and multidirectional technology.

Following this interpretive suggestion, we would have to say that indeed, technoscience is one of the historical techniques of presence, in a way, however, that is substantially unprecedented compared to the examples we could find in the past. And yet, its element of originality is also the most problematic one, for constant renewal implies constant failure to reintegrate selfhood and, ultimately, the loss of the horizon of stability that is to be assured by magic.

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Research article

Hermeneutical Analysis of Scientific Experiments

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Abstract

Scientific experiment provides important practical content of contemporary science, and the practical understanding of scientific experiment constitutes an important topic of contemporary philosophy of science. The practical understanding of scientific experiment calls for the clarification of the connotation and significance of scientific experiment from the perspective of hermeneutics. And the hermeneutics of scientific experiment requires both practical and textual hermeneutic. The scientific author's intention and the nature of the experimental object determine the hermeneutic meaning of the scientific experiment. The experimenter is both the author and the reader of the experimental text, and the experimenter realizes the identity of the author's original intention and the meaning of the text. Experimental text is not a fixed text, but a text completed in the process of practice. Experimental text has a dual nature which is the unity of scientific text and technical text. The hermeneutical field of scientific experiment is the fusion of theoretical and experimental horizons, which is embodied in the fusion of experimenter's horizon and laboratory context horizons, as well as the fusion of scientific and technical horizons. The hermeneutics of scientific experiments requires both scientific and technical hermeneutics, which is a unification of scientific and technical hermeneutics. The textual hermeneutics of scientific experiments offers some new ways of understanding universal knowledge and experiments having multiple lives of their own.

Keywords: Scientific experiment; Textual hermeneutics; Scientific text; Technical text; Horizon

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Научная статья

Герменевтический анализ научных экспериментов

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Аннотация
Научный эксперимент составляет важное практическое содержание современной науки, а практическое осмысление научного эксперимента составляет важную тему современной философии науки. Практическое понимание научного эксперимента требует уточнения смысла и значения научного эксперимента с точки зрения герменевтики. А герменевтика научного эксперимента требует как практической, так и текстовой герменевтики. Замысел ученого и характер объекта эксперимента определяют герменевтический смысл научного эксперимента. Экспериментатор является одновременно автором и читателем экспериментального текста, и экспериментатор осознает тождество первоначального замысла автора и смысла текста. Экспериментальный текст – это не застывший текст, а текст, дорабатываемый в процессе практики. Экспериментальный текст имеет двойственную природу, которая представляет собой единство научного текста и технического текста. Герменевтическое поле научного эксперимента представляет собой слияние теоретического и экспериментального горизонтов, что воплощается в слиянии горизонта экспериментатора и горизонтов лабораторного контекста, а также слияние научного и технического горизонтов. Герменевтика научных экспериментов требует как научной, так и технической герменевтики, которая представляет собой объединение обоих. Текстуальная герменевтика научных экспериментов предлагает несколько новых способов понимания универсального знания и экспериментов, имеющих множество собственных жизней.

Ключевые слова: Научный эксперимент; текстовая герменевтика; Научный текст; Технический текст; Горизонт

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INTRODUCTION

The current hermeneutics of scientific experiments focuses on scientific practice, which is an important element of the philosophy of scientific practice. There are three approaches to the philosophy of scientific practice, including the cognitive science and the hermeneutic approach and the new experimentalism (Wu, 2005). In the hermeneutic approach, scientific experimentation as a scientific practice is local and existential (Rouse, 1987). The new experimentalism focuses on the experiment itself, and philosophically reflects on scientific experimentation and laboratory activities. Some Chinese scholars have already addressed the hermeneutics of scientific experiments in their elaboration of scientific hermeneutics. Xiaohan Huang (2002) believes that the hermeneutics of scientific experiments is to explain the status and role of scientific experiments in scientific understanding from the perspective of scientific experiments, as well as a series of problems of philosophy of science and scientific hermeneutics in scientific experiments. In a sense, hermeneutics of scientific experiments is actually a hermeneutic approach to understanding and interpreting scientific experiments, especially laboratory activities. Yanfei Shi (1991) focuses on the role and significance of scientific experimental apparatus, pointing out that in scientific experiments, scientific apparatus plays a decisive role in the discovery of new things. Other scholars like Tong Wu, Zhiping Cao, etc. have discussed Joseph Rouse's practical hermeneutics and Heelan's scientific hermeneutics which address the hermeneutic issues related to scientific experiments. In addition, technical hermeneutics also discusses the hermeneutic relationship between technology and the world involved in scientific experimental apparatus. From all of this, we can summarize that the main content of the hermeneutics of scientific experiments is practical hermeneutics which includes the hermeneutics of experimental apparatus.

The hermeneutics of scientific experiments is not only practical hermeneutics, however, but also a textual hermeneutics. At present, the hermeneutics of scientific experiments is rarely carried out from a textual perspective, and the textual hermeneutics of science and technology will be a new research path (Wu, 2021). In this regard, this paper will conduct a hermeneutic analysis of scientific experiments from a textual perspective, specifically examining the author, meaning, and characteristics of scientific experimental texts, exploring the duality of scientific experimental texts, and revealing the characteristics of the scientific experimental field of vision.

A BRIEF EXAMINATION OF THE HERMENEUTICS OF SCIENTIFIC EXPERIMENTS

In traditional philosophy of science, scientific experiments are often associated with observation which provide observable phenomena, so as to give corroboration or falsification of scientific hypotheses or theories. The status of scientific experiments is beneath that of theories, and they are not subject of hermeneutics, but are used as hermeneutic tools to explain and illustrate scientific theories. The traditional philosophy of science is actually a philosophy of science of theoretical superiority or a primacy of theory, however, the experiment itself has its own value and significance. Scientific

experiments are not just tools but should be the subject of scientific hermeneutics. As the philosophy of science takes a practical turn, the scientific experiment as a practical activity requires hermeneutic analysis as well. The hermeneutics of scientific experiment in the philosophy of scientific practice focuses on two aspects: the hermeneutic approach to the philosophy of scientific practice, and the philosophy of scientific experiment and laboratory research of the new experimentalism. The former is mainly represented by Joseph Rouse (1987). Rouse clearly defines the relationship between scientific experiments and theories, experiments and laboratory characteristics, and the understanding and interpretation of experimental results, forming a preliminary hermeneutics of scientific experiments. The latter is mainly represented by Hacking (1983), Latour and Woolgar (1979), Knorr-Cetina (1981). The philosophy of scientific experiments seeks to provide an explanatory account of scientific experiments, and the laboratory researches focus on the laboratory itself as well as the social construction of facts in the laboratory.

Joseph Rouse critiques the "theoretical primacy" of traditional philosophy of science and establishes the primacy of scientific experimentation. In *Knowledge and Power*, Rouse points out that scientific research takes place in the practical context rather than in the context of systematic theories, which means practice has priority over theory, namely precedence. The "theoretical priority" takes experiments as the possible exemplars of the theory or theories. In Rouse's view, this understanding of the experiment undoubtedly ignores the priority of experiment as practice. Experiments must be understood in the light of their practical nature. The practical nature of experiments is mainly reflected in laboratory practice. Rouse points out that laboratory practice is characterized by isolation, intervention, and tracking of the microcosm being constructed. The laboratory constructs a microcosm of phenomena that is isolated from other influences, and through the intervention of the researcher the characteristics of this microcosm of phenomena can be observed and traced, leading to an understanding and explanation of the object of study. Laboratory practice is able to isolate, intervene and trace because of the control of the experiment in the research. The researcher is a subject in a certain cultural context and power relations, which determines that laboratory research is necessarily concerned with power relations and social contexts. Rouse absorbed Foucault's idea of "knowledge is power" and introduced power relations into laboratory research, which involves the relational context in which the laboratory is located. The power relations in the laboratory constitute the relational context of laboratory hermeneutics, and it has been pointed out that "in the hermeneutical sense, the relational context, in fact, is more important than the thing itself; it is only in the relational context that we hold the interpretation, that we can explain" (Wu, 2019). A relational context can be analogous to a hermeneutic horizon.

Hacking (1983) proposes that "experiments have a life of their own" (p. 150) and "experiments have multiple lives of their own" (p. 165). Some experiments and observations are prior to theories, that is, experiments and observations can exist independently of theories. Also, experiments are diverse, there are not only experiments for testing theories and exploratory experiments, but also experimental practices centered on technological inventions. Hacking takes the history of thermodynamics as an example

to further point out that experiments can precede theories, and experiments not only have their own lives, but experiments themselves are constantly developed and improved in practice, gaining multiple lives of their own in practice.

Latour and Woolgar, referring to the laboratory as a site for the construction of scientific facts, point out that the laboratory, including the experimental equipment, constitutes the material environment of the experiment, and the material environment is the basis on which experimental phenomena are produced. So the laboratory practice is the process of constructing scientific facts.

Knorr-Cetina provides a detailed analysis of the laboratory, revealing four distinctive features of laboratory research that point to the contextuality of knowledge production, namely the contextuality of science. Because the scientific facts are constructed by scientists in the laboratory, the construction of knowledge in the laboratory is highly contextual. With the publication of scientific results in the form of papers, scientific knowledge undergoes a de-contextualization in which contextuality and serendipity are fixed. This is similar to the local knowledge emphasized by Rouse. Rouse‘s local knowledge is essentially the unification of the local and the universal, while Knorr-Cetina's contextualization is actually the unification of contextualization and de-contextualization. Both these unifications are achieved in the process of scientific experimental practice.

These above hermeneutics of scientific experiments almost all focus on the practice of scientific experiments, and the hermeneutics of scientific experiments is the same process as the practice of science. Obviously, both fail to see the textual character of scientific experiments, and fail to pay attention to the fact that theory and practice have the same fundamental position in scientific experiments. For scientific experiments, theory and practice are equally important. Firstly, the scientific experiment itself is a practical activity based on a certain theory, whether it is the design of the experiment, the operation of the experiment or the collation of the experimental results, all of which are inseparably intertwined with theory that provides guidance. Secondly, the purpose of scientific experiments, whether they are hypothesis-testing or exploratory scientific experiments, is ultimately to get a theoretical hypothesis. Finally, from the point of view of the experimenters, the experimenters have their own unique theoretical background, which plays an important role in scientific experiments. There is theory throughout the practice of scientific experiments, and practice is the entire process of specific experiments. Theory and practice are intertwined and interact in scientific experiments. It is obvious that the hermeneutics of scientific experiments only from the perspective of “practical superiority” is not sufficient.

Especially in contemporary quantum science, theory is even further ahead compared to practice, and without cutting-edge theoretical breakthroughs it is impossible to conduct experimental probes. Scientific experiments are the unity of theory and practice, both of which have a fundamental position. The hermeneutics of scientific experiments should be the unity of theoretical hermeneutics and practical hermeneutics. Theoretical hermeneutics of scientific experiments is mainly manifested as textual hermeneutics. The hermeneutic of scientific experiments is not only practical hermeneutics but also requires textual hermeneutics. The textuality of contemporary

scientific experiments is remarkable. For example, the tools and instruments involved in scientific experiments are technical texts, the experimental phenomena recorded during scientific experiments are scientific texts, and even the whole scientific laboratory can be used as a laboratory text in a broad sense, and the operational texts have been fixed when the experimental plan is made. The textual character of scientific experiments requires textual hermeneutics of scientific experiments, and textual hermeneutic involves the author and reader of scientific experimental texts, the nature of the text and the interpretive field of view, all three of which are highlighted in the process of scientific experimental practice.

AUTHOR AND READER OF SCIENTIFIC EXPERIMENTS

The experimenter is both the author and the reader. The author and the reader are two important factors in the hermeneutics of a text: the author forms the text and assigns meaning to it, and the reader understands and interprets a text. The text formed by the experimenter is restricted by the experimental objects and scientific theories. The experimental text should record the phenomena of the experimental objects as truthfully as possible. Generally, the author and the reader of a text are separated, and the reader's hermeneutics of the text requires the reader and the author to achieve a fusion of horizons in order to understand the author's original intention and the meaning of the text. The universality and objectivity of the text's meaning is ensured by achieving intersubjectivity between the author and the reader. Unlike ordinary texts, the author of a scientific experiment text is the experimenter, but there are two readers of an experimental text: the experimenter and other non-experimentalist readers (e.g., scientists, the public, etc.). The experimenter creates the scientific experiment and also needs to understand and interpret the scientific experiment as well as the results of the experiment, and the experimenter is both the author and the reader of the experimental text.

On the side of the author, the experimenter's intention, theoretical background, knowledge of the experimental object, knowledge of the experimental tool, and possible preconceptions of the experimental results constitute the construction of the scientific experiment. Among them, the experimenter's intention is given to the whole experiment in the form of meaning, which determines the object of the experiment, the design direction of the experiment and the control of the experimental process. The experimenter's theoretical background, knowledge of the experimental object and the experimental tools together constitute the theoretical content of the experimenter's pre-understanding, which determines the specific design of the experiment and the operational process. The experimenter's possible preconceptions about the results of the experiment determine the way in which the results are experienced and the way in which the experimenter processes the results. The experimenter is in the lifeworld, so the construction of the experiment is also in the lifeworld. The living world is the ontological foundation of Heelan's scientific hermeneutics, and the living world is actually the real world in which we live. It is the world in which people are actually given and which is experienced through perception.

On the side of the reader, the experimenter is the first and direct reader of the experimental text. The experimental text is constantly revealed to the experimenter. Therefore, what the experimenter explores in the process of reading the experimental text is the consistency of the meaning of the experimental text with the author's original intention. While the author's original intention is fixed and self-explanatory to the experimenter, for the general reader's hermeneutics of the experimental text its meaning is constantly constructed until the meaning of the experimental text agrees with the author's original intention to some extent or generates fundamental contradictions, and the reader obtains the final meaning of the text and also realizes the author's intention. Another important feature of the experimenter as a reader is that the fusion of the reader's and the author's horizons is no longer needed to establish a connection between the reader and the author, nor is it necessary to ensure the universality and objectivity of textual understanding through intersubjectivity. The reader only needs to fuse the horizon of the experimental text with the reader's former horizon of understanding to grasp the understanding and interpretation of the experimental text.

As the unity of the author and the reader, the construction of the experimental text and the hermeneutics of the experimental text are two aspects of the same practical process, which also determines that the experimental text is constantly yet-to-be-completed text.

The author's intention and the nature of the experimental object determine the meaning of the experiment. Hermeneutics seeks meaning and understanding. In scientific experiments, the meaning of the experiment is expressed in the experimenter's hermeneutics of certain scientific phenomena or instrument “readings,” which are determined by the experimenter's intended purpose and the nature of the experimental object itself.

The experimenter's intended purpose is the author's intent, which is “the intention to obtain something.” In scientific experiments, the author's intention is influenced by the author's theoretical background. The author's theoretical structure, the theoretical content that may be involved in the experiment, and the author's knowledge of the possible nature of the experimental object, constitute the author's theoretical background in the form of a pre-understanding which provides the theoretical basis for the author's intention. The author's intention is not entirely a subjective intention or want, but contains an intentional pointing, which is determined by the author's intentional structure. The coupling of intentional structure with the nature of things themselves produces an objective field of view that characterizes the real nature or real structure of things (Cao & Yan, 2011). The objective field of view in scientific experiments is the field of understanding the results of scientific experiments, which is constituted of the author's purpose and the nature of the experimental object. Take the famous delayed choice experiment as an example, the intention of the author of the delayed choice experiment is to test the particle and fluctuation of photons. The original scientific perception is that photons have both particle and fluctuation, physicist Wheeler designed the delayed choice experiment based on this. The author's intention and the nature of the experimental object determine the experimental operation and the hermeneutics of the experimental results, and thus the

meaning of the experiment. In a broader sense, the process of the author's intentional activity is the process of giving meaning to the experiment.

The nature of the experimental object composes part of the author's pre-understanding in the form of a theory, which in turn influences the author's intention. On the other hand, the nature of the experimental object has to be constantly revealed or tested in the experimental practice, which directly determines the appearance of the experimental results. In the actual experimental process, especially in some quantitative experiments, the experimental object itself will be disturbed by many factors, and thus the experimental results need to be screened. A typical example is the measurement of acceleration through the dot timer, when the car with a strip of paper to accelerate the form of motion, the strip of paper will appear a series of points, the distribution of these points have an approximate law, there are also individual points that do not conform to a certain law distribution, which is determined by the nature of the object, because the car in this experiment is idealized as a mass, while the actual car is not.

The nature of the experimental object does not determine the appearance of the experimental results alone, but is influenced by the author's intention and is related to the experimental means taken by the author. The author's intention is similarly influenced by the nature of the experimental object. Both are important components of the scientific experiment, and together they constitute and determine the meaning of the scientific experiment.

THE CHARACTERISTICS OF SCIENTIFIC EXPERIMENTAL TEXTS

Experimental texts are dualistic, meaning that they are both scientific and technical texts.

There are three types of scientific texts. (1) The text “written” in mathematical language, which is different from the pure mathematical text and still contains the description of natural language. (2) The description and description of the experiment and its object, which is an empirical description of observable phenomena. (3) The text in between, which is the first two types of texts logically connected to form a fully structured text. Most scientific texts are of the third type, that is, texts that consist of formal systems as well as empirical facts (Cao, 2005). Scientific experimental texts belong to this category. (1) The design of scientific experiments is guided by certain theories that contain formal systems and empirical facts, determine the construction of experiments, and presuppose the possible empirical facts and the related mathematical forms obtained. (2) Laboratory operations are similar to the hands-on state of tools that create a practical connection between the experimenter and the experimental object, and the laboratory is the place where empirical facts and formal systems are produced. (3) The experimental results are revealed mainly by instrument readings or instrument displays, which as a “symbol” can express mathematical forms as well as empirical phenomena. The scientific experimental text is a holistic hermeneutic text that includes the laboratory, the experimenter, the experimental object and the experimental results, and is a unity of formal system and empirical facts.

In contemporary quantum science, scientific experimental texts are not only scientific texts but also technical texts, which are reflected in two aspects. (1) Microscopic objects are to be revealed through technology. In laboratory research, the laboratory is considered as the place where the microcosm is constructed and the micro-objects are constructed and thus observed and known in the laboratory. Micro-objects are entered into the experimental practice as scientific texts, which are transformed into technical texts to the experimenter through the observation instruments. (2) The experimental results should be displayed with technical artifacts as the carrier. Scientific experiments are the process of observation, observation results are often displayed through instrument "readings," reading the results is similar to reading text, and the instrument is a typical technical artifact. Thus, the instrumental display should be the unity of the technical and the scientific text.

Scientific experimental text unifies scientific text and technical text, and both are unified in the process of experimental practice. To understand and explain scientific experiment, both texts and their characteristics must be understood and explained at the same time.

Experimental text is a text completed in practice. The general text, as an object of interpretation, has certainty. The content, structure and even meaning of the text are fixed by the author in the process of text construction. The reader reading the text to obtain the meaning of the text from the determined content as well as the structure, or to understand the original intention of the author. A scientific experimental text is a special kind of text. It is not fixed but to be completed and needs to be realized in practice.

Firstly, the experimental text is a holistic text with a certain structural level including the laboratory text, the text of the experimental object, the text of the experimental operation and the text of the experimental result. In experiments, the first thing that is formed and fixed is the object text. Once the object is determined, the object text is also determined. But when the object is quantum matter, the object text is formed in connection with the experimental operation. The experimental operation text includes instrumentation, i.e. technical artifact texts, and knowledge of instrumentation, i.e. technical knowledge texts (Wu & Liu, 2021). When the experimental instrument and experimental operation are determined, the experimental object is revealed, and the experimental operation text is fixed. The text of experimental results is the text of the experimental object revealed under the experimental operation, which is formed gradually as the experiment progresses. In addition, the experimenter's processing of the experimental result text, such as the formation of the experimental report or experimental paper, can also be included in the category of experimental tex. Actually, the laboratory text is a broader text, which includes the constructed laboratory as well as the text formed in the laboratory, and in a sense, the contemporary scientific experimental text can be directly understood as the laboratory text.

Secondly, the experiment is a practical process to be completed, so the experimental text is a text to be completed. The experimental object should be constantly revealed in the experimental operation, and thus the experimental text should also be formed in practice. The experimental operation acts directly on the experimental object, and the text of the experimental object is constantly formed and presented in the way the instrument

appears. The experimental result text is influenced by the experimental object as well as the experimental operation, and the experimental result text is both the text formed in practice and the result of practice. The laboratory, as the main place where the experiment takes place, is generally a place isolated from the environment, but the laboratory is a dynamic process of practice, the basic laboratory text is formed with the completion of the construction of the laboratory, and the complete laboratory text is constantly completed with the experiment. The whole laboratory text is a text to be completed. We can describe it figuratively as an object waiting to be made visible by experimental operations so that we can gain concrete knowledge about the object.

Finally, the duality of the experimental text is revealed in practice and unified in practice. The duality of experimental texts reveals that scientific experimentation is a process in which science and technology are united, and that the text of the experimental object, the text of the experimental operation, the text of the experimental result, and the text of the laboratory are both scientific and technical texts. Thus, scientific and technical texts are also texts formed in practice, and scientific practice reveals the duality of experimental texts. At the same time, the scientific and technical texts are linked by instrumental observations, and the instrumental observations in scientific experiments are not only loaded with theory, but also with technology, and the scientific and technical texts are unified in experimental practice.

CHARACTERISTICS OF THE TEXTUAL HERMENEUCTICS OF SCIENTIFIC EXPERIMENTS

Scientific experiments are the fusion of theoretical and practical horizons. The characteristics of scientific experimental texts reveal that scientific experiments are both the unity of science and technology, and the unity of theory and practice. Both the textual and practical hermeneutics of scientific experiments, and the scientific hermeneutics as well as the technical hermeneutics of scientific experiments, take place in a certain field of horizon. The understanding, interpretation, and application that hermeneutics seeks is achieved within a certain field of horizon and requires a fusion. In general, the fusion of horizons means the fusion of the reader's and the author's horizon. The hermeneutics of scientific experiments also requires the fusion of horizons, but in this case the fusion of horizons takes on a new character.

The theoretical horizon of scientific experiments includes the pre-understanding horizon of the experimenter, the theory of the experimental object, the theory of the experimental apparatus, and the theoretical horizon involved in the whole laboratory situation, etc. The latter theoretical horizon is implicitly included in the pre-understanding horizon of the experimenter in the process of scientific experiments. The practical horizon of science experiments refers to the entire laboratory construction and the experimental operation. Science experiments emphasize both theoretical guidance and practical operation, and both theory and practice run through the whole process of science experiments. Theoretical and practical horizons are inextricably linked with each other. Scientific experiments should first realize the fusion of theoretical and practical horizons. Only the fusion of theoretical and practical horizons, scientific experiments can be

implemented in accordance with the experimenter's intention, to achieve the experimenter's intention. The theoretical horizon of scientific experiments implies the universality of scientific experiments, and the practical horizon implies the locality of scientific experiments. The fusion of the two horizons shows the unity of the universal and local characteristics of scientific experiments.

The hermeneutics of scientific experiments is the unity of scientific hermeneutics and technical hermeneutics. Experimental text is a text done in the process of experimental practice, which is the unity of scientific text and technical text in practice. The horizon characteristics of scientific experimental text determines that scientific experiment needs both scientific hermeneutics and technical hermeneutics.

Scientific hermeneutics takes scientific text or natural text as the object, and is a hermeneutic reflection on natural science. Heelan (1997) builds the ontological foundation of scientific hermeneutics on the lifeworld, pointing out that “our task is to give modern science an ontological and epistemological foundation in the contemporary living world.” The lifeworld constitutes the context in which experiments are formed and interpreted. The lifeworld is first of all perceptual, that is, the lifeworld can be experienced by perception, and perception is practical, and thus the lifeworld is practical. According to this understanding, scientific experiments construct their objects through the experimenter's perceptual practices and establish empirical connections between the objects and the lifeworld, while giving meaning and purpose to the lifeworld.

From the perspective of scientific hermeneutics, the hermeneutics of scientific experiments also involves pre-understandings, scientific texts, the fusion of horizons, and the meaning and truth. However, it differs from general scientific interpretation in that: (1) The hermeneutics of scientific experiments involves a wider range of pre-understandings and horizons, including the different pre-understandings and different horizons of the experimenter as author and reader, as well as the pre-understandings and horizons of the general reader, who may also acquire new pre-understandings and horizons of understanding by conducting repeated experiments. (2) Experimental texts are not fixed texts in the same way as general scientific texts, but as texts generated in practice. According to Heelan (1989), experimental objects are prepared, formed, and revealed in the laboratory. This process is also the process of formation of experimental texts, and the hermeneutics of experimental texts should take into account both the hermeneutics of scientific texts that have already been formed and the hermeneutics of texts that are in the process of formation. (3) The problem of meaning and truth is an important topic in hermeneutics. The meaning of general scientific hermeneutics contains three elements: the scientific text as the carrier of meaning, the object to which the meaning refers, and the reader of the meaning (Cao, 2005). The meaning carrier and the object to which the meaning refers are the experiment itself, and the reader of the meaning is the experimenter himself in the first place, from which it can be inferred that the interpretative meaning of a scientific experiment is, to a certain extent, fixed, i.e., the intention of the experimenter. The truth in hermeneutics is a kind of practical truth, in the hermeneutics of scientific experiments this practical truth is expressed as the unity of scientific truth and technical truth. Among them, scientific truth is the conformity of empirical facts to nature in experiments, and technical truth is an indication of the validity

and reliability of the technical operation in an experiment that is consistent with the experimenter's purpose. Scientific hermeneutics is a dynamic practical process, especially the hermeneutics of scientific experiments, in which the reader, the hermeneutical text, the hermeneutics meaning and the hermeneutics truth are all constructed and formed in practice.

Technical hermeneutics takes technical texts as the object of study, and studies the understanding and interpretation of the meaning of technical texts. In scientific experiments, technical texts are mainly carried by instruments and their operation, and most of the existing technical hermeneutics studies are related to instruments. Don Ihde (1990) understands hermeneutics as "a particular kind of interpretive activity in a technical context. This activity requires a particular mode of behavior and perception that is similar to the process of reading." The direct perception obtained by the experimenter with the help of the apparatus is actually the text of the apparatus, and the meaning of this text can be known only with the help of hermeneutics. Thus, the technical text in scientific experiments is mainly carried by the apparatus and its operation. The experimental apparatus as a technical element constructs the connection between the experimenter and the experimental object, and at the same time establishes the connection between the experimenter and the world. Thus, there are three types of technical hermeneutic relations in scientific experiments as follows:

(1) Experimenter → (experimental apparatus – experimental object)

(2) The particular experimenter → (this laboratory – the living world)

(3) Reader → (experimental text – (experimenter – world))

Scientific experiments are both theoretically loaded and technically loaded, therefore, the hermeneutics of scientific experiments should have both scientific and technical hermeneutics. Scientific experiments exemplify both "theoretical superiority" and "practical superiority," therefore scientific experiments should have both textual and practical hermeneutics. Scientific experiments are a kind of scientific practice since both the formation of the experimental text and the hermeneutics of the experimental text are practices. Therefore, the hermeneutics of scientific experiments is the unity of scientific and technical hermeneutics, textual and practical hermeneutics in practice.

A BRIEF RESPONSE OF TEXTUAL HERMENEUTICS TO PRACTICAL HERMENEUTICS

The practical hermeneutics of scientific experiments reveals the local character of scientific experiments. The knowledge of locality in the philosophy of scientific practice is built on the local characteristics of scientific experiments. The key to understanding the concept of locality is to understand contextuality, and practice itself is characterized by contextuality. Different scientific experimental practices are based on different experimental contexts and thus have locality. Scientific experiments not only need practical hermeneutics, but also need textual hermeneutics. The textual hermeneutics of scientific experiments reveals that scientific experiments are the fusion of theoretical and practical horizons. The theoretical horizon is a universal horizon, while the practical horizon is a local horizon, thus scientific experiments are the fusion of universality and

locality, the unity of universal knowledge and local knowledge. The textual hermeneutics of scientific experiments does not agree that scientific knowledge is only local, but goes beyond local knowledge to seek universal knowledge.

The textual hermeneutics of scientific experiments shows that experiments have multiple lives of their own. The text of a scientific experiment is a text to be completed in practice, and each practice or each stage of practice gives a life to the scientific experiment. Whether it is an exploratory experiment ahead of the theory or a theory-oriented test experiment, once the experiment or even the laboratory is formed, it gains its own life as an independent body, the experiment has its own growth and development cycle, the development of the experiment is the extension of the experimental life, and the experimental practice is the process of dealing with the world. The textual hermeneutics of scientific experiments also shows that scientific experiments have a complex meaning structure, i.e., different experimenters and scientists will have different understandings, and the choice and support of scientific theories are not unique. The textual hermeneutics of scientific experiments provides additional interpretive vectors for the practical interpretation of scientific experiments.

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Research article

Understanding and Interpretations of Quantum Mechanics

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Abstract

Taking Heisenberg's and Schrödinger's theories of quantum mechanics as his case study, De Regt's contextual theory of understanding argues that recognizing qualitatively characteristic consequences of a theory T without performing exact calculations is a criterion for scientific understanding. From the perspective of this theory of understanding, the task of understanding quantum mechanics seems to have been achieved already or even finished. This appears to disagree with some physicists' attitude to the understanding of quantum mechanics in line with Richard Feynman's famous slogan that "I think I can safely say that nobody really understands quantum mechanics." Moreover, if the task of understanding of quantum mechanics has been finished already, there would be a conflict between the context theory of understanding of quantum mechanics and interpretations of quantum mechanics. This paper shows that de Regt's theory of scientific understanding and interpretations of quantum mechanics conflict either on scientific understanding or on the understanding of quantum mechanics. It explores various avenues for dissolving that tension but none appears plausible. One suggestion is that quantum mechanics is understandable but that it does not provide understanding of quantum phenomena. Equally problematic is the proposal that the notion of understanding has changed since the time of Heisenberg: Though he was equipped with the right theory, he did not understand quantum phenomena whereas today one does? The review of these and other options remains at a productive impasse.

Keywords: De Regt; Understanding; Explanation; Quantum Mechanics; Interpretations

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Научная статья

Понимание и интерпретации квантовой механики

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Аннотация

Взяв теории квантовой механики Гейзенберга и Шредингера в качестве кейса, контекстуальная теория понимания Де Регта утверждает, что признание качественно характерных следствий теории Т без выполнения точных вычислений является критерием научного понимания. С точки зрения этой теории понимания задача понимания квантовой механики кажется уже решенной или даже законченной. Это, кажется, не согласуется с отношением некоторых физиков к пониманию квантовой механики в соответствии со знаменитым лозунгом Ричарда Фейнмана: “Я думаю, что могу с уверенностью сказать, что никто на самом деле не понимает квантовую механику”. Более того, если бы задача понимания квантовой механики была уже решена, возник бы конфликт между теорией контекста понимания квантовой механики и интерпретациями квантовой механики. Эта статья показывает, что теория научного понимания де Регта и интерпретации квантовой механики противоречат либо научному пониманию, либо пониманию квантовой механики. В ней исследуются различные способы снятия этого противоречия, но ни один из них не кажется правдоподобным. Одно из предположений состоит в том, что квантовая механика понятна, но не дает понимания квантовых явлений. Столь же проблематичным является предположение о том, что понятие понимания изменилось со времен Гейзенберга: хотя он был вооружен правильной теорией, он не понимал квантовые явления, как сегодня понимают? Обзор этих и других вариантов остается в продуктивном тупике.

Ключевые слова: Де Регт; Понимание; Объяснение; Квантовая механика; Интерпретации

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INTRODUCTION

Philosophers posit various theories of scientific understanding. Some use case studies from the history of quantum mechanics to support their theories of scientific understanding (de Regt, 2017). Based on those case studies, they argue for certain criteria for the understanding of quantum mechanics and scientific understanding more generally. For them, there is a criterion for understanding of quantum mechanics, at least in certain contexts. Meanwhile, Richard Feynman's famous slogan "I think I can safely say that nobody really understands quantum mechanics" (Feynman, 1967, p. 129) won support among many physicists (e.g., Carroll, 2019). It appears that, for many physicists, they do not think they understand quantum mechanics, while for some philosophers, there are criteria for understanding quantum mechanics among physicists. This is weird. Why would philosophers think physicists understand quantum mechanics while many physicists say they do not?

Moreover, there are various interpretations of quantum mechanics since the birth of the theory, and still there is no agreement on which interpretation is the best for the understanding of quantum mechanics. If physicists have already reached agreements on the understanding of quantum mechanics, then what are efforts on interpretations of quantum mechanics for? If physicists, as Feynman's slogan indicates, have not achieved an understanding of quantum mechanics, then how could philosophers argue for a general theory of scientific understanding with case studies on the understanding of quantum mechanics from the history of quantum mechanics?

I will examine Henk de Regt's theory of scientific understanding and interpretations of quantum mechanics, and argue that the two conflict either on scientific understanding or on the understanding of quantum mechanics.

DE REGT'S CONTEXTUAL THEORY OF SCIENTIFIC UNDERSTANDING

In his monograph *Understanding Scientific Understanding* (2017), Henk de Regt argues for a contextual theory of scientific understanding. According to the theory, "A phenomenon P is understood scientifically if and only if there is an explanation of P that is based on an intelligible theory T and conforms to the basic epistemic values of empirical adequacy and internal consistency" (de Regt, 2017, p. 92). The notion of intelligibility here is a rephrasing of the pragmatic understanding of a theory by de Regt. If scientists understand a theory, de Regt would say that the theory is intelligible to them (de Regt, 2017, p. 40). "A scientific theory T (in one or more of its representations) is intelligible for scientists (in context C) if they can recognize qualitatively characteristic consequences of T without performing exact calculations" (de Regt, 2017, p. 102). The criterion means that intelligibility or unintelligibility is not an intrinsic feature of theories, but is a context-dependent value.

To argue for the contextual theory of scientific understanding, de Regt distinguishes three levels of scientific activity: the macro-level which is practiced by all scientists, the meso-level which is practiced by scientists from different communities, and the micro-

level which is practiced by individual scientists. With this distinction de Regt thinks that, although aims on the macro-level are agreed on by all scientists, they could be articulated in different ways on the meso- or micro-level. For example, on the macro-level, all scientists will agree that they aim to produce knowledge that is supported by experience, but on the meso- or micro-level scientists from different communities and sometimes even scientists within a same community might have disagreements on how and how strongly scientific knowledge has to be supported by experience (de Regt, 2017, p. 90).

Following the distinction, de Regt argues that although achieving understanding is among the general (macro-level) aims of science, scientists in different historical periods or in different communities (on the meso- or micro-level) have quite different views about how precisely scientific understanding is to be achieved (de Regt, 2017, pp. 90-91).

De Regt supported this context-dependent view of scientific understanding with case studies. One of his major case studies is the investigation of the debates among physicists in the 1920s on the intelligibility of two rival quantum theories, Heisenberg's matrix mechanics and Schrödinger's wave mechanics.

Heisenberg's theory was a highly abstract theory based on matrix theory that most physicists were unfamiliar with in the 1920s. It was intended to describe only relations between observable quantities, such as the frequencies and intensities of spectral lines emitted by atoms, and did not provide a visualizable model of the internal structure of atoms. In contrast to Heisenberg's theory, Schrödinger's wave mechanics was based on wave equations which were more familiar to physicists than matrix theory in the 1920s. It described the atom in terms of wave phenomena and suggested the possibility of visualizing atomic structure.

Supporters of the two theories debated which theory was superior. Schrödinger brought the notions of understanding and intelligibility to the debates and claimed that his wave mechanics was much better in providing a true understanding of quantum phenomena. De Regt thinks that Schrödinger argued for a position that only theories that are visualizable in space and time are intelligible and can give us the understanding of phenomena. And he believes that Schrödinger expressed a strong commitment to the view that visualization is a necessary condition for scientific understanding (de Regt, 2017, p. 4).

However, Heisenberg thought that what Schrödinger said about the intelligibility of wave mechanics scarcely makes any sense (de Regt, 2017, p. 243). Wolfgang Pauli argued further that although matrix mechanics appears less intelligible than wave mechanics, understanding it was just a question of becoming familiar with the new conceptual system of the matrix mechanics. Pauli believed that once physicists get familiar with the matrix theory, Heisenberg's matrix mechanics will also be intelligible (de Regt, 2017, pp. 243-244). Heisenberg later adopted Pauli's views on intelligibility and claimed that "We believe to understand [*anschaulich zu verstehen*] a physical theory when we can think through qualitatively its experimental consequences in all simple cases and when we have checked that the application of the theory never contains inner contradictions" (Heisenberg, 1927, p. 172).

Although there were disagreements between supporters of the two theories, the competition ultimately led to their synthesis. Schrödinger's hope for a visualizable

interpretation of quantum mechanics was not fulfilled for technical reasons and Heisenberg abandoned his radically abstract approach and reintroduced visualizable notions. The quantum mechanics that is accepted and taught today is a combination of matrix and wave mechanics（de Regt, 2017, section 7.3).

De Regt thinks that this debate in the history of quantum mechanics shows that standards of intelligibility and understanding may vary and change. He acknowledges that the debates inspire him to develop his contextual theory of scientific understanding（de Regt, 2017, p. 245).

Anyhow, from the perspective of the relationship between understanding and knowledge, it is not knowledge but intelligibility conceived as an ability that leads to understanding in de Regt's contextual theory of understanding. In other words, de Regt believes that the truth of a theory is not what leads to understanding.

FEYNMAN'S SLOGAN AND DE REGT'S INTERPRETATION OF IT

Debates on the understanding of quantum mechanics played an essential role in the development of de Regt's theory. According to him, there was a criterion for the understanding of quantum mechanics, a synthesis of Schrödinger's and Heisenberg's criteria, after the matrix/wave-mechanics debates. Although the criterion is contextual, it indicates nevertheless that at least after the matrix/wave-mechanics debates physicists thought they understand quantum mechanics in some sense.

However, in 1967, Richard Feynman (1967) said "I think I can safely say that nobody really understands quantum mechanics" (p. 129). This famous slogan was often quoted by physicists after Feynman and still wins support among many physicists (Baggott, 2020; Carroll, 2019; Charap and Dombey, 2021). Feynman's slogan was echoed by many later physicists and appears to contradict de Regt's finding that there was a criterion for the understanding of quantum mechanics at a certain historical period: If physicists agreed on the synthesized criterion for the understanding of quantum mechanics after the matrix/wave-mechanics debates, why would Feynman and many physicists claim that nobody understands quantum mechanics decades later? Did physicists change their criterion for the understanding of quantum mechanics in Feynman's time and quantum mechanics fails to satisfy the new criterion? Or are there developments in quantum mechanics that changed quantum mechanics such that the developed version of quantum mechanics no longer satisfies the criterion that emerged after the matrix/wave-mechanics debates?

Before considering these possibilities, it is necessary to show de Regt's response to Feynman's slogan:

> "... of course, he [Feynman] did not mean that nobody–not even experts in the field–understands the theory itself (like first-year physics students who do not understand quantum mechanics and hence fail their exam on the subject). Rather, he plausibly meant that even those who are familiar with the theory have trouble in seeing how one can understand the world if quantum mechanics is true." (de Regt, 2017, p. 45)

As we have stated at the beginning of the first section, according to de Regt to say that one understands a theory is to say the theory is intelligible to people. A theory is intelligible to certain groups of people at certain periods if those people know how to use the theory and more specifically know how to "recognize qualitatively characteristic consequences of T without performing exact calculations." Therefore, if de Regt believes that Feynman refers not to the understanding of quantum theory, then what "nobody" understands should concern quantum phenomena. Moreover, de Regt interprets the notion that nobody understands quantum phenomena as people having „trouble in seeing how one can understand the world if quantum mechanics is true."

De Regt did not explain why people would have trouble in understanding the world if quantum mechanics is true. However, he quotes another line from Feynman in the Introduction of his book:

> Even the experts do not understand it the way they would like to, and it is perfectly reasonable that they should not, because all of direct, human experience and of human intuition applies to large objects. (Feynman et al., 1965/2015, p. 1–1)

A possible interpretation is that people have trouble understanding the world if quantum mechanics is true because people usually understand the world by direct human experience which applies to macro-objects, and the world understood by direct human experience contradicts what quantum mechanics says about the world. Anyway, Feynman's "nobody understands quantum mechanics" is interpreted by de Regt as nobody understands quantum phenomena.

THE UNDERSTANDING OF QUANTUM PHENOMENA

If „nobody understands quantum mechanics" means that nobody understands quantum phenomena, then what does understanding a quantum phenomenon mean? De Regt's criterion for the understanding of a phenomenon is "A phenomenon P is understood scientifically if and only if there is an explanation of P that is based on an intelligible theory T and conforms to the basic epistemic values of empirical adequacy and internal consistency." Therefore, a quantum phenomenon P is scientifically understood if and only if there is an explanation of P that is based on an intelligible quantum mechanics theory T and conforms to the basic epistemic values of empirical adequacy and internal consistency.

From the discussion of the matrix/wave-mechanics debates we learn that Schrödinger believed, and Heisenberg and Pauli admitted, that wave mechanics is intelligible. Also, the debates led to an intelligible quantum mechanics theory which is a synthesis of matrix and wave mechanics. Therefore, the condition of"an intelligible quantum mechanics theory T"as the criterion for the understanding of a quantum phenomenon P is satisfied. The condition "conforms to the basic epistemic values of empirical adequacy and internal consistency" since the criterion would not pose a problem for both matrix and wave mechanics which are both empirically adequate and internally consistent. Therefore, to say a quantum phenomenon P is understood, one just

needs to satisfy the condition that "there is an explanation of [the quantum phenomenon] P"which is based on an intelligible quantum theory.

What does it mean to be an explanation? There are debates about it. Here we do not need to examine various theories of scientific explanation in the philosophy of science. The way how de Regt understands or uses the notion of explanation in his contextual theory of scientific understanding is most relevant to our discussions here.

"An explanation is an attempt to answer the question of why a particular phenomenon occurs or a situation obtains, that is, an attempt to provide understanding of the phenomenon or the situation by presenting a systematic line of reasoning that connects it with other accepted items of knowledge (e.g., theories, background knowledge)" (de Regt, 2017, pp. 24-25). Explanation also requires a pragmatic skill or ability to construct deductive arguments from the available knowledge to answer the question of why a particular phenomenon occurs or a situation obtains (de Regt, 2017, pp. 24-25).

Therefore, to say that one has or gives an explanation of a quantum phenomenon P means that one has the skill or ability to construct deductive arguments from the available knowledge that answer why the quantum phenomenon P occurs. "The available knowledge" for the construction of an understandable explanation includes an intelligible theory since the criterion for understanding is that "there is an explanation of P that is based on an intelligible theory T."

> "...the fact that the theory of matrix mechanics appeared unintelligible to many physicists hampered the construction of explanations to understand phenomena by means of this theory. Not only Schrödinger and most mainstream physicists, but even Bohr, Heisenberg, and Pauli had difficulties using matrix theory to explain and understand. By contrast, the more intelligible theory of wave mechanics yielded explanatory understanding of a wide variety of phenomena in a relatively straightforward manner. (Because of its initial unintelligibility – and the fact that it remains a counterintuitive theory that is difficult to master many physicists adopted the positivist idea that quantum mechanics can furnish only description and prediction but no understanding of phenomena. This is a mistake, however.)" (de Regt, 2017, pp. 91-92)

It is easy to see from the above quotation that de Regt thinks that, with intelligible wave mechanics physicists are already able to yield explanations of various quantum phenomena and obtain explanatory understandings of a wide variety of quantum phenomena. Moreover, de Regt claims that it is a mistake to think quantum mechanics cannot provide an understanding of quantum phenomena although quantum mechanics remains a counterintuitive theory.

What we obtain from the above discussion would lead to two possible consequences. First, if physicists are already able to yield explanations of quantum phenomena with an intelligible wave mechanics (as well as the quantum mechanics taught today that incorporates the intelligibility of Schrödinger's wave mechanics) and if they thus obtain understanding of quantum phenomena, then there is no further need to understand quantum phenomena. Also, de Regt's interpretation of Feynman's slogan of "nobody understands quantum mechanics" stated that people understand quantum

mechanics theory. Now it would seem that people understand both quantum mechanics theory and quantum phenomenon. If both of them are understood, then what are the various interpretations of quantum mechanics (Copenhagen interpretation, many-worlds interpretation, etc.) about?

Second, if we agree with de Regt's interpretation that Feynman meant that nobody understands quantum phenomena when he said that nobody understands quantum mechanics, then the apparent contradiction between de Regt's study of the matrix/wave-mechanics debate and Feynman's slogan would be rephrased as: If physicists understand quantum phenomena based on an agreed synthesized criterion for the understanding of quantum phenomena after the matrix/wave-mechanics debates, why would Feynman and many physicists claim that nobody understands quantum phenomena decades later?

Is it because, with the developments of quantum mechanics in recent decades, people only now understand quantum mechanics? No! It is absurd to say that quantum mechanics is now understood whereas it was not 50 years ago. The conceptual framework of quantum physics remains as it was. Most applications of quantum mechanics (nuclear plants, medical scans, lasers, etc.) were understood 50 years ago.

Is it, finally, because a new or re-interpretation of the theory of understanding, such as de Regt's contextual theory of understanding, allows people to think that they understand quantum mechanics? If this were so, why are there still physicists who agree with Feynman that nobody understands quantum mechanics? Maybe it is because some physicists haven't got to know these new theories of understanding that were developed by philosophers. Anyhow, if we say that a new or re-interpretation of the theory of understanding makes quantum mechanics understandable, then, again, what are interpretations of quantum mechanics for?

CONCLUSION

When people talk about understanding quantum mechanics, it is important to first know which aspects of quantum mechanics need to be understood. If we accept de Regt's contextual theory of scientific understanding, it seems that the task of understanding quantum mechanics has already been achieved or even finished as both quantum mechanics theory and quantum phenomena do not require to be further understood. If this is so, interpretations of quantum mechanics as one of the central issues in the philosophy of physics might be doomed to be meaningless.

There were complaints that quantum mechanics needs no interpretations (de Ronde, 2020; Fuchs & Peres, 2000). I'm not saying that I agree with this position, but I think there might be conflicts between de Regt's contextual theory of scientific understanding and the various efforts regarding interpretations of quantum mechanics.

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Research article

Unfolding Actor-Network Theory: What Bruno Latour's Notion of Folded Space Could Learn From Origami

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Abstract

A skilled Origami folder can create sophisticated three-dimensional figures from a simple square of paper. Regardless of its complexity, a folded figure can be transformed into its original form: Once it is unfolded, a network of creases appears, representing the two-dimensional blueprint of the figure. The fascinating geometry of paper folding has not only attracted the attention of scholarly fields like robotics or microengineering – it also has deep roots in a contemporary debate on Actor-Network Theory (ANT) and digital connectivity. Here, the metaphor of the fold is used to analyze the hidden connections between seemingly distinguishable phenomena. When folding is performed, flat network structures collapse into envelopes that are smaller in size yet more complex in terms of the number of enveloped nodes. Interestingly, there's no connection between the metaphorical conceptualization of the fold and the actual process of folding paper. This article draws on the formal language developed by Origami science to enrich further the understanding of folding in ANT. In addition, I will show how Latour's idea of topographic relations can be better understood by folding actual paper prototypes that can be pushed and pulled to comprehend how the action is distributed through a network of creases.

Keywords: Actor-Network Theory; Folding; Algorithms; Origami

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Научная статья

Развитие акторно-сетевой теории: чему концепция свернутого пространства Бруно Латура может научиться у оригами

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Аннотация
Опытный оригами-специалист может создать сложные трехмерные фигуры из простого квадрата бумаги. Независимо от ее сложности, сложенную фигуру можно преобразовать в ее первоначальную форму: как только она развернута, появляется сеть складок, представляющая двухмерный план фигуры. Увлекательная геометрия складывания бумаги не только привлекла внимание таких научных областей, как робототехника или микроинженерия, но и имеет глубокие корни в современных дебатах по теории акторно-сетевых связей (ANT) и цифровой связи. Здесь метафора складки используется для анализа скрытых связей между, казалось бы, различимыми явлениями. При свертывании плоские сетевые структуры схлопываются в оболочки, которые меньше по размеру, но более сложны с точки зрения количества окутанных узлов. Интересно, что нет никакой связи между метафорическим представлением о сгибе и реальным процессом складывания бумаги. Эта статья опирается на формальный язык, разработанный наукой оригами, чтобы еще больше обогатить понимание складывания в ANT. Кроме того, я покажу, как можно лучше понять латуровскую идею топографических отношений, складывая настоящие бумажные прототипы, которые можно двигать в разные стороны, чтобы понять, как действие распределяется по сети складок.

Ключевые слова: Акторно-сетевая теория; Складывание; Алгоритмы; Оригами

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INTRODUCTION

Origami is the art of creating two or three-dimensional figures from a single square of uncut paper. Models of breathtaking complexity can emerge from simple bases in a structured process of combining specific folding operations. However, the end product remains fully reversible and can be unfolded to the original square sheet. This makes paper folding an extraordinary work process in which the original blueprint and the final form can seamlessly be translated into each other. While the underlying crease pattern remains the same, every folding step alters the relation between points and edges, resulting in a myriad of possible topologies. In Origami, simplicity and complexity are profoundly connected, and seemingly distinguishable points are embedded in an opaque network of creases.

The fascinating geometry of paper folding has not only attracted the attention of scholarly fields like robotics or microengineering as well as theoretical research in mathematics or physics. It also has deep roots in a contemporary debate on Actor-Network Theory (ANT) and digital connectivity that draws on the notion of the fold to conceptualize (algorithmic) complexity. Although Bruno Latour uses this metaphor rather casually, folding is crucial to understanding ANT's paradigm of translating socio-technical complexity into flat networks (and *vice versa*). In this regard, I will draw on Latour's earlier works on ANT (Latour, 2012; Serres & Latour, 1995) and some of his later considerations on Gabriel Tarde's monadology (Latour, 2011; Latour et al., 2012). Both threads have been reflected in recent discussions from science and technology studies (Lee et al., 2019; Napolitano & Grieco, 2021; Rieder, 2020, p. 319) and explorative data analysis (Brüggemann et al., 2020; Dörk et al., 2014; Latour, 2013b). It is primarily through his engagement in Big Data-driven social research (Latour, 2013b, p. 201; Latour et al., 2012) that Latour develops a specific reading of the fold as a possibility of bridging the gap between different ranges of empirical research. However, although he is excited about the possibilities of a "continuous sociology" (Venturini et al., 2017, p. 2) propelled by Big-Data analysis, Latour is relatively lenient in conceptualizing his notion of the fold as well as the question of how networks are folded and unfolded.[1] As mentioned in another context (Couldry, 2008, p. 100), Latour's understanding of networks is relatively static and ignores both the dynamics of network expansion as well as the social reason for their existence (Kneer, 2009, p. 27; Latour, 2012, p. 137). This leaves interesting questions unanswered: How can we describe the topological complexity of folded spaces and the nature of different folding operations, as proposed by Lee et al. (2019)? What is the specific quality of a node in the network (Moats & Borra, 2018), and how can we understand its connection within the figuration of other points? And finally, what terminology could be used when describing folding processes and their impact on networks?[2]

[1] For the use of metaphors in Latour's work, see (Otto, 2016; Turner, 2015). I will follow Turner in understanding Latour's notion of the network (and thus also of the fold) as an "observer's tool" and not a "deeper component of reality" although Latour has claimed both positions (Turner, 2015, p. 124).
[2] For a first attempt see Lee et al. (2019).

This paper aims to further enrich and clarify the notion of the fold by referring to the art (and science) of paper folding. In the last decades, Origami has been propelled by an increasing interest from scholars of different fields of applied sciences and the emerging possibilities of computational development, which has led to folding to super-complex prototypes from scratch (Lang, 2015). However, there is no connection between the metaphorical conceptualization of the fold and the actual folding process. As I am going to show in this paper, the notion of the fold in ANT and Monadology can profit in several ways from Origami science: First, with a well-established formal language for describing an expanding variety of folding maneuvers, Origami offers a valuable analytical perspective to describe the multifold complexity of networks. As we will see, established folding operations like combination folds or sinks and un-sinks can be applied to describing algorithmic folding processes. Second, I will argue that some aspects regarding the actual nature of folding paper go beyond a metaphorical description of digital networks. By folding, we can store information on a piece of paper (Chen & Mahadevan, 2019) to encode the desired geometric figurations. As I will show by drawing on Origami theory, a pattern of carefully prepared creases might almost automatically translate into a complex three-dimensional shape. This makes Origami a pre-digital 'software without hardware'" (Huzita, 1992 as cited in Ida, 2020) or – to be more precise –something that is both program *and* output. Finally, I will outline how some more abstract notions of folded space in ANT can be better grasped by folding actual paper prototypes that can be pushed and pulled to understand how the action is distributed through a network of creases.[3]

Before I give a brief overview of Latour's more recent work on folding in light of his engagement with the work of French sociologist Gabriel Tarde, I draw on ANT's concept of folded space that is rooted in Latour's claim to *keep the social flat* (Latour, 2012, p. 165). I will argue that complexity in ANT always comes in the form of a multifold reality. In the following, I will introduce Origami as a framework to conceptualize the notion of the fold further. Folding will be presented as *a structured process of assigning information to creases, resulting in envelopes that are smaller in size yet more complex folded structures*. I will finish by discussing the idea of unfolding ANT by creating folded paper models.

ACTOR-NETWORKS AS FOLDED SPACES

The philosophical notion of the fold has deep roots in western philosophy and can be traced back to Leibniz's concept of the monad (Deleuze, 2017) as a Baroque concept of spatial complexity. As Friedman (2020) argues, these early ideas of folded space stem from the study of folded drapery in Baroque paintings: Whereas the visible parts of the curtain form singular, independent entities, they are all connected through the same fabric. The resulting space is an appealing surface enveloping complexity: "a Baroquian resistance to a well-defined mathematized space of the Renaissance perspective" (Friedman, 2020, p. 13). In Leibniz's Monadology, the metaphor of the fold makes it

[3] It is noteworthy that Latour (2010b) himself has used art to explore the characteristics of networks.

possible to harmonize the supposed paradoxical relation between separation and unity (Cuntz, 2022, p. 161; de Freitas, 2016).

Although the concept of Monadology enters Latour's work relatively late through his engagement with the French Sociologist Gabriel Tarde (Latour, 2002a, 2010; Latour et al., 2012), it is fair to say that the idea of folded space is already a fundamental concept of his earlier work on ANT. As in Monadology, complexity in ANT always comes in the form of folded time and space – and Latour has spent most of his scientific career unfolding socio-spatial "envelopes" to reveal the hidden networks (Latour et al., 2012, p. 591). Under his hands, a simple lock unfolds into a strange contraption hosting a mechanical algorithm (Latour, 1991), a square of Amazonas soil is folded into a global chain of lab experiments (Latour, 1999, p. 38), a hammer envelops a "garland of time" that has the "antiquity of the planet" (Latour, 2002b, p. 249), a command room unfolds to a communicative infrastructure connected to the soldiers at the front (Latour, 2012, p. 182), and the name of a person unfolds to a wide-reaching network of associations (Latour et al., 2012).

Among others, Lee et al. (2019) pointed out that the notion of the fold enters Latour's metaphorical toolset through the backdoor of his conversations with French philosopher Michel Serres:

> MS: (…) If you take a handkerchief and spread it out in order to iron it, you can see in it certain fixed distances and proximities. If you sketch a circle in one area, you can mark out nearby points and measure far-off distances. Then take the same handkerchief and crumple it, by putting it in your pocket. Two distant points suddenly are close, even superimposed. (Serres & Latour, 1995, p. 60)

It should be added, though, that Latour adopts this argumentation most prominently in his introduction to ANT (2012):

> It's as if the maps handed down to us by the tradition had been crumpled into a useless bundle and we have to retrieve them from the wastebasket. Through a series of careful restorations, we have to flatten them out on a table with the back of our hand until they become legible and usable again. (Latour, 2012, p. 172)

In the light of this "topographic metaphor" (Latour, 2012, p. 172), Latour further unfolds one of ANT's core ideas, namely that actor-networks work only in two dimensions. According to Latour, networks are widely ramified, flat structures that distribute action among different kinds of actors (and actants). However, just like protein chains fold into complex three-dimensional conformations, actor-networks tend to produce hierarchies, stratifications, organizations, etc., that could suddenly "pop out" of the flat surface (Latour, 2012, p. 174).

The conceptional restriction to what Latour would later call a "one-level standpoint" has far-reaching consequences (Latour et al., 2012, p. 591). Firstly, it implies a specific methodology: To see properly, ANTs' analytical gaze requires a flat world. Whenever the researcher tackles social complexity, her subject should be flattened,

stretched, and unfolded until the underlying two-dimensional topology becomes visible (Latour, 2012, p. 172). To borrow a metaphor from optical physics: A fast lens with an open aperture collects much light but has a shallow depth of field, so the focused objects have to be on the same plane to be rendered sharply. In his ANT textbook, Latour develops methodological key questions that could be used as "clamps" hindering the object from popping out of the focusing field:

> Whenever anyone speaks of a 'system', a 'global feature', a 'structure', a 'society', an 'empire', a 'world economy', an 'organization', the first ANT reflex should be to ask: 'In which building? In which bureau? Through which corridor is it accessible? Which colleagues has it been read to? How has it been compiled?' (Latour, 2012, p. 183)

Once the 'social maps' are unfolded and kept flat, the ANT-researcher could follow the pleats (Latour, 2012, p. 174) to measure the real distances and estimate the actual "transaction costs" of social operations (Latour, 2012, p. 180).

Second, it is worth noting that the analytical ideal of a flat network stands in stark contrast to the everyday perspective in which networks are usually folded into black boxes: the intrinsic logic of technology is covered behind its functioning (Halfmann, 1996, as cited in Häußling, 2010, p. 182). In other words, functionality in ANT comes at a price. Beyond the interface, the everyday user will soon get lost in a complex structure. Here lies an essential accent in Latour's understanding of a social situation that never fully reveals itself to the agents in the absence of the knowledge, the tools, and time that would be needed to get an idea of "what is it that is going on here?" (Goffman, 1986)[4]

One may add that this applies only to working technology. Once the lock is jammed, the hammer is broken, or the screen is frozen, a black box must be opened, and parts of the enclosed network must be unfolded to find the cause of the malfunctioning. In his notes on the relationship between objects and networks, John Law (1992) describes how a closed unity could turn into a vast network "of electronic components and human interventions" (p. 384). To explain how order can emerge from networks, Law introduces the notion of the "resource" that he describes as a "network package", allowing the user to draw "quickly on the networks of the social without having to deal with endless complexity" (Law, 1992, p. 385). The process of "punctualization" – the term could be replaced by *black-boxing* or *enveloping* – thus explains how disparate entities become more or less stable objects that could be further addressed. It is interesting to note the similarities to Latour's notion of the monad, as mentioned above: How can an expanding network be narrowed down to a particular instance? (Latour et al., 2012, p. 593) "The answer is that if a network acts as a single block, then it disappears, to be replaced by the action itself and the seemingly simple author of that action" (Law, 1992, p. 385).

[4] The connection between Goffman and Latour seems far-fetched. However, like Latour, Goffman (1986) understands a social situation as coined by forces that are outside the actual 'frame.' This includes people as well as technical artifacts. In contrast to Latour, Goffman's situation has an empirical core, a primary frame, that might be socially addressed while the nodes of an ANT spread far beyond the boundaries of what could possibly be grasped within a situation. For a more detailed analysis of Latour's ambivalent relationship to social constructivism, see (Gertenbach & Laux, 2019, p. 53).

Following Law, one could assume that networks must be folded to become socially handled – or, more precisely, that "social structure is not a noun but a verb" (p. 386). However, this is not a bug but a feature: Folding translates complex structures into unities available for social interaction.

Third, the procedure of folding implies both space *and* time. In his thoughts on technology and morality, Latour (2002b) further draws on Serres' idea of folded time and develops a procedural reading of actor-networks, which – over time – are becoming more and more powerful through folding. This implies a fascinating research perspective: In the light of ANT, one can assess the power of simple tools by tracing their successful translations through the history of technology: By using a hammer, the "clumsy Sunday bricoleur" (Latour, 2002b, p. 249) becomes immersed in the process of technical innovation that ranges back to the first hand axe, providing him with the cumulated knowledge of hammer engineering. By using a multi-fold technology, he becomes, in other words, an actor-network. Contrary to the notion of a tool as a mere extension of a natural organ,[5] for Latour, every technical object opens a world of possibilities:

> One can easily understand the anthropoid monkey in Stanley Kubrick's film 2001, stupefied and surprised when faced with the world opened up by a jawbone held like a hammer – and as a club handy for killing. If, in a famous swirling movement, he flings it so high and far that it becomes the space station of the future, it is because all technologies incite around them that whirlwind of new worlds. (Latour, 2002b, p. 250)

DIGITAL NETWORKS AND MONADOLOGY

As mentioned above, ANT conceptualizes time and space as a flat network, whereas – in its natural form – social reality mostly comes in three-dimensional arrangements. As I will further discuss below, both the folded envelope and the unfolded network can be understood as two different modes of the same instance. Before I come to that, I will discuss a second aspect in Latour's conceptualization of the fold that stems from his more recent engagement with the complex yet somewhat quirky work of French sociologist Gabriel Tarde (1843–1904) and his alternative take on social theory. In a series of papers (Latour, 2002a, 2010; Latour et al., 2012),[6] Latour not only adopts Tarde as his theoretical 'ant-cestor' but also proposes his idea of Monadology as a theoretical stance to conceptualizing and analyzing digital social networks. Like Latour, Tarde rejects the idea that to observe the social, one has to choose between different sociological ranges – on the contrary, both assume a continuum between the specific and the general and the micro and the macro (Latour, 2012, p. 14). Accordingly, the sociologist should take a "one-level standpoint" (1-LS) that rejects the notion of a stratified social reality with distinguishable actors: what appeared to be clear distinctions between actors and

[5] See, among others, Popitz (2015).

[6] One should also add that Latour offers Tarde a prominent section in the first chapter to his Introduction to ANT (Latour, 2012, p. 14).

organizations, micro and macro level, etc. will appear as different sections of the same Actor-Network as it is unfolded (Latour et al., 2012, p. 591).

Against this background, it becomes clear why Latour hails Tarde as his ancestor (Latour, 2002a, p. 224). Through Tarde, ANTs contested notion of the social as a relational force circulating in a network was legitimized long before its invention (Latour, 2012, p. 108). It is interesting to note that Latour gives his engagement with Tarde a new spin when he claims that the paradigm of relational sociology could be empirically operationalized through network analysis and big data information mining. As co-founder of *Science Po Médialab*, a think tank dedicated to "research the role of digital technology in our societies" established in 2009,[7] Latour created a testing ground for some of the ANTs most daring hypotheses. Thus, the conceptual idea to bridge the "blind spot" between quantitative and qualitative data (Venturini et al., 2017, p. 4) through a "continuous sociology" (p. 1) is heavily fueled by both, Tarde's monadology as well as the technical possibilities of shifting seamlessly through big data sets.

His "digital test of Gabriel Tarde's monads" (Latour et al., 2012), co-authored by physicians and data engineers, argues that by browsing through the dataset without ever leaving the level of perspective, Tarde's notion of the monad comes to life:

> This new experience of moving easily through profiles already makes clear that what is meant by 2-LS and 1-LS social theories does not refer to different domains of reality but to different ways of navigating through data sets. (Latour et al., 2012, p. 593)

The authors illustrate this idea by a simple search query that starts with a person's name and adds further information to this entity by browsing node to node through the person's network. With more nodes becoming actively associated with the person, and more attributes being added to its entity, the network expands to eventually – and here Latour draws a surprising conclusion – *collapse into a single point:*

> What has happened? In effect, we have drawn a monad, that is, a highly specific point of view – this or that entity – on all the other entities present in the dataset. (Latour et al., 2012, p. 599)

It is important to note that contrary to its original understanding, the monad, according to Latour et al., is a temporary unit – an "envelope" that could be unfolded or expanded anytime (Latour et al., 2012, p. 599). Latour's theoretical approach is thus founded on the digital tools used for its exemplification: It could be conceptualized as a set of attributes, a click path, a search query, etc., creating a data array that is a temporary instance of the entire data frame. This subset is well-defined but remains open: it can be stored, expanded, or dissolved without changing the relation between the selected nodes and their whole.

Due to their dynamic character, understanding monads cannot be achieved with fixed attributions but through an exploratory process of data navigation. Against this background, the notion of the monad provides a conceptual counterbalance to ANT's

[7] https://medialab.sciencespo.fr/en/about/

tendency to dissolve the contours of a feasible research framework as it provides a temporal boundary for the researcher's empirical scope. In the closing plenary at the Conference on Human Factors in Computing Systems (CHI) in Paris (2013b), Latour formulates four challenges to the community of data engineers and programmers and calls for the development of new tools propelling monadology (Brüggemann et al., 2020; Dörk et al., 2014). His closing statement can also be read as a new sociological program: "The future belongs to those who are able to navigate through overlapping monads" (Latour, 2013b).

FOLDED PAPER

As discussed above, Latour's concept of space draws intensively on the metaphor of the fold. I have highlighted two threads in his work, indicating that complexity in ANT always comes multifold: If the "whole is smaller than its parts" (Latour et al., 2012), it has to be larger regarding the number of enveloped folds. Before I examine this concept critically, I will elaborate on the notion of the fold against the background of paper folding. I argue that Origami offers a sophisticated understanding of folding operations defined by a highly-developed formal language that could propel the understanding of monads as folded structures.

Origami is the art of creating figures from a single square of uncut paper. According to Hull, the Japanese word for *fold* also translates to *god* or *deity*, indicating Origami's deep roots in the Shinto religion, where folded paper symbolizes the souls of the dead (Hull, 2016). The philosophical nexus between square and form, simplicity and complexity, or matter and life, has further implications regarding the shared knowledge of folding paper since every form – regardless of its complexity – carries its blueprint and can be transformed into the original crease pattern. I will come back to this aspect below.

The last 50 years have seen both a dramatic rise in the complexity of Origami and an increasing interest from scholars in different fields. Besides researching the mathematical foundations of paper folding (Lang, 2012), the principles of Origami could be applied in fields like (nano-)engineering (Bircan et al., 2020; Ishida & Hagiwara, 2016; Peraza Hernandez et al., 2019) or robotics (Howell et al., 2016). Origami artists like Robert J. Lang, a renowned physicist, pioneered the potential of computational Origami by creating the first algorithm that could turn a simple drawing into a foldable crease pattern (Lang, 2015), opening room for models of unseen super-complexity. However, as mentioned above, one could also take the opposite perspective and consider the algorithmic potential of Origami as "software having no hardware at all" (Huzita, 1992 as cited in Ida, 2020). Through the operation of folding, different geometries can be 'programmed' into the 'memory' of a blank piece of paper (Chen & Mahadevan, 2019; Hawkes et al., 2010; Stern et al., 2017), with every crease assigning a new bit of information to the code. It is interesting to note that although a skilled folder performs a great variety of folding operations, only two different types of folds can be assigned to a crease: Mountain folds, with the ridge of the paper pointing upwards, and valley folds pointing downwards. This binary information allows innumerable combination folds and,

more importantly, creates a crease pattern that carries the entire program code of the resulting figure.

What happens exactly when a piece of paper is folded? (1) The operation of folding creates a crease that cannot be erased from the paper´s memory; (2) the crease is assigned with a single bit of information[8] – the "fold direction" (Lang, 2012, p. 23) – forcing the section to form a mountain or a valley; (3) the flattened paper is smaller yet more complex as it envelops a folded section and (4) its geometry has changed: By folding a square in half, its two distant sites align. Whereas the distance of two given points on the paper's surface remains the same, their *topological* relation is reconfigured, resulting in new adjacencies. Folding paper means operating a "universal geometric machine" (Ida, 2020, p. 8) that creates a new topology with every turn. When we open the folded section, we can observe several things: (5) The envelope unfolds to a form that will not lie flat (with the near side of the paper pointing upwards) and could (6) be further flattened into the original state – the crease pattern. This trinity is probably the most wondrous magic of paper folding and is repeated over and over when folding: A pattern of creases can be carefully turned into a three-dimensional form that could then be collapsed into a flat envelope. We might see an eight-legged tarantula, a samurai helmet beetle, or a koi with a complex pattern of fish scales[9] – all these figures can be unfolded to their original crease pattern. *Envelope, form, and crease pattern are three different modes of the same instance and can be translated more or less seamlessly into each other (see fig. 1).*

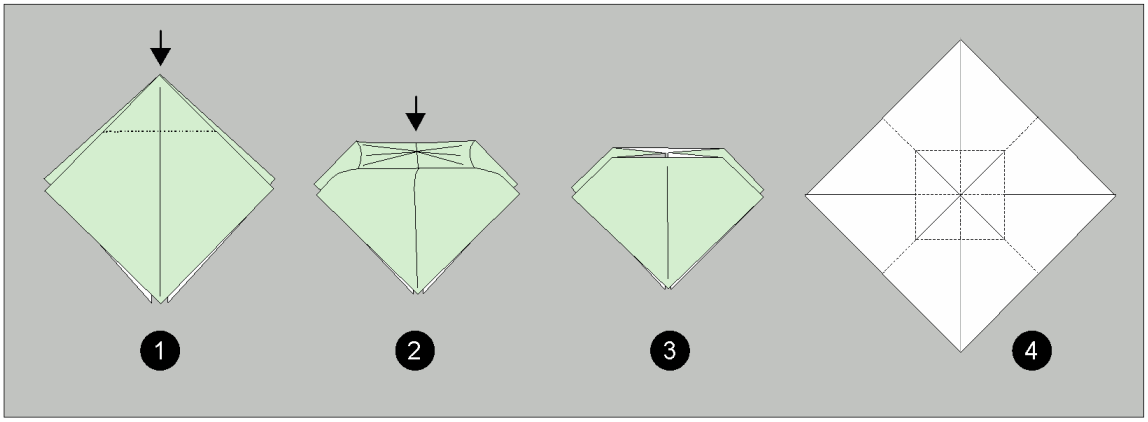

Figure 1. Open unsink (following Lang, 2012, p. 34). A preliminary base is pre-folded (1) and partly opened to a three-dimensional form (2). The top is then sunk into the envelope, and the model lies flat again (3). (4) shows the crease pattern of the opened model.

Following the notion of paper as programmable matter, one might consider the pattern of folds as the program creating a two- or three-dimensional form. Experienced

[8] To be more precise, a crease is formed by an array of points that have a binary information. Like this, creases with different lengths are possible.

[9] These examples are taken from Robert J. Lang's portfolio and can be found online on langorigami.com.

folders could read this 'source code' to estimate the resulting form or even fold a model without further instructions from its annotated crease pattern (Fig 1, left) (Lang, 2012, p. 681). [10] However, the usual procedure for many figures – as well as the key to the enduring popularity of folding paper – is to follow step-by-step instructions translating the code 'line by line' into more complex forms. To create a complex figure like a spider[11] the paper has to be folded into an envelope with at least ten points (eight legs, head, and abdomen), the excess paper has then to be 'sunk' into the model without 'locking' the flaps of the extremities resulting in a slimmer base that could then be further shaped into a realistic model. To create the desired number of separate points or flaps without cutting the paper, modern paper folding could draw on a variety of complex folding operations that build upon each other: *combination folds* to invert the direction of a point, *open sinks* to hide excess paper while keeping the flaps 'open,' *unsinks* to reveal hidden layers of paper, etc. To be consistent with our analogy, these operations can be considered functions carrying a more or less complex sequence of folds that must be performed in a specific order to create the desired effect on the paper.[12] In most cases, every function creates new possibilities as it 'unlocks' new sections of loose paper that could then be further pre-creased and collapsed. The folder navigates through this process by creating envelopes offering the desired functions.

Accordingly, the crease pattern could be read like a map allowing the folder to navigate different topologies. In a crease pattern like Lang's famous Tarantula Opus 406 (fig. 2, left), every circle represents a flap, whereas the size of the circle corresponds to the length of the flap (Lang, 2012, p. 299). The indicated creases (dashed for mountain-fold, solid for valley folds) are performed successively through folding operations that 'activate' a specific area of the crease pattern, resulting in the desired envelope. Once a section is pre-creased, the paper translates into the form that was 'programmed' into the matter of the paper. For complex operations, parts of the envelope have to be opened entirely – a nerve-wracking procedure for Origami novices – and carefully collapsed into nested envelopes hidden insight the model. However, if pre-creased correctly, the extent paper turns effortlessly into a perfect pyramid or a pattern of triangles, which is then sunk into the model.

Many modern models come from a grid of hexagons, squares, or triangles that are pre-folded to be collapsed into a complex base.[13] An interesting example is the simple triangle grid that could be used to create several tessellations. Like a formatted hard drive, papers pre-creased to 16 or 32-pleat division grids can store granular information of different spatial states and the resulting topologies. Once a specific state has been folded

[10] As Lang emphasizes, the crease pattern is even more important than sequential folding instructions that exist only for a fracture of possible designs (Lang, 2012, p. 680)

[11] The challenge of designing more realistic insects peaked in the so-called 'bug wars' in the 1990's. https://langorigami.com/article/design-challenge-at-origamiusa/

[12] A single step described with ‚Open sink in and out' could easily take 20 minutes to perform.

[13] The process of bringing together a large number of creases at once is called 'collapse'. Robert Lang demonstrates this process of with a more complex version of the original cicada design: See https://youtu.be/MDwPXRy9IFc?t=710

from this pattern, the unfolded paper ‘remembers’ the activated creases so the programmed envelope can be easily restored from the paper’s memory (see fig. 2).

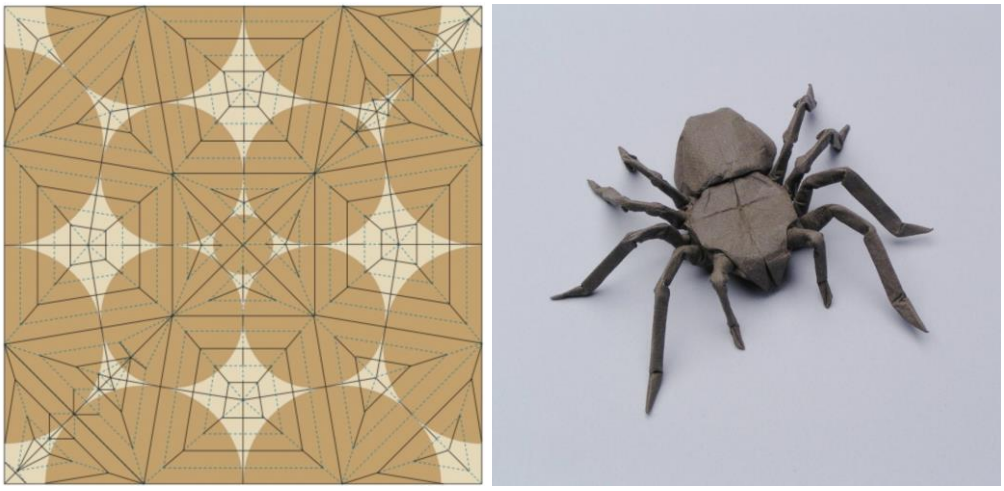

Figure 2: Origami Tarantula Opus 406 by Robert J. Lang and its crease pattern. The circles represent the separated flaps to form eight legs, pedipalps, mouthparts, body, and abdomen. [Retrieved from https://langOrigami.com/artwork/tarantula-opus-406-3/, reproduced with the kind permission of the artist].

PAPER PROTOTYPES

It should have become clear that Origami offers a consistent model to describe the process of folding and its outcomes. So far, this potential has been ignored in the discourse on ANT and Latour’s later works on Tarde’s monadology (Latour, 2010; Latour et al., 2012). This might be because Latour’s methodological approach of deconstructing socio-technical phenomena[14] is more interested in the process of ‘un-folding’ than in folding operations. However, as I will try to show in the following, the process of folding complex structures into envelopes that are “smaller than its parts” (Latour et al., 2012, p. 20) could be described as a systematic operation that fuels both our understanding of ANT as well as the analysis of folded (digital) artifacts.

As mentioned above, Latour's notion of the fold is only very loosely oriented to the Baroque metaphor of the monad as developed by Leibniz and Deleuze but draws more strongly on Michel Serres‘ topological conception of time and space (Serres & Latour, 1995) and Tarde’s approach to monadology (Latour, 2002a). Yet it should be mentioned that the idea of distinct elements being folded parts of a universal entity (Deleuze, 2017, p. 17) perfectly reflects in the Origami philosophy of creating complexity while preserving the uncut elementary form:[15]

[14] See Couldry (2006), who has pointed out that ANTs reflex to deconstruct (sociological) knowledge is indeed a healthy way of avoiding the “implicit functionalism” of social theory building (p. 103)

[15] Hull indicates that the Japanese word *kami* translates into ‘fold’ as well as into ‘god’ why folded paper is used as a symbol for the spirits of deceased relatives in the Shinto religions (Hull, 2016, p. 3457).

> Distinctness is no longer that which separates and cuts off one individual or object from another but refers rather to a particular fold or twist in the undulating fabric of the universe. Processes of individuation, by which identities and subjects and institutions come into being, are not acts of disconnection or separation, whereby the one is cut off from the rest, but are continuous topological folds of the whole. (de Freitas, 2016, p. 225)

Latour, however, is more interested in the relational topology created when structures are folded. Using ANT as a toolset to dissolve institutional formations and following the "liaisons between humans and nonhumans" (Latour, 2013a, p. 62) means opening envelopes to reveal the underlying geometry, enabling the researcher "to measure the real distance every social connection has to overcome to generate some sort of tracing. What was hopelessly crinkled must now be fully deployed" (Latour, 2012, p. 172).

The concept of folded space can be further clarified against the background of the above analysis of folded paper. As argued above, envelope, form, and crease pattern are three modes of the same instance. From an Origami standpoint, opening the figure to see the underlying network of creases is a valid strategy of reverse engineering – ANTs geometrical twin-sister, if you will. On the other hand, folded envelopes host complex sections of the paper, providing the necessary "resources" for the folding process. However, all states remain "precarious" (Law, 1992, p. 385): the unit may unfold into a disparate set of creases or re-produce structures that have been flattened and reappear as if " Merlin's castle pops up out of the lake" (Latour, 2012, p. 174).

As a temporary unit hosting a folded section of the network, the notion of the envelope helps to mitigate a problem often addressed in ANT and post-Ant discourse: ANTs' "interest to include *everything*" (Gad & Bruun Jensen, 2010, p. 74). Following Latour et al. (2012), we can understand the monad as a singular active section of a network reflecting the whole entity (p. 599). As discussed, Latour draws on big data analysis tools to develop an empirical perspective focused on moving from monad to monad rather than drawing information from well-defined samples, clusters, or aggregates. In other words, by focusing on the temporary instance of the monad, the ANT researcher can be greedy and humble at the same time, exploring the data by dynamically folding and unfolding nodes. This idea can be seen, for example, in the form of exploratory data analysis associated with monadology:

> Designing visualizations along the fold means to understand information spaces as elastic, coherent, and potentially infinite systems. Instead of focusing on static snapshots of visualizations, which would favor their visual encoding, the fold sheds more light on the "in-between" states of folding processes, emphasizing the transitions between visualization states as meaningful views that need to be considered throughout the entire design process. (Brüggemann et al., 2020, p. 7)

However, this explorative endeavor does not come without limitations: As Moats and Borra (2018) have pointed out, Latour is not interested in the "numerical properties of networks, as computational social network analysts would, to make statistical claims

about the centrality of particular nodes" (p. 3). As discussed above, a paper-folded crease carries information about the fold direction, and a network of 'assigned' creases translates to the folded form like a protein chain would self-fold into its three-dimensional structure. On the contrary, the folds in ANT seem to be neutral and static. In their network analysis of a Twitter dataset, Moats & Borra (2018) have shown that nodes and connections could possess a variety of 'charges,' as some entries were more or less randomly generated by automated scripts while others followed a specific communication strategy (p. 12). The same can be said about digital maps that are not always characterized by level structures: On the contrary, they form "uneven geographies" of knowledge (Graham & Zook, 2013) and are biased by socioeconomic conditions (Fry et al., 2020), which may lead to all sorts of distortions (Pranz, 2021).

As argued above, the concept of folding sheds light on translating a network section into a more complex but opaque technical artifact. In the last step, I would like to elaborate on this idea by drawing on recent work by Lee et al. (2019) who apply the metaphor of the fold to illustrate the complexity of datafication. They argue that instead of thinking of "objects, relations, and concepts as stable entities with fixed distances and properties, we might attend to how different topologies produce different nearnesses and rifts" (Lee et al., 2019, p. 3). To explore the relational dynamics in networks, they propose three different folding procedures. "Approximation" (Lee et al., 2019, p. 3) addresses the ability to map distances based on topological relations emerging from statistic assumptions. The resulting artifacts could be read like a map, yet they envelop a hidden complexity that has to be unfolded by tracing the implemented relations and underlying assumptions. As a complementary operation, "universalisation" inductively draws assumptions from specific cases that are algorithmically "transformed into apparent universals" (p. 6). Finally, "normalization" (p. 6) addresses the complex approach to creating a statistical 'normal' that could then be used to measure deviations. Following Lee et al. (2019), the methodological key point of understanding algorithms as folded structures is to render visible the hidden translations that underly seemingly intuitive visualizations. To exemplify the mentioned modes of operation, the authors draw on the mapping of diseases like the AIDS space by geographer Peter Gould (1993; Lee et al., 2019), translating the pace of the pandemic distribution of the Aids virus to a generated map. In the resulting topology, cities that might be geographically distanced become adjacent (Lee et al., 2019, p. 4).

Against the backdrop of the above discussion, and by drawing on the formal operations of folding, several specifications can be made in this regard. First of all, Origami provides simplification. Albeit maps like the AIDS space might be easy to read at first glance, they require a data-literate viewer to be fully understood. Thus, a possible analysis step is to translate the metaphor of folded space into a foldable model – a physical 'paper prototype' that can be further scrutinized.[16] The exemplary model in fig. 3 might only be a rough adoption of the concept of proximation. However, it illustrates some of the critical points of Lee et al.'s analysis: Projecting epidemiological data to a map alters

[16] The term is borrowed from web development, where paper prototypes are used as a first step in planning websites.

the topographical relations between points. At the same time, the geographical distances between cities remain the same. The distances between 1, 2, and 3 are bridged by folding the prototype, and the excess paper is stored in an envelope that could be re-opened. Both dimensions remain intact, while the resulting topology is entirely reversible to its raw form (Latour et al., 2012, p. 593). The open form (fig. 3, right side) shows the underlying network of creases that could be traced to measure the "real distance" between the points (p. 172).

It is interesting to see what happens with the model when it is unfolded: by stretching it carefully, one can see how the network changes its form while all the folded sections remain connected – this interconnection can be felt when handling the paper. In this process, a hidden part of the envelope rotates 60° counterclockwise before the enclosed section is unlocked and pops out of the rear part of the model. Although we cannot see what Gould's algorithm *did* to the map, the prototype shows how the network changes its configuration by adding data. In addition, we can see and feel the traces of this operation. As discussed above, folding means assigning information to creases – once a paper is folded, the resulting envelope is stored in the paper's memory. In the unfolded crease pattern (Fig, 1, right side), we can outline a three-dimensional form in the network of creases: a triangle shaped by a pattern of mountains and valleys. These are both a reminder that "folding is not an innocent operation" (Lee et al., 2019, p. 9) and an illustration that complex three-dimensional patterns can emerge from a network of pre-folded creases. Following Latour's (2012) metaphorical reading of the fold (p. 175), we can assume that the folded space will not lie flat – it is characterized by artifacts, distortions, and slopes that carry a memory of the performed translations.

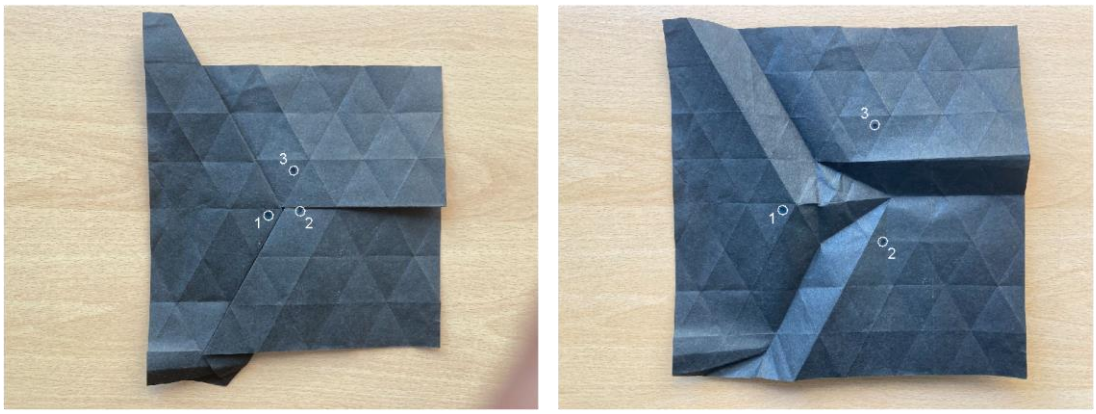

Figure 3. The process of "approximation" (Lee et al., 2019, p. 3) displayed with a paper prototype folded from a hexagon grid. Note how points 1 – 3 change position when the paper is unfolded, and the hidden center of the paper appears.

CONCLUSION

This paper reviews the notion of the fold as a metaphor against the background of paper folding. As discussed, Latour develops his understanding of the fold mainly along two lines of argument. The concept of space as a folded topology enters his work likely

through the conversations with Michel Serres (Serres & Latour, 1995) and is fully expanded in Latour's (2012) ANT textbook, where he unfolds a methodological program dedicated to 'keeping the social flat.' The second line of reasoning can be found in Latour's reading of Gabriel Tarde's Sociology, where he connects ANT's one-level standpoint with the philosophical notion of the monad – a temporary unit enveloping a folded network. In summary, one can say that technology, according to ANT, is always multifold. Latour invested part of his scientific endeavor in 'unfolding' envelopes to see the underlying networks.

By drawing on Origami, folding was introduced as *a structured process of assigning information to creases.* Following ANT's understanding of folded structures, complexity in paper folding is achieved by collapsing networks in envelopes. A finished model can always be reverse-engineered to its blueprint. Once unfolded, the crease pattern 'remembers' the three-dimensional structure stored in the folding directions of the creases. I argued that the trinity of *crease pattern – form – envelope* sheds further light on Latour's assumption that social complexity emerges from level network structures. In addition, ANT scholars who focus more intensively on adding points, folds, and sections to the network could draw on Origami procedures for a richer understanding. From this angle, different stages of translation can be integrated into the analysis: for the researcher, this means that his/her analysis might encompass an ethnomethodological study of algorithms in practice with a more technology-focused strategy (Lee & Björklund Larsen, 2019) without leaving the one-level-Standpoint (Latour et al., 2012).

For exemplification, I draw on Lee et al. (2019), who introduced specific algorithmic folding operations that could be further examined when physically folded from paper. The resulting paper prototype provides a conceptual and sensual understanding of how a network is translated into a topology – and vice versa. Here is one of the most valuable assets of the folding metaphor: While recent works on digitization drew on a variety of analogies, e.g., information layers (Manovich, 2006, p. 220), spatial distortions (Pranz, 2021), or data shadows (Graham & Zook, 2013), the fold projects an understanding of algorithms that remains open for reverse-engineering (Lee & Björklund Larsen, 2019, p. 2). According to ANT, technical artifacts cannot be dismantled to the core like the layers of an onion. On the contrary, when a black box is opened, its content unfolds into a vast network, and what appeared as an arrangement of individual parts is now connected by the fine lines of a crease pattern.

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Research article

Gaming Slang: The Influence of Video Games on the Russian Language

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Abstract
Computer games are of vast importance. They are both a part of a modern human life and an extensive source of linguistic production. What the article analyzes is specifically the formation of gaming community slang. The aim of the research is a comprehensive study of the origin and formation of new words used by people in the gaming field. Particular attention is paid to the specific aspects of linguistic production in the Russian speaking gaming community. In the context of this work, the data was collected on players' online communication platforms and via interviews with experienced gamers. Altogether 2340 slang words were analyzed. The goal was to trace the origin of new words in the Russian-speaking gaming environment. Given that English is the predominant language in gaming communities, some of the words got into Russian slang via transcription or transliteration. However, borrowing is just one out of many ways of word formation. Another significant phenomenon is the "interlingual homonymy" of words from different languages. The traditional way of forming words according to existing models (lexical derivation) occurs in the game world according to an affixal model (in the form of abbreviation or truncation). Often gaming slang is formed by transferring the name to a new object – i.e. semantic derivation, which can be built on the basis of a metaphor, a joke, or by transferring a proper name into a common noun. The most popular way is the metaphorical transfer of meaning by way of similarity with a game object. However, there are more complex options related to the semantic associations among gaming terms.

Keywords: Gaming slang, Computer games, Gamers, Lexical derivation, Semantic derivation

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Научная статья

Игровой сленг: влияние видеоигр на русский язык

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Аннотация
Компьютерные игры не только являются значительной сферой жизни современного человека, но и активным источником словотворчества. В данной статье рассматривается такое явление как сленг компьютерных игр. Целью работы является всестороннее изучение происхождения и образования новых слов, которые используются людьми в игровой сфере. Особое внимание уделено специфическим аспектам словообразования, присущим представителям русскоязычных игровых серверов. В ходе работы над статьей было проанализировано 2340 сленговых слов, собранных на интернет-площадках общения игроков и благодаря интервью с опытными игроками. В результате было выявлены базовые способов происхождения новых слов в русскоязычной игровой среде. Английский язык играют важную роль в игровых сообществах, поэтому часть слов попадет в русский игровой сленг благодаря транскрипции или транслитерации. Однако часто происходит не простое заимствования, а творческого переосмысления слов в виде, например, “межязыковая омонимия”, слов из нескольких частей, заимствованных из разных языков. Традиционный способ формирования слов по существующим моделям (лексическая деривация) происходит в игровом мире по аффиксальной модели или словосложением (в виде аббревиации или усечения). Часто в играх сленг формируется посредством переноса наименования на новый предмет – семантическая деривация, которая может строится на сновании метафоры, иронии, перехода от имени собственного к имени нарицательному. Наиболее популярным способом метафорического перенесение значений является использование сходства по внешнему подобию игровых объектов, однако существуют и более сложные варианты, связанные с семантическими ассоциациями исходных слов.

Ключевые слова: Игровой сленг, Компьютерные игры, Геймеры, Лексическая деривация, Семантическая деривация

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INTRODUCTION

Video games, gamification and gaming culture overall have spread around the world and have been impacting the lives of many. Some use video games as entertainment, others have made it their occupation (Ensslin & Balteiro, 2019). Nowadays, gaming is heavily criticized, discussed and examined by journalists and scientists alike (Ensslin, 2012). As a result, the topic of "gaming slang" has become widespread (Afzali, & Zahiri, 2021).

It is known that any communication between gamers occurs not only by way of common language but specifically via game slang. This is a conventional language with which players of various games share information. It allows gamers to quickly communicate during the game, as well as talk to each other in vocal and textual chat, inside or outside the specific game interface.

We can trace the emergence of gaming slang to the first publication of the role-playing game (RPG) *Dungeons & Dragons* in 1974. Certainly, even if it was not a digital game, the kind of language that developed around it constitutes one of the earliest and perhaps the most influential sources that would shape the formation of specific gaming slang. The game requires varying numbers of physical players, from 2 and up, and involves long sessions and extensive use of rule manuals. The need to speed up individual interactions and the reference to a technical language specific to the game generated, likewise, the need for fast and precise slang to make communication smooth and unambiguous.

Gradually, gaming slang became more and more popular and eventually turned into a versatile means of communication among gamers from all over the globe. For example, in any game where you control a single entity, it is normal to refer to it as a "character." This reference is most likely borrowed from the technical language of *Dungeons & Dragons*, the core of which is precisely the interpretation of a fictional character modeled by the player. Even if some words and expressions are universal for all games and seem generally understood by all the gamers, for people outside the gaming community this slang may be completely incomprehensible. For example, the expression "kachat persa" "качать перса" will likely be understood by a non-gamer as "to muscle up the Persian" or even "swing the Persian," where it actually means "прокачивать ("prokachivat") навыки персонажа" (personage) – "to improve the character's skills."

LITERATURE REVIEW

Digital technologies largely determine the development of modern society, including language changes. New phenomena require new concepts that did not exist before. Barseghyan (2013) notes that with the existence of computer- or internet-based communication systems and the readiness of people to meet the new demands of a more technological world, they will continue to modify their language to adapt to the new dimension of communication. Slang is one of the vehicles through which languages change and become renewed, and its vigor and color enrich daily speech. The speech of

people is filled with new words and expressions which are not found in standard language but which are formed in different ways to form modern slang (Alimemaj, 2012).

Tyurina (2005) believes that computer slang is a complex linguistic phenomenon that allows one to observe in English- and Russian-speaking countries the interaction of different layers of vocabulary, language groups, and word formation processes on a phonetic, morphological and semantic level, as well as the use of professional and common vocabulary.

Gaming slang is one of the largest and most interesting families of digital slang. With the growing popularity of online games and e-sports, the language used by gamers is becoming a relevant subject of research. According to Astrid Ensslin (2012), when we talk about the language of video games, we can mean different layers of linguistic reality. There is a language about games and gaming that is used by gamers, industry professionals, and journalists, which is not exactly the same as the one used by politicians, parents, activists and other media stakeholders. Another is then the language used within games themselves, as part of user interfaces, scripted dialogues, instructions and backstories, and language used in manuals, blurbs, advertising and other 'peri-texts' (Ensslin, 2012, p. 6). In this study, we are interested in what Ensslin (2012) calls "ludo logical jargon, gamer slang (or ludolect)" (p. 9). This refers to the specific features of the language used by players when communicating within the game: words are often abbreviated, and short phrases are often turned into acronyms, much like in other contexts of discourse outside gaming (Grange & Bloom, 2007).

The specificity of the gaming slang of non-English-speaking countries is its dependence on the English language. Despite the presence of localizations,[1] English is the main language for the gaming environment. Ryu (2013) even states that players often "played games to learn English or they learned English to play games" (p. 292).

Thus, in the Russian-speaking environment of gamers, the language is defined both by 1) the general development of trends associated with the use of abbreviations and acronyms which is common in the widespread of any technical language, and 2) the phenomenon of adapting technical terms from English without translating them properly. Merkulova (2015) argues that the slang of Russian-speaking gamers is a mixture of English words and abbreviations (so-called "digispeak," i.e. digital language) which are sometimes written in Cyrillic to compress information at the lexical level. Volosnova (2010) notes that one of the most common ways of slang formation in Russian is the reduction (abbreviation) of a term, otherwise perceived as too long or too difficult to pronounce in its entirety. Krylova (2011) notes that the addition of Russian affixes to the borrowed root has the result of "russifying" the neologisms. On the other hand, Sklyar (2019) points out the popularity of calquing (borrowing the whole word) in gamer slang, with subsequent assimilation.

As remarked by Ageeva & Dementyev (2021), due to the relative novelty, dynamism and variability of gamer slang it is quite a challenging field for systemic study

[1] Localization sometimes involves imperfect translations. Gonzales (2019) notes that Japanese, English and Spanish versions of the RPG series *Final Fantasy* have little in common and just share the core concepts when it comes to translating the names of the characters' skills and abilities (p. 82).

and categorization, as the general criteria of engagement have not yet been determined. Despite the fact that over the past ten years many articles have been written about gaming slang, none of them appears to be based on a large sample and none claims a general classification of terms, providing only examples for consideration.

METHODS

The methods for obtaining empirical material involved the study of various sources of information (mostly from the Internet), the analysis of the received information, as well as interviewing and polling. During the research, 2340 words were collected from various sources such as game forums and platforms, sites and groups in social networks created to post information on games such as *Counter Strike*, *DOTA 2*, *Genshin Impact etc*. In addition, interviews with players were conducted in which they shared their personal experiences and clarified the meaning of slang expressions.

ORIGIN OF NEW WORDS IN COMPUTER GAMES

Origin from the English language

As we mentioned, English is undoubtedly the most important language for the entire digital world. As a shared, common language it provides opportunities to facilitate cross-cultural communication among people (Lifintsev & Wellbrock, 2019). Many gamers from non-English speaking countries play video games in English, and the international servers where gamers from all other the world communicate with each other are in English as well. Moreover, a staggering number of interactions and phenomena that are common in the gaming world lack a matching word or designation in other languages. Thus, in the sphere of computer games there is a tremendous number of borrowings, some of which are universal for different games and in some cases even transfer from gamer-specific slang to the vocabulary of everyday life.

Words in gaming slang appear in a multitude of ways. The first and most common one consists in borrowing from the original language of the game. Those borrowings can happen in a multitude of different ways. The most prevalent are transcription and transliteration.

Transcription is a rewriting of the original word that aims to give as accurate a record as possible of all the subtleties of the pronunciation of a language, regardless of its graphic and spelling norms, because what is important here is to preserve the original sound (Zherebilo, 2010, p. 418). A good example is the transcription of the word "headshot" from English to Russian, in which "headshot" (/ˈhɛdʃɒt/) becames "хедшот" (х'этш`от).

Transliteration is the transfer of the letters of one language through the letters of another, ignoring the phonetic component (Zherebilo 2010, p. 418). For example, the transliteration from English to Russian of the word "damage" into "дамаг." The latter is a letter-by-letter translation, that completely ignores the pronunciation. As a result, instead of |ˈdæmɪdʒ| the word is pronounced |ˈdʌmɑːg|.

In addition to such direct borrowing, the creative rethinking of a foreign word in the environment of the Russian language is also frequent. Often an English word takes on a form corresponding to the rules of Russian word formation. For example, in the formation of Russian verbs from English words prefixes, suffixes and endings are added: the word "boost," which means climb up a hill in the game *PlayerUnknown's Battlegrounds* (PUBG), is translated "забуститься" (zaboostit'sya). The word keeps the root word "-boost" ("-буст"), however adds the Russian prefix "за-" ("za-"), the ending and the suffix "-иться" ("-it'sya"). Following the same principle, English words can take the form of an adjective in the Russian language with the help of appropriate suffixes and endings. For example, the phrase "rare item" is translated as "рарный айтем" via adding the suffix and ending "-ный" ("-nyi").

There are also some instances of so-called "interlingual homonymy" (full or partial) where the sound of a foreign word in Russian evokes new associations. Quite often, long foreign words or words with complex pronunciation are not only simplified or shortened in the Russian language, but also phonetically reduced. For example, "сало" ("salo") is a "debuff," that is, an effect that weakens a character or prevents it from performing certain actions, preventing the player or enemy from casting spells or use other techniques which in gaming slang is expressed by saying that the character is now made "silent." The word was transliterated as "сайлент" ("silent") and shortened to "сало" ("salo"). Another example regards the very name of a game, *Lineage 2*, that is difficult to pronounce for a Russian speaker. As a result, its generally accepted name has become "линейка" ("lineyka") which means "a ruler." In the game *World of Tanks*, the German model RHM-Borsig Waffenträger ("armored personnel carrier") is simply called "борщ" ("borsh", as the Russian dish).

Associations can also arise when adding affixes, for example, diminutive suffixes, as in the case of the word "милишка" ("milishka," from "melee weapon"). It is formed via adding the suffix "-шк" ("-shk") and is associated with the word "милашка" ("milashka") which means "cutie" ("colloquial").

But the process of word formation can also develop in a more complicated way from the original term. For example, the term "в соляного" ("v solyanogo" which literally translates "in a salty one") is derived from the word "solo," signifying a prestigious victory achieved without the help of other players. Even though the word "solo" is present in the Russian language ("соло"), it was transformed into a derivation of "salt," and it became an adjective and acquired a preposition.

There is also the case where some words are formed from two roots, one of which is Russian and the other is foreign. For example, "самореп" ("self-report") is a term that indicates a specific situation in the game *Among Us* when a character, acting as an undercover traitor, announces the discovery of a corpse to avert suspicion. It comes from the Russian root word "-само" ("self") and the English "-report" ("-реп").

Lexical derivation

Another notable way in which words emerge in game slang is called derivation. The very term "derivation" (from the Latin verb *dērīvo,* which original meaning is "to lead" or "to deviate") means the formation of a word in a language according to existing

models with the help of affixation, alternation of sounds, compounding contraction, development of new meanings, as well as other means (Zherebilo, 2010, p. 88). In Russian language, there are several models of lexical derivation, but in the context of slang in computer games only two are used.

The first is the affix model of word formation, which can be classified into: 1) words formed only from prefixes, 2) words formed using the suffixes, and 3) words formed from a combination of prefix and suffix (Zemskaya, 2011, p. 25). For example, the slang words "Achivka" (an achievement or bonus that helps the players) and "Fleshka" (a grenade that blinds enemies) were both formed by adding the suffix "– k." In "Donater" (a player who buys items in the game using real world currency) – the suffix "– er" was added. In the word "Guslya" (a tank harp) were added the suffix "– i" as well as the ending "– ть," which results in the word "Guslit" which indicates the action of trying to knock out a tank. And then the prefix "za –" was added and the expression thus became "Zaguslit," to knock down the "gusly," i.e. the tank. A similar example is provided by the word "Prokachka" (the training of a character, which occurs in building up new skills and qualities), that was formed as a result of the addition of the prefix "– pro" and the suffix "– k" to the verb "kachat'."

The second model of lexical derivation is compounding. The most common types of this model in game slang are abbreviation and truncation.

Abbreviation is the addition of abbreviated elements of words integrated into one combination. There are several structural varieties of abbreviation: 1) sound – a combination of the initial sounds of abbreviated words, 2) alphabetic abbreviation – an association of initial letters, 3) syllabic abbreviation and etc. (Zherebilo, 2010, p. 20). Here are some examples: "AVG" is the abbreviation of "average" which is not only a shortening but usually has further meaning, indicating the average number of points scored by the player in the last set of games. Similarly, "AFK" is an acronym that stands for "Away From Keyboard" and is usually used as a warning that the player in the chat is going to leave the game station for a brief time.

Truncation is an affixless word-formation method based on the reduction of the generative stem (according to the type of abbreviation) without taking into account the morphemic seam (Zherebilo, 2010, p. 425). Gamers use this technique to speed up their speech or to make chat correspondence shorter. Words such as "Akk" (that stands for "account") and "Molik" (Molotov Cocktail) are good examples of truncation.

Semantic derivation

Semantic derivation happens when a proper name, already existing in the language, is transferred to a new object. It can also be regarded as a process of expansion where the semantic scope of a word is widened. There are several types of derivation.

Metaphor is a literary technique in which a word or expression is used in a figurative meaning. It is based on a comparison of an object or phenomenon with another by a common feature. Put simply, it is a transfer based on similarity. Metaphorical word formation is the most popular and simplest method of semantic derivation. Commonly, animal names, food, household items and other familiar words are used to create metaphors.

Researchers note that video game developers and players both make use of existing words by assigning them completely new meanings (Susanti, 2022; Zefanya et al., 2019). In its simplest form, metaphor is based on an external resemblance: in *Counter-Strike: Global Offensive*, the weapon P90 submachine gun (fig. 1) is normally referenced by players as "Rooster," because of its unusual design with the front part of the gun resembling the comb of a rooster. In the same game, a small, curved passageway in the map is called "Banana" resembling the shaper of the fruit. In the game *Apex Legends* from 2019 a "Jar" is a large energy shield cell that looks like a container. To activate its in-game effect, the player animation is similar to one of sticking one's hand into a jar to reach for some food. Other eloquent examples of this kind of metaphor are the words "Drop," "Slam," and "Garland." "Drop" in *League of Legends* refers to an item that improves a character's strength (a simplified name for the item "Goddess Tear" which is similar in appearance to a teardrop). "Slam" in *Deep Rock Galactic* is a lost explorer's gear (named so because it resembles one of the game's cosmetic elements). "Garland" in *S.T.A.L.K.E.R.* is a belt for carrying artifacts and does resemble this decoration in appearance. Elements of external resemblance are often used to simplify the naming of factions that differ in some way. For example, in *Warhammer 4000* and in *Ingress*, some of the factions or armies in the game are called "Smurfs" (from the animated series about creatures with blue skin), because of the color of their uniform. In *Ingress* the "Smurf" was initially invoked as a mockery, but later it became a kind of unofficial mascot representing the faction.

Figure 1. The P90 submachine gun called "Rooster".

Figure 2. A map showing the advancement of a division into the territory of the enemy ("Worms").

Another case is that of metaphor tied to the specific in-game function of a character or an object. "Shuttle" is an NPC (Non-Player Character) in *Black Desert* that can take a player character to one of the archipelago islands or across the ocean. "Sandwich" is a situation where a player is squeezed from two or more sides and happens to be in the center of events. "Turquois Eider" is someone who plays for good statistics and humiliates other players without any reason apart from frustration or a desire to show off.

There are also variants such as similarity of impression and similarity of form, i.e., there is a transfer of meaning from one word to another which are connected by similar characteristics. Such examples are "Herbarium" and "Worms." "Herbarium" in the game *S.T.A.L.K.E.R.* refers to the collection of artifacts. This process is indeed reminiscent of collecting leaves, creating the same impression. "Worms" in the game *Hearts of Iron 4* refers to a deep and uneven sinking of unprotected divisions from one side into the territory of the enemy (fig. 2). The word comes from the similarity shown in the game map to the movements of the troops that indeed resembles a colony of worms.

Semantic associations related to the source word may also serve as a basis for metaphor. As Galina Kustova (2001) points out, transferred meanings in this case are hardly predictable, as "semantic associations are not a part of the original meaning, have a pronounced national-culture, etc." (p. 57). For example, "Toad" is one of the strongest characters in *Dota 2*, his in-game name is "Slark." That the character evidently belongs to the underwater world is shown by his fins, scales, etc. However, despite his 4 limbs, he looks more like a fish of prey than a toad (fig. 3), and the English name is derived from the words "shark" and "lurk." However, unlike a shark, a toad has a derogatory

connotations in the Russian language. In a figurative sense, it signifies an unpleasant, aggressive, and mean-spirited person.

Figure 3. Character of *Dota 2*, Slark, also known as “Toad”.

However, Galina Kustova also highlights the role of non-metaphorically derived expressions, which are constructed either exclusively from components of the reference term or by regular replacement of some types of components with others (Kustova, 2001, p. 56).

Irony, as is well known, is the technique of hiding the true meaning of a word or expression or contradicting its obvious meaning. Because of this, irony can only be defined in relation to its context. The gamers don’t use it as often as metaphors, but this technique is quite common. For example, in the game *Genshin Impact* the character Jun Li, who in the game narrative is several thousand years old, is called “дед” (“ded”, grandfather). By so referring to this character the players comment ironically on his age. Another interesting example is “Алеша” (“Alesha”). In *World of Tanks* “Alesha” is a bad player. Among Russian-speaking gamers that’s what you use to call an “idiot”, “klutz.” In *Grand Theft Auto*, Oppressor Mk II (a vehicle resembling a flying motorcycle without wheels and with heavy weaponry) is called “Broomstick” where the parallel is not only due to some similarity in use, but is also intended to be a mockery, as the use of the vehicle prevents the player from moving around, and does not require any particular skill.

Another well-known form of semantic derivation is the transition from a proper name to a common name, with the word still being written with the capital letter, but no longer considered an individual name. To create this kind of slang, the community often uses names of both real people and fictional characters of cartoons, fairy tales, and so on. For example, the word “Васик” (“Vasik”), derived from “Basic,” in a computer game denotes a basic or automatic attack. The original name is “Вася” (“Vasya”), and as a slang word it is used in a diminutive form of the male name (as well as cat, because in Russia it is one of the most common variants for nicknaming cats).

There is also the case when items in-game are named after real players. For example, “Edward” in *Counter-Strike: GO* is a specific position found in the Mirage map.

The name comes from John (Edward) Suharev, an Ukrainian "kaeser" (as a player of *Counter-Strike: GO* is called), who liked to play in this place behind a large column. Due to the popularity of this game strategy, this position has been named after him on the FACEIT platform for players of *Counter-Strike: GO*.

If we look instead at words derived from the names of fictional characters, such examples can be "Яга" ("Yaga"), "Шрэки" (Shreks), and "Локи" ("Loki"). "Яга" ("Yaga") is a tank E100 in *World of Tanks*. This name, which draws a parallel with a character of the Russian fairy tales and cartoons "Баба Яга" ("Baba Yaga"), was invented by the players because of the shape of the tank's barrel. Also in *World of Tanks* "Шрэки" ("Shreks") is the name given to the players of the Horde (an in-game faction) by players of an opposing faction (the Alliance). The name came from the fact that the "Orcs"-character one plays in the Horde looks similar to the character named Shrek from the animated movie of that name, also sharing with him similar habits. "Локи" (Loki) is a character from the multiplayer online game *Ragnarök Online* that has the peculiarity of borrowing names of people and places from German-Scandinavian mythology. Loki (after whom the character is named) is a god of fire and cunning. The character himself also possesses fire magic, which makes the players see in him a similarity with this deity.

The already mentioned word "Смурф" (Smurf) is used not only as a metaphor of external likeness. In many highly rated multiplayer games (such as *Counter-Strike: Global Offensive*, *DOTA 2*, etc.) the word is used for an experienced player who uses an account with a lower rank (or ELO) and therefore fights with less experienced players. The word derives from the names of the players who first used this stratagem in 1996:

> It was started by Shlonglor, who is more than a SC player (he works for Blizzard as their webmaster). He was one of the all-time War 2 gurus and was extraordinarily famous due to his War 2 page […] everyone, hearing his name, would do one of the following things: cower in fear, worship like mad, or repeatedly challenge like a newbie. In the midst of this it was virtually impossible for him to get a game. So… Shlonglor and his roommate at the time, Warp, came up with a stroke of genius: make up a false name that no one would recognize […] For whatever reason, the names they chose were "Papa Smurf" and "Smurfette." (Webster's Timeline History, 2009, p. 101).

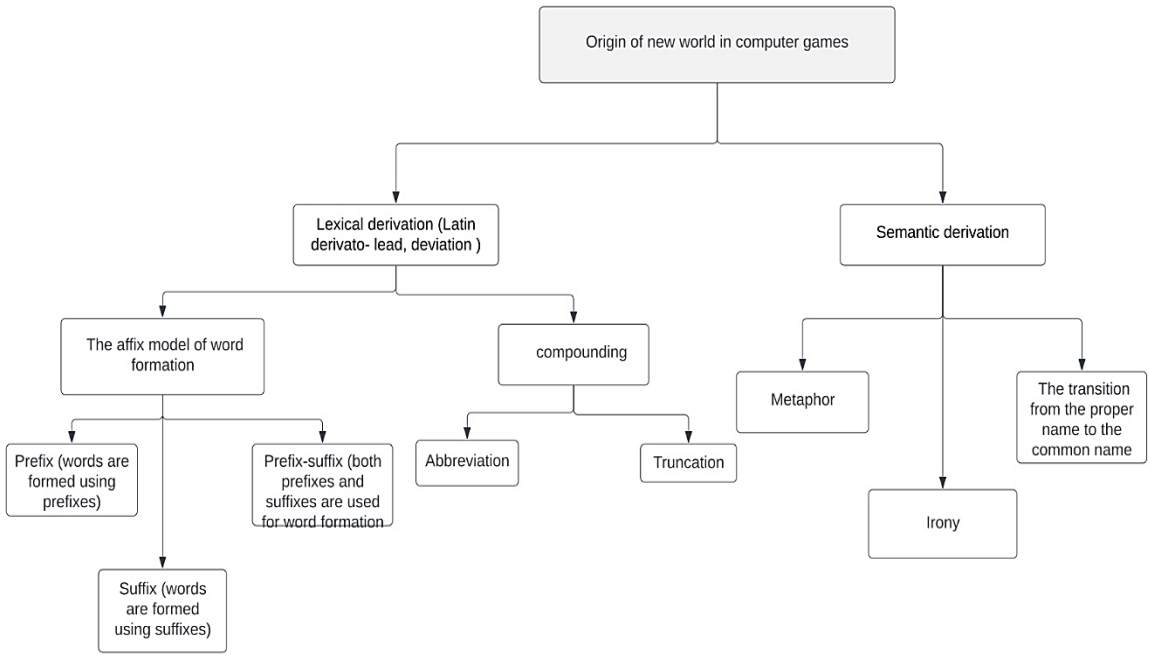

Figure 4. The scheme shows the pattern in which a new word is formed.

By way of summary, figure 4 showcases the different patterns in which computer slang is formed from English words: through transcription, transliteration, creative rethinking of words, as well as through lexical (by affixal model or composition) or semantic derivation (metaphor, irony, transition from a proper name to a common noun).

CONCLUSION

Modern technology has quickly and quietly entered into human life. With the rapid development of computer technology and the popularization of digital entertainment, game slang has become a popular subject for study. Many researchers have analyzed both the phenomenon of slang of computer games in general, and its narrower spheres, including the ways of word formation (affixed model of word formation, word complexity) and borrowing (transliteration, transcription).

Equally significant is the fact that the semantic derivation in game slang is grounded mostly in metaphors. The basis for the metaphor can be various features: external similarity, similar functions, forms, semantic associations and the like. The semantic derivation as a transition from proper names to the common ones occurs no less often. As we have shown, there are a large number of examples confirming that Russian players actively use the names of both real people and fictional characters as slang expressions.

In this article, much attention was paid to slang, having a Russian-speaking basis, as well as unusual and rarely encountered terms with interesting origins. So, the findings can be refuted in the future or be changed, as game slang is constantly replenished with

new words and expressions, and the number of computer games and gamers is increasing. These processes will likely continue, as well as in general the development of modern technologies.

What is being analyzed in video games is in fact only one aspect of a general linguistic phenomenon. On the one hand, there has always been a need to resort to operational simplification of technical language, especially in the performative sphere. During a sports competition it is normal to use simple gestures that refer to complex patterns, just as in an operating room it is normal to refer to tools and tasks with abbreviations. The same instance occurs in gaming, especially multi-player and competitive gaming, where speed and simplicity of communication become pivotal in assuring a satisfactory result.

On the other hand, the wide circulation of video games, more and more omnidirectional in regard to countries and demographics, makes the study of the slang that develops within the singular communities (usually devoted to just one game or a series of similar games) of transversal interest. Indeed, not only does the most widespread slang extend to other gaming communities and become a kind of common language that applies to video games in general, but it extends all the way to society. The use of video game slang terms in everyday informal communication is indeed increasingly common to notice, especially in the younger generation. This is also starting to be evident in work and recreational language, where it is increasingly common and universally accepted to refer to one's duties as "tasks," to one's goals as "stages," and to the achievement of them as a "level step. "

For these reasons, the study of the specific language that is formed and transmitted through the medium of the video game appears especially important today, calling for detailed, in-depth investigation.

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Research article

A Socio-Technical Inquiry into the Olbanian Language

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Abstract

The article aims to analyze some of the main features of the Olbanian language which became popular on the Russian Web during the period of the 2000's, when the Internet had already become a relevant means of communication and it was necessary to transmit a maximum of information using a minimum of time. It was online communication that spawned the trend of mass language distortion to minimize the intellectual expenses required for writing. This was the main reason why the Olbanian words and expressions was widely recognized by Internet users. In the article authors trace the history of the Olbanian language and draw the causal relationship between the Olbanian language and the specifics of the era which spawned it. This is considered not only as a linguistic phenomenon but also as a peculiar sign of the time and one of the direction in which the regular Russian language started to change and adapt. As a result of the study of Olbanian as a linguistic phenomenon, the authors conducted a linguistic analysis of Olbanian words and expressions, which revealed such features of word formation as: frequent use of double letters, replacement of a sound with a corresponding one, transliteration of foreign words, acronyms of set expressions, merged spelling of phrases, reverse transliteration. Situations will be pointed out in which well-established Olbanian are used. It will be addressed that the distortion of the literary language occurs in other countries as well (in such online languages as English LOLspeak and German Vong-Sprache). After reviewing the examples of literary works in Olbanian, the article will conclude by arguing that they can be attributed to an entertaining genre, which is clearly relevant due to people's attempts to move away from the established linguistic structure and rules of the literary language.

Keywords: Olbanian; Slang; Pandokaff; Language; Internet; Spelling

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Научная статья

Социально-техническое исследование олбанского языка

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Аннотация
Предмет изучения научной статьи – феномен олбанского языка периода 2000-х гг., времени, когда Интернет стал актуальным средством общения и возникла потребность передавать максимальную информацию за минимальное время. Именно интернет-коммуникация породила тенденцию к массовому искажению языка для минимизации интеллектуальных затрат на обдумывание текста сообщения и экономии времени, что стало важнейшей причиной, благодаря которой олбанские слова и выражения получили широкое признание среди пользователей сети Интернет. В статье авторы проследили историю возникновения олбанского языка, выявили причинно-следственную связь между самим олбанским языком и особенностями эпохи, породившей этот язык, который рассматривается в статье не только как лингвистическое явление, но и как интересная примета времени и одно из направлений изменения русского языка. В результате исследования олбанского как языкового феномена авторами был предложен лингвистический анализ олбанских слов и выражений, который позволил выявить такие особенности образования слов как: частое использование удвоения букв, замена звука на парный, транслитерация иностранных слов, аббревиатуры устоявшихся выражений, слитное написание выражений, обратная транслитерация и др. В статье представлены ситуации, в которых используются устоявшиеся олбанские выражения. Искажение литературного языка происходит и в других странах (в таких онлайн-языках, как английский LOLspeak и немецкий Vong-Sprache). Рассмотрев примеры литературных произведений на олбанском языке, авторы пришли к выводу о том, что их можно отнести к развлекательному жанру, который пользуется популярностью из-за попыток людей отойти от чёткой языковой структуры и правил литературного языка.

Ключевые слова: Олбанский; Сленг; Язык падонкафф; Язык; Интернет; Орфография

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INTRODUCTION

Change within Russian language is caused not only by general changes in life conditions, but it is also a manifestation of the protest against a “top-down power” over language in terms of a “reference” language of soviet broadcasters and writers. Mass media are another source of change, introducing fashionable and new words to draw attention of the audience.

In the 21st century, the development of information technologies undoubtedly has a major influence on the life and worldview of modern society with processes of social transformation leading to changes in Russian language as well.

Communication on the Web requires an expedited exchange of information. In order to save time, it is common for people to not pay adequate attention to grammar and spelling rules, actively using slang and offensive language. As a result, the so-called Olbanian language spread at the beginning of the 2000’s in Russian net communication. One of the most characteristic signs of this language is that the spelling of words is practically correct phonetically, but consciously distorted orthographically.

As a predecessor of Olbanian one might rightfully consider the Padonkaff language. However, the main difference between them is that Padonkaff. is based on the “how we hear, so we write” rule, and among the speakers is shown a staggering level of illiteracy. Meanwhile in Olbanian the incorrect spelling of words is used deliberately in order to attach a “peculiar” meaning to the message conveyed.

Russian orthography is quite difficult and has undergone many changes throughout the ages, so it achieved its stabilization only in the mid-20th century. Vasily Trediakovsky (1748/1948) suggested a phonetic principle of spelling in 1748, whereas Mikhail Lomonosov (1788) suggested a morphological one in 1755 and only in 1885 the first set of “Russian spelling” rules was published by Yakov Grot (1885). In 1917-18 a reform of Russian language was implemented which simplified the spelling and the rule book. These rules are still in force with only some changes introduced in 1956 (*Rules of Russian spelling and punctuation*, 1956).

Perhaps surprisingly, the history of the creative distortion of the Russian language in relation to the Albanian language started long before the appearance of Olbanian in the Web and the appearance of the Internet itself.

Janko Lavrin (1916), who visited Albania in the early 20th century, writes: “The Albanian alphabet was still terribly disordered: Catholics used Latin, Orthodox Christians – Greek, and Muslims – Turkish letters.”

Albanian has a Indo-European character in its lexical and grammar elements and a number of similarities in phonology and grammar with South-Slavic languages such as Serbian, Macedonian, and Bulgarian. The Russian world had an important influence in Albanian culture, especially in the second half of the 20th century, when scientific and technical knowledge, as well as the relative terminology was introduced in the country with the arrival of specialists and qualified personnel from the Soviet Union.

The beginning of the 20th century was especially rich in linguistic experiments, in which sometimes the phonetic conventions of the language could be replaced by the author's. Thus, in 1916, the futurist Ilya Zdanovich (Ilyazd) wrote the play “Yanko, Krul Albansky” which is written in a mixture of zaumi and spelling distortions of the Russian

language: “пачиму ни смучяйтись помнити шта вот изык албанский… ” [distorted: “don’t be embarrassed to remember that this is the Albanian language…”] (Zdanovich, 1918/2001). In this sentence, only the words *remember*, *this* and *Albanian* are correctly spelled. In other words, the word phonetics is transmitted by absolutely incorrect literal means. At the end of the 20th century, the distorted language of the network was called Albanian, but the name itself suffered – Albanian became “Olbanian.”

BIRTH OF THE “OLBANIAN” LANGUAGE

Nowadays there are some hypotheses regarding the origin of the “Olbanian” language. Perhaps it is that many Russian users began to write with deliberate errors in different parts of the Web, but it is difficult to establish what prompted the great prevalence and popularity of this Internet language. According to one of the hypotheses, it is believed that distorted language appeared in Runet (Russian Internet) at the end of the 20th century. Among the sites that appeared in the 1990s were humorous ones where freedom of expression was encouraged. This manifested itself in ridiculing everything while seeming serious, using obscene language and the distortion of all rules. The sites were created by groups of enthusiasts with Internet access, and with growing popularity other users began to send their texts to them (that were called *creatiff*, derived from *creative*). In an appropriate ironic vein, the authors called themselves *padonok* [*bastard*, written with a mistake]. As one of the creators of one of the earliest such sites recalls, “before we came with fuck.ru, no one used foul language on the [Russian] Internet” (Krongauz, 2013). There the “Anti-literacy manifesto” was published, authored by the virtual girl Mary Shelley, invented in 1997 by writer Alexei Andreev. The manifesto called for the rejection of spell checks. In all its words the letters were changed as much as possible but so that it was still possible to guess the sound of the word: “ ‘Биз грамотичискай ашипки я русскай речи ни люблю!,’ писал наш лудший паэт Аликсандыр Сиргеич Пушкин. Эти слава мы бирем дивизом на наш флак в барьбе с засилием биздушнай кампьютырной правилнасти каторую нам навязывают гацкие робаты-акуппанты!!!!” [roughly translated: “‘I do not like Russian speech without a grammatical mistake!‘ wrote our best poet Aleksandr Sergeech Pushkin. We take these words as divisive on our flag in the fight against the dominance of soulless computer correctness, which is imposed on us by nasty occupant robots !!!!”] (Shelley, 1999/ n.d.). At the time when it was written, the manifesto sounded funnier than it does now, since today the question of the negative impact on the language of texts created by AI is the subject of scientific discussion (Thomas, 2022). Dmitry Belinsky (with the nickname “Linxy”) was a designer at fuck.ru and one of the first to constantly and deliberately distort the words in his posts. In honor to its progenitor Linxy the new language was at first named “L-yazyg” (L-language) and, after its spread, has become known as Padonkaff language [roughly: language of bastards]. The main argument for the hypothesis that Olbanian originated here is the fact that the Padonkaff language acquired its mass character and widespread use precisely on the udaff.com site as the successor of fuck.ru.

When the Olbanian language was formed in the 2000‘s, there were no strict rules enforcing content blocking for the use of obscene language, the spread of pornography, etc. However, the users understood that not all words and formulations were appropriate. With the introduction of internal measures to curb obscene language, “euphemisms” began to appear which replaced unacceptable words by more neutral ones (Mahmutai, 2019). The other root of the Olbanian language refers to the later period of the development of the Internet and to the resource of online diaries. There is also a hypothesis which claims that the name Olbanian may derive from the curious situation on the LG (Live Journal) site in 2004. A user under the nickname of “scottishtiger” was outraged by a text written in Russian and started to ask angrily why someone wrote in that language on the American site livejournal.com.

> scottishtiger: “I cannot read that text,” “I knew I should have been a translator, after all.”
> In response, the user “maxxximus” called the “unknown” language Albanian:
> maxxximus: “This is Albanian, i am only guessing what the (…) they are talking about…”
> The next day scottishtiger responded:
> scottishtiger: “Because? It's LIVEJOURNAL. An American website. Not an Albanian (…) site. Plus, being an American means that the rest of the world should have to cater to me. But that's just mypointofview.” (Krongauz, 2013)

The Russian-speaking community of LJ organized a flash mob, called “Albanian Lessons” during which scottishtiger received several thousand comments in which he was asked to apologize and write a post in his journal (in Russian), stating that he had already learned Albanian, and so scottishtiger did (Lipatov, 2013).

It should be noted that there were loads of search queries related to the meaning of Olbanian words and Internet memes formed from them. The first chance meeting with Olbanian spelling of words caused shock and protest in people. And if a naive user like scottishtiger immediately resented this, it provided a great opportunity for trolling and exercise in Olbanian:

> Wrote my first post (…) today. The post was devoted to the “incorrectness” of the language of some authors, purely from my point of view. This meant the use of some words that I honestly considered wrong, i.e. written with errors. I honestly ASKED to explain to other users why the authors use this.
> As a result, I was poured with slops and labeled, ranging from illiteracy and much more. lol. But that's not the point. There was only one person who explained to me the concept of “Olbanian” language. By the way, thanks to him for mentioning this linguistic phenomenon. (Xpath, 2021)

Aleksandr Berdicevskis (2013) studying texts from the website udaff.com (one of the main successors of the tradition after fack.ru) discovers that the frequency of use of the Olbanian language rapidly dropped after 2001. That year, almost every word was written wrong. Then a sharp drop began in 2002, and continued in gradual decline. By 2011, the frequency reaches almost zero (Berdicevskis, 2013, p. 196). If udaff.com was

the site where the Olbanian language was created and users made up spellings as they went along, the picture is different for the subsequent use of Olbanian for instance in Web blogs. In 2008 researchers mentioned that on average, the ratio of online requests containing correctly and incorrectly spelled expressions popular in the Olbanian language is 1 to 7 (Snigirev & Snigireva, 2008). According to the results of the analysis of Web blogs, the peak of popularity falls on 2006 (Berdicevskis, 2013).

Table 1 shows the current popularity (in 2022) of some slang word and expressions in the Internet. Today, some Olbanian words and expressions have remained in the active vocabulary of Internet users, but mixed with English expressions and new memes and linguistic jokes.

Table 1 Popularity of slang words on the web

Correct grammar	English translation	Number of searches on the Internet	Olbanian word or phrase	Number of searches on the Internet
Привет медведь Privet medved’	Hi, bear	138 000	Привед медвед Preved, medved	5 000
Здравствуйте Zdravstvujte	Hello	2 000 000	Дратути Dratuti	17 000
До свидания Do svidaniya	Goodbye	386 000	Дотвидания Dotvidaniya	3 000
-	-	-	kek	902 000
Ой, всё Oy, vs’o	Oh, whatever	1 000 000	Ойвсё Oyvs’o	4 000
Автор жжёт Avtor zhzhet	The author writes well	384 000	Аффтор жжот Afftar zhzhot	7 000
-	Laughthing out loud/LOL	1 000 000	LOL	2 000 000
Предсказывать Predskasyvat’	To predict	911 000	Ванговать Vangovat’	24 000

The wave of literary creativity in Olbanian came at the heyday of the Padonkaff language, during the first quarter of the 21st century. This linguistic phenomenon has gone beyond Internet communication and turned into a tool for creating lyrical and prose works.

One of the most famous authors who turned to the Olbanian language is the poet Alexander Noskov, who writes under the pseudonym Chen Kim. His work "Leftolstoy" (Rus. "Lev Tolstoy"; Eng. "Leo Tolstoy") deserves special attention. In addition to the peculiar spelling rules that sharply distinguish Padonkaff language from the background of Russian, the writer, like Zdanevich, deliberately avoids any punctuation marks, except for the dot. In addition, proper names in the text do not begin with a capital letter and are distorted along with other common nouns, there is no punctuation within sentences. In addition, the first word of each line does not begin with a capital letter, as established by the rules of Russian language. And it is perhaps in this disruption of the usual norms that lies the most emotional appeal of Olbanian language. According to Olga Zverlina (2016):

> Olbanian gives amazing creative freedom! It was like a tongue, moving strictly along the rails of the rules all the time, suddenly jumped off the running board of its locomotive – and began jumping, frolicking, picking flowers and catching butterflies. Absolutely not serious, but easy and joyful (...).

DISTORTIONS OF THE LANGUAGE ON THE INTERNET

Distortions of the language are not an exclusive peculiarity of the digital era. Playing with language, bending it and subverting its rules, is common among writers and innovators. Also, when there is a large community of people that doesn't master the official language of an area, it often happens that these people end up in creating their own versions of the language. For example, "Ebonics" (from "ebony" (black) and "phonics" (sound)) is a distorted version of the English language. Many more examples can be found in the style of using European languages from those communities that share an African root, as in an expression like: 'The Brotha be lookin good; that's what got the Sista nose open!' (Kifano & Smith, 2005).

But whether these forms are an unintended result due to events such as immigration or colonization, what is peculiar in Internet communications is the birth of intentional language distortions. For some scholars, language changing in the network is a subject of concern (O'Connor, 2005). They argue that massive communication on the Internet contributes to simplifying and impoverishing the language, and that the use of abbreviations, slang, etc., is a danger to the richness of expression. Even taking into account these issues, the phenomenon of language distortion that we are considering is situated on a different level of complexity. Here, the violation of the language norms happens deliberately, by a group of people that, in fact, masters the original language. At the same time, even violation has its own regularity. The linguistic rule is not distorted arbitrarily, but by virtue of what we can call an "anti rule," which presupposes an understanding of the original norm. Languages distortions usually cause a sharp reaction from representatives of traditional culture: "Olbanian is like a powerful powder charge laid under the foundations of the grammar and spelling of the Russian literary language,

to which this 'verbal scum' causes damage that is difficult to repair and severe wounds to its speech richness" (Lipatov, 2013, p. 71).

Needless to say the phenomenon of the distortion of the standard language happens in the majority of linguistic communities (Bridle, 2022). One of the most famous example is the English internet language named "LOLspeak,"[1] also known as Kitty Pidgin, used online since 2006, that includes morphological reanalysis, atypical sentence structure, and lexical playfulness (Gawne & Vaughan, 2011). A widespread image, to which the popularization of language is traced, is a picture of a cat with the caption "I Can Has Cheezburger?" which gave rise to a variety of new distorted phrases. Calka (2011) describes "LOLspeak" as such: "the closest approximation would be to imagine English put through an automatic translator into another language and then translated back and spelled phonetically." Kirsi Kauppinen (2016) claims, that "LOLspeak" inherited the most well-known, deliberate misspelling of the English language, i.e. the distortion of the definite article "the" into "teh" in videogames.

It is typical for this language to over-use the weak verbs' past tense suffix "-ed" and to bend English grammar in other ways. (Gawne & Vaughan, 2011; Kauppinen, 2016). Born as a language of memes, it became quite popular in Internet communication. This is the answer given to the common question by uninitiated people about what this strange language is: "Izz lolspeek. Lolspeek5 izz allaways opshunal tho" (Eng. "It's Lolspeak. Lolspeak is always optional though"). The less popular variant of Internet-English, "Chanspeak" (a language born on 4chan, a website with over 7 million users created in 2003), also contained misspellings and its main features include shortening, simplifying and cutting down words (Fiorentini, 2013). However, the oldest language of such kind on the Web, known since the '80s, is probably "Leet" (also known as "1337", "Eleet" or "Leetspeak"; the name is derived from the word "elite"). Its main feature is the use of numbers and other symbols instead of similar-looking letters. 1337 is actually Leet spelling for the word "leet" (Fiorentini, 2019, p. 91).

A similar case can be found in the German speaking Internet community. It is the "Vong-Sprache" that appeared in the 2010s. The term "Vong" refers to the prepositional phrase "Vong... her" (a distortion of the preposition "von ... her" or "where … from"). In 2017, a popular phrase became "I bims", which stands for "Ich bin's" or "this is me" (Turysheva, 2018). Shcherbakova (2017) points out that Vong-Sprache is characterized by writing nouns in lowercase letters, in place of the uppercase letters prescribed by the German grammar, and also in the widespread replacement of the consonant "n" with "m". The words are still written according to their original phonetics, but there is a tendency to ringing or deafening. For example, the diphthong "ie", in which the "e" is not pronounced, but emphasizes the elongation of the vowel that precedes it, is truncated into just "i".

[1] LOL is the popular acronym for 'laughing out loud.'

LINGUISTIC SPECIFICS OF OLBANIAN WORDS

Even though the spelling variant of one or the other Olbanian phrase depends ultimately on the user's taste, the language still retains some of the established principles of words-formation. Let us take a closer look:

1. Double letters. This redoubling aims to get rid of complicated combinations of consonants in the words. As a rule, one consonant is taken as a basis and generated in transcription by its devoicing or the fusion of the other sounds. For example: the transcription of the word "author" (Russian transliteration: "avtor") is [ˈa:fta:r], the letter "v" transforms into the [f] sound. That's why the Olbanian equivalent of this word is "afftar". Another example: "affiget'" (Rus. "ofiget'", [afi:get']; Eng. "my gosh/it's nuts"). The double "f" becomes here the [fˈ] sound). We can also examine the word "atstskiy"[2], shaped from the Russian word "adskiy" (Eng. "hellish"). The combination of letters "ds" makes the sound [ts], so the transcription is [ˈatskij]. The same tendency can be seen in such words as "atststoy" (Rus. "otstoy"; Eng. "sludge"). Here the combination "ts" makes the sound [ts]. The same happens in the word "napidetstski" (Rus. "ne po-detski"; Eng. "not childish, really"). In the word "peretstsa" (Rus. "peret'sa"; Eng. "to trudge" is the combination "t'sa" that makes the sound [ts]. Last, in the word "zash'sh'itat'" (Rus. "zaschitat'"; Eng. "to count/to deduct"), the combination "sch" makes the sound [sh'].

However, it is worth mentioning that this occurrence is not always about doubling the letter whose sound is formed in transcription according to the Russian language's spelling rules. The letters in the word "zhossko" are redoubled according to another principle. The transcription for the Russian word "zhestko" (Eng. "harsh") is [ˈzhostka]. Although the combination of letters "st" make two different sounds, [s] and [t], only the letter [s] is doubled. Such a modification is explained by the same difficulty in combining letters that one finds in the original Russian word, and the consequent desire to avoid this difficulty in writing and especially in speech. This is the case in the sentence: "zotsenite noviy atstskiy saitets" (Rus. "Zatsenite novyj adskij sajt"; Eng. "Check out the new hellish website"), and in: "afftar peshy ischo" (Rus. "avtor, pishi esh'o"; Eng. "author, write more").

2. Replacement of a sound with a paired one. In Russian language there are some paired sounds for both vowels and consonants. It is customary to divide sounds into strong and faint ones (in the case of vowels we distinguish between stressed and unstressed sounds, in the case of consonants between voiced and deaf). Speaking about vowels, it is noteworthy that when in the strong position (stressed) the pronunciation is determined by the letter that occasions it. For example, in the Rus. "vody" (Eng. "waters"), the pronunciation is [ˈvody[3]], because the vowel "o" determines the [o] sound.

[2] There is no sound "ц" in English language, so it is customary to designate it as "ts" symbol (as it reads in the word "tsar"). In the word "atstskey" there is a double "ts". Hereinafter this symbol is used in transcriptions as well.

[3] There is no correspondence for the sound "ы" in the English language, so it is customary to designate it with "y" symbol (as it reads in the surname "Bykov"). Hereinafter this symbol is used in transcriptions as well.

But when the vowel finds itself in the weak position, the sound is replaced by a paired one. As it is the case for the Rus. “voda” (Eng. “water”), pronounced [vaˈda], so that the vowel “o” results here in the sound [a].

As for the consonants, a weak position is the one in which deaf consonants stand before voiced ones (as in the Rus. “sdacha” (Eng. “change (money)”), pronounced [ˈzdacha]), or when voiced consonants stand before deaf ones (as in the Rus. “leopard”, pronounced [l’iaˈpart], resulting in a deafening). In Olbanian language this rule works in the reverse way. In weak positions both vowels and consonants acquire the features of strong sounds. The most striking example is the very name of the language itself: Olbanian (“Olbanskey”). The phonetic transcription of Russian word “albanskiy” is [albansk’ij]. The letter “I” is unstressed, but in Padonkaff language there is a deliberate replacement of weak sound [i] with the strong one [e]. We can mention here several examples: “atstskey” (Rus. “adskiy”, [ˈatsk’ij]; Eng. “hellish, infernal”), where the weak sound [i] is replaced with the strong [e]; “dnivnig” (Rus. “dnevnik”, [dn’ivˈnik]; Eng. “diary”), the weak sound [k] is replaced with the strong [g]; “zaycheg” (Rus. “zaychik”, [ˈzajch’ick]; Eng. “tiny bunny”), the weak sound [k] is replaced with strong [g]; “zokhavat’”[4] (Rus. “zakhavat’”, [zaˈhavat’]; Eng. “to eat”), the weak sound [a] is replaced with the strong [o]; “zaftro” (Rus. “zavtra”, [ˈzaftra]; Eng. “tomorrow”), the weak sound [a] is replaced with the strong [o]; “ketaitsy” (Rus. “kitaitsy”, [k’iˈtajtsy]; Eng. “Chinese”), the weak sound [i] is replaced with strong [e]. Then, if we move to short sentences, we see the same happening in: “Uchi Olbanskey” (Rus. “Uchi Olbankiy”; Eng. “Learn “Olbanian”), “Zokhavaite svai kamenty, ketaitsy” (Rus. “zakhavaite svoi kommenty, kitaitsy”; Eng. “eat (delete) your comments, Chinese”).

3. Transliteration of foreign words. It is not a secret that the creation of Padonkaff language was dictated by a surge in virtual communication through the spread of social networks. Olbanian, like most languages, is replete with borrowed words, even more than the usual, having developed in the already linguistically multifaceted environment of the Internet. The fascination for foreign words defined transliteration as one of the most common features of Olbanian phrase-formation. Transliteration, in contrast to borrowing, is a far simpler process. It does not take any special effort for the speaker except to reassemble the same word with corresponding letters from a different alphabet. For example, the phrase “v gazwagen!” (“to delete/to destroy”) originates from the German word “Gaswagen”; “v memories!” (“add to favorites”), from the English “memories”; “v gazwagen ego kommenty” means “Delete his comments!”; “affiget’ kinu v memories” is translatable as “My Gosh, I add it to favorites!”

4. Acronyms. Acronyms are an efficient method of abbreviation in writing, formed by shortening two or more words highlighting only their first letters. They are often found in everyday life and the Olbanian language is no exception. Some, as FBI (Federal Bureau of Investigation) or NASA (National Aeronautics and Space Administration), are so well known that they’re rarely mentioned in their full form. In

[4] The [kh] symbol commonly represents the voiceless velar fricative [x]. It is similar to the English sound [h], but they are not the same, so it is customary to transliterate this sound as [kh], not [h]. However, in the transcription it will be designated as [h], since there is no symbol “kh” in the English transcription.

Olbanian we find, for example, that the phrase “podpisyvayus' pod kazhdym slovom” (Eng. “I agree with every word”) is so frequent that is normally used in acronymic form to save time when typing: “PPKS.” The same happens in all phrases consisting of modified Olbanian words and phrases borrowed from English: “APVS” (Rus. “A pachimu vi spgashivaete”; Eng. “Why do you ask?”); “IMKHO (ИМХО)”, a transliteration of the English “IMHO” (“In My Humble Opinion”); “ROFL (РОФЛ)”, meaning “rolling on the floor laughing”; “faku”, for FAQ (“Frequently Asked Questions”). As example of acronyms used in full sentences, we can mention: “APVS, vi antisemit?” (Eng. “Why do you ask? Are you an anti-Semite?”), and “Ftopku afftora IMKHO” (Rus. “v topku avtora, IMKHO”; Eng. “IMHO, the author is good for nothing”).

5. *Merged spelling of phrases*. In the vast majority of orthographies it would be considered an error if one does not insert spaces between different words, phrases and expressions. But in a subversive language like Olbanian this rule is also turned upside down. The motivation for this type of distortion is not entirely clear, presumably it is done in order to strengthen the emotional flow of a person originally wanted to express. Examples of this phenomenon can be found in constructions such as: “niachyom” (Eng. “about nothing”), “niponil” (Eng. “I didn’t understand that”), “rzhunimagu” (Eng. “I laugh a lot”). Initially, these blocks looked like: “ni o chyom”, “ne ponyal,” and “rzhu, ne mogu.” However, their forms probably retained a feeling of serosity and formality considered inadequate for communication over social networks. As a consequence, they started to be expressed as a single linguistic block. When used in full sentences, they look like this: “Afftar, vypej yadu, kament niach’yom” (Rus. “Avtor, vypej yadu, kommentarij ni o chyom”; Eng. “Author, drink poison, your comment is about nothing”); “Kortinki v khukhle rzhunimagu” (Rus. “Kartinki v Google ochen' smeshnye”; Eng. “The pictures in Google are really funny”).

6. *Reversed transliteration*. This is another highly unusual feature that became specific in the word formation of Olbanian language. A person who for the first time sees phrases formed by this scheme might even think that their interlocutor forgot to switch the keyboard layout. Of course, that user has no understanding of Padonkaff language and why such words appear as a meaningless bunch of letters. However, if we understand this feature, we can learn to track the patterns of the Olbanian word formation. Let us examine several examples: “З. Ы.” (“Z. Y.”) stands for “P. S.” (“postcriprum”) written on the Russian keyboard layout; “GGW” stands for “ППЦ” (“PPTS”, Rus. “pipets”; Eng. “bloody hell/screwed”) written on the English keyboard layout. “лытдыбр” (“lytdybr”; Eng. “diary”) is the Russian word “dnevnik” written using the English keyboard layout and transliterated into Russian, just as in “гхбдтн” (“ghbdtn”, Rus. “privet”; Eng. “Hi”). Complete phrases will look like those: “Z.Y. Afftor, lytdybr zachot” (Eng. “P.S. hey, author, your diary is cool”); “Ghbdtn, tusafsh’eg” (Eng. “Hi, partymaker”).

7. *Transformation of verbs with reflexive suffixes*. According to Russian language rules, reflexive verbs have the suffix “-ся /-sya” (a shorten form of “sebya”, “myself”). Verbs such as “vytirat’sya” (Eng. “wipe oneself”), “umyvat’sya” (Eng. “wash your face”), “odevat’sya” (Eng. “put your clothes on”) are just some examples. There is a specific transformation tendency of these verbs in Olbanian language. The suffix “-sya”

turns to “-so”. Therefore Olbanian analogues of the above-mentioned verbs in Past tense will look like “vytiralso”, “umyvalso”, “odevalso.” Infinitive forms are subject to change as well, but suffix and other parts of the morpheme are modified, for example by doubling the letters of the suffix. That’s exactly the case in “smeyatstso” (Eng. “to laugh”), and “rugatstso” (Eng. “to swear”). Reflective sentence construction remains unchanged: “Smiyalso vsem ofisom” (Rus. “Smeyalis’ vsem ofisom”; Eng. “The whole office laughed”); “Kartinki ne gruzyatstso” (Rus. “Kartinki ne gruzyatsya”; Eng. “Pictures are not loading”).

8. Word formation and emotional expression. For sharing emotions and feelings, the human being has many methods at its disposal: facial expressions, gestures, voice tone modulations, etc. However, in messenger boards and chat it is impossible to convey the emotional palette in its full extension. Is precisely to make up for this shortcoming that a language born and spread mostly in a written and digital form values the emotional component of a message. Therefore Olbanian is rich of interjections: “bugoga” (“bugaga”, “bugogi”, “bukake”), Eng. “bwa-ha-ha”, an expression of animalistic, crass laughter; “gy”, an expression of surprise; “ggg” (“gy-gy-gy”), that means “approving chuckling”; “y” (“yyy”[5], “khy”) is a laughter with a smirk; “dyk” (“dyk””, “dek”, “dak”) indicates that speaker is fully confidence of its rightness; “y”yyo!” is an exclamation used in a moment of clarity (an analogue of expressions such as “Got it!”, or “Eureka!”); “Bugogy, fupazor!” (Rus. “Ha-ha-ha, fu, pozor!”; Eng. “Ha-ha-ha, ew, this is a shame!”); “Dyk, on dyrchatyj!” (Rus. “Tak on zhe dyrchatyj[6]! “; Eng. “It is clear that he is homosexual!”).

9. Misspelling of foreign words. Almost all of the Olbanian words are misspelled deliberately and this, as we have already seen, is a key feature of the language. However, not only the original Russian words, but also foreign words are subjected to distortion. For instance, “tru””[7] (Rus. “pravda”) is formed from the English word “true”. The transmission of the word with letters of another language, unlike transliteration, is inaccurate because the word has the letter “ъ” (’’) at the end. One of the reasons for this letter’s appearance is the absence of the sound “e” at the end of the word “true.” The word “khukhl’” formed from English “Google”, is quite interesting too. The Russian transliteration is “gugl”, but sometimes the letter “g” stands for the sound [h] (as in: “lyokgij”, [ˈl’ohkij]; Eng. “easy/lightweight”; “Bog”, [boh]; Eng. “God”). In the Olbanian method of misspelling, the letter “g” is replaced with “h”: “Chuvag, ty ni khunderstandish’” (Rus. “Chuvak, ty ne ponimayesh’”; Eng. “Man, you do not understand”), “Khukhl’ vynis mnu moskh” (Rus. “Gugl vynes mne mozg”; Eng. “Google blew my mind”).

10. Tendency to force the use of “й”[8] *and* “ъ”. The two letters “й” and “ъ” are rarely used in general, and never used at the beginning of words, but Olbanian demands

[5] In Russian this phrase looks like “ыыы,” the vowel is very prolonged.
[6] “Dyrchatyj” is a derogatory term for an homosexual person, born from the word “dyrka” (Eng. “a hole”).
[7] “ъ” in Russian is not a sound but a sign, used to separate a consonant and a vowel (example: “podezd”, [pod’’ezd]; Eng. “entrance”). Hereinafter “ъ” is designated with [”].
[8] “й” is a sign for a combination of two sounds: [j+ short “i”]. In transliteration and transcription it is customary to designate it with “j”.

an inversion of this custom. The letter “й” (“j”) is actively used in order to intentionally misspell words starting with the letter “я”, which results in the combination of two sounds: [йа], and [ja] (their transliteration is the same), when it comes at the beginning of a word, after a vowel or after the letters “й” and “ъ”. These Olbanian words take a following forms: “йа”[9] (“ja”; Eng. “I/me”), “йад” (“jad”; Eng. “poison”, “vypej jadu”, “drink some poison”), “йух” (“juh”, Rus. “jug”; Eng. “south”), etc. Speaking about the letter “ъ”, it is important to remember the Russian spelling rule which was in place during the pre-revolutionary period. At that time “ъ” was written at the end of every word ending with a consonant. Since there is no equivalent to this in Latin lettering, this would amount to: “kakъ”, “telefonъ”, “Sankt"-Peterburgъ” (Eng. respectively for “how”, “phone”, and “St. Petersburg”). In Olbanian it happens in the same way: “plakalъ”, “rydalъ” (Eng. “cried”, “wept”). This, however, is not to say that “padonkaff” speakers try to return to the spelling traditions of pre-revolutionary Russia. This way of word formation is only a parody that uses the comical and out-of-place character of outdated rules to attract the attention of the network audience: “Yaplakalъ” (Rus. “Ya plakal”; Eng. “I was crying”), “On zhosko rydalъ” (Rus. “On gor’ko rydal”; Eng. “He was bawling his eyes out”).

11. Associative method in forming the names of the months. It is worth mentioning that some of the months have been given names based on the Olbanian speakers’ attitude and associations to that particular period of the year. For instance, “bukhar” (Rus. “yanvar’”; Eng. “January”) is formed from the verb “bukhat” (Eng. “to drink”), because New Year is celebrated in Russia during January and the festival is accompanied with large quantities of alcohol; “morozen” (Rus. “fevral”; Eng. “February”) is formed from the verb “morozit’” (Eng. “to freeze”); “mard” (a misspell of Rus. “mart”; Eng. “March”); “aperel” (another misspell, of Rus. “aprel”; Eng. “April”). As we can see, these words are formed in ways already familiar to us, by the replacement of a sound with the pairing one and by the addition of another letter.

SEMANTIC MEANING OF OLBANIAN WORDS AND PHRASES

Patterns in the formation of linguistic units, one of the most important aspects of a research, were analyzed in detail, and the main points were covered above. But equally important is the lexical side of a language, which is responsible for the meaning and the subjective content of expressions and concepts. If it was initially assumed that the author independently distorts words when writing, then later a number of standard patterns accumulated, which are quite popular and easy to use. Speaking about Padonkaff, it is noteworthy that its main purpose, as a language born out and for internet communication, is to fully express users’ emotions and feelings, and that is why the main lexical criterion for every Olbanian word is the particular emotion that one wants to convey. Depending on the mood and feelings of the speaker, few categories of the semantic meaning of Olbanian words could be highlighted.

1. *Approval of a statement or of a particular user*. As a rule, Olbanian speakers prefer the use of uncommon phrases when expressing their approval. The usual

[9] It is impossible to show the difference between Russian “я” and “йа” because both their correct and distorted variant is designated as [j’a] in transcription and “ja” in transliteration.

expressions “Good job!”, “Well done!”, “Very well!”, or even their misspelled versions are deliberately avoided. Most often they prefer borrowings or phrases built on vivid associations.

The highest degree of approval is “respect”: “respect”, “rispekt”, “rispegd” (Rus. “uvazheniye”; Eng. “respect”); “peretstsa” (Rus. “peret’sya”; Eng. “to enjoy”, “to admire”); “plyus adyn”, “+1” (Rus. “plyus odin”; Eng. “plus one”) expresses that the speaker is joining an already formed circle of approval (as in the case of a “like” button); “Afftar, peshy ischo!” (Rus. “Avtor, pishi yeshcho!”; Eng. “Author, write more!”) is a positive assessment of a post, an acknowledgement of author’s abilities and an invite to do more; “nra”, “nraitsa” (Rus. “nravitsya”) just means to like something; “kriatiff” (Rus. “kreativ”; Eng. “creativity”) is an acknowledgement of the author’s ingenium. Also, there is “Eta pyat’” (Rus. “Eto ‚pyat‘”; Eng. “It is a ‚five‘”) where 5 is the highest mark in the Russian education system, so this expression means the same as the Eng. “10 out of 10.” “Ftemu” (Rus. “v temy”; Eng. “on topic”) indicates that the author’s statement is relevant, and deserves approval; also “Affiget’, dayte dve (AD2)” (Rus. “Ofiget’, dayte dve”; Eng. “OMG, give me two of them”). “Vesch’!” (Rus. “veshch’”; Eng. “It is a good thing!”) is used in the Russian language to mark that a product is of high quality; “zhosko” (Rus. “zhostko”; Eng. “harsh”), means “impressive”; “zhiznenna” (Rus. “zhiznenno”; Eng. “relatable”) designates something that is close to a real state of things and deserves approval; “zachotnyj” (Rus. “zachyotnyj”; Eng. “outstanding”) is simply “excellent”, or “valid.”

A specific type of endorsement is to indicate that something is funny: “rzhunimagu” (Rus. “Rzhu, ne mogu”; Eng. “very funny”); “rofl” (from Eng. “Rolling On The Floor Laughing”); “plakalь”, “rydalь” (Rus. “plakal”, “rydal”; Eng. “I was crying from laughter”); “patstalom”, “patstulom” (Rus. “pod stolom”, “pod stulom”; Eng. “under the table”, “under the chair”) also means that out of laughter I fell to the floor, under the table; and, lastly, there is also the simple “lol” (from Eng. “Laughing Out Loud”).

2. *Criticism of an author and its work*. In Padonkaff language there are a lot of negative statements characterized by extreme sharpness, that can provoke arguments to start and even to escalate into serious conflicts between users.

For example, “Afftar, vypey yadu!” (Rus. “Avtor, vypey yadu!”; Eng. “Author, drink the poison!”) is self-explanatory; “bayanist” (Eng. “accordionist”) where “bayan” (Eng. “accordion”[10]) is a statement or a joke that lost its relevance because of overuse. “Nub” (from Eng. “newbie”; Rus. “novichok”) is a mockery pointing to the inexperience of someone. “Ubey sibya ap steny”, “ubey sibya cherepashkoy”, “ubey sibya ap bochku” (Rus. “ubey sebya ob steny”, “ubey sebya cherepashkoy”, “ubey sebya ob bochku”; Eng. “kill yourself on the wall”, “kill yourself with a turtle”, “kill yourself on a barrel”) are expressions of particular rancor. “F Babruysk, zhyvotnoye” (Rus. “V Bobruysk, zhivotnoye”; Eng. “Go to Bobruysk[11], animal”) is aimed to point out the author’s low intellectual abilities; “fluderast” (from Eng. “flood”; Rus. “zapolnit’”) is the name given

[10] Bayan is a Russian traditional musical instrument similar to the accordion. The translation as “accordion” is used in order to facilitate the understanding.
[11] Bobruysk, the city in Belarus.

to someone who writes a lot of comments that repeat each other. “Ktulkhu s”yel tvoy moskh” (Rus. “Ktulkhu s”yel tvoy mozg”; Eng. “Cthulhu ate your brain”) ; “Ftopku!” (Rus. “v topku!”; Eng. “throw it in the stove!”) means “to eliminate”; “atststoy” or “atstoy” (Rus. “otstoy”; Eng. “sludge”) means that something is not funny, and hopelessly bad; “niach’om” (Rus. “ni o chom”; Eng. “nothing”) stands for “good for nothing”; “nizachot” (Rus. “ne zachot”; Eng. “fail”) has the same meaning as “niach’om” or “nismishno” (Rus. “ne smeshno”; Eng. “not funny”).

3. *Referencing somebody else*. In order to add creativity and draw the attention of other users, Olbanian speakers often address their interlocutors not by their proper names or usernames, but by nicknames which could also be really offensive: “afftar” (Rus. “avtor”; Eng. “author”) is a neutral one, it just means the author of the post or the comment, where “ventilyator” is the same as Eng. “fan.”

The ambiguity of the translation gives Olbanian speakers an opportunity to choose deliberately wrong words as a mockery: “Jiday” (Eng. “Jedi”, Rus. “Jedi”) is used to be dismissive of Jews and police officers; “divais” (Eng. “device”) is in Russian a derogatory term used to insult a female person, and has the meaning as “tool/device”; “krosavcheg” (Rus. “krasavchik”; Eng. “handsome/pretty boy”) is sometimes used in an ironic sense; “odmen” (Eng. “admin”) is the administrator. “Petushneg” (Eng. “college student”) is used in Russian to mock persons indicating their extremely low intellectual abilities, originating from PTU (“professional'no-tekhnicheskoe uchilishche”) a vocational school for students who, according to a common stereotype, are not characterized by deep knowledge and wide erudition. “Tusafshcheg” (Rus. “tusofsh’ik”; Eng. “partymaker”) is a person who often spends time at parties and get-togethers; “Uchasneg” (Rus. “uchastnik”; Eng. “participant”) is a member of the Internet community; “ftykatel” (Rus. “vtykatel”; Eng. “forum reader”, is a reader of an online forum who “sticks” around and is spending a lot of time with it. And then there is “chuvag” (Rus. “chuvak”; Eng. “dude”).

4. *Surprise or misunderstanding*. As in any other language, surprise and misunderstanding occur unexpectedly, so people cannot find the right words and replace them with specific interjections. The same phenomenon is found in Olbanian: “V rot mne nogi” (Eng. literally, “legs in my mouth”) which means: “I'm shocked”); “gee!”, (Eng. “omg”) is the translation for the acronym that stands for “oh my god”; “itit’” is an old Russian expression of surprise, similar to “goddamn”; “yyp” (Eng. “Umm…”) is a interjection used in a moment of confusion.

CONCLUSION

Initially, when an accessible Internet connection was something new, people visited websites and created accounts in social networks due to curiosity and desire to express themselves through comments, posts, or reviews. This is, in general, still the reason why we used Internet today. In this context, is interesting that most people used to prefer the Padonkaff language rather than traditional Russian. The spread of this style of writing and speech can also be explained by a fashion trend of the 2000s. The ease, simplicity in the expressions, the underlying sarcasm, and the rapid global spread certainly make Olbanian phrases very popular.

The Padonkaff language, which became widely spoken in Runet at the beginning of the 21st century, is a sociocultural and linguistic phenomenon. Similarly, the Olbanian language also did not go without a trace. Although few people use this language on a regular basis today, some words and expressions remain popular. Indeed, because slang words began to go beyond the Internet, these appear in spoken language, media, youth films and talk shows (Mahmutay, 2019). There are also books that depict this phenomenon. For example, in Victor Pelevin's novel "The Helmet of Horror" (2005), written in the form of an Internet chat, one of the characters speaks exclusively in the Olbanian language.

The specificity of communication in the network has defined some features of the use of language as abbreviations or common typos. Nevertheless, there are distortions of language that deserve special consideration. English LOLspeak, German Vong-Sprache, Russian Olbanian have their own developed system of rules, or anti-rules. It is worth mentioning that among the three listed items, Olbanian was the first to appear. As early as the late 1990s, it was found that the most popular Olbanian words could be already collected and categorized. So, in this work was proposed a classification of words and expressions of Olbanian language, relative to the emotional and semantic component: approval of the statement or the user himself; respect, as extreme form of approval; appreciation of humor; criticism, harsh condemnation of the author and his work; appeals; surprise or misunderstanding.

The study also revealed linguistic features of word formation in Olbanian language: doubling of letters, substitution of sound with its pair, transliteration of foreign words; abbreviations of well-established expressions, uniform writing of expressions, reverse transliteration, transformation of verbs with reflexive suffixes; formation of words by way of expression of emotions; intentional misspelling of foreign words; tendencies to introduce the letters “й” and “ъ”, otherwise avoided.

We may have thought the Olbanian language to be just a joke, sometimes even a distasteful one, the consequences of the widely discussed illiteracy of people who “changed books for the Internet,” but closer analysis has revealed that its structure is more complex than it might appear at first glance. In fact, only if we consider Olbanian as well as other languages born directly from the Web, as a necessary form of expression related to their context of emergence, we will appreciate its expressive richness. As a variant and deformation of ordinary language, it not only meets the needs of Internet communication (speed, simplicity, effectiveness), but also constitutes a parody of it. So, like all distortions, it has a subversive potential, which is to challenge ordinary structures, exhibiting a disfigured and in some ways grotesque version of them.

Therefore, Olbanian is not just a degraded way of writing online, or the sectarian and exclusive language of a community, but manages to be assessable in terms of a vehicle for creativity. A kind of creativity that is only made possible by those forms of interaction that have developed on the Internet. So, the Olbanian also constitutes a privileged way to access the mechanisms, expressive and linguistic, internal to the wider Russian sphere of the Web.

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Research article

Conflation of Technology and Language: A Cognitive Artifact

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Abstract

We use concepts to make distinctions. Blurring these distinctions results in conflations. So, they are commonly seen as vicious. The claim here is that, by contrast, conflations are virtuous because they can do cognitive work. They enrich our conceptual resources. It is not conflation *per se* that is destructive but the lack of evaluation. Committing a conflation requires two cognitive acts at once. First, keeping things together and, second, appreciating the gap between them. Conflation thus has a family resemblance with notions like *analogy* and *metaphor*. Despite their apparent difference, a shared trait is recognizable in this family: the *simultaneous* maintenance of similarity and difference. This is not a bug, but a feature. The cognitive work is done *because of* it not *despite of* it. Consequently, we should evaluate conflations not by appealing to their being conflations *per se*, but by appealing to *what they have done and can do* according to our cognitive *goals* and our cognitive and cultural *resources*. Throughout history, many have conflated technology and language—most notably Socrates who conflates tools and names. A recent conflation is the case of „computer languages." I exhibit the virtuous cognitive work of this conflation in at least three respects: the historical development of computers, their real-time workings, and the incommensurability between computer and human language.

Keywords: Conflation; Analogy; Metaphor; Computer language; Incommensurability; Machine Learning; Artificial Intelligence

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Научная статья

Слияние технологии и языка: когнитивный артефакт

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Аннотация
Мы используем понятия, чтобы проводить различия. Размывание этих различий приводит к смешениям. Таким образом, они обычно рассматриваются как негативные. Утверждение здесь состоит в том, что, напротив, смешения позитивны, потому что они могут выполнять когнитивную работу. Они обогащают наши концептуальные ресурсы. Деструктивно не смешение само по себе, а отсутствие оценки. Совершение смешения требует двух когнитивных актов одновременно. Во-первых, держать вещи вместе, а во-вторых, ценить разрыв между ними. Таким образом, смешение имеет родственное сходство с такими понятиями, как аналогия и метафора. Несмотря на кажущуюся разницу, в этой семье узнаваема общая черта: одновременное сохранение сходства и различия. Это не баг, а фича. Познавательная работа совершается благодаря этому, а не вопреки ему. Следовательно, мы должны оценивать слияния, апеллируя не к тому, что они являются слияниями сами по себе, а к тому, что они сделали и могут сделать в соответствии с нашими когнитивными целями и нашими когнитивными и культурными ресурсами. На протяжении всей истории многие смешивали технологию и язык, в первую очередь Сократ, который смешивал инструменты и имена. Недавнее смешение относится к “компьютерным языкам”. Я демонстрирую позитивную когнитивную работу этого смешения, по крайней мере, в трех аспектах: историческое развитие компьютеров, их работа в реальном времени и несоизмеримость между компьютером и человеческим языком.

Ключевые слова: Слияние; Аналогия; Метафора; Компьютерный язык; Несоизмеримость; Машинное обучение; Искусственный интеллект

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INTRODUCTION

Conflation is usually a negative thing that should be avoided. If you don't see subtle differences between concepts, you are conflating them. If you put your money on the *bank* of a river, you have done a clear case of conflation. If you do not distinguish between "bank" as *the shore of a river* and "bank" as *a monetary system* you will soon suffer the consequences and get poor. Besides these exaggerated cases of everyday life, we have other sophisticated cases of conflation and the business of philosophers is to *un-con-flate* them: We shall not conflate concepts. However, there are many occasions for *committing good conflation*, most notably in metaphor and analogy. So, by dismissing all conflations, we might end up dismissing many good ones.

In a post-Darwinian era, the desire to "carve nature at its joints" has lost steam. However, when dealing with concepts, it seems that philosophers still want to "carve thought at its joints." It is common for us to see concepts as the building blocks of our cognition. If we frame cognition like this, then the defense of conflation would be twofold. First, concepts (the supposedly building blocks of our cognition) are not as rigid and clear-cut as the frame suggests. Concepts are fuzzy, vague, analogical, metaphorical, and as I summarize: all born out of conflations. Second, the working of our cognition (the supposed construction of our cognition with those blocks) is not a formal practice following fixed eternal laws. Rather, the working of our cognition is informal. Our cognition takes advantage of *bizarre conflations*. In other words, what makes our cognition a *working* one is not its rule-following behavior in accordance with rigid laws but, by contrast, its ability to bend laws in order to conflate.

In the first main section, I review Socrates' conflation of technology and language. In the second section, I elaborate upon the notion of conflation and the importance of the *simultaneous* maintenance of similarity and difference. The moral is: we should see conflation as a virtue, not as a vice. In the third section, I examine a special case of conflation between technology and language: the conflation of computer and human language.

SOCRATIC CONFLATIONS

To *see* words *as* tools is widespread in different cultures. However, my review here is very brief and restricted to Socrates. The aim is to show that the conflation of technology and language is nothing new or out of ordinary.

The conflation of Names and Tools

Socrates, in Plato's *Cratylus*, sees names as tools. Names, as Socrates claims, are the smallest part of our statements. The topic of the dialogue is the "correctness of names". The debate is framed as a contrast between "conventionalism" or „nominalism" and "naturalism or „realism." The former argues for an arbitrary designation relation between names and their meanings, or referents. The latter argues for a natural non-arbitrary relation.

To argue for "naturalism," Socrates appeals to an analogy with tools: if you want to cut something you should "cut in accord with the nature of cutting and being cut and

with the natural tool for cutting" (Plato, 1997, p. 105, 387a). Here "natural" is not contrasted with "artificial." Rather, it is contrasted with "arbitrary" or „contrived." We cannot use tools as we wish. The use of anything as a tool, found in nature or built by humans, is enabled and, at the same time, restricted by the "nature" of the tool, or – to put it in contemporary parlance – by its "affordances." Socrates conflates tools (like "drills" and "shuttles") with names. Once the conflation is established, interesting corollaries follow.

By using the analogy, Socrates is enabled to discern *inferential patterns* of the source domain (weaving) and transfer them to the target domain (thinking). Socrates observes that as good weaving needs good shuttles, good thinking needs good names: "So just as a shuttle is a tool for dividing warp and woof, a name is a tool for giving instruction, that is to say, for dividing being" (Plato, 1997, p. 107, 388c). Socrates believes that a mark of good thinking is being able to "divide" being and this needs a good dividing tool.[1] In more familiar words, to carve nature at its joints we need good carving tools.

Another *inference pattern*, which is transferred from weaving to thinking, is this: any tool should be designed and built by experts, so naming should be done by experts who know "the craft of grammar." Another *inference pattern*, which is transferred by Socrates from tool use to naming, is this: as one can reverse-engineer tools in order to find rational reasons behind their construction, one can do etymology by reflecting upon the letters and syllables of names in order to find the rationality behind them. This leads Socrates to a tally of amusing etymological speculations.[2] Socrates is following his conflation wherever it leads.

It is clear that Socrates is conflating words and names. However, he commits another conflation related to the discussion in the next section of how conflations become productive. At some point, Cratylus challenges Socrates' account of the "craft of grammar" by pointing to a difficulty. By doing etymological speculations, Socrates is presupposing that the working of our tools (names) are very sensitive to their working parts (syllables and letters). It has a corollary: if we just change a letter in a name it might stop working! If we play too much with them they might break! If we play too much with the letters and syllables of a name – as Socrates is doing by his speculative etymology – the name ceases to be a name at all. How can Socrates play with syllables and letters without breaking the names?

Socrates claims the problem arises because Cratylus has made a conflation between numbers and names. The sensitivity to internal parts is true of numbers not of "sensory qualities." Socrates suggests another conflation: paintings and names. Socrates compares colors and shapes with syllables and letters. In this new conflation, the relation between

[1] The irony is that he is arguing for the importance of "dividing" by blurring the divide between names and shuttles!
[2] For example, heros are called "heros" either because they were borne out of love ("eros") or else because they were sophists ("rhetores"). Humans are called "anthropos" because they reflect ("anathron") upon what they see closely ("opope") and because they are the only animal doing this (Plato, 1997, p. 117-118, 398). Socrates' examples might seem preposterous. Some contemporary interpreters say Plato wants to mock etymological practice. At some point, Socrates says there are "serious" explanations and "playful" ones and analyzes "Dionysos" and "Aphrodite" playfully because "even the gods love play" (Plato, 1997, p. 124, 406c). However, Sedley (2020) rejects this interpretation and claims his etymological efforts are seriously meant. It looks weird to us because we now know much more about their language than the Greeks themselves.

a name and what it means remains stable *despite of* subtle changes in the internal composition of the name. Why? He transfers an *inferential pattern* from the realm of painting to the realm of naming: an image of Cratylus would remain an image of Cratylus *even* if patches of colors or shapes are changed slightly. In other words, the workings of names are sensitive enough to their syllables and letters to enable etymological speculations, but they are not so sensitive as to make those speculations meaningless.

Take Courage in Committing Conflations

There are two points in regard to the conflation of painting and naming which are related to the discussion in the following section on the work of differentiation. First, Socrates is using his cognitive and cultural resources to commit conflations. However, he is discriminating against conflations: one is good (paintings and names) the other is bad (numbers and names). He prefers one because it works better for his cognitive goal – which is here etymological speculations. Second, Socrates knows that something is eerie but insists that one should overcome the fear. Socrates says to Cratylus:

> "Take courage then and admit that one name may be well given while another isn't. Don't insist that it have all the letters and exactly resemble the thing it names, but allow that an inappropriate letter may be included" (Plato, 1997, p. 148).

In other words, Socrates is claiming that an image represents Cratylus not *despite of* its inability to perfect imitation, but *because of* this inability. Socrates is acknowledging the importance of imperfection: it is risky but we should take courage. If an image imitates perfectly, it results in two exact things. But nobody wants another exact copy of the world. One is already too much! The next section can be read as an exposition of this *simultaneous* maintenance of similarity and difference.

SEEING CONFLATION NOT AS A VICE BUT AS A VIRTUE

One of the findings of cognitive science is that the majority of our cognitive work is done backstage and we are not conscious of them.[3] So are the conflations. Ordinarily, we make exaggerated out-of-context conflations just to ridicule them: "where do fish keep their money? At the river bank." Here, a conflation is supposed to make us laugh[4] and, at the same time, it is supposed to belittle itself. We come to see how ridiculous is to conflate. But even this ridiculous conflation can do some "work": it can make us laugh if it is well-said[5], and at the same time it can warn us against conflations. However, contrary to the moral of this joke, conflations can do much more than make us laugh or belittle themselves. Their life is not restricted to jokes. They are active in our most cherished

[3] For a good exposition of three revolutionary findings of cognitive science (cognition is metaphorical, unconscious, and embodied) see Lakoff and Johnson (1999).
[4] This joke is overused and the funny part is broken, but I hope at least it is *imaginable* how funny it could be.
[5] Baird and Nordmann (1994) use a well-said-joke to clarify the notion of a well-put-thought and finally the notion of a well-put-fact. Their focus is on how well-put-facts, produced and sustained by technological toys, can anchor us in a "sea of linguistic and theoretical confusion." Here I have this analogy in mind, but I do not see one (fact) as the savior of the other (thought). I look into their mutual relation: sometimes a well-said sentence can anchor us in a sea of practical confusion. Seeing facts and sentences in this way is a good example of conflating technology and language.

cognitive works. Our cognitive work is done *because of* doing conflations not *despite of* it. Conflations are *cognitive artifacts*[6] having a productive life of their own.

The Shared Trait of a Family

What is *conflation*? Its *intension* is vague. Instead, we can look at its *extension.* But, spotting conflations is not easy because many of them are *established* and we do not *see* them *as* conflations anymore. A working strategy would be to look at similar notions in order to find a "family resemblance."[7] By so doing, we would have a better grasp of the notion of conflation.

Opposition: In opposition, first, there should be some kind of relevance and, second, this relevance should be challenged. Entities should be related *but* against each other. Oppositions are celebrated in different cultures. Lloyd (1966) explains, in *Polarity and Analogy: Two Types of Argumentation in Early Greek Thought*, how "pairs of opposites" were crucial for Greek thought: left and right, male and female, etc. Opposition or polarity is also obvious in the Chinese "yin and yang." The ancient book of *Tao Te Ching* is a poetical glorification of opposites.[8] Also in Islamic mysticism oppositions are celebrated in the saying: "Things are known through their opposites."

Contradiction: In logic, two propositions are contradictory if they share everything *except* the truth. For any contradiction, as with opposition, there should be a high degree of similarity *except* a decisive difference. Formal contradictions are almost identical *but* different.[9] Contradiction can be less formal and be called informal contradiction which is famously the hallmark of Hegelian philosophy. Here, again, we have the *recollection* of both similarities and differences.[10] In both, formal and informal, there is a *simultaneous* contrast between similarity and difference at work.

Mistake: If we mis take something for another, it is a "plain mistake." An entrenched philosophical derogatory term for this blunder is "Category Mistake." We shall not mis take a robot for a person. However, Dennett (1996) writes, arguing for attribution of intentions to things, "There is no taking without the possibility of mistaking" (p. 37).[11] Inversely, as the word "mis-take" already shows, there is no mistake without the possibility of taking. In sum, "making mistakes" can do cognitive work and it needs a *simultaneous* maintenance of similarity and difference.

Metaphor: We *see* something *as* another thing and we celebrate this conflation by calling it a "metaphor." Some see the conflation as a reason for rejection: metaphor is decorative and "just a metaphor." Others see it as a reason for appreciating metaphor's

[6] Explaining a pun might ruin its fun. However, it should be noted that "artifact" can be understood in two ways. First for its negative meaning: false observations. For example, Galileo's discoveries were dismissed by some as artifacts of his telescope. Second, for its positive meaning: tool.
[7] Wittgenstein's "family resemblance" celebrates *the missing* of any single shared property for grounding the resemblance. Here, we can see this *missing* as a *shared trait*.
[8] For an English translation of Tao Te Ching see Chen (1989).
[9] In the logic of sets – dealing with sets of objects – a negation is a "complement". A term that clearly has positive connotations.
[10] See Brandom (2019), chapter 3, "Representation and the Experience of Error" for how the process of experiencing errors (incompatibilities and negation) leads to truth.
[11] This is what Dennett calls an "Intentional Stance". One can (mis)take almost *anything* as an intentional system and attribute intentionality if there is a cognitive or biological payoff.

cognitive work. In either case, we are *simultaneously* maintaining similarities and differences. Metaphor has been celebrated by many, old and new, thinkers as the fundamental element of our cognition, most notably by Lakoff and Johnson's *Metaphors We Live By*, first published in 1980.

Analogy: Analogies are so similar to metaphor that drawing a line between them seems arbitrary. Conflation is also explicitly at work in analogy: the maintenance of a *simultaneous* similarity and difference. It has also been celebrated by many thinkers as the base of our cognition, like Hofstadter's (2001) *Analogy as the Core of Cognition*.

Error: Errors have a double life. On the one hand, they are something passive that should be avoided. Measuring units should be as precise as possible to eliminate any errors. On the other hand, they are something active that can do work. The paradigmatic case is the error signal in a feedback loop. A feedback loop can do extraordinary feats by incorporating the error as an active part of the system. Mayr (1989) makes explicit the role of "feedback mechanisms" in modern thought. The active role of error in feedback loops is borne out of a *simultaneous* maintenance of similarity and difference between the output and the setpoint.

Abstraction: Abstractions are celebrated as the ultimate feat of the human mind. However, they are nothing but *established* conflations.[12] To see two red edible spheres as "apples" is to abstract from their differences and conflate them.[13] We usually do not *see* abstraction *as* conflation. We realize only if their establishment is challenged, for example by a fake apple. Abstraction and conflation are two sides of the same coin: they need a *simultaneous* maintenance of similarity and difference.

We can conflate "conflation" with these notions and see if this conflation can do cognitive work. One might object that even if we accept conflation as legitimate, we need similarity in the first place to begin with. The response would be that similarity is the product of conflation not the ground of it. Similarity is something we construct. It is not a given.

What Do Cabbages Share With Kings?

It is ancient wisdom that everything is similar to everything else. In many cultures,[14] Gentner and Jeziorski (1993) write, "The alchemists' willingness to heed similarities of all kinds derived in part from their belief that all things above and below are connected, and that similarity and metaphor are guides to those connections" (p. 464). Carnap, who wanted to unify everything in a deductive formal system, tells a "dialectical" story of the struggle between "critical intellect" and "imagination" which led the "critical intellect" to make a discovery in antiquity, "That is the discovery of *one* [single] *comprehensive space*. All things are in space; any two things are always spatially related to each other. So there is also a path from me to any [given] thing" (quoted in Leitgeb & Carus, 2023). Sellars (1962) writes in a similar way:

[12] We nowadays use "rock" to refer to celestial bodies as well as terrestrial ones. This is, in the eyes of the ancients, a clear case of conflation.
[13] A Platonist would reject this.
[14] For example, Ibn Arabi and Rumi, and many other Islamic mystics, claim that everything in the world is similar and related because they are manifestations of God, the Unit.

> The aim of philosophy, abstractly formulated, is to understand how things in the broadest possible sense of the term hang together in the broadest possible sense of the term. Under 'things in the broadest possible sense' I include such radically different items as not only 'cabbages and kings', but numbers and duties, possibilities and finger snaps, aesthetic experience and death. (p. 1)

I do not want to put cabbages and kings together here. However, encouraged by this old wisdom, I claim despite the apparent diversity wihin the family (opposition, contradiction, mistake, metaphor, analogy, error, abstraction, etc.), they resemble each other in this respect: the *simultaneous* maintenance of similarity and difference. This is what can be called *the shared trait* (some migh consider it a defect) of the family.

Committing a conflation requires two acts at once. First, keeping things together and, second, appreciating the gap between them – recall Socrates. These are two sides of the same coin. The derogatory meaning of "conflation" is the result of seeing conflation as one-sided: appreciating only the gap. But, there is another side which is as important: keep things together while aware of the inellinimalble gap. Is it rational? Does it pay off?

When analyzing literary metaphors, Black (1962) explained his "interactionist view" of metaphors by appealing to the "interaction" of "distinct ideas" or "primary and subsidiary subjects" and the need for "simultaneous awareness of both subjects" which should not be reduced to a "simple comparison" between the two, because then the "cognitive content" would be lost (see Black, 1962, chapter 3). Black restricted his analysis to literature, despite his willingness to extend it to philosophy. But the accumulation of empirical evidence in Cognitive Linguistics throughout the years has revealed the importance of this *simultaneous awareness of distinct ideas* not only in language but in *every* cognitive activity. Fauconnier and Turner (2002), after reviewing many examples of what they call "conceptual blending", write "We have now seen a wide range of cases in which there is *a need to be able to maintain simultaneously what looks like contradictory representation*" (p. 84, emphasis added). The point is that there is something contradictory, *but* it should be entertained not avoided. Because "… blends are efficient at many levels of cognition" (p.85). In other words, we should conflate because our cognition works by it. The moral is that conflation – in the two-sided meaning of the term – can do cognitive work *because of* being a conflation not *despite of* it.

However, it is not easy to conflate! Conflation needs a lot of work. Keeping things together while appreciating their distinctiveness needs different amounts of work. It needs a lot of work for radically different things like cabbages and kings. It is effortless for two ordinary apples. We *see* these established conflations *as* conflations only when they *do not function as always* and our relation with them changes from *ready-to-hand* to *present-at-hand* (Heidegger's tool analysis). Only then can we *see* these cognitive artifacts *as* cognitive artifacts. Conflations work under the threshold of our consciousness. They do not require our conscious effort. We are not aware of them. However, we can make them explicit, evaluate them, and make improvements.

There are similar claims in cognitive science.[15] However, if we abstract from the differences between their theoretical nomenclature (Metaphor, Analogy, Conceptual

[15] Most notably Lakoff and Johnson's (2011) "Conceptual Metaphors", "Analogies as the fuel and fire of thinking" by

Blends, etc.) we would end up with a very abstract notion of conflation: conflation as a *useful defect*, a *cognitive artifact*.

Evaluation of Conflation

Appraisal of conflations might be seen as opening the door to chaos. This is a false impression. It is not conflation *per se* that is destructive but the lack of evaluation. As in evolutionary biology where it is not the mutation that is destructive, but the lack of selection and inheritance mechanisms. As in a feedback loop where it is not the error that is destructive but the lack of a set point and negative feedback. Similarly, to be constructive, conflations should be domesticated. Imitating Kant we can say, "Conflation without evaluation is blind, evaluation without conflation is empty."

There are at least two ways of evaluation. First, we can evaluate conflations against how they satisfy cognitive goals. This can be done by analyzing conflations that have already done great cognitive work in everyday life, science, art, technology, etc. History has already sifted out good ones from bad ones and we, by hindsight, know a lot about their merits.[16] Second, we can evaluate them according to the effort they need. For example, putting cabbages and kings might do substantial cognitive work but at the expense of very sophisticated mental gymnastics. In other words, the success of a conflation is constrained by the cognitive and cultural resources we have. So, for making a new conflation, it is better to build upon *established* conflations.

We can summarize this section by building a *mental model* for thinking about conflation. We are experiencing the world as a 3D space *thanks to* the *errors* our eyes are making in front of our eyes. Our vision conflates, in real-time, two *similar* but *different* sensory inputs to produce a stable 3D vision. We can manipulate this error. On the one hand, we can eliminate it by closing one eye. On the other hand, we can increase the error by moving our eyeball with a finger (be cautious!). In both cases, we would ruin our 3D experience. Our 3D vision works *thanks to* an *optimal error* which is determined by our *goals* plus our bodily and cognitive *resources*. The same goes for our cognition and conflation.

In sum, a strange inversion of morals is needed: we should appreciate conflation as a virtue, not as a vice. However, we should evaluate conflations according to our *goals* and *resources*. In the final section, I will now scrutinize a special case of the conflation between technology and language, and follow the conflation where it leads.

THE CONFLATION OF TECHNOLOGY AND LANGUAGE

We can discern, analytically, at least three "clusters of issues" in regard to the relationship of technology and language.[17] First, their definitions. How do we define technology and language: etymological, essential, prescriptive, linguistic, or pragmatic?

Hofstadter and Sander (2013), and "Conceptual Blendings" by Fauconnier and Turner (2002), to name but a few.

[16] Thagard (2012), chapter 9, reviews 200 inventions in science and technology to show how they are borne out of combinations of mental representations. His account is *mental* and *representational*. For a *non-mental* and *non-representational* account see Hutchins (2005).

[17] I am inspired by Radder's analysis of the relationship between technology and science. See his intro to part one in Meijers et al. (2009).

Second, our interest: in which way are we interested in their relationship? (a) empirical: interested in their actual and historical engagement, (b) conceptual: interested in our conceptions of them, or (c) evaluative: interested in judging them according to epistemic, social, moral, or other values. Third, their relationship balance: which one is superior? We might see their relation as: (a) bilateral independence: having their own identities and living their own lives, (b) unilateral dependence: one is superior, prior, primary, more valuable, higher in rank, more meaningful, more human, etc., or (c) bilateral co-constitution: they are shaping each other in substantial ways.

Addressing all these issues is beyond the scope of this paper. However, we can situate our discussion according to them. First, our aim here is not *defining* technology and language. Second, our interest is not *evaluating* them in terms of social, epistemic, or other values. Our interest here is *empirical* and *conceptual*. Third, we see their relationship as a bilateral co-constitution. In sum, we are conflating them: keeping both in mind, reflecting upon their similarities and differences, and allowing them to blend and shape each other through the course of analysis and synthesis. In what follows, the focus is on a special case of technology (and language): computer language. I would scrutinize the *empirical* aspect of the relation between human and computer languages, and how our *conceptions* of both *are* and *should* be affected by this engagement.

Computer Language: An Oxymoron or A Platitude?

The *notion* of computer language is less commonsensical than the *notion* of human language. After all, human language is more widespread and a subject of reflection for a long time. Despite this reflection, however, our conception of human language is far from being established and standardized. On the one hand, there is a long history of failed attempts for purifying the human language and building an ultimate formal rational one: from Leibniz's dream of "let us calculate" for settling all philosophical debates to Carnap's ultimate formal language for unifying all knowledge. On the other hand, there is a parallel history of successes: from the language of "punched cards" for playing music and weaving complex textiles to the modern programming languages of computers. We wanted an ultimate rational language for ourselves (humans) but ended up with a robust language for them (computers). Philosophers wanted a robust language for settling debates effectively. However, while philosophers are still under the curse of Babel's Tower, computers are collaborating so effectively that they are now playing the role of the old wise philosopher who is answering all the questions.[18] Have computers found the ultimate language? What is the relation between our language and theirs?

It is easy for programmers to see the similarities between them. Because, after all, they are similar! But one might object that they are not *really* similar. Computers work with zeros and ones but we talk with letters and words. Computer language is precise and static. Ours is vague and dynamic. A student in humanities does not know, and does not feel the need to know, very much about computer languages. A computer programmer does not know, and does not feel the need to know, very much about human language.

[18] ChatGPT is the newest and maybe the most successful achievement. It is so authentic that some try to list it as an author of scientific publications. See van Dis et al. (2023).

They are not similar because, after all, they are different![19] However, as explained in the previous section on the virtues of conflation, the point is the *simultaneous* maintenance of similarities and differences. This is the working part of any conflation. So, let us follow the conflation: where does it come from and where does it lead?

A Brief History of the Conflation[20]

Mechanical clocks and automata (Ancient Chinese, Islamic Golden Age, premodern Europe) are amongst the oldest "programmed" machines in which an orchestra of toys and gadgets play a short theater thanks to a hard-wired algorithm realized by mechanical and hydraulic tricks. Here, with a little imagination, we can *see* these tricks *as* a from of "language" – a semi-language. There are regularities that craftsmen know how to use for expressing a meaningful theatrical chain of movements: a grammar of things.

One might object that the workings of these mechanical devices are far from the realm of language. They are not even a primitive form of language. Some linguists, most notably Chomsky, believe that our language faculty does not come in degrees. We have no evidence of any intermediate forms of human language – proto-language or semi-language. Humans are endowed with the Universal Grammer, a uniquely human faculty. In other words, human language is *sui generis* and completely different from mechanical chains of movement. However, ironically, Chomsky writes, in 1957, at the beginning of his seminal *Syntactic Structures*, "Syntactic investigation of a given language has as its goal the construction of a grammar that *can be viewed as a device of some sort* for producing the sentences of the language under analysis" (Chomsky, 1957/2002, p.11, emphasis added). One can see how Chomsky's conception of language is already shaped by his conception of a "device". We know that this linguistic "device" shaped the root metaphor of cognitive science, namely seeing the mind as a computer. So, even in the mind of ardent linguists, the supposedly unique human language is already conceived as something mechanical and algorithmic.

The systematic chain of movements in a mechanical device can be considered in more abstract terms like the term "algorithm" which is derived from the name of Al-Khwarizmi, the ninth-century Persian mathematician. With his algorithms, one could follow myopically a finite chain of steps in order to solve arithmetic or geometrical problems. The human language was combined with Arabic numerals and geometrical shapes in order to instruct – "to program" – ordinary people, other than genius specialized mathematicians, to solve problems. It was a big step toward mechanizing thought, and toward closing the gap between humans and machines.

Before and after, we had also many other "algorithmic" mechanical devices: Mechanical Calendars; Antikythera; Astrolabe; Zaicha which was a Persian diagram for horoscope; Lull's disc diagrams (*Ars Magna*) for reasoning mechanically about God,

[19] Some might *see* the "human language" *as* the *differentia* between humanities and other sciences. In the human realm we "interpret" but in the non-human world we just "explain". The conflation of technology and language is meant to cut across this division.

[20] The history behind is much richer, but not in a vague way that "history is rich and complex". We know many details. However, for the sake of brevity, I tell a very short and selective story.

inspired by Zaicha and similar mechanical diagrams; Pascal's mechanical calculator; Leibniz's mechanical calculator – inspired by Pascal's *Pascaline*, Lull's diagrams, and by the "binary patterns" in Chinese wisdom[21] – in which cogs and wheels were "programmed" to do arithmetic; self-playing musical instruments like carillons, music-boxes, and special pianos "programmable" by a bunch of bumps on a cylinder or holes on a paper; Maillardet's automata "programmable" by highly-detailed indented camshafts for painting and hand-writing;[22] Jacquard's weaving machine "programmable" with punched cards for different textile designs. In all of these device, we can see how a mechanical and algorithmic "language" is emerging with its own vocabulary – cogs, wheels, levers, punched cards, and other mechanical gadgets – and its own grammar – "algorithm" as the abstract norm. This new mechanical and algorithmic language is meaningful because it does arithmetic, plays music, weaves textile, paints, writes, and more. It is universal and anyone can use it effectively.

The rest is history: Babbage's analytical engine for doing complex mathematics which was inspired by camshafts and punched cards;[23] Boole's algebra which was a "translation" of traditional logic to the "language" of ones and zeros which was the "language" of punched cards; Shannon's implementation of Boolean algebra in the electrical circuits which again was a "translation" from the "language" of Boolean algebra to the "language" of electrical circuits. To make a long story short, in the mid of 20th century, at the end of a highly convoluted path, with many conflations and "translations" established throughout the journey, the modern computer was born, idealized as a "Turing Machine."[24]

For running a Turing Machine, which is theoretically the base of all computers, all we need is a very long band of paper, a pen, an eraser, and a very minimally intelligent being who can read and write zeros and ones on the paper band according to the very primitive logical conditions described in the Turing Table of the machine. In sum, the computer boils down to a simple machine that manipulates a bunch of zeros and ones according to some simple *instructions*.

The Turing Machine looks great. It is mechanical, myopic, almost idiotic, and at the same time can do a lot of intelligent work. It is an idiot savant. However, it is intelligent because it follows *our instructions* implemented in its Turing Table. The Turing Table is the brain, or mind, of the Turing Machine and its design needs a lot of work – which makes the difference between an expert programmer and a newbie.[25] A good programmer *instructs* the machine *successfully* and *efficiently*.

In the early days, one had to instruct the computer with punched cards (until the 60s). The big difference between our computers and early ones is that now the *instructions* are written with digital zeros and ones in digital registers, not with holes in punched cards. As Hayes puts it succinctly, the paper band of the Turing Machine is now turned into a

[21] See Gardner (1983) and Sowa (1999) for more on mechanical reasoning devices.
[22] See the documentary narrated by historian of science Simon Shaffer (Stacey, 2013).
[23] Ada Lovelace, Babbage's friend and collaborator, wrote, "We may say most aptly that the Analytical Engine weaves algebraic patterns just as the Jacquard-loom weaves flowers and leaves" (quoted in Thagard (2012), p. 163).
[24] There are many other prominent figures in the history of modern computers. However, it is customary to use Turing with his abstract machine as the protagonist.
[25] Saunders and Thagard analyze some creative aspects of being a programmer (see chapter 10 in Thagard, 2012).

"magic paper" on which, "writing might spontaneously change, or new writing appear" (quoted in Angius et al. 2021). Thanks to this magic, our computers can bootstrap themselves out of a bunch of zeros and ones into the human world.

Besides many "translations" made and established throughout history, many "translations" take place in real-time in the hierarchy of computer languages: from zeros and ones, to machine code, to assembly language, all over to the high-level programming languages. Nowadays, the computer language is so human that not only professional programmers "speak" it but almost anybody. We "type," "click," and "google" without realizing that actually we are *instructing* the machines through its Turing Table. Computers are now so human that we "speak" with computers *literally* in our own human languages.

I have three observations in regard to this brief history. First, throughout the long process of the evolution of computers, many "translations" have happened. It is thanks to this chain of translations that we have "computer language." These translations took place first on a historical scale and second in real-time in our computers. Thanks to these conflations[26] of different "languages" we now have "computer language." With "computer language" we (collectively) are enabled to speak with machines and even, more dramatically, we are enabled to speak with each other. In other words, even our human language is now mediated thoroughly by computer language.

Second, computers are built upon the paradigmatic case of conflation! They use the simultaneous maintenance of similarity and difference: zero and one. It is not about being "0" or "1." It is about their "opposition." Theoretically, we can realize this opposition in any medium: the direction of an arrow (up and down), the voltage in a circuit (high and low), the being and the non-being (hole and non-hole), etc. What really matters is the *simultaneous* use of two opposing things. This is another way of claiming: computers are borne out of conflations.

Third, despite all the similarities, a recalcitrant difference remains. In the above brief history, I glossed over a very important difference. Turing Machines work by *our instructions*. Their work is comprehensible within the human scale: we speak to them through a chain of *tractable* translations. However, today's Turing Machines are hosting new creatures whose language is alien to us – new guests who are transforming their host.

The current hype in AI is a Cambrian explosion of Machine Learning creatures. According to Domingos (2015), we can discern five "tribes": Symbolist, Connectionist, Evolutionist, Bayesianist, and Analogist. These tribes speak different languages, some of them comprehensible to us but some of them not: Symbolists speak using the old familiar notions of induction and deduction; Analogists use similarities; Connectionists use neural networks; Evolutionists use genetic algorithms; and Bayesianist use statistics. Computer scientists know the languages of these tribes and they are working to unite them – Domingo's "Master Algorithm" is meant to do this. However, there is a communication problem between Machine Learning language and human language. It is a problem more than just a misunderstanding or a mere difference in speed or scale.[27] The difference is more fundamental, suggesting an ineliminable gap.

[26] For a brief review of recent conflations (analogies) used in computer science see Thagard (2012), chapter 10.
[27] The focus of our discussion is on the linguistic aspect of computers, hence incommensurability. However, there are

The Incommensurability Problem of Human and Computer Languages

There are many different high-level computer languages and they can speak to each other – even if they are substantially different. Virtual Machines are built to translate computer languages into each other. However, sometimes they cannot: either because it is technically too cumbersome and inefficient or because of business conflicts. Either way, there is nothing incommensurable *in principle* between computer languages because at the bottom all of them are *instructions* written by *us* for Turing Machines. However, Machine Learning creatures are different. They are computer programs but they use computer language in a different way. They do not follow *our* instructions. They instruct themselves and solve problems in their own way. As Domingos (2015) writes, "We can think of machine learning as the inverse of programming." They are Turing Machines turned on their heads: they write their own instructions. To put it more precisely, their instructions are so alien to us that calling them "instructions" is just a metaphor! Their Turing Table is just a numerical spaghetti for us. Their thoughts are ineffable, not only in our human language but even in the language of Turing Machines.[28]

Haugeland (1985) coined the term GOFAI (Good Old Fashioned Artificial Intelligence) to mark a shift in the conception of artificial intelligence. With the advent of connectionism and embodied approaches, it was difficult to maintain the concept that intelligence *is identical* with internal symbol manipulation epitomized by the Turing Machine. At best, a Turing Machine could be a *simulation* of intelligence, the way a computer simulation of a hurricane is just a simulation and is not identical to the real hurricane. However, despite this conceptual shift, computers were at the bottom still Turing Machines and one could, at least theoretically, look at their Turing Table to see their instructions.

For example, "neural networks" – an imitation of the brain's neural networks – do not need Turing Machines. Anyhow, they are simulated by them and we can look at their *instruction* table. Nevertheless, the promise of "neural networks" has encouraged engineers to throw away this ladder -- after reaching the rooftop. So, "neural networks" now can be realized not as softwares on Turing Machines but directly as hardwares. With the advent of these non-Turing Machines, the situation can get more dramatic: there is no table of *instructions* to look at, even metaphorically speaking! Does it mean that the analogy between computer language and human language breaks down? Does it mean that computer language and human language are eventually incommensurable?

To answer this question, let us scrutinize the notion of "incommensurability." The oldest meaning of the term comes from the fact, first revealed in ancient Greece, that there is no "common measure" between the realm of geometrical shapes and the realm of numbers. In other words, there are lines we can measure their length, qualitatively, by a piece of string but we cannot express their length, quantitively, in terms of numbers. The discovery of this ineliminable gap was a threat to the power of numbers. So, it was swept

other *qualitative* differences between humans and computers borne out of the accumulation of *quantitative* differences. As Lenhard (2015) shows, the "iterative" power of computers can result in their epistemic opacity to us. We cannot understand them simply because we cannot iterate as much as they can.

[28] This explains why Machine Learning creatures now are migrating to a new host environment: non-Turing Machines without Turing Tables – e.g. analog and quantum computers. See Haensch et. al (2019).

under the rug by their discoverers. However, as Fauconnier and Turner (2002) show, throughout the history of mathematics, the power of numbers actually increased by incorporating these "gaps" into the very notion of number. Zero, negative numbers, irrational numbers, imaginary numbers, and complex numbers all were first "outsiders" but eventually, they turned into "insiders." They changed our *conception* of "number." They enriched our cognitive resources and contributed to the cognitive power of numbers. So, incommensurability is not necessarily a reason for rejection. Ineliminable gaps, far from being a threat, might be opportunities for revising our old conceptions.

Another important notion of "incommensurability" was developed in philosophy of science by Kuhn and Feyerabend. Scientific theories are incommensurable when their viewpoints are so different that it is difficult to maintain one view and make sense of the other. A holistic shift of perspective is needed. This might be interpreted pessimistically: there is no way for a mutual constitutive exchange. In line with Quine's *indeterminacy of translation* we might suspect that there is no shared ground for meaningful exchange. However, mutual exchange in terms of this formal concept of *translation* is just one way of realizing a bilateral co-constitution. As Kuhn (1962) claimed in his later works, instead of *translating* them one can *learn* both languages. So, another way of overcoming the barrier of incommensurability is to become *bilingual* (see Oberheim and Hoyningen-Huene, 2018). Incommensurability *per se* cannot undermine a meaningful bilateral co-constitution.

In sum, the apparent incommensurability between computer and human languages cannot be a reason for the dismissal of the conflation. By contrast, it is a reason for maintaining it. Because, after all, the problem of incommensurability is an old question and we know a lot thanks to philosophy, logic, and linguistics. Computer languages are just mirroring all kinds of problems we have already within our human languages. Maintaining the conflation between human and computer languages might help us to transfer insights between them in order to know both in better ways. In the end, our conceptions of both might change radically.

CONCLUSION

Whenever we have a *simultaneous* maintenance of similarities and differences, we have a case of conflation. It seems vicious, but our cognition works by conflation through and through. Even in ordinary life, we *see* two apples *as* "apples" thanks to conflating them. Some of these conflations are so established that we do not *see* them *as* conflations. They satisfy cognitive goals by effective use of available cognitive and cultural resources. Hence, they do not look like conflations at all. However, they are present under the threshold of our consciousness. They are at work in analogies, metaphors, conceptual blendings, and alike. In all of these cases, a *simultaneous* maintenance of similarity and difference is at work.

Consider "computer language." At first glance it might be seen as an oxymoron: computers are far from language, and putting them together is a bad conflation. It is at best "just a metaphor." However, a closer look would reveal their similarities: how they have shaped and are shaping each other. Computers are borne out of a long chain of

conflations: “translations” between different languages in different media. Moreover, we are using computers thanks to many conflations and “translations” happening in real-time, though under the threshold of our awareness.

Computer languages are so similar to human language that similar problems are arising, like the problem of incommensurability. Machine Learning creatures are part of our everyday life. They solve our problems. But, we cannot ask them for reasons behind their solutions. Their style of reasoning is alien to us. Of course, these are mostly our problems, not theirs. Computers are more active and more productive than us. They are learning and speaking our language fast and fluently. However, the inverse is not true. We cannot speak the language of these new intelligent beings. Like it or not, they are coming to us. We should either speak their language or force them to speak ours. It would be a difficult journey. Meanwhile, we have to speak a *lingua franca*, before the emergence of a proper *technolingua*.

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Research article

Computer Programs and Musical Compositions as Technical Artifacts – Ontological Parallels

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Abstract

This article compares tonal music and computer programs on a level of technicity, their linguistic properties, and their ontology. In light of Raymond Turner's concept of a technical artifact, both artifacts are technical in the sense that they were created with intention by someone at a certain time. Computer programs as well as music come in physical notes, a symbolic composition, and a physical manifestation when being run or respectively played. They share important properties and similarities in their modes of usage. This investigation presents the parallels between computer programs and tonal music regarding compositionality and normativity. Incorporating Wittgenstein's approach to music as well as the works of Tim Horton and Hanne Appelqvist, the quasi-linguisticness of music and the consequences of this will be shown. Music as well as natural languages and programming languages are composed in a rule-governed way and form meaning through the syntactical combination of context-independent constituent parts. Adopting Raymond Turner's perspective on technical artifacts both are portrayed as such. The result of this ontological investigation is that they show certain parallels in their genesis as well as in the ways they are handled. We will therefore claim, that their ontological status may also exhibit parallels. Hence, the investigation of one of the two may contribute to gaining knowledge about the other's ontological status.

Keywords: Computational Artifacts; Music; Ontology; Technical Artifacts; Wittgenstein; Turner; Grammar; Semantics

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Научная статья

Компьютерные программы и музыкальные произведения как технические артефакты – онтологические параллели

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Аннотация
В этой статье сравниваются тональная музыка и компьютерные программы на уровне техники, их лингвистических свойств и онтологии. Ссылаясь на концепцию технического артефакта Рэймонда Тернера, оба артефакта являются техническими в том смысле, что они были созданы кем-то намеренно в определенное время. Компьютерные программы, как и музыка, представлены физическими записями, символической композицией и физическим воплощением при запуске или воспроизведении. Они имеют общие важные свойства и сходство в способах использования. Это исследование представляет параллели между компьютерными программами и тональной музыкой в отношении композиционности и нормативности. Включая подход Витгенштейна к музыке, а также работы Тима Хортона и Ханны Аппельквист, будет показана квазилингвистичность музыки и последствия этого. Музыка, а также естественные языки и языки программирования составляются в соответствии с правилами и формируют смысл посредством синтаксической комбинации независимых от контекста составных частей. Используя точку зрения Рэймонда Тернера на технические артефакты, оба представлются как таковые. Результатом этого онтологического исследования является то, что они обнаруживают определенные параллели в своем происхождении, а также в том, как с ними обращаются. Поэтому мы утверждаем, что их онтологический статус также может иметь параллели. Следовательно, исследование одного из двух может способствовать получению знаний об онтологическом статусе другого.

Ключевые слова: Вычислительные артефакты; Музыка; Онтология; Технические артефакты; Витгенштейн; Тернер; Грамматика; Семантика

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INTRODUCTION

Computer programs influence our daily lives to an enormous degree. We are monitoring our health and physiology wearing fitness trackers such as wristbands to record our data. We are retrieving news feeds that are based on algorithms that determine our preferences based on our previous behavior. We are creating new career paths by turning our use of video games into an entertaining video for others to see. Computer programs are in motion all around us and still we are unsure to answer the question about when, where and how they exist. One does not see them operate as such and yet they propel or structure our environment. This article suggests striking parallels between computer programs and music, which may be productive for such investigations. From the perspective that both can be described as technical artifacts we will compare the properties that both share, as in being created with intention, compositionality and normativity, to then investigate their ontological status in the third segment. In what way can we see music and computer programs to be the same and where do they differ?

WHAT MAKES A TECHNICAL ARTIFACT 'TECHNICAL'? – THE QUESTION OF TECHNICITY

This article investigates both music and computer programs as technical artifacts. The question what the word 'technical' even means is widely debated. To elaborate the question of technicity should be clarified. How do we understand the term 'technical artifact'? Is it the fact that it is created with intention, that is serves certain means to an end? This is the question the following section is trying to illuminate. Some common opinions on the issue will be presented whereafter the working definition is introduced with which this paper continues..

Computer programs and music can both be created for a certain purpose. While a piece of music may be prone to incorporate a certain type of emotion or tell a story, it could also be seen as a means to influence the listener in a certain way. Marching music may motivate to march, whereas a waltz might invite to dance. Music in movies is supposed to add musical accompaniment and illustrate the mood. We are listening to music to let us feel a certain emotion, to calm us down or make us feel happy. When it comes to computer programs, since we are mostly using them as a means to an end, they apparently represent a tool or an instrument in pursuit of a certain cause. Computer programs enable us to easily get groceries delivered to our door, book flights and let us check the weather forecast or our bank accounts any time of day.

This is not to paint computer programs or music merely as means to an end. They can and most of the time do represent a lot more. They may both be seen as pieces of art. For music this observation might be a little more intuitive than for computer programs. But by investigating the philosophy of computer programs we can easily find sources that do not define computer programs as to even requiring a certain type of purpose or use. Wiliam J. Rapaport for example argues for an approach that accepts lines of code as a program, even if they do not fulfill a certain goal, neither does a program require semantic content in order to be called a program (Rapaport, 2019). Rapaport is pointing out, that

as long as lines of code – as in instructions – are being followed, the structure may be called a program.

Also Nurbay Irmak elaborates, there are digital audio and video files as well as video games, that do not seem to serve any certain practical purpose (Irmak, 2012).

While Irmak in general categorizes computer programs as artifacts, he as well does not define their serving towards a certain practical goal as a necessary property for computer programs. Therefore he refrains from calling computer programs in general 'technical.'

There are other ways to navigate the often drawn line between technical artifacts and what we call art. In his paper "*Die schöne Technik der Verschwendung [The fine Technique of Squandering]*" Alfred Nordmann is pointing out the interconnection of technical and artistic skills in piano music as well as in a show of fireworks (Nordmann 2021). In his elaboration he presents an immanent technicity and artistry in playing the piano as well as in shooting fireworks. Playing the piano as well as coordinating fireworks takes a certain trained skill and technique as well as knowledge about the instruments and materials being used (Nordmann, 2021). Using this knowledge and skill one can then create an artificial world for the audience of the composition (Nordmann, 2021). Nordmann questions the dividing line of artistry versus technicity and opens up a perspective of grasping them as collaboratives rather than opposites (Nordmann, 2021). The so-called goal does not have to be well-defined beforehand, neither does it ever have to be. Creating an artificial world that can be grasped as a whole relies on technicity and artistry in collaboration (Nordmann, 2021). The emerging creation is enabled by two practices that are falsely believed to be opposed to one another, when in reality they complement one another (Nordmann, 2021).

Raymond Turner is categorizing technical artifacts as material objects being created with intention by humans and serving a practical goal (Turner, 2018, p. 25). His definition of technical artifacts is opposed to natural things and occurrings, such as stars in space (Turner, 2018, p. 25). So for Turner the intention through which an artifact is created is a vital part of the definition of a technical artifact. It involves a practical function that needs to be fulfilled. This definition is more bound to the instrumentalist view, that a purpose should be defined, than Nordmann's. Still, we will use Turner's for now to explore what his approach to technical artifacts and computational artifacts might hold for our desired comparison of music and computer programs.

COMPOSITIONALITY

Having discussed the practical properties of a technical artifact we will now focus on structural properties. The first shared structural property of music and computer programs is compositionality. Generally, compositionality means that the semantic meaning of an expression is determined by the structural relation of the entities that make up this expression (Horton, 2001).

In most cases when we talk about compositionality we talk about it in a linguistic context and therefore in combination with "syntax" and "semantics". Rapaport explicates these terms in the following way: The syntax of, for example, a language determines the

correct way that words can be aligned, if the rules of the specific syntax are violated, the expression cannot be called correct regarding the language. So "*the syntactic domain is simply any domain (not necessarily a language) understood solely in terms of its components, their properties, and the relations among them* [...]" (Rapaport, 2019, p. 311-312).

For a language the syntactic domain is its grammar. "*A semantic interpretation of a syntactic domain requires a "semantic" domain: a distinct domain that is also understood solely in terms [...] of its syntax*" (Rapaport, 2019, p.312). The semantic interpretation requires these two domains to share a relation that may connect the domains but is not part of either. This function serves as a connection between the two to enable interpretation through understanding these relations. When one understands the relationships the syntactic domain can be unbundled regarding its entities and their relational status to others in the expression and translated into the semantic domain (Rapaport, 2019).

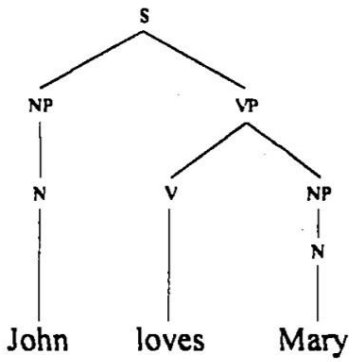

Figure 1. A syntactic analysis of a sentence in a natural language. Here: "John loves Mary." (S = Sentence; N = Noun; V = Verb; NP = Noun Phrase; VP = Verb Phrase). [Taken from Horton 2001, Figure 1].

The way in which the elements of the expression are put together determines the meaning of the entire expression. Deriving the meaning from the construction of the expression may be illustrated using a hierarchical tree graph in figure 1 (Horton, 2001). The sentence "*John loves Mary*" is being analyzed by arranging the different elements of the expression hierarchically in a tree graph in correspondence with their functional role in the expression. While the verb 'loves' forms a verb phrase (VP) with the noun 'Mary', this part is then combined with the noun phrase (NP), which in this case only consists of the noun 'John'. The syntactic combination of these constituents is rule-governed and shows the recursive nature of compositionality that will become important for our later investigations. By combining the individual meanings of the constituents in the way suggested by the rules of the structure we can then form the overall meaning of the sentence. The rule-governed nature of these combinations makes it possible to achieve

complex meanings (Horton, 2001). The property of compositionality is therefore achieved by the combinatorial possibilities of meaning in a certain structured language or any other domain. These foregoing elaborations are taken from Rapaport and Horton. While Rapaport illustrates compositionality in the context of artificial language artifacts such as software, Horton aims to prove the property of compositionality for pieces of music. We will go deeper into Horton's line of argument in the following. He shows that in the light of seeing the individual parts of a tonal structure as structural constituents of a rule-governed complex expression, we may prove that pieces of music – as in tonal structures – do exhibit compositionality.

Context-Indepence of Constituent Parts

Horton first names Context-Indepenence as an important feature of compositionality (Horton 2001). The individual constituents may be taken from their position in an expression and replaced by a structurally identical entity without hurting the structure. Horton (2001) here uses the example of a d minor triad in one expression that may be substituted with any d minor triad that can fulfill the same structural requirements, as in being a subdominant, and this will not hurt the overall tonal content. Horton therefore states that structurally equivalent parts in music are also tonally equivalent. So we will now assume that a triad, or any self-contained constituent part of a tonal structure for that matter, may be called context-independent.

The Relevance of Syntactic Structure

The question about how to combine these constituent parts is answered by the specific structure of the respective syntactical domain (Horton, 2001). Horton analyzes the example expression in figure 2 to illustrate his statements. The components are assigned a certain structural role through the aid of the underlying grammar. Horton here demonstrates how the same sequence of notes may be read in two different ways. In the reconstruction on the left we see how the first three events may be combined to form a tonic phrase consisting of tonic, subdominant and tonic (Horton, 2001). In the reconstruction we can see on the right the first event stays as a tonic, while the events 2-6 are combined to form a more complex tonic articulation. The sequence may thus be read in two ways, both rule-governed and in agreement with the domain. These rules may be formulated in a grammar.

The rule-governed Nature of Syntactic Combination

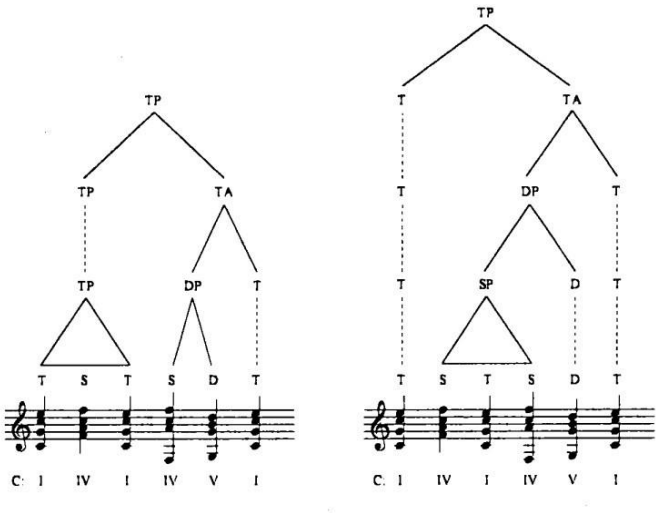

Figure 2. An ambiguous chord sequence. [Taken from Horton 2001, Figure 3].

All structures that are syntactically equivalent to one another may be substituted by a syntactically equivalent structure without changing the content even if they might differ in complexity (Horton, 2001). To illustrate this property we may take a look at two examples Horton (2001) presents. Looking at figure 3 it can be seen how Horton demonstrates the ‘recursive pumping’ of constituent parts of a structure. This can go on infinitely making the emerging structure more and more complex, without changing the underlying tonic articulation it poses. Horton proves in his paper, that these constituent parts then can still take the same role in the grammatical structure of the expression they form.

They may form the same kind of constituent part of the expression their simpler predecessors do. An impressive example of this is shown in figure 3.

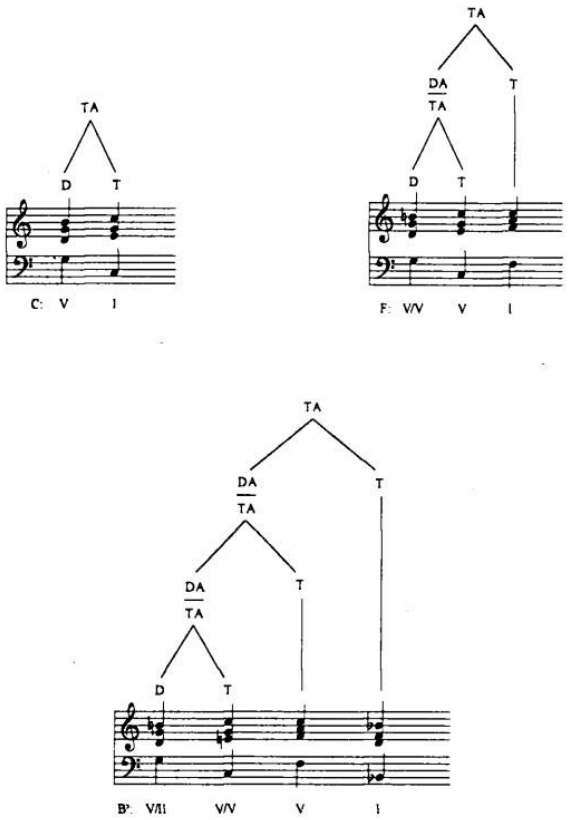

Figure 3. Three musical scores and their syntactic analysis showing the recursive nature of structural relations in tonal music. (DA= Dominant Articulation). [Taken from Horton 2001, Figure 6.].

Their functional properties remain the same while they may get more complex in themselves. The resulting construct may still be (in this case) a tonic articulation. After we have already discovered that self-contained components are context-independent and replaceable by structurally equivalent components, we only need to show now the fact, that the recursive pumping of these components (according to the rules of the grammar) results in also context-independent components, that may be used in the same way as the previous ones (Horton, 2001).

If they can still fulfill the same role in the expression we will assume this to be successful. In figure 4 we see, how this aspect is fulfilled.

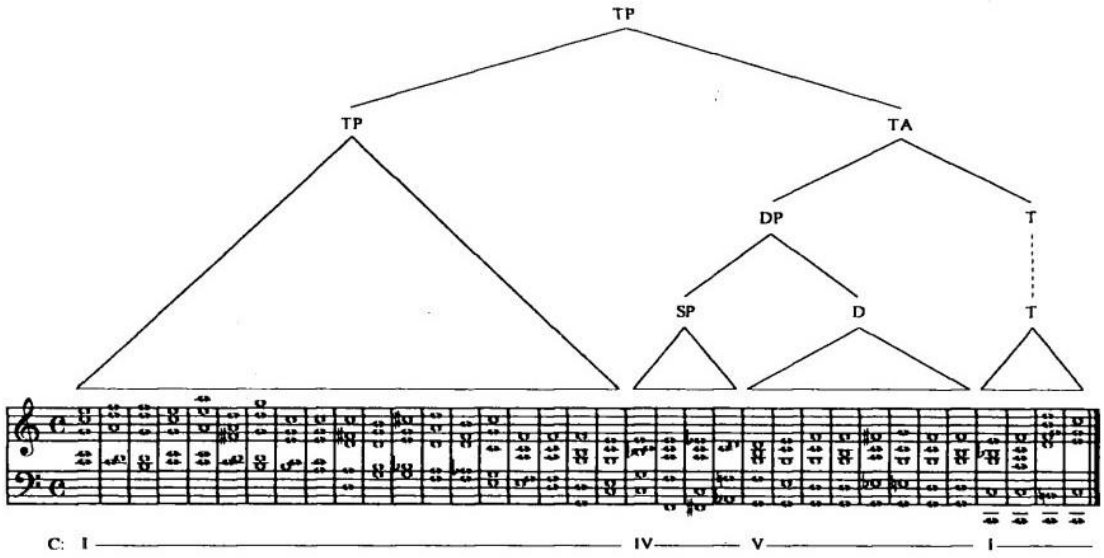

Figure 4. A structural description of the large-scale of J.S. Bach's C Major Prelude from Book I of "The Well-Tempered Clavier". [Taken from Horton 2001, Figure 7.]

The combinatorial possibilities remain the same, however complex the individual components may be. With another example (figure 4), Horton shows "that the same combinatorial mechanisms apply equally to constituents that differ widely in their structural complexity [...]" (Horton, 2001, p. 146). While two bars that come in a sequence have a certain structural relation to one another, let us say posing as the subdominant and then the dominant, more complex constructs may also have the exact same relation to one another. As we can see in bars 20-23 (subdominant) and bars 24-31 (dominant) in figure 4 these chords share the same syntactic relation (Horton, 2001). Their complexity levels do not interfere with their structural roles.

Establishing these three properties, Horton (2001) has explicated the assumption of compositionality for tonal music. So it may be assumed that music has a quasi-linguistic form. Horton makes it clear how music and language may correlate structurally, but also where they differ. To understand the meaning of a piece of tonal music we rely on the compositionality of music to analyze its parts and overall structure, but we are missing the conceptuality that language inhabits. While certainly their content is understood in terms of the syntactic principles that underlie the structure and the content of their constituent parts, tonal structures may be understood without knowledge of the characterizing concepts. To understand language we need to understand the concepts that are carried through it. This is not the case for tonal music (Horton 2001).

Compositionality of Computer Programs

In this paper it will be taken as fact that computer languages find their basis in language systems and therefore rely on the principles of such, hence exhibiting compositionality. Computer programs are written in formal and artificial languages. Their structure is based on mathematical notation systems, such as the lambda-calculus for Haskell and Ocaml. Compositionality therefore is already their precondition and a requirement for their creation. Therefore they must exhibit compositionality.

Still, we are going to look into some remarks by Raymond Turner (2018) on the role of semantics (pp. 77-81). Turner states that programmers need to be able to determine whether a code is fulfilling a certain goal in order to be able to program in the first place. They need to be enabled to see the semantic impact of a construct of a certain programming language (p. 77). This requires the property of compositionality (pp. 80-83). For Turner this means that for all complex expressions in a language their semantic meaning is defined through their structure in combination with the meanings of their constituent parts (p. 80). This property is especially important when it comes to programming languages. Compositional semantics allows for the substitution of equivalent entities for one another, as we have also seen in Horton's elaborations (p. 81). If a semantically well-defined entity is denotationally equivalent to another one, they can be substituted for one another without changing the semantic meaning of the expression (p. 81). This property is analogous to Horton's example of the substitution of certain musical structures for others. We can substitute the constituent part X for Y, if they share the same functional properties. If they share the same type or produce the same output for the same inputs, and therefore realize the same function, we can use either of them and the meaning of the whole expression remains the same. For example we can substitute 2x for (4*x)/2 and the expression would stay the same, as both may receive, for example, integers and put out integers. Here, also the input-output table would be the exact same. These two expressions do of course vary in cost and elegance, but will produce the same output. It is important to highlight the fact that for programming languages low-cost programming is of relevance for good practice while this aspect may be less important in natural languages.

Moreover this property makes structural induction possible for a language. This means that having shown a property for a certain statement we can use formal reasoning to also prove it for a more complex structure. It is a useful mechanism for structural reasoning about the language as a whole (Turner, 2018, p. 81). This works in a way opposite to the 'pumping' the tonal structures which were referred to in figure 3. After having proven that the expression X has property A, we can also show it for a more complex expression Y whether it fulfills the same functional role. Rules can be proven for all valid structures in a language, however complex they might be. But what does 'valid' regarding a language even mean?

NORMATIVITY

The property of normativity allows for determining whether an expression is valid or not. Normativity – as in the decidability of correctness – applies to languages, as in computer programs as well as other realms. Normativity means that there is a rule or axiom system that regulates what a valid expression is and what is not. These rules apply without conditions. They guide the design process and make it possible to judge the correctness or rather the correct use of the language or the music.

Normativity in Computer Programs

We will look into two perspectives of normativity in computer programs. On the one hand the structural or formal normativity – the question whether an expression is correct regarding the underlying grammar. And on the other hand the normativity regarding the relation to the underlying semantic sense a given program aims to implement – the content-wise normativity.

Formal Normativity – Normativity of Syntax in Computer Programs

Turner cites Boghossian (1989) in the 9th chapter of his book and derives Boghossian's definition of normativity:

> The fact that the expression means something implies, that is, a whole set of normative truths about my behaviour with that expression: namely that my use of it is correct in application to certain objects and not in application to others. (p. 513)

Regarding programming languages, normativity of meaning therefore means "that any semantic account must provide a criterion for correctness" (Turner, 2018, p. 79). Especially for formal languages these norms facilitate the design of compilers (pp. 79-80). A compiler is the instance that examines the code it gets as an input for correctness and then translates it into a lower level language for lower instances to execute the assignments. Finally, compiler architectures facilitate the step-by-step translation from higher languages like Java to lower languages and pass this down to the next layer until we reach the level of machine language that directly corresponds with the physical processes in the device that is called a computer. The compiler is therefore the instance that evaluates whether an expression is correct and if this is the case translates the expressions into expressions in another language, maintaining its correctness (pp. 79-80). Determining a formally correct expression is accomplished by only consulting the normative rule system, while determining correctness in terms of meaning requires a lot more effort.

Content-wise Normativity – Normativity of Semantics in Computer Programs

Turner (2018) states that the evaluation of the correctness of the meaning would represent a complex and tedious task (pp. 205-206). Going from the step of specification to the symbolic program, hence being in the design phase, we are taking paths that are implying certain assumptions and preconditions as well as making decisions on certain details. The resulting symbolic program must then later be compared to the original idea

in the specification in order to determine whether this phase has been successful. Verifying these steps is conceivably complex. It requires a the semantic understanding what the specification is and which key aspects need to be preserved in the symbolic program. Turner names four challenges we are facing when aiming to prove the correlatedness of a program with its specification: the mathematical, the mechanical, the pragmatic and the scientific challenge (p. 205-212). The focus in the upcoming section will be on the first three challenges in order to illustrate the complexity of judging content-wise correctness.

The mathematical challenge concerns the workload, or cost in IT-jargon. Especially when it comes to bigger computer programs than the example of the GCD, the formal proof will be complex and take a long time to be carried out. (Turner 2018, pp. 205-206). The result of such a process then is only valid for the one entity it was carried out for and will not hold any general knowledge gain, even though Turner points out that this is debatable (pp. 206-207). While proofs in the Cartesian tradition demand the forth-bringing of general mathematical knowledge, the Leibnizian perspective argues for a mechanical and meticulous way of carrying out mathematical proof, neglecting the property of bringing forth generalizable knowledge. The emergence of general mathematical knowledge (in the Cartesian view) is achieved by deduction from normative, valid axioms, assuring that the arising rules will also have normative character. Mathematical proof according to the Cartesian notion involves abstraction and generalization (p. 206). The Leibnizian proofs, such as the formal proofs of construction and verification which Vladimir Voevodsky argues for, focus on the procedure of working in small steps and being easy to comprehend. Voevodsky sees the future of mathematical proof in the implementation of computer systems supporting automated ways of proving the correlation of a program with its specification. (Turner, 2018, p. 207 and Voevodsky, 2010).

With this prospect Turner presents to us the second challenge, the mechanical challenge (Turner, 2018, pp. 207-209). We do have the possibility to check a computer program's correlation by using another computer program to evaluate it. If we can now judge the correctness of a program with the aid of another computer aided system, who will inspect this system and prove its correctness (pp. 207-208)? This poses the same challenge as in translating a problem of meaning of one language into another one. It is only shifting the problem, but not solving it (pp. 207-208). "So, we have replaced the correctness problem for one program by another, and we have the beginning of an infinite regress" (pp. 208). Where is the point at which one can settle semantic correctness? No computer system itself can solve this question.

The third challenge Turner mentions revolves around the empirical testing of a program (Turner, 2018, pp. 209-210). Testing a program serves to verify for certain inputs the exhibition of the desired behavior. This is easier to do and goes without having to face thousands of lines of code (Turner, 2018, p. 209). The tests then must be designed in a manner that would cover (the most relevant) model cases. So in reality most computer programs are tested empirically and not proven formally. When testing you can only find bugs, as in mistakes in the code. This is cheaper concerning resources and more pragmatic. Via empirical testing we can never fully verify the program for every possible

input. If it results in an unwanted output, we can fix it. But as long as we do not enter a certain input we will not know if this might produce an unintended behavior. Also we can only empirically test the specific physical implementation, not the symbolic program directly (pp. 209-210). Proving the correctness of a program regarding its aim, its specification, therefore still poses a tedious task.

Normativity in Music

Normativity, as stated before, is a property a variety of crafts exhibit. And even more so than other realms of art, music comes with a range of rules that exceed genres. Even people who have no idea about musical theory are able to hear if there is something wrong with the sounds they hear – may it be a wrong tune in a structure or wrong timing in a beat (Appelqvist, 2013). Such disagreements between what we hear and what we think we should hear leave people alerted (Wittgenstein, 1967, LC I 15). This observation sheds light on the normative nature of tonal music.

Normativity in Form – Normativity of Syntax in Music

To answer the question whether music also follows normative rules, we will look into Hanne Appelqvist's elaborations on musical grammar and the philosophy of Ludwig Wittgenstein. Appelqvist (2013) describes a Kantian understanding of Wittgenstein's discussion of language and music. She highlights that Wittgenstein holds music to be rule-governed, in the same way language is. "He [Wittgenstein] states, that correctness is an aesthetic attribute far more important than beauty and compares the understanding of a sentence to the understanding of a musical theme, thereby suggesting that musical understanding too is a form of rule-following" (Appelqvist, 2013, p. 299). Using Wittgenstein's philosophy Appelqvist shows us that music, just like language, is a rule-following enterprise and by no means arbitrary. In the Tractatus Wittgenstein point out this analogy himself when he describes the gramophone record, musical thoughts and notations, and also the sound waves produced by the record being played as having an internal relationship to one another, that exists between language and the world (Wittgenstein, 1922, TLP 4.014). "The gramophone record, the musical thought, the score, the waves of sound, all stand to one another in that pictorial internal relation, which holds between language and the world. To all of them the logical structure is common". He further elaborates that they share the property of being logically constructed (Wittgenstein, 1922, TLP, 4.014). Being constructed in a formal way brings the constituents of the record, the notations and the thoughts of music together to exist as one. They are all constructed following a certain set of rules, just as language and the world are. In the following section of the Tractatus, namely 4.141, Wittgenstein describes the inner similarity between the musical score and the audible symphony on the gramophone record.

> In the fact that there is a general rule by which the musician is able to read the symphony out of the score, and that there is a rule by which one could reconstruct the symphony from the line on a gramophone record and from this again-by means of the first rule-construct the score, herein lies the internal similarity between these things which at first sight seem to be entirely different. And the rule is the law of

> projection which projects the symphony into the language of the musical score. It is the rule of translation of this language into the language of the gramophone record. (Wittgenstein, 1922, TLP, 4.0141).

He calls this the law of projection meaning that one of these instances may be projected into the other following the rules (Wittgenstein, 1922, TLP, 4.0141). This possibility implies the existence of an underlying normative set of rules. And "[W]ithout knowledge of the rules of an art form one cannot make aesthetic judgements" (Appelqvist, 2013 referring to LC I 15).

Appelqvist further summarizes that a musical theme, just like a mathematical sentence has meaning, but only in the sense of showing us something about the world (Appelqvist 2013). Wittgenstein proposed that with the aid of our knowledge about the nature of logic we may gain knowledge about the nature of music (Appelqvist, 2013). "A tune is a kind of tautology, it is complete in itself, it satisfies itself" (Wittgenstein, 1961 NB, 40). And "[m]usical themes are in a certain sense propositions. Knowledge of the nature of logic will for this reason lead to knowledge of the nature of music." (Wittgenstein, 1961, NB 40). Wittgenstein's tautologies characteristically lack sense as they are empirically empty, are always true and are complete in themselves (Appelqvist, 2013). For example the axioms underlying our logic are tautologies too and "show the logical form of language" (Appelqvist, 2013). "The propositions of logic are tautologies." (Wittgenstein, 1922, TLP 6.1) – "The propositions of logic therefore say nothing. (They are the analytical propositions.)" (Wittgenstein, 1922, TLP 6.11). They cannot show us any content of reality but can only reveal the logical structure of the world (Appelqvist, 2013). Since logic itself cannot be shown, it can only be shown in propositions (Appelqvist 2013).

> The fact that the propositions of logic are tautologies shows the formal-logical-properties of language, of the world. That its constituent parts connected together in this way give a tautology characterizes the logic of its constituent parts. In order that propositions connected together in a definite way may give a tautology they must have definite properties of structure. That they give a tautology when so connected shows therefore *that they possess these properties of structure*." (Wittgenstein, 1922, TLP 6.12).

So the musical tune itself does not formulate any content-wise proposition about the world, but can only represent its own form (Appelqvist, 2013). Hence, music as well as logical propositions show the so-called logic of the world, that represents its essence according to Wittgenstein. Exhibiting a logical structure is a necessary requirement for having content for Wittgenstein (Appelqvist 2013). Only within a clear structure we can form a complex meaning from the combination of individual meanings. A sentence or here a proposition by itself is not just a jumble of words. And also a theme in music is not a jumble of tones, hence it is also structured in a certain way (Wittgenstein, 1922, TLP, 3.141). In most translations the word used for "Gemisch" is "mixture"; here we translate it to "jumble" to stress the structuredness or rather non-structuredness of the German expression "Gemisch". And this structure is made possible by their shared logical form (Appelqvist, 2013). As Wittgenstein describes it, the constituents match with one another

and form a whole in the same way as links of a chain do (Appelqvist, 2013 and Wittgenstein, 1922, TLP 2.03.). Here we can experience the logic in the rules that make this possible – logic is apriori (Appelqvist 2013).

Self-evidence, of which Russell has

> said so much, can only be discarded in logic by language itself preventing every logical mistake. That logic is a priori consists in the fact that we cannot think illogically. (Wittgenstein, 1922, TLP 5.4731)

While a musical tune does not exhibit any content that may correspond to the world, it shows through itself by way of being a rule-governed structure the logical form of the world (Appelqvist, 2013). But there is a difference between logical propositions and musical tunes. Musical tunes are bipolar. By this, Appelqvist means that descriptions, pictures and other means of communication represent something in the real world and have a projective relation to reality. Being bipolar, the musical tune cannot do that. Musical tunes have no representative character and no counterpart in the real world that they would relate to (Appelqvist, 2013).

Following these statements we may assume that music is rule-governed.

Normativity referring to Content – Semantic Normativity in Music

Investigating correctness is not as relevant for music as it is for a computer program. As long as the structure itself follows the rules of the art, it may not be questioned. Moreover since music does not correlate directly with concepts in the world in the way language does accordingly there is no way of formally proving any correspondence. If we desire a way to do so, we might have to turn to empirical testing in an analogous manner to the way we verify a program empirically, e.g. by playing the music to an audience. This endeavor may not be *formally* decidable, or verifiable for music, however it is able to show the successful outcome of a piece of music. Also a piece of music, if played as conventionally written, does not accept different inputs and therefore does not produce different outputs. Once written, it is played in the exact same way each time, if played correctly. The question whether it is being played correctly is decidable again. Since we have seen that the direct correlation of music and things in the world does not exist in the way it does for languages, we cannot unambiguously judge their correspondence on the criteria of correctness.

Using Raymond Turner's Understanding of Technical Artifacts on Computer Programs and Music

Since we have examined the quasi-linguistic properties of music, the aspect of compositionality and normativity, we can now move on to the investigation of their ontology. For this we are going to give an outline of Turner's approach to the genesis of technical artifacts to then apply it to the emergence also of a musical composition.

The notion that music and computer programs are comparable on multiple levels is not entirely new. Among others, Nurbay Irmak describes in his article that both computer programs and pieces of music may be classified as abstract artifacts. He uses the word 'abstract' to underline the importance of the non-physical qualities of the two (Irmak,

2012). They can therefore not be reduced to their physical form but are reliant on it to exist in the first place. They cannot be reduced to their physical manifestations. Both are created intentionally and exist only after a certain point in time (Irmak, 2012).

Raymond Turner sheds light on the notion that not only do the two in some way depend on a physical manifestation (be it notes on a sheet of paper or being run or played on a certain device), their relation enables them to be integrated into a single definition of technical artifacts. Turner (2018) describes technical artifacts to exist in a trinity of specification, structure and artifact (p. 52). This construction unifies the widely stated opposition of the physical and ideal understanding of technical artifacts. We want to argue that his approach also contributes to an understanding of music. In agreement with what we learned from Irmak, Turner also states that computer programs also exist only after a certain point in time, they do not exist as immanent ideas (Irmak, 2012 and Turner, 2018, pp. 25-26). Just as music does. This allows us to incorporate the ideas and thoughts that go into a technical artifact.

Raymond Turner's Genesis of a Computer Program as a Technical Artifact

In chapter five of his book on "*Computational Artifacts: Towards a Philosophy of Computer Science*" Turner focuses on the genesis of a computer program as a technical artifact (Turner, 2018, p. 52). The following reconstructs Turner's approach to later show its applicability to music. From the trinity that is depicted as a process of specification, symbolic program and physical program the technical artifact that is a computer program.

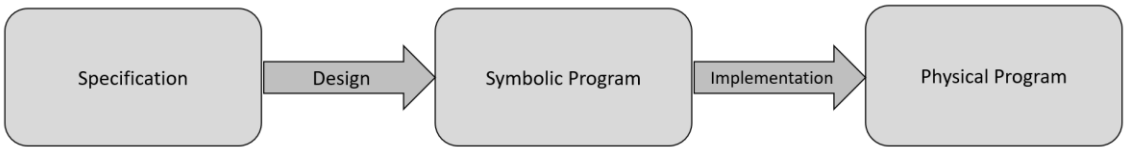

Figure 5. The Trinity of Specification Symbolic Program and Physical Program and their transitions. Figure configurated after (Turner, 2018, pp. 43-44).

While in Turner's view computer programs in general appear in a formal manner he adds the aspect of the contributing factors for their creation as parts of their existence. He uses GCD – the greatest common divisor of two numbers to illustrate his view (Turner, 2018, pp. 44-45). With the definition of the GCD, we already know *what* the output is supposed to be for any inputs, but we do not know *how* exactly the function may be realized (p. 45). Turner calls this the functional specification or rather the program specification (p. 44). This specification in the case of computer programs poses a normative character for the following steps in the emergence of the technical artifact (as in the symbolic program and the physical program) (p. 46). So these steps will be judged regarding their correctness according to this formal definition. If they correspond to the specification they will be called correct (pp. 45-46).

In the following design step the intended realization of the program will be determined, namely the way exactly *how* we are going to fulfill the specification. What

we will end up with after this step may then be called the symbolic program (Turner, 2018, pp. 46-47). When it comes to computer programs we can choose between different algorithms, as in what certain structure of assignments is going to produce the output we wish for (Turner, 2018, pp. 46-47). They may differ in their approach, goal-directedness and overall efficiency (some algorithms work more efficient for different types of inputs, i.e. different sorting algorithms for different lengths of lists) and still produce the same output. The then chosen algorithm needs to be compared to the specification in order to determine their correctness (pp. 46-47, pp. 205-206). Turner therefore sees algorithms as part of the second step, and not part of the specification itself (pp. 47). Turner then calls this structural description, which aims to be as mechanical as possible (in the best case already in a programming language) the symbolic program. This describes the certain way in which the input is permutated and the output is computed (pp. 47-49). While the specification can, at least in parts, be described in a natural language, the symbolic program may not (pp. 44-49). Algorithms for Turner are therefore the dedicated structures of assignments that are realizing the specification and constituting the symbolic program.

In the implementation step the symbolic program is implemented into a physical process, this physical realization is therefore called the physical program. While the structural description of the symbolic program does not inhibit all of the physical details of the resulting technical artifact, the physical program, realized by running the program on a certain piece of hardware eventually sets them via producing these physical details (Turner, 2018, p. 49-50). The specific way the program is run on a certain device takes part in shaping aspects of the artifact's properties. Turner uses the example of a program in form of a punch card to illustrate this. Only in combination with the interpreting device (Turner calls it the "*underlying mechanism*") of the certain punch card we designed, the artifact becomes what it is (Turner, 2018, pp. 49-50).

In summary we can say that Turner presents us a trinity that the technical artifact passes the course of its emergence. He makes the certain stages where the artifact's existence might still be considered vague graspable and enables us to analyze these. We can decide if we are talking about a specification of a technical artifact, the *what* that is aimed to be realized, the symbolic program, the structural description telling us *how* exactly it is realized and the physical program, the eventual manifestation of that specific artifact.

Turner also stresses the fact, that all technical artifacts, however abstract, may be resolved into this trinity metaphor of his (Turner, 2020). He elaborates that a technical artifact that is the construction of a car can also be dissected into these parts:

> The manufacturing process for cars is itself an artifact. The structural description of the process does not describe cars; it is a structural description of a process for building them. The inputs to the manufacturing process are car plans. When executed, the process outputs cars. The structural description of the implementation process for programs also describes a process. But its output are not objects but processes. The input to the implementation process are process plans (programs) and the output, when executed, are running processes (Turner. 2020, p. 362-363).

We have seen how broad Turner's approach of a technical artifact is and therefore how various constructs may be seen as technical artifacts. This also holds for musical compositions, which we want to investigate in the following.

Application of Turner's Theory to Pieces of Music

This understanding of the genesis of a technical artifact can be applied also to tonal musical compositions. If we take a certain piece of music that we are creating with a certain intention, perhaps to illustrate a character's feelings in a movie scene, we can go through the steps described by Turner. The composer is intending to write a piece of music that realizes the idea of the scene. Understanding how the character would feel and imagining what the music is to transport through the intended piece of music would make for the specification. This step does not yet include a certain way of how to later arrange the notes, it only circumscribes the intention. And we will have to point out that the specification of a piece of music may not be able to be written down as formal and unequivocally as the specification of a computer program.

In the design phase the composer would then focus on using their musical skills to compose the notes in a fitting way. Knowing the way notes are combined to exhibit certain patterns and themes, they are able to compose a certain arrangement of notes that will fulfill the previously set specification. There will be endless possibilities of how to realize this Specification. This is analogous to the endlessly possible algorithms one can use to satisfy a certain in- and relations. Multiple melodies and patterns of sound as well as different lengths, volumes, et cetera can satisfy the specification. Hence the analogy holds for pieces of music that are created with a certain intention.

Still we have to mention one restriction that comes with the composition of music. When it comes to music the effect it shows on people may be considered highly subjective. While we can mathematically prove that a certain algorithm meets a specification, this is not easily done for pieces of music. Some might say it is impossible per definition to do so. As we have stated earlier it is at least debatable whether this is a decidable matter. Since music does not exhibit conceptuality in the same way as language does (and is not prone to exhibit a direct correspondence with formal concepts or even certain emotions), this decision is finally up to the audience and its interpretation, as we have already pointed out in the previous section. The verification of the fulfillment of the set specification lacks formal principles that would enable us to make a clear and provable decision.

Having gone through the design phase we now have a symbolic program. For a computer program this means the lines of code are set, whereas for a piece of music this means that the individual notes are set in a chosen sequence and pattern. The next step is the implementation of the symbolic program that will yield the eventual physical process of the technical artifact. Taking our arrangements of notes, they can be implemented on a fitting device such as a (certain) musical instrument. Playing the arranged notes (the symbolic program) on this device will make for the implementation. It takes a learned skill to be able to correctly translate the notes into a way of playing the instrument. Here it is possible to decide whether this is carried out correctly. Is the beat on time? Is the piece played with the correct notes at the correct volume? Correct here means

corresponding to the symbolic program or musical score that was adopted in the previous step. In the thereby realized physical process the piece is finally brought into its desired manifestation. The device, here the specific instruments also influence the way of the realization of the artifact. The way the specific piano functions and sounds affects the piece of music that is performed. This part of the process works truly in analogy to Turner's elaborations.

In summary we can therefore maintain that Turner's description of technical artifacts can also be applied to musical compositions. We have found a core difference when it comes to the conceptuality of music and therefore a constraint on proving the correlation of the certain arrangement of notes with the set Specification. It is still up to us what to make of this difficulty. We could use empirical proof instead of mathematical proof where we accept that in case the majority of the audience agrees with the arrangement of notes we may consider them fitting. Just as we do when testing computer programs. The remaining aspects of Turner's theory were shown to be equally applicable to music.

The disclaimer might be added, that one need not consider all music to be composed in this exact way. Restrictions in the creation of art and music is not the aim of this investigation, only to show that a comparison *is* possible if we think of their creation from this perspective. It was done to show how we can perceive and investigate pieces of music as technical artifacts according to Turner's approach.

CONCLUSION

The aim of this paper was to illuminate the striking similarities between music and computer programs when we investigate them as technical artifacts. Especially through the arguments of Appelqvist, Horton und Turner we tried to underline these parallels. Nordmann shows us that the borders between technology and art are in fact drawn more firmly and arbitrarily in our everyday understanding than is called for by the facts.

Music as well as computer programs may be written on a sheet of paper manually, be it as notes on a score sheet or a list of assignments in a formal language. Whoever is able to read these, and therefore has learned the skill to grasp their content, is enabled by the given notes to understand the structure of the intended technical artifact that is contained in this structure. If implemented into the required device, be it a piano or a computer, they can play the program or the music and bring the artifact into its desired form as a physical process; through the sound waves leaving the body of the piano as well as through the physical running of the code on the computation device the artifact manifests itself.

Of course nonetheless some characteristic differences remain. When it comes to evaluating how 'good' they are, we do judge computer programs based on their efficiency with resources such as time and other costs. For music this is generally not the case. Also determining whether a piece of music meets its desired specification is an even more complex task than it already is for computer programs.

Though music and computer programs are mostly perceived as contrary, as contrary, they might be very similar in their ontology. Both can be viewed as technical

artifacts when it comes to their process of creation or genesis, and both become manifest and fully defined only through being played or run on a certain instrument or device. The ontological investigation of one may therefore contribute also to the ontological investigation of the other.

OUTLOOK

There is another striking similarity of the two that we have not considered as yet. Both, musical compositions and computer programs can keep their identity even through change. This is a remarkable point made by Nurbay Irmak (2012). A certain piece of code that inhabits a bug does not prevent us from seeing a program as still the same video game. And a certain piece of music that may have a note or a fraction missing may still be identified as the same song. The computer program, as in the video game might go through a bug-fix and realize a certain function by way of another algorithm than before (Irmak, 2012). A piece of music might be played with another yet accompanying line than originally and still we would call it the same piece of music. Computer programs might be emulated on another device and a piece of music could be played by a different instrument than originally set. The keeping of their original identity will remain only up to a certain point of course, beyond which they will assume a new identity. These common properties are what motivate further investigation. Especially the question of identity holds another fascinating challenge.

In this article we have approached pieces of music and computer programs as technical artifacts and shown the productivity of such a perspective. Turner's theory enables us to structure and categorize the steps of vague existence before the manifestation of the fully described artifact. Horton and Appelqvist make possible the use of the quasi-linguistic features of music for this comparison. Thanks to this approach tonal music and computer programs benefit each from ontological research of the other.

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Research article

Deep Technogrammar: A Wittgensteinian Approach Towards a Philosophy of Technology

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Abstract

This paper compares two conceptions of a grammatical analysis of technology (*technogrammar*) based on a Wittgensteinian analysis of language. The first theory, syntactical technogrammar, proposed by Alfred Nordmann by mainly drawing on the *Tractatus*, only concerns syntactical rules of composition. The second one, deep technogrammar, introduced by Mark Coeckelbergh and based on the later work of Wittgenstein, adds to this the dimension of *depth* which describes less transparent transcendent rules which account for the social embeddedness of the meaning of words as well as things. The two approaches are parallelised with two interpretations of what Wittgenstein means by *grammar*, one reducing it to occasion-insensitive surface-level rules and the other one accounting for a new dimension of grammar introduced in the *Philosophical Investigations*. Furthermore, the notion of depth is problematised as it evokes a metaphysical feeling. It is shown that depth grammar needs to be considered as transcendental, but not transcendent as its rules are constituted by concrete social practice. The implicit character of rules concerning depth grammar naturally arises from the problem of rule-following. It is concluded that surface technogrammar fails to properly describe certain aspects of technology due to its rules being occasion-insensitive. Deep technogrammar, therefore, is deemed to be more capable of constituting a philosophy of technology.

Keywords: Philosophy of technology; Wittgenstein; Depth grammar

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Научная статья

Глубокая технограмма: подход Витгенштейна к философии техники

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Аннотация

В статье сравниваются две концепции грамматического анализа техники (технограмматики), основанные на анализе языка Витгенштейна. Первая теория, синтаксическая технограмматика, предложенная Альфредом Нордманном, главным образом опираясь на “Логико-философский трактат”, касается только синтаксических правил композиции. Вторая, глубокая технограмматика, введенная Марком Кекельбергом и основанная на более поздних работах Витгенштейна, добавляет к этому измерение глубины, которое описывает менее прозрачные трансцендентные правила, объясняющие социальную укорененность значения слов, а также вещей. Эти два подхода сопоставляются с двумя интерпретациями того, что Витгенштейн имеет в виду под грамматикой, одна из которых сводит ее к нечувствительным к обстоятельствам правилам поверхностного уровня, а другая объясняет новое измерение грамматики, введенное в “Философских исследованиях”. Кроме того, проблематизируется понятие глубины, поскольку оно вызывает метафизическое чувство. Показано, что глубинную грамматику необходимо рассматривать как трансцендентальную, но не трансцендентную, поскольку ее правила конституируются конкретной социальной практикой. Неявный характер правил, касающихся грамматики глубины, естественно возникает из проблемы следования правилам. Делается вывод, что поверхностная технограмма не может должным образом описать некоторые аспекты технологии из-за того, что ее правила не зависят от обстоятельств. Таким образом, глубинная технограмма считается более подходящей для философии техники.

Ключевые слова: Философия техники; Витгенштейн; Глубинная грамматика

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INTRODUCTION

Employing the Wittgensteinian theory of language to conceptualize technology is not a widely utilized approach. Nonetheless, several authors have written on this topic, most notably Mark Coeckelbergh, whose theory this paper will focus on. What those approaches have in common is that they evoke a notion of grammar in regard to technology. What exactly the authors mean by grammar differs depending on which part of Wittgenstein's philosophy they focus on. Alfred Nordmann (2018, 2020), drawing on the early works of Wittgenstein – primarily the *Tractatus Logico-Philosophicus* (TLP) – introduces a "grammar of things" by claiming that language and technology are merely two sides of the same coin, both based on some sort of underlying grammar understood as syntax. Mark Coeckelbergh (2018, Coeckelbergh & Funk 2018), on the other hand, takes into account the late Wittgenstein's findings in the *Philosophical Investigations* (PI) and while also acknowledging a syntactical grammar of technology, adds to this concept a second grammatical structure, a depth grammar, in the form of games and a form of life. In this paper I seek to analyze how these two different concepts of grammar relate to Wittgenstein's work and explore the consequences the different conceptualisations of technological grammar have when applied to a philosophy of technology.

It is not the object of this paper to discuss whether Wittgenstein should be considered a philosopher of technology (see e.g. Funk 2018) or not (see e.g. Nordmann 2018) and whether the theories discussed in this paper are in line with Wittgenstein's thinking. Instead, an account is developed of how Wittgensteinian thinking can help us think about technology. Therefore, the two aforementioned approaches towards a Wittgensteinian grammar of technology are presented and discussed in relation to Wittgenstein's writings on grammar, mainly the notion of depth. Finally, the two theories are compared in how productively they can provide an understanding of technology.

DEEP TECHNOGRAMMAR: TECHNOLOGY GAMES AND FORM OF LIFE

Mainly drawing on the *Philosophical Investigations*, Coeckelbergh (2018) argues for a "use-oriented, holistic, transcendental, normative, social, and historical understanding of technology" (p. 1505). He proposes that technology can be conceptualized in analogy to how the later Wittgenstein analyzes language, namely that the meaning of a word depends on its use, which "must be seen as embedded in activities and structured by games and a form of life, which contains many games". Technology, then, can also only be understood as technology-in-use, embedded in technology games as well as a broader form of life (Coeckelbergh, 2018, p. 1506). This notion of games and form of life has to be understood in a transcendental sense and can also be described as a grammar:

> They [language games] 'make possible,' structure, and limit a particular use of language and its related meaning. Without these games and forms of life, a particular use of language would be meaningless. Another way of saying this is to use the term 'grammar': a particular use of language is made possible by words

> but also by a grammar that is given, that is already there before a particular use of language. (Coeckelbergh 2018, p. 1507)

Grammar here is used in a broader sense, which Coeckelbergh further explicates by citing PI §664, in which Wittgenstein differentiates between surface grammar and depth grammar:

> In the use of words, one might distinguish 'surface grammar' from 'depth grammar.' What immediately impresses itself upon us about the use of a word is the way it is used in the sentence structure, the part of its use – one might say – that can be taken in by the ear. – And now compare the depth grammar, say of the verb "to mean," with what its surface grammar would lead us to presume. No wonder one finds it difficult to know one's way about. (Wittgenstein, 1953/2009, §664, 176e-177e)

> I propose to interpret this passage as implying that our use of language is not only shaped by a particular surface grammar as syntax, which includes rules concerning how to compose a sentence, but also by a depth grammar in the form of games and a form of life, which constitutes a transcendental condition that must be presupposed in order for the sentence to have meaning. (Coeckelbergh 2017, p. 1508)

The surface and depth grammar of technology can be characterized analogously. Here, the surface grammar also consists of syntactical rules describing how to put things (words) together, with the depth grammar corresponding to games and a form of life. These grammars are transcendental in that they must be presupposed to make the use possible (Coeckelbergh, 2017, p. 1511). Surface and depth grammar as well as the difference between the two dimensions can be illustrated by the example of a navigation device (Coeckelbergh, 2017, p. 1512): There are surface grammars of how the parts of the device are assembled, how the navigation device interacts with a satellite, how it may be installed in the car, including also the built roads the navigation system has to operate on. There is also a depth grammar consisting of games of interacting with a device (voice assisted or via a keyboard), driving and (temporally optimized) wayfinding as well as an overarching form of life, a way of how we do things, commute, travel, and use individually operated vehicles to arrive at certain destinations. In a form of life where time was not as important and instead the most beautiful route (however that would be quantified) would be considered the optimal one, a navigation device would function in a fundamentally different way. In a (from our perspective hardly imaginable) form of life where the only merit ascribed to locomotion would be to be in the outside world, a navigation device would not have any meaning at all.

It follows, then, that artifacts cannot be interpreted as isolated things, but are instead not only bound by a syntactical surface grammar, but also made possible by a depth grammar, which is transcendental and normative in the sense that it is already there and tells us what to do, what surface grammar to follow, and which uses and activities are permissible. To stress the notion of depth, meaning that there is more to a grammar of

technology than just syntax, namely an additional dimension of how we do things, this conception will in the following be referred to as „deep technogrammar."

SYNTACTICAL TECHNOGRAMMAR: LIMITED WHOLES AND WORKING KNOWLEDGE

Another philosopher who employed Wittgensteinian thinking to propose a grammatical theory of technology is Alfred Nordmann (2018, 2020), whose approach focuses on the earlier work of Wittgenstein and identifies opportunities within the *Tractatus* to think about technology and arrive at a "grammar of things". Nordmann (2018) differentiates between two Wittgensteinian concepts of *world*, the world as the "totality of facts" and the world as a "limited whole", the former being the object of the problems of philosophy, the latter providing access to the world for a philosophy of technology. Through this lens every artifact on its own can be viewed as a limited whole:

> This alternative conception of "the world" does not necessarily refer to the "whole world" in a cosmic or planetary sense but takes any limited whole to be a world unto its own. If a clockwork, an artwork, any socio-technical system, the whole of God's creation, or a particular situation in human experience can be contemplated as a limited whole, each of these works or objects of contemplation is a world – and any world is a work not in the sense of labour, but in the sense of being a composition of things such that these things work together in a coherent, effective, or meaningful manner. […] [T]he contemplation of a limited whole affords knowledge of right and wrong ways of fitting things together. In a musical composition, a certain note 'doesn't work here' and does not agree with an acquired competence as well as a sense of right and wrong, of better and worse. Likewise, a composition of cogwheels, gears, and levers has to meet the criterion of compositional rightness. (Nordmann 2018, pp. 339-340)

A philosophy of technology would then need to explicate these working orders of things – this grammar of things – which makes up a work as it affords attunement. The question then arises of "what makes for the right, successful, felicitous arrangement of notes, symbols, or things, and what are the grounds for the normativity of [sic!] 'rightness' of composition?" (Nordmann, 2018, p. 344).

This grammar in the sense of a working order that constitutes a work seems to be located at the surface level of grammar as it was sketched out by Coeckelbergh. The examples Nordmann provides can all be captured by syntax: How things interact in a work – be it cogwheels in a clockwork, notes in a musical composition or rules and symbols in an algorithm – is merely a syntactical matter. Nonetheless, Nordmann still accounts for the normativity of grammar and – although he uses the term *grammar* in a narrow sense – seems to leave room for interpretation concerning some kind of interaction between working knowledge and a form of life: "To acquire working knowledge and to achieve attunement is to know or enact that grammar of things – which then provides a form of life or 'technology game'" (Nordmann, 2018, p. 343). However, later work by

Nordmann on the "grammar of things", suggests that his conception of a grammar of technology seems to be exhausted by the notion of syntax or surface grammar:

> "A sentence, statement, or proposition is a linguistic structure which can express a fact and how a thing appears to us. A clockwork, waterwork, or steelwork also provides a structure in which things can express themselves – where they reveal not what they are or how they appear, but what they can do or effect in concert with other things. […]
> There is a grammar, then, for mechanical engineers. It is a grammar of things and works in analogy to the grammar of words and sentences. It allows them to properly arrange elements such that they can form a meaningful whole. It also allows them to judge whether the resulting structure is well-formed. […]
> These are grammars in the sense of providing principles. (Nordmann 2020, pp. 88-89)

Although I will discuss possibilities of navigating the mentioned room for interpretation, it seems appropriate to refer to this theory by the term *syntactical technogrammar*.[1] Having sketched out these two different approaches towards a grammar of technology, two questions now arise: How can surface and depth grammar best be conceptualized, taking into account the whole of Wittgenstein's philosophy (of language)? And which conception of technogrammar proves more useful in building a framework for a philosophy of technology?

DEPTH GRAMMAR IN WITTGENSTEINIAN PHILOSOPHY

The notion of depth grammar in Wittgenstein's philosophy is not uncontroversial and plays into the ongoing debate of the significance of Wittgenstein's turn and the possible coherence between his earlier and later work. Tamara Dobler (2011: 76) identifies two main interpretations of surface and depth grammar: the first stresses continuance in Wittgenstein's work and interprets depth grammar as a "more ramified, more exhaustive and restrictive version of surface grammar" while the second treats *depth* as describing new dimensions of language use. These two conceptions of depth grammar roughly align with the two presented theories of a technological grammar. Nordmann's syntactical technogrammar concerns only aspects that would fall under the umbrella of surface grammar as described by Mark Coeckelbergh, whose theory of deep technogrammar on the other hand stresses the aspect of depth adding another dimension to the notion of grammar.

Coherence and Syntax

The portrayed theory of syntactical technogrammar rests only on the earlier work of Wittgenstein, hence explicit claims regarding the relationship to his later work – in particular the possibility of a wider, deeper grammar – are not made. As Wittgenstein's

[1] In her contribution comparing musical composition to that of computer programs, Lisa Borchert (2023) presents a view that provides for a non-conceptual semantics of syntactic principles.

conception of grammar has presumably evolved since writing the *Tractatus*, though, it seems appropriate and fruitful to relate the notion of syntactical technogrammar to the complete work of Wittgenstein in order to afterwards discuss possible limits of its scope.

What Dobler (2011) calls the "standard view" of Wittgenstein's conception of use and grammar is most prominently articulated by Peter Hacker and construes grammar as universally applicable rules:

> Grammar] consists of rules which function as standards of correctness or norms for correct application of words. The rules of grammar determine which combinatorial possibilities are licit, and which aren't; they, thus, distinguish meaningful from meaningless sentential constructions. But they also function as norms we follow when we speak meaningfully. Rules are inherently general and valid for the multiplicity of occasions. On this view, meaningful uses of language (understood both as combinatorial possibilities of words and particular instances of speech) are necessarily rule governed: there is no such thing as a meaningful use independently of rules. (Dobler, 2011, p. 48)

This view of grammar seemingly coincides with the syntactical conception of technogrammar: meaningful uses of technology are necessarily rule-governed – "Those who know [the grammar], can see or hear immediately what works and what doesn't" (Nordmann, 2020, p. 89). In this sense the grammar of technology is normative as it provides rules that define which arrangement of things is well-formed and which one is not. Grammar in a Wittgensteinian sense, then, can be thought of as a continued concept within a more or less coherent work, the later notion of grammatical rules being "the direct descendants of the 'rules of logical syntax' of the *Tractatus*. Like the rules of logical syntax, rules of grammar determine the bounds of sense" (Baker & Hacker, 1985, p. 40).

While surface grammar in this interpretation concerns typical syntactical categories (verbs, nouns, adjectives, …), depth does not constitute a new dimension of grammar, instead it accounts for the fact that grammatical rules – while still being universally valid – are tied to use:

> For instance, according to its surface grammar "to mean" belongs to the ("largely syntactic" as Hacker sees it) category of action-verbs […]. However, once we inspect its depth grammar – that is, the combinatorial possibilities and impossibilities of this word with other expressions in a greater number of constructions – we see that it is mistaken to take it as an action-verb. (Dobler, 2011, p. 56)

Akin to how the depth grammar of a word can be explored by looking at its use, "i.e. logico-syntactic employment, in a broad range of sentences, not merely at its superficial 'form'" (Dobler, 2011, p. 56), according to syntactical technogrammar, facts about a thing can be obtained by implementing it in technological contexts, resulting in a similar distinction:

> A clockwork, waterwork, or steelwork also [like a sentence] provides a structure in which things can express themselves – where they reveal not what they are or

> how they appear [i.e. their surface grammar], but what they can do or effect in concert with other things [i.e. their depth grammar].” (Nordmann, 2020, p. 88)

Thus, this conception of technogrammar can be reduced to (logico-)syntactical rules, which are occasion-invariant, but nevertheless only explorable by examining how things are used.

Turn and a New Dimension

The standard reading of PI §664 concerning surface and depth grammar has been criticised for falsely ascribing aspects of what actually would need to be considered surface grammar to depth grammar. According to this critique, every kind of “rules of *logical* grammar which impose restrictions on the *combinatorial possibilities of words* in framing *meaningful* (significant) sentences” fall under the umbrella of surface grammar (Baker, 2001, p. 308) – in contrast to the standard view, which differentiated between immediately apparent and use-based rules of composition and placed the former on the surface and the latter on the depth level of grammar. According to Baker, the former reading would be more on par with Wittgenstein’s inquiry in the *Philosophical Investigations*:

> This [subsuming all (logico-)syntactic grammar that is of interest according to the standard reading under *surface grammar*] would connect “surface grammar” with a major preoccupation of the philosophers who are the principal explicit targets of critical investigation in PI: namely Frege, Russell, and the author of TLP and RLF. (All three of them focussed on the logical analysis of propositions, even though all three schemes of analysis were logically incommensurable.) […] Rules for constructing *significant* sentences could be precisely what Wittgenstein meant to pick out there by the phrase “surface grammar”, hence *not* by the phrase “depth grammar”. If so, his declared intention to describe depth grammar was presumably to *differentiate* his later method of describing the grammar of our language from the standard method of constructing a classification of words into logical categories or types […]. His primary concern in ‘depth grammar’ must then be *different* from pointing out category-mistakes or clarifying type-restrictions or combinatorial possiblities [sic!] and impossibilities. (Baker, 2001, p. 308)

This conception of grammar, then, would mark a turn in Wittgenstein’s thinking as “his concern with ‘depth grammar’ would put emphasis on aspects of his investigations which have no counterpart there [TLP]” (Baker, 2001, p. 316). It would furthermore elucidate Wittgenstein’s usage of *depth* as depth grammar, and would open up a new dimension of grammar compared to mere surface-level rules of combination and composition. As for what this dimension might be, Baker offers several options Wittgenstein emphasizes in the PI:

> “(1) Differences in the ways individual words are integrated into human activity, the different ways of *operating* with words.” (Baker, 2001, p. 309)

> “(2) Differences in the ways *complete* sentences are *employed*.” (Baker, 2001, p. 310)

> "(3) The dependence of the question whether a particular utterance of a well-formed sentence (one having unexceptionable *Satzklang*) really makes sense (i.e. has a role in a language-game) on the *circumstances* surrounding its utterance." (Baker, 2001, p. 311)
>
> "(4) The nonsensicality (uselessness) of a proposition based on a *wrong calculation*." (Baker, 2001, p. 312)
>
> "(5) The construction of imaginary or hypothetical language-games as objects of comparison." (Baker, 2001, p. 313)
>
> "(6) Concern with *pictures* which individuals may associate with the uses of particular words." (Baker, 2001, p. 314)

Some of these dimensions are also captured by the depth dimension in deep technogrammar, which covers integration into human activity (1), grammars concerning the employment of artifacts (2) and occasion-sensitivity (3). While it certainly could be argued that (4)-(6) are covered by deep technogrammar as well, this would demand an extensive discussion which is not needed to make the point that this interpretation of depth grammar falls in line with deep technogrammar, as (1)-(6) are only suggestions for what the deep dimension of grammar *could* be. Furthermore, Mark Coeckelbergh (2018) stresses that "form of life" is a central part of depth grammar, which describes a holistic whole containing multiple language/technology games (pp. 1506-1508). Although Baker does not explicitly mention this aspect of holism, the embeddedness of language/technology use in human activity can be extrapolated to some extent. Moreover, Dobler (2011) – although similarly not applying this term in a holistic sense – identifies the lack of exactly this analysis of the dimension of human activity to be one of the main reasons for why the standard reading is insufficient as well as the constitutive aspect of Wittgenstein's turn (p. 165). While the standard reading does not discard this social aspect, it is interpreted as "part of the framework within which a language-game is played" (Baker & Hacker, 1985, p. 243) instead of being part of grammar itself. Grammar, with its occasion-insensitive rules, then, does not capture the difference between sense and nonsense regarding certain uses of language to which the categories (1)-(6) apply. Consider the following example in regard to (3):

> "[I]f somebody had an arm 10 feet long and put it down a hole, we would have no difficulty in making sense of his statement "I feel water ten feet underground"; but if a normal human being makes the same statement in similar circumstances, we could make no sense of it." (Baker, 2001, p. 311)

To what extent this insufficiency of the standard view on surface and depth grammar is relevant in regard to the grammar of technology – syntactical technogrammar – will later be taken up and examined further.

Depth and Transcendence

Being presented with these two different interpretations of the Wittgensteinian notion of surface and depth grammar, two problems arise. The first reading, stressing

coherence in Wittgenstein's work and the syntactical nature of rules, does not account for the social dimension of use – the embeddedness of use in human activity – and postulates rules that are occasion-insensitive. The second reading, on the other hand, opens up an additional dimension of grammar and hence proposes a turn in Wittgenstein's philosophy, especially regarding his conception of grammatical rules. This evokes a metaphysical feeling of a more fundamental set of rules lying beneath the surface – in particular the interpretation by Coeckelbergh, who identifies depth grammar as being "transcendental". This metaphysical conception of depth would be quite contrary to Wittgenstein's analytic inquiry as "Philosophy simply puts everything before us, and neither explains or deduces anything. […] For what is hidden, for example, is of no interest for us" (Wittgenstein, 1953/2009, §126, 55e).

Though Coeckelbergh introduces the notion of depth grammar being transcendental in a (post-)Kantian way, denoting 'conditions of possibility' (*Bedingungen der Möglichkeit*), he still employs vocabulary that evokes a perception of hiddenness: "[D]epth grammar is less easy if not impossible to fully make explicit" (Coeckelbergh, 2018, p. 1508). The image of transcendence can be avoided by further unpacking what is meant by *transcendental*:

> [L]anguage games and forms of life are transcendental conditions of language use and meaning in particular situations. They "make possible", structure, and limit a particular use of language and its related meaning. Without these games and forms of life, a particular use of language would be meaningless. (Coeckelbergh, 2018, p. 1507)

Coeckelbergh (2018) stresses that said transcendental grammar is neither "in the head" nor in a "noumenal realm", but "rather immanent" as it "lives in concrete use, in human activities and practices" (p. 1508). A better understanding of how this transcendental, yet immanent grammar arises, can be gained via the aspect of performance in technology use as emphasized by Coeckelbergh and Funk (2018), who "propose to interpret transcendental depth grammar as the grammar of human performances – performances that are more than language and enable meaningful usage of words" (p. 183). Thus, technological performances – uses of technology, which constitute its meaning – are only meaningful if they are made possible by this grammar:

> Performance is about skilled use of words, body, and tools, and this is only possible in a meaningful way and in a successful way if and since there is already a socially and culturally shared whole of largely implicit know-how that forms the linguistic, bodily, and technological "grammar" which shapes and *makes possible* a particular use-performance. (Coeckelbergh & Funk, 2018, p. 183)

This notion of technological performance that is only made possible by culturally shared know-how adheres to the Wittgensteinian concept of rule-following: in PI §202 Wittgenstein refers to rule-following as "practice" and concludes his argument with the observation that it is impossible to follow a rule privately (Wittgenstein, 1953/2009, §202, 87e-88e), hence opening up a social perspective and tying grammatical rules to a whole linguistic (technological) community. The mentioned difficulty to make depth grammar

explicit can also be captured by the problem of rule-following, eliminating the metaphysical quality that might have been associated with it.

In this sense, the grammar is already there, immanent, as it lives in concrete practices performed by a wider community. *Depth*, therefore, describes the embeddedness in social practice that goes beyond merely syntactical rules – the implicit character of rules concerning depth grammar naturally arises via the problem of rule-following.

TOWARDS A DEEP TECHNOGRAMMAR

Thus far I have presented two conceptualisations of technogrammar, correlating – as I have interpreted them – with two interpretations of surface and depth grammar. While deep technogrammar at first sight appears to make metaphysical claims about some kind of hidden structures that underlie grammatical rules, *depth* rather concerns a new dimension, namely the embeddedness of use within wider social practice. Syntactical technogrammar, on the other hand, lacks said dimension by reducing grammar to occasion-insensitive rules. Since this (standard) view only insufficiently captures the meaning of language – as seen by the 10-feet-long-arm example –, it is yet to be examined whether the same critique applies when this conception of grammar is employed to analyze technology.

When unfolding his theory of a – in my view, syntactical – grammar of technology, Nordmann (2020) draws on a certain notion that is constitutive for the dimension of depth in deep technogrammar: different technology games (e.g. architecture, pharmacy, electrical and software engineering) make up different grammars. It is also mentioned that acquiring working knowledge – which does not seem to be implicit in the same way know-how is in deep technogrammar – provides technology games and a form of life (Nordmann, 2018, p. 343). It seems, though, that – analogously to how the standard view on surface and depth grammar accounts for the relation to use and human activity – this is only "part of the framework within which a *technology*-game is played" instead of an actual part of the grammatical structure of a technology (or *work*). The example of musical compositions, which both Nordmann and Coeckelbergh utilize, further supports this interpretation and illustrates the difference between the two grammars of technology. Syntactical technogrammar does acknowledge different musical languages which consist of different grammars, but constricts those to "principles of composition":

> These are grammars in the sense of providing principles of composition […]. Music provides the most obvious example. There is counterpoint, romantic harmony, twelve-tone music – each with its own principles of composition that tell composers and listeners whether the tones are rightly arranged so as to carry the musical logic forward and so as to produce a desired effect. (Nordmann, 2020, p. 89)

Deep technogrammar, on the other hand, stresses the performance character of technology and the grammar being transcendental:

> Music is again a good example [of surface and depth grammar] since it involves these different kinds of grammar: the syntactical grammar of musical language/logic, for example, but also the grammar and games of styles, and indeed the depth grammar of an entire music culture, such as the rock culture, which constitutes a form of life. […] [M]usical grammars and cultural embodiments in music, but also music technologies, constitute *transcendental* forms of life. For example, the e-guitar becomes a condition of possibility of how to talk with and about music. Of course there is a concrete artifact, such as a Stratocaster guitar or tube amplifier. But there are also concrete skills that are enabled by these instruments and at the same time shape the possibilities of how to use it – what we called "innate technique" – and on the link between these skills and techniques and the form of life as a transcendental condition. Before a musician starts playing and performing, there is already a form of life which provides grammars that make possible the playing and shape particular performances, techniques, and styles." (Coeckelbergh & Funk, 2018, 186-187)

What immediately strikes one's attention are the examples of concrete distinct musical grammars both authors introduce: syntactical technogrammar describes grammars that consist in compositional rulesets, while deep technogrammar establishes a wider conception of what a musical grammar might be. Thus, it is unclear how, for example, the grammar of rock music could be properly captured by syntactical technogrammar. Even the examples Nordmann lists are illuminated by deep technogrammar more successfully: twelve-tone music emerged from a music performing community with existing grammars – implementations of twelve-tone techniques *made possible* by those grammars. Hence, analysis of conditions of possibility of technologies, transcendental grammars, could not only lead to further insights about said technologies, the latter must be understood as essentially being bound by these depth grammars. This is also shown by the aforementioned example of a navigation device, which would have no meaning at all outside of a form of life where certain destinations are to be reached. Syntactical technogrammar, therefore, proves insufficient in properly capturing technology.

CONCLUSION

In this paper I have presented two conceptualisations of a Wittgensteinian grammar of technology. Syntactical technogrammar concerns rules of composing things within a technological work, while deep technogrammar stresses that the meaning of a technology can only be understood by taking into consideration wider grammars – forms of life – that are social and transcendental. It has been shown that syntactical technogrammar falls in line with an interpretation of Wittgenstein's work which views the latter as more or less coherent, in particular regarding the notion of grammar. Surface grammar, then, describes apparent syntactical categories while depth grammar consists of rules regarding the correct employment of words/things in a variety of linguistic/technological constructions. By remaining on a merely syntactical level of occasion-invariant rules, this interpretation

not only fails to do Wittgenstein's later writing of grammar justice, but also seems to fall short of appropriately describing technology.

Deep technogrammar, on the other hand, recognises the turn in Wittgenstein's thinking by ascribing all rules of syntactical technogrammar to surface grammar and construing *depth* as opening up a new dimension which is social and transcendental. In spite of – at first sight – evoking a rather metaphysical feeling, this conception of *depth* is still immanent as it lives in concrete technology uses performed by a wider community. This analysis of depth grammar – as part of deep technogrammar – opens up new and fruitful perspectives to think about technology.

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Research article

Teaching Students to Communicate in a Foreign Language through Teamwork on Virtual Communication Platforms

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Abstract

The article describes the advantages of organizing students' collaborative language practice sessions on virtual communication platforms and the results of the research which was aimed at identifying whether teamwork was more conducive to improving monologue or dialogue speech skills than each student's autonomous work. To this end, we conducted an experiment during the epidemic of COVID-19, in which all the participants were to analyze the quotations, following the scheme which was offered in the additional textbook. The exposure groups were given a home assignment to analyze the quotations in the form of monologues in the course of working in teams on a virtual communication platform. In class, they were asked discussion-generating questions, and they made dialogues in pairs to answer them. The students in the reference groups did the same home and classroom assignments individually. At the end of the experiment, the students were asked to prepare final monologues and dialogues related to one of the topics studied in the course of the experiment. The difference between the scores they got for the final and diagnostic monologues and dialogues was much higher in the exposure groups than in the reference ones because teamwork was mutually enriching for all the members of the small groups: their members contributed to each other's level of foreign-language proficiency by exchanging ideas, sharing their knowledge of grammar and vocabulary, correcting their partners' mistakes and encouraging them to use new words, phrases and grammatical structures. The experiment allowed us to make an additional conclusion: the scores for the monologues increased in both the reference and exposure groups to a greater extent than the scores for the dialogues. Since the scores for the diagnostic dialogues were higher than those for the diagnostic monologues, the scope of improvement for the monologues was greater than that for the dialogues. The results of the research indicate that teamwork on virtual communication platforms is an indispensable tool which can be used in EFL classroom to teach the students to communicate in a foreign language.

Keywords: Dialogues and monologues; Quotations; Foreign-language proficiency; Grammar and vocabulary; Virtual communication platforms; Collaborative learning, Teamwork

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Научная статья

Обучение студентов общению на иностранном языке путем организации командной работы на виртуальных коммуникационных платформах

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Аннотация
В статье описываются преимущества организации совместной учебно-познавательной деятельности студентов на виртуальных коммуникационных платформах и результаты исследования, целью которого было определить, способствует ли командная работа улучшению навыков монологической или диалогической речи в большей степени, чем индивидуальная работа. С этой целью мы провели эксперимент во время эпидемии COVID-19, в ходе которого все участники должны были проанализировать цитаты, следуя схеме, предложенной в дополнительном авторском учебном пособии. Экспериментальные группы получали домашнее задание проанализировать цитаты в форме монологов в ходе работы в командах на виртуальной платформе. На занятиях им задавали вопросы для обсуждения, и они вели диалоги в парах, чтобы на них ответить. Учащиеся из контрольных групп выполняли те же самые аудиторные и домашние задания индивидуально. В конце эксперимента студентам было предложено подготовить заключительные монологи и диалоги, относящиеся к одной из тем, изученных в ходе эксперимента. Разница между баллами, которые они получили за финальные и диагностические монологи и диалоги, была намного выше в экспериментальных группах, чем в контрольных. Это можно объяснить тем фактом, что командная работа способствовала взаимообогащению всех членов малых групп: их участники обменивались идеями, делились своими знаниями грамматики и словарного запаса, исправляли ошибки своих партнеров и поощряли их использовать новые слова, словосочетания и грамматические структуры. Эксперимент позволил нам сделать дополнительный вывод: баллы за монологи увеличились как в контрольной, так и в экспериментальной группах в большей степени, чем баллы за диалоги. Поскольку изначально баллы за диагностические диалоги были выше, чем за диагностические монологи, масштабы для улучшения монологов были больше, чем для диалогов. Результаты исследования показывают, что командная работа на виртуальных коммуникационных платформах является незаменимым инструментом, который может быть использован на занятиях по иностранному языку для формирования коммуникативной компетенции студентов.

Ключевые слова: Диалоги и монологи; Цитаты; Владение иностранным языком; Грамматика и словарный запас; Виртуальные коммуникационные платформы; Совместное обучение; Командная работа

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INTRODUCTION

Teaching students to communicate in a foreign language has always been a challenging task. For one thing, some learners have difficulty using a language in the course of communication because they find it hard to break through the invisible barrier that prevents them from getting their message across when they have a conversation. Surprisingly, this applies not only to underachieving students, who cannot communicate in a foreign language just because they do not have enough controlled practice due to poor training attendance. This also concerns dutiful and efficient learners who gain high scores in any activities other than conversational practice: learning vocabulary, writing essays, reading and listening comprehension. Anecdotal evidence suggests that such students' passive vocabulary can be quite extensive, which allows them to understand other speakers' remarks in the flow of a conversation, but for them producing a quick response is a stumbling block. Students may feel inhibited by the presence of their peers, or probably they do not speak in class for fear of making a mistake. Being interrupted and corrected by the teacher in mid-flow is another reason for their failure to speak a foreign language fluently. Generally speaking, these obstacles can be removed if teachers and educationalists find new ways of organizing conversational practice, which can be conducive to involving learners in foreign-language communication.

THE SIGNIFICANCE OF TEAMWORK IN DEVELOPING LEARNERS' FOREIGN-LANGUAGE SPEAKING SKILLS

In the studies dedicated to language training methods, teamwork is described as an effective means of teaching learners to communicate in a foreign language. Learning processes and outcomes can be taken to a new level if students form communities, in which they collaboratively discuss various topics and brainstorm ideas. It helps create a favorable environment in which learners feel free to take risks and make mistakes (Uličná, 2021, p. 3). When a teacher supervises students while they speak a foreign language in front of the audience, they often feel too self-conscious and inhibited to freely discuss the topics they feel strongly about. However, by working in small teams with their peers, learners immerse themselves in foreign-language communication and overcome invisible barriers preventing them from speaking fluently.

Collaborative learning can be perceived as hands-on experience in foreign language communication. In this way, learners acquire topic-oriented vocabulary more successfully since freedom and autonomy, which are inherent to teamwork, make learning more interesting and enjoyable for them (Palea & Mihăilă-Lică, 2016). However, even though teamwork gives students freedom and turns practicing a foreign language into an exciting activity, it does not necessarily mean that new words and sophisticated grammatical structures will be used. Generally, learners tend to stay in the "comfort zone" and use the vocabulary and structures that they are already familiar with. When a teacher wants to have learners internalize new vocabulary, minimum requirements should be laid

down so that the new lexical and grammatical material is included in the dialogues and monologues.

Preparing task-based collaborative dialogues in an EFL class is instrumental in developing foreign-language skills. Opinion polls indicate that learners get a chance to reflect on their own accuracy and fluency as well as to detect and correct their own errors by getting feedback from the other team members (Shirazifard, et al., 2022). If some of the team members have remarkable foreign-language skills, they can serve as a benchmark for the other students whose level of language proficiency is lower. On the other hand, the students with the highest level of the language skills can also benefit from correcting the other students' mistakes and providing them with the detailed explanations of the learning material.

Teamwork is instrumental in developing learners' foreign-language speaking skills not only when it comes to collaborative out-of-class work, but also in the course of free classroom discussions. Students are more interested in discussing the topics that will enable them to communicate in the real world than in those that they generally come across in their course books (Paulikova, 2018). This applies in particular to senior students majoring in linguistics because their high level of foreign-language proficiency allows them to speak about any subject without being inhibited by its complexity. To this end, discussion points should appeal to the learners and get them to talk spontaneously.

All team members should contribute to achieving the common goal regardless of their level of foreign-language proficiency. Any utterance has a social function since the interlocutor expects feedback and response from the listener. By making dialogues, students learn to recognize different types of functional language (request, command, refusal, apology, etc.) (Christianto, 2020). Christianto dedicated his article to classroom communication between a teacher and students, in which the foreign language serves practical purposes. When EFL students do an assignment in the course of collaborative out-of-class work, the requirement to speak a foreign language should extend not only to the task itself, but to any other discussions, regardless of the fact whether or not they are directly related to the assignment in question. The teacher can use such technologies as speech recording or teleconferencing facilities to check if it is the case when students work autonomously and to ensure that they do not switch to their native language under any circumstances. Without such regular checkpoints, learners' foreign-language skills may not develop, and teamwork will not make any sense.

Checking learners' conversational activities in small teams is absolutely essential because it is often argued that when students speak a foreign language in small teams without being corrected, such an activity cannot be regarded as controlled practice. However, it is recommendable that errors should not be corrected in the course of discussion: all mistakes should be recorded and corrected later (Azimova, 2019). That is why before students embark on working in teams, they should be instructed to record each other's mistakes and correct them later. Moreover, if learners collaborate on communication platforms, such as MS Teams, their conversation is recorded, so the mistakes that go unnoticed can be corrected later.

Apart from establishing the minimum lexical and grammatical requirements, the teacher needs to ensure that they are complied with, especially when it comes to out-of-

class work. Since computer-mediated communication has synchronous and asynchronous modes, it is possible for students and learners to communicate both in a delayed fashion using offline modes, and in a synchronous environment, by contacting via chat discussion software (Farahian and Ebadi, 2023). Such computer-mediated communication is crucial for the EFL teacher because without regular supervision some students are reluctant to join in when a group discussion is held, whereas others, on the contrary, speak too much, not letting the other team members get a word in edgeways. Thus, the teacher can check each student's performance by using either synchronous or asynchronous communication modes.

Technologies have provided more opportunities for collaborative learning. Both learners and teachers can use Stixy (an online whiteboard space), Google groups or Mikogo (Rao, 2019). By applying technologies like the ones mentioned above students can collaborate both in class and in the course of doing home assignments. When students work on online platforms like MS Teams, their performance can be monitored by the instructor directly in the course of the communication session or indirectly, by listening to its record.

DEVELOPING STUDENTS' COMMUNICATIVE SKILLS BY ORGANIZING TEAMWORK IN VIRTUAL ENVIRONMENTS VS. FACE-TO-FACE TEAMWORK

The only option for students in some situations, such as COVID-19, when they do not have access to face-to-to-face contact with peers and teachers, is to work in virtual environments (Klisowska et al., 2020). Even though interpersonal communication in MS Teams is sometimes interrupted by technical failures, it still allows learners to work in small groups and acquire foreign-language communicative skills. Moreover, the functions that this platform features make it more convenient in some situations than face-to-face communication, and at times students feel more confident when they contact each other online because for Gen-Z it recreates their familiar environment.

E-learning enables students to study in accordance with their individual learning styles, which makes the learning process more personalized. By using hyperlinks, learners can find information in accordance with their personal needs and interests. On top of that, by working in virtual environments, students broaden their knowledge about the internet, which is essential for their future careers (Neveda & Dimova, 2010). Learners can contribute to teamwork in accordance with their individual preferences and interests. Even if their level of foreign-language proficiency is lower than that of their groupmates, they still feel less inhibited when they come up with their ideas than when they have to speak in front of the whole group. Moreover, whenever they have something valuable to contribute to teamwork, but they have difficulty getting their idea across in English, they can find supporting arguments on the internet and either use the chat function to send the hyperlink to their partners, or just share the screen to show them a text or a video spot to illustrate the point. In this way, students learn to use internet resources not only for entertainment, but for educational purposes.

Another advantage of teamwork in virtual environments is that even the shiest students have their voice. When they study face-to-face, such learners do not share their ideas with the rest of the group because more self-confident students do all the talking and do not allow anyone to get a word in edgeways. If students are too shy, they can use the chat function, jot down their ideas and share them with their teammates. The teacher can listen to the recording of the communication session in an asynchronous mode to check whether all the members of a small group joined in and contributed to achieving the common goal when the discussion was going on. On top of that, the chat function available in MS Teams allows users to save time: while one person is talking, someone else can contribute their ideas in a written form. A participant of the communication session may also want to share such content as short videos, texts and vocabulary lists. All the learning materials are brought together on one single platform, which enables the students to resort to them whenever it is relevant.

However, apart from all the conveniences provided by MS Teams, it has a significant disadvantage when it comes to acquiring foreign-language speaking skills. When learners work in small groups on this platform, they do not see their partners' facial expression, posture and body language, which inhibits the natural flow of communication.

ASSESSMENT CRITERIA OF STUDENTS' FOREIGN-LANGUAGE SPEAKING SKILLS

Formative assessment of students' foreign-language speaking skills is part and parcel of the learning process. Students should be allowed to participate in the process of tracking their own progress since they need to be encouraged to take responsibility for their learning outcomes (Hatipoğlu, 2021). To this end, teachers should develop assignments that could help them thoroughly evaluate learners' conversational skills by having them deliver monologues and engage in dialogues. Teachers can also give a voice to learners by getting them to undertake peer assessment. However, students should be provided with a set of criteria that could assist them in measuring their peers' skills.

Assessment of speaking skills is probably a more complicated task than assessing skills in grammar or listening and reading comprehension because they cannot be measured by having students write tests and by calculating their test scores. In order to evaluate students' speaking performance in an ESL / EFL classroom, a teacher needs to draw on a list of assessment criteria.

In a study by Valoojerdy (2022), the assessment criteria are divided into four groups: voice control, which includes loudness, pace, intonation and legibility; body language (posture, gestures, eye contact); the content of a presentation (whether the verbal message has an introduction, a body and a conclusion), and the fourth criterion, effectiveness, which comprises the choice of the topic, language use, vocabulary and achieving the goal of the speaking assignment. The list includes some criteria that are difficult to assess objectively, such as loudness and legibility, as well as some extralinguistic criteria that do not indicate the command of English, like posture, gestures and the choice of the topic.

The comprehensive list which was made by B. Knight comprised grammar and vocabulary, pronunciation, fluency, conversational skills, sociolinguistic skills, non-verbal clues and the relevance of the content (Knight, 1992). Six out of eight criteria on this list were used as a basis of evaluating the students' speaking skills in the experiment that was conducted in this study. The sociolinguistic skills, which comprised distinguishing the register and style, was not included since the conversations that were to be evaluated in this study were all in the same style. Non-verbal clues were also excluded from the assessment criteria because evaluating them was irrelevant to this research. The maximum score the students could achieve was 24 (4 for each of these criteria).

In order to get the highest score in grammar it was not enough to use the grammar constructions correctly. The range of constructions was also taken into consideration: the use of a wide variety of tenses; infinitive, participial constructions, gerund and subordinate clauses. Meticulous attention was paid to the correct usage of articles and prepositions. On top of that, the way the learners used the vocabulary was of paramount importance. Apart from the word accuracy, lexical co-occurrence was considered. The range of vocabulary was to correspond to C2 (proficiency level): to get the highest score for this criterion the students had to show the teacher that they had mastered English vocabulary to an exceptional level. The students' phonetic skills were evaluated along with grammar and vocabulary. The pronunciation of individual sounds, their clusters, linking consonants and assimilation, as well as the stress, intonation and rhythm were assessed.

The other three criteria that were on the checklist referred to the process of speaking as a whole rather than to its individual components. Fluency, which was the first of these criteria, included such components as the speed at which the students were speaking. Apart from speed, it was important to determine whether the learners hesitated before they started speaking, and whether they paused so as to reflect upon what to say next. When it came to the assessment of the conversational skills, it was considered if the students fully developed the topic, whether their remarks were relevant and if they understood the interlocutor's utterances. The other components of this criterion included the way the learners filled the pauses in the conversation as well as their ability to clarify the unclear issues and to digress in order to give additional information. The content of the speech was also assessed: to achieve the highest score, the students were to adhere to the topic; they had to put forward coherent and relevant arguments. If they were unable to support their arguments, or if their ideas were irrelevant to the topic, their score was lower.

METHODS: THE EXPERIMENT MEASURING THE EFFICACY OF TEAMWORK IN ACQUIRING FOREIGN-LANGUAGE SPEAKING SKILLS

The experiment aimed at identifying whether teamwork was more conducive to improving monologue or dialogue speech skills than each student's individual work was carried out at Peter the Great Saint Petersburg Polytechnic University during the outbreak

of COVID-19 (in the seventh semester of 2020 and 2021). It involved 82 senior students majoring in linguistics. There were 42 participants (22 in 2020 and 20 in 2021) in the reference groups and 40 participants (19 in 2020 and 21 in 2021) in the exposure groups. In the seventh and eighth semesters the students worked with the core course book Upstream Proficiency and an additional textbook which trained them to analyze quotations. The words of wisdom (adages and quotations) covered in the additional textbook were relevant to the topics in Upstream Proficiency, and in the course of the experiment the students in both the exposure and reference groups were assigned to make a dialogue and prepare a monologue on the basis of quotations. At the beginning of the experiment all the participants were given a diagnostic assignment to analyze a quotation related to one of the topics from Straightforward Advanced that were studied in the previous semester. The purpose of the assignment was to determine the students' initial speaking skills. The quotation related to the topic "Success and Failure" and the problems that the participants were to discuss in a dialogue are given below:

Quotation: "The secret of success in life is for a man to be ready for his opportunity when it comes." (Benjamin Disraeli, 1804-1881, Prime Minister of the United Kingdom)

Questions to discuss in a dialogue: 1. Do you agree that happiness is a measure of success? 2. What part does luck play in success? 3. Why can a person be successful in one part of life and a total failure in another?

The students were already familiar with the algorithm of quotation analysis because they had been taught to interpret words of wisdom before, and it was even one of their assignments in the exam at the end of the previous semester. The first step was to give some background information about the author and to suggest why he might have expressed such an opinion. The next step involved reiterating the quotation and explaining its idea in the student's own words. Then the learners were expected to agree, disagree or partly agree with the quotation and to justify their viewpoint by giving supporting arguments and telling a story illustrating their opinion. The story supporting the arguments could be just the students' anecdotal evidence, or it could be taken from a film or a book, which was more preferable because it indicated the learner's erudition. Finally, the students were to summarize all their points in a comprehensive conclusion. The learners were given 15 minutes to prepare a monologue and one minute to deliver it. While they were speaking in turns, the teacher assessed each of them and wrote down the results of the assessment. After the students analyzed the quotation, they were given another 15 minutes to prepare a two-minute dialogue in pairs on the basis of the three additional questions related to the quotation.

The teacher listened to the diagnostic monologues and dialogues, which were then assessed on the basis of the 6 criteria proposed by Knight (1992). Their results are given in the table below.

Table 1. The results of the diagnostic dialogues and monologues in the reference and exposure groups in 2020-2021 (maximum score – 24)

Partici-pants	Scores, (24 max.)							
	Reference groups				Exposure groups			
	Dialogue		Monologue		Dialogue		Monologue	
	2020	2021	2020	2021	2020	2021	2020	2021
1	14	13	12	10	12	14	11	12
2	12	14	9	12	14	12	12	11
3	15	17	13	15	10	14	10	12
4	10	11	10	10	12	13	11	11
5	13	12	11	10	11	13	11	10
6	10	13	11	13	15	15	14	13
7	16	14	14	13	14	12	12	11
8	11	11	13	9	13	13	11	12
9	15	16	14	13	12	12	11	10
10	14	12	14	10	12	15	10	13
11	10	12	11	10	11	14	10	13
12	11	13	9	11	13	12	12	10
13	11	10	8	9	14	14	13	12
14	17	13	14	12	12	13	11	12
15	15	12	14	10	10	12	10	10
16	13	15	12	12	11	12	11	10
17	15	12	13	11	13	13	11	12
18	10	10	9	9	12	12	11	11
19	9	11	9	10	13	13	12	13
20	17	14	15	13		14		11
21	13		12			15		13
22	12		12					
Average score	12,86 53,6%	12,75 53,1%	11,77 49,1%	11,10 46,3%	12,32 51,3%	13,19 55,0%	11,26 46,9%	11,52 48,0%
Average for 2 years	**12,81** **53,4%**		**11,44** **47,7%**		**12,75** **53,1%**		**11,39** **47,5%**	

Table 1 illustrates the results of the diagnostic dialogues and monologues in the reference and exposure groups in 2020 and 2021. In the reference groups, the average score for the dialogues was 12.86 (53.6%) in 2020 and 12.75 (53.1%) in 2021, and the average score for the monologues was 11.77 (49.1%) in 2020 and 11.1 (46.3%) in 2021.

In the exposure groups, the average score for the dialogues was 12.32 (51.3%) in 2020 and 13.19 (55%) in 2021, and the average score for the monologues was 11.26 (46.9%) in 2020 and 11.52 (48%) in 2021. Interestingly, in all the groups the scores for the dialogues were higher than the scores for the monologues. It can probably be explained by the prevalence of dialogues in regular ESL classroom activities, whereas monologues accompanied by presentations are less frequent at most primary and secondary schools, so students get more controlled practice of making dialogues before they go to university. In general, the average scores in the reference and exposure groups were approximately the same, which indicates that their foreign-language speaking skills did not show considerable difference at the initial stage of the research.

At the next stage of the research, both the exposure and reference groups worked with Units 1-5 of their basic course book Upstream proficiency and with an additional textbook "Acquiring discursive skills by senior linguistic majors via explaining maxims and catchphrases: teaching manual" (Dashkina and Sosnina, 2021), which describes the structure of quotation analysis and contains additional questions that help learners generate ideas, topic-oriented glossary and biographical entries that carry information about the authors of the quotations. The topics covered in the additional textbook correspond to the ones in Upstream Proficiency. Each unit includes one quotation with the questions that are aimed at giving learners deeper insights into its gist and text extracts related to the topic under consideration. At the end of the unit students are given another three quotations for independent analysis, this time without any leading questions.

In the course of the experiment the students in both the exposure and reference groups were given the same home assignments based on the material from the additional textbook. The learners were to use at least 5 grammatical structures and 10 words and expressions from either Upstream Proficiency or the topic-oriented glossary in the book "Acquiring discursive skills by senior linguistic majors via explaining maxims and catchphrases: teaching manual". In the reference groups, the students did the home assignment on their own. They were to answer all the leading questions and analyze the other three quotations. In the next class the teacher checked the home assignment: the students took turns to answer the questions related to the first quotation from the unit, and then five students were asked to deliver a monologue in which they analyzed one of the quotations prepared by them at home.

The exposure groups were divided into 5 teams that were to do their homework together. Each of the teams created their own MS Teams channel with the teacher's name added to it. All the communication sessions were recorded so that the teacher could listen to either the students' conversations directly or their records. It was vitally important since the teacher had an opportunity to assess how active the team members were in the course of the communication sessions. The learners contributed to teamwork in accordance with their individual level of foreign-language proficiency and their interests. When they looked for supporting arguments, they selected examples from the films and fiction in their favorite genre and shared the hyperlinks with the other team members. The main guideline that the students were supposed to adhere to was to speak English in the course of their communication on MS Teams platform. In the next class, the home assignment

was checked in the same way as in the reference groups. The students from different teams answered the questions from the additional textbook and delivered the monologues.

The students also made dialogues in each class in the course of the experiment. In all the groups that participated in the experiment the teacher asked one provocative question related to the topic but not included in the additional textbook. For example, when the students were analyzing the quotation by Marcus Tullius Cicero "The authority of those who teach is often an obstacle to those who want to learn", the teacher asked the following provocative question: "If learners always question the authority of those who teach and never believe anything they say, what possible consequences can such an attitude have?" In the reference groups, the students were given 5 minutes to think about the question, and then the teacher initiated the discussion, in which everyone was expected to participate and to come up with their own opinions. In the exposure groups, the teams were seated together so that they could discuss the provocative question in English for five minutes. Afterwards the whole group was involved in the discussion, in which the students exchanged their opinions. In both the reference and the exposure groups, the teacher assessed the monologues and dialogues in accordance with the criteria introduced by B. Knight. It is necessary to emphasize once again that in the course of the experiment the reference and the exposure groups did exactly the same assignments and in the same volume. The only difference was that in the reference groups the students prepared dialogues and monologues on their own, whereas in the exposure groups they worked in small teams.

RESULTS

At the end of the experiment, all the respondents were given a final assignment to analyze a quotation related to one of the topics from Upstream Proficiency that were studied in the course of the experiment. The final assignment was in the same format as the diagnostic one, and its purpose was to determine the students' progress. The quotation the students were to analyze was related to the topic "Communication". The quotation itself and the problems that the participants were to discuss in a dialogue are given below:

Quotation: "We have two ears and one mouth so that we can listen twice as much as we speak." (Epictetus – a Greek Stoic philosopher)

Questions to discuss in a dialogue: 1. According to the quotation, people should listen rather than speak. If everyone listened and nobody spoke, would the world plunge into silence?

2. How could we benefit from listening both to other people and to everything that happens around us?

3. Why should a good communicator listen rather than speak?

By the same token as in the diagnostic dialogue, the learners prepared a monologue for 15 minutes and delivered it for a minute. After analyzing the quotation, they were given another 15 minutes to prepare a two-minute dialogue in pairs on the basis of the three additional questions given above, which were related to the quotation. While the students were speaking in turns, the teacher assessed each of them on the basis of the

criteria proposed by Knight (1992). and recorded the results of the assessment. The results of the final monologues and dialogues are given in the table below.

Table 2.The results of the final dialogues and monologues in the reference and exposure groups in 2020-2021 (maximum score – 24)

Partici-pants	Scores, (24 max.)							
	Reference groups				Exposure groups			
	Dialogue		Monologue		Dialogue		Monologue	
	2020	2021	2020	2021	2020	2021	2020	2021
1	15	15	15	13	18	22	20	21
2	14	15	11	14	20	18	22	19
3	16	18	15	19	17	21	21	22
4	13	13	14	13	19	19	20	20
5	14	14	12	13	18	20	19	19
6	12	15	14	14	20	23	23	24
7	18	16	19	15	21	19	22	19
8	14	14	15	12	23	21	20	22
9	16	16	16	17	18	18	19	19
10	16	14	15	13	19	21	18	22
11	13	15	14	14	17	18	20	20
12	13	15	12	14	21	17	23	18
13	13	13	11	11	23	22	23	22
14	18	16	16	15	20	20	20	21
15	17	14	16	14	17	18	19	20
16	14	17	14	16	17	19	20	20
17	18	14	16	14	21	21	21	22
18	13	12	12	12	20	18	20	21
19	11	13	12	12	21	19	23	21
20	17	17	17	18		20		19
21	16		15			23		22
22	13		14					
Average score	14,73 61,4%	14,80 61,7%	14,32 59,7%	14,15 59,0%	19,47 81,1%	19,86 82,7%	20,68 86,2%	20,62 85,9%
Average for 2 years	**14,76** **61,5%**		**14,23** **59,3%**		**19,67** **81,9%**		**20,65** **86,0%**	

Table 2 illustrates the results of the final dialogues and monologues in the reference and exposure groups in 2020 and 2021. In the reference groups, the average score for the

dialogues was 14.73 (61.4%) in 2020 and 14.8 (61.7%) in 2021, and the average score for the monologues was 14.32 (59.7%) in 2020 and 14.15 (59%) in 2021. In the exposure groups, the average score for the dialogues was 19.47 (81.1%) in 2020 and 19.86 (82.7%) in 2021, and the average score for the monologues was 20.68 (86.2%) in 2020 and 20.62 (85.9%) in 2021.

Bar chart (fig. 1) below illustrates the general outcome of the experiment.

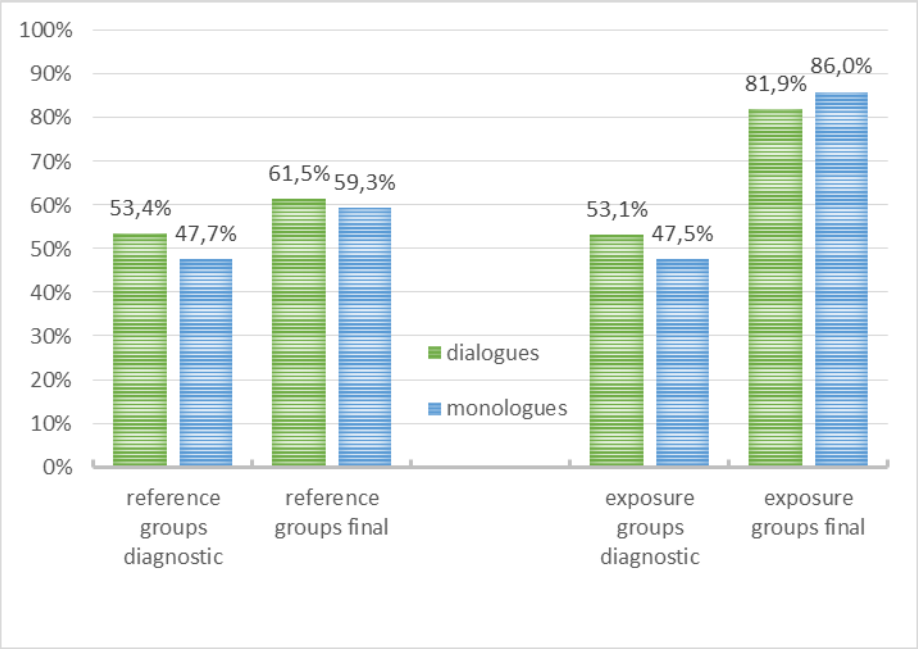

Figure 1. The results of the research

The bar chart shows that on average (in 2020 and 2021) in the reference groups the score for the dialogues increased by 1.95 (8.1%), whereas the score for the monologues increased by 2.79 (11.6%). In the exposure groups, the difference between the diagnostic monologues and dialogues and the final ones was far more considerable. On average (in 2020 and 2021), the score for the dialogues increased by 6.92 (28.8%) whilst the score for the monologues increased by 9.26 (38.6%).

The increase in the average score in the exposure groups was 4.97 (20.7%) larger for the dialogues and 6.47 (27%) larger for the monologues than in the reference groups. Such a substantial difference between the results can be attributed to the fact that exposure groups participated in teamwork on virtual communication platforms on a regular basis. On top of that, when the exposure groups were given discussion-generating questions by the teacher, they prepared the dialogues on their basis in pairs. In the course of teamwork, they exchanged ideas, corrected each other's mistakes and spent more time speaking English. Even though the students in the reference groups spent as much time preparing the dialogues as their peers in the exposure groups, they just jotted down what they were going to say without speaking aloud. Useful as self-talk might be, it is nowhere as conducive to acquiring foreign-language communicative skills as a conversation with a partner. Besides, the students in the reference groups analyzed quotations at home by

writing down the main ideas and doing research into the topic related to the quotation on the internet.

Each component which constituted foreign-language speaking skills improved to a greater extent in the exposure groups than in the reference ones. While the students in the exposure groups were preparing dialogues and monologues in teams, they encouraged each other to use more sophisticated grammatical structures and a wider variety of vocabulary. It can be explained by the fact that everyone has their own individual preferences when choosing grammatical constructions, words and phrases in the course of holding a conversation. Therefore, while learners make dialogues and monologues in teams or pairs, their collaboration is mutually reinforcing: they weave their vocabulary and structures into the texture of the conversation, contributing to each other's level of foreign-language proficiency.

At the end of the experiment, the students of the exposure groups were asked a number of questions about their progress in mastering each of the components that constitute remarkable speaking skills. Among the grammatical structures that they started using in the course of their collaborative work, they mentioned Complex Subject, Mixed Conditionals and different kinds of emphatic structures, including inversion. They also pointed out that they exchanged valuable lexical information, such as idiomatic expressions (on the same wavelength, to talk at cross purposes); collocations (push the agenda, vested interest) and individual words (commuter, tailback, provost, tutorial). Some members of the teams might not have been familiar with these vocabulary units for some reasons, and collaboration with their partners helped them fill these knowledge gaps. The third criterion – pronunciation – improves when students work in teams. After the experiments some learners reported that they had frequently argued with their partners about the pronunciation of some words while they were making dialogues and monologues together. Eventually, they ended up checking the pronunciation in an online dictionary, which helped them consolidate their knowledge. They claimed that if it had not been for teamwork, they would not have had second thoughts about the pronunciation of these words, and they would still be unaware about it.

The students' fluency also improved significantly in the course of group work. When they were asked to give reasons what aspects of teamwork contributed to their ability to speak fluently, they gave such reasons as competitiveness (their desire to speak better than their partners), favorable and stimulating environment as well as the fact that having a conversation in a foreign language encourages the interlocutors to retrieve grammar and vocabulary from their long-term memory. On top of that, the students of the exposure groups claimed that teamwork was mutually enriching when it came to producing relevant content. The members of the groups who tend to organize and systemize the information prevented their partners from getting carried away by getting them to stay focused on the topic. On the other hand, the participants who pay attention to details without seeing the whole picture also contributed to achieving the common goal by correcting minor mistakes. In addition, the learners believed that teamwork had helped them practice conversational skills: by speaking with their peers, they learned to understand the interlocutor's utterances and respond to them much better than when they worked individually in the previous semesters.

It is also worth noting that the scores for the monologues increased in both reference and exposure groups to a greater extent than the scores for the dialogues. First and foremost, it can be attributed to the fact that the scores for the diagnostic dialogues were higher than those for the diagnostic monologues. That is why, the scope of improvement for monologues was greater than that for dialogues: over the years the students had already had numerous classroom activities which involved making dialogues, whereas they had only had an opportunity to practice monologue skills when they prepared exam topics or presentations. The students also made such remarkable progress in making monologues since they worked with the additional textbook "Acquiring discursive skills by senior linguistic majors via explaining maxims and catchphrases: teaching manual", in which all the assignments were aimed at teaching learners to analyze the statement from different perspectives and come up with a reasoned opinion expressed as a monologue. Previously, they only worked with the quotations from their basic coursebook, Upstream Proficiency, which were not supported by any explanations or leading questions. Such a format was clearly insufficient for the students, who needed to get deeper insights into the quotation analysis.

Apart from conventional statistical methods, we used a neural network to trace the trends that could have gone unnoticed if we had only compared the average score. The figure below shows the graph built by the neural network which illustrates the relationship between the results of the diagnostic and final dialogues in the reference and exposure groups.

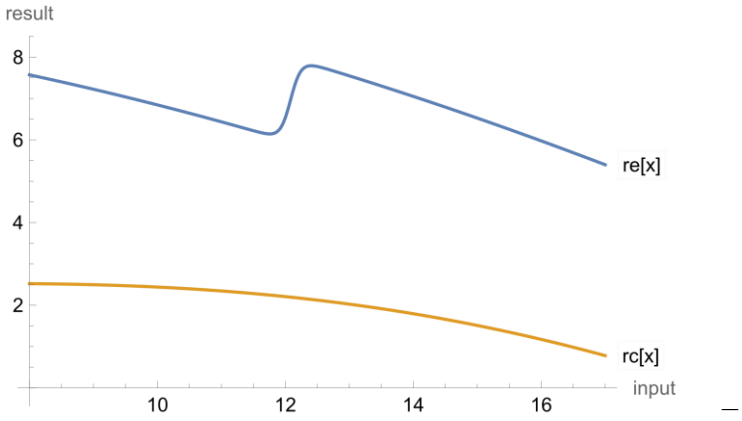

Figure 2. The relationship between the results of the diagnostic and final dialogues (the blue curve – the exposure groups; the orange curve – the reference groups)

Generally, a graph built by a neural network provides more accurate information about specific trends that may be overlooked if only statistical analysis of average results is performed. The graph (fig. 2), which was produced by a neural network illustrates the specificities within the groups that participated in the experiment. It shows the results of the diagnostic dialogues on the horizontal axis and the difference between the results of the final and the diagnostic dialogues on the vertical axis. The blue curve shows how the top-performing, average and weak learners in the exposure groups improved their performance in the course of the experiment. The right section of the graph indicates that

the top performers' results did not show a significant growth. It can be explained by the fact that they already produced good results in the diagnostic dialogues, and for them there was not enough room for growth. They may not have produced as impressive results as average students because they had been working in small teams with the learners whose degree of foreign-language proficiency was lower than theirs. However, even though the top performers' increase in the results was not as considerable, it was still bigger than in the reference groups (the orange curve).

The middle section of the blue graph illustrates that the average students' performance shows the most remarkable improvement. On the one hand, they acquired foreign-language skills because they received help from the top-performing students. On the other hand, they offered help to the weakest team members, and, in so doing, they consolidated the learning material. The middle section of the graph also indicates that the average students can be divided into two distinct groups. It depended on whether their team-mates were mainly top performers or weak students. If they collaborated with someone whose level of foreign-language proficiency was higher than theirs, they benefited from such cooperation; if most of their partners' skills were not as good as theirs, they made less progress. Nevertheless, in both cases their progress was more substantial than that in the reference groups (the orange curve), in which the results of the final dialogues were also higher than those of the diagnostic ones. It is also worth mentioning that, just like in the exposure groups, the top performers in the reference groups made less progress than average and weak learners because, again, there was little room for improvement.

Even though the assignments that students did in MS Teams were quite similar to the tasks that are done in face-to-face environments, the students who worked in MS Teams in small groups took advantage of various tools available on the communication platform.

1. They used OneNote to plan their discussions and to record the most relevant ideas which the team members came up with in the course of brainstorming sessions.
2. If a team member suddenly had an idea he wanted to share with everyone while someone else was talking, he used the chat function, so he did not need to interrupt the speaker.
3. Since MS Teams allows teachers and learners to share their screen, students sometimes supported their arguments by sharing video spots and creolized texts with their team mates. Figure 3 below is an example of a creolized text demonstrated on the screen by one of the students in the course of discussing the quotation by Robert Collier "People blame their environment. There is only one person to blame – and only one – themselves."

Figure 3. Creolized text (Source https://cpb-use1.wpmucdn.com/sites.psu.edu/dist/e/952/files/2012/09/Rhetorical-Analysis.jpeg)

Sharing video spots and creolized texts enabled team members to produce creative ideas if the discussion came to a halt for some reason. Thus, learning content in the form of videos, texts and presentations was unified on one platform, so that all the learners could access it instantly. Thus, in the exposure groups conversational practice was supported by additional resources available on the internet.

CONCLUSION AND OUTLOOK

In general, organizing teamwork on virtual communication platforms is instrumental in teaching the students majoring in linguistics to communicate in a foreign language, especially when, for some reasons, their face-to-face contact is limited. By doing their home assignments in small groups and making dialogues in class, learners brainstorm and exchange ideas, enrich each other's vocabulary, correct their partners' mistakes and encourage them to use new words, phrases and grammatical structures. Teamwork creates a friendly and favorable environment which lifts the barriers to foreign-language communication.

Virtual communication platforms like MS Teams make the learning process more inclusive since even students who are too self-conscious to participate in group discussions, can still share their ideas with the teammates by writing them in the chat. In addition, students who have difficulty conveying their ideas because of a low level of foreign-language proficiency can resort to various resources available on the internet whenever that is relevant.

Another distinct advantage of teamwork on virtual platforms over face-to-face foreign-language practice is the possibility for the teacher to check the students' degree of involvement either asynchronously, by checking the records of the teams' communication sessions, or synchronously, by meddling with their work and correcting their mistakes, if necessary. In that respect, teamwork on virtual communication platforms can be regarded as controlled practice with the teacher acting as a supervisor, whereas when learners work face-to-face, many mistakes go unnoticed since no one oversees their foreign-language communication.

Having students do their home assignment collaboratively by using teleconferencing facilities proved to be good practice, which can be adopted not only by educators teaching foreign languages, but also by instructors teaching other subjects. Further research should be done into developing new forms of students' teamwork on distance learning platforms.

To be sure, there remains an ambiguity that needs to be resolved in future research: the findings offer support to the notion that students' teamwork is good but it does not allow us to measure the contribution of the MS online platform. Our observations indicate that the technical tool affords certain forms of interaction which are not available in personal team-working. Also, the online platform might lower the threshold and add to the fun of teamwork. In order to ascertain this more precisely, another comparative study might consider the effect of personal group-learning on monologue and dialogue construction.

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