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Field creativity and post-anthropocentrism

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Can matter, things, nonhuman organisms, technologies, tools and machines, biota or institutions be seen as creative? How does such creativity reposition the visionary activities of humans? This article is an elaboration of such questions as well as an attempt at a partial response. It was written as an editorial for the special issue of the *Digital Creativity* journal that interrogates the conception of *Post-Anthropocentric Creativity*. However, the text below is a rather unconventional editorial. It does not attempt to provide an overview of the issue's theme but, instead, samples it via a particular example. The idea of the issue was to think about post-anthropocentricism by considering (1) agents, recipients and processes of creativity alongside with its (2) purpose, value, ethics and politics. This article addresses the first subtheme by puzzling at the paradoxes of "field learning" and picks at the second by considering the texture of "automated beauty". Both of these parts use chess for an example. The narrative on chess is intermitted by a section "on creativity" that attempts to contextualize the case-based discussion in the wider context and to consider motivations and implications.

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The human minds one can encounter today depend on technologies and practices of communicating, remembering and planning. Dennett (1996, 153) terms this integration with technology "cultural redesign of enormous proportions" and Clark (2003) insists that people are "natural-born cyborgs" or "human-technology symbionts". This symbiosis with technology undermines the idea of the mind/body duality by making common functions such as communication, perception or memory dependent on various external devices. This dependence extends the human into the world making cognition and action radically distributed. Interfacing with such external devices is unavoidable and if one acknowledges that this context has its own histories, tendencies and agencies human cognition and action also emerge as collaborative: co-performed with nonhuman entities. Examples of old and profoundly formative technologies include paper and pencil: tools for remembering, organizing, calculating and inventing. Supported by alphabets and the grammar of natural and artificial languages, these devices act as tools for the organization of thoughts or as methods for thinking about thinking. Today the action of such devices is extended by digital technologies with new capabilities. Such technologies—including email, mobile phones, search engines or global-positioning systems—distribute cognition and action even more radically putting in question sources of volition and authorship.

It is, therefore, prudent to extend creativity research toward complex and hybrid creative processes that implicate broadly heterogeneous actors including all forms and systems of life,

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algorithms and mathematical models, computational objects, physical entities and cultural constructs. Such reconsideration is needed to update the existing—and often dated—pathways to mastery and virtuosity, two of the most desired characteristics associated with creativity. In a world where an increasing number of tasks is delegated to automated processes, further research is also necessary for a reappraisal of what creative outcomes can be considered worthwhile, and for whom. Whether this decentering of individual human consciousness and intention as autonomous sources of action can be justifiably called post-anthropocentric creativity and what such creativity might imply are the open questions for further work.

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> *If chess is a vast jungle—deep, relatively unexplored and slow to yield its myriad secrets—computers are the chainsaws in a giant environmentally insensitive logging company. (Short 2004)*
>
> *For every door the computers have closed they have opened a new one. (Anand 2008)*
>
> *Chess programs are our enemies, they destroy the romance of chess. They take away the beauty of the game. Everything can be calculated. But we still have twenty years, at least. (Schwager and Lotter 2008)*

The following sections use examples from the field of chess to suggest areas of attention in relationship to the post-anthropocentric creativity. On one hand, chess originated in the sixth-century AD, and since then has been the subject of many thousands of books (30,000 in the Cleveland Library alone (Hooper and Whyld [1984] 1996). On the other, today's chess relies on multiple technologies including networking, remote collaboration, large organized data sets, sophisticated search, compare and analysis facilities, high performance computing, complex algorithms, artificial intelligence, standards for file types and interfaces, commercial and open-source approaches to software development, crowd-sourcing and so on. Furthermore, chess is a remarkably widespread activity. A 2012 study (Fédération Internationale des Echecs [World Chess Federation] 2012) estimated that over 600 million people regularly played chess, a number that at the time was comparable with the number of people using FaceBook. More than 70% of adults across nationalities and demographics have tried chess. Counterintuitively, the number of players has grown significantly since the 1970s and this growth can be attributed to the broad availability of chess engines and opportunities for online play; a state of affairs that Rogoff (2012) describes as a mini-boom in chess interest in many countries. This growth is surprising because it occurred in the period when computers overtook humans in playing strength. As a result, the requirements for preparation in serious play have increased significantly while the interest in high-level competitions has diminished, at least in the eyes of the popular press, leading to worries about the future of chess. For example, already in 2002 the makers of the first world champion among computer programs (title awarded in 1974) insisted that "to everybody who is familiar with the problem it is evident that, thanks to computers, the next few years will spell the end of chess as a sport" (Kostinskiy 2002, translated by the author). Given the major influence of technology in the field of chess, this article presumes that chess can serve as a sample of the unevenly distributed future that can help to imagine possible tendencies in other fields.

1. Automated beauty

One way to probe the values and purposes of creativity is via its relationship with beauty. For example, it is often argued that chess can be classed as art because it can be beautiful. The grounds vary. Lasker insisted that:

> [t]he spectator enjoys not a game of chess, but history, drama; that a chess board is its stage, and chess pieces its actors, matters not. If the

> drama of a chess game be presented by human actors on the stage of a theatre, its aesthetic effect would not be a particle different […]. ([1925] 2008, 199, 200)

Alternatively, Botvinnik ([1960] 1987) argued that chess was an art form because of its "realist" power to express the logical capabilities of human intelligence. No matter whether metaphoric or realist, this "art" is directed at:

> the spectator [who] must not be deaf and dumb to [the language of chess moves], else he perceives nothing or misunderstands. But the spectator by no means need be a master. The master can create, the sympathetic spectator, not gifted with the genius of discovery, comprehends. He has imagination to follow the drama of the game with interest, and he has intellect to understand what each move aims at and accomplishes. (Lasker [1925] 2008, 199)

Perhaps. But the peculiar question then is: what happens when the creator is a machine that has no comprehension but can perform moves that defeat the understanding of the best human masters?

The appreciation of aesthetics is the central focus of a form of chess called chess composition. Chess compositions, or problems and studies, are designed to present human solvers with particular tasks. They include multiple genres, from those resembling situations in competitive games, such as direct mates, to more artificial constructs such as helpmates, selfmates or compositions that extend standard rules of the Western chess.

Historically, problems were the spontaneous inventions of individual authors. With time, specific themes became known and influential, such as those triggered by the Indian problem of 1845. Schools such as the New German School, the Strategic School and the Bohemian School emerged around particular aspects and styles. Gradually, the activity became institutionalized and regulated with the help of various tools including formal notation, handbooks and rules. These tools are deployed by institutions and community groupings communicating through periodicals, competitions, the Internet and so on. The common criteria that are now used to judge the quality of chess compositions evolved within this ecology and were conditioned by its history. Many early compositions would now be considered unsound because they included redundant pieces or additional solutions. In general, contemporary compositions are more refined and at the same time more artificial because they are further removed from the situations that are likely to emerge in competitive games. Sources include various and sometimes diverging criteria for judging "beauty" in chess compositions but a typical consensus list would include: (1) expediency in achieving tangible outcomes such as the checkmate or a decisive material gain; (2) disguise of the key move(s); (3) sacrifice of pieces or other advantages; (4) correctness; (5) preparation or evidence that the current position is an outcome of previous strategic play; (6) paradox that violates common tactical principles; (7) unity or cooperation between pieces and (8) originality.

Today, specialized software is commonly used to assist with composition and to check whether problems are unique and correct. However, the involvement of computers extends beyond this auxiliary use into attempts to automatically generate "beautiful" or "creative" chess problems (Fainshtein and HaCohen-Kerner 2006; Iqbal and Yaacob 2008). Such projects are possible because software for automated aesthetics can rely on existing criteria of beauty such as those listed above. When such canons can be formalized and quantified, values embedded into specific criteria become instrumentalised as evaluation procedures that can be applied to rank existing compositions or search for new "beautiful" problems among automatically generated positions (e.g. see Lipton, Matthews, and Rice 1963).

An approach taken by Iqbal and Yaacob in automatic generation and evaluation of mate-in-3 problems is to take a similar list (Margulies 1977), exclude compositional criteria that rely on previous knowledge and experience (such as avoiding stereotypy or shunning extreme strangeness and difficulty) and calculate numerical values for the remaining rules. For example, they implement rule (6) above, violation of common tactical principles, as a combined value of "heuristic violation", or deviation from four common principles: (i) keeping one's king safe, (ii) capturing opponent's pieces, (iii) avoiding positions where one's pieces might be captured (not leaving them *en prise*) and (iv) increasing mobility of one's pieces. For example, their system gives the score of 1 to the position where the king is in the center of the board—a complete violation of the principle "i"—and awards 0.25 points to the positions with the king at the edge of the board because the king located there is less exposed to an attack.

The view motivating this work is that powerful computers can help to discover brilliant combinations of moves that might otherwise not be found for centuries, or at all. Similar principles can also be applied to related tasks such as generation of automatic game commentary and to similar problems in other domains. The public discussion of this work (Iqbal 2015) makes clear that such automatic generation is not aimed at the production of world-class chess problems. Instead, its ambitions are more modest: to fabricate compositions that are better than those assembled randomly and can be of interest to average learners. At the moment, such automatically generated problems have to be evaluated by a human expert who decides whether they deserve distribution or can be used as templates for further refinement. The criteria for making and selection in such a system are an expression of the market conditions that call for good-enough products that can be distributed to large-enough audiences. Within this value system, an especially sophisticated problem is undesirable as it will have a very small potential audience. Technically, the generative system can become more sophisticated or at least considerably more powerful, as happened with chess-playing programs. However, in this case, the threshold defined by the capabilities of an average human trivializes the outcomes, casting them as a form of entertainment of average quality for an average solver.

The lack of ambition to produce "world-class" automatically generated compositions makes it difficult to compare them with best human produce. Some ridicule machine-generated chess problems as pathetic, as can be seen in the objections of Marjan Kovačević (Iqbal 2015). Others point out that computer programs for competitive play and analysis, so called "chess engines", were also ridiculed, and very recently. Newborn reports that the first "United States Computer Chess Championship" in 1970 "featured six programs and loud laughter from the experts in the audience" (1997, ix). In the public opinion, this disdain remained until the matches with Deep Blue in the 90s.

One way to consider the possible destination for machine-generated output is through the appraisal of values built into the process. The values that guide the composition-generating software described above are different from those employed by typical chess engines. Efforts to construct an analytic, thinking—anthropomorphic—program that could successfully play competitive chess did exist—notably, if altogether unsuccessfully (Kasparov and Greengard 2007, 18, 19), led by Botvinnik—but strongest current engines are "computer-morphic", they rely on fast calculation rather than on overarching analysis or sophisticated understanding of strategy.[1] However, even predominantly brute-force approaches not only support innovative discoveries appreciable and useable by human masters but also lead to reassessment of human theory, strategy and logic. These achievements are possible despite the fact that such programs do not attempt to resolve difficult problems of artificial intelligence but focus of the technical challenges of optimization that seek more efficient and, consequently, faster algorithms.

By contrast, the "aesthetic" values of chess composition employed for automatic generation are more "intelligent" and, at the same time, profoundly conservative. Ravilious (1994) chooses to describe them as "classical", rather than, say, "romantic", given their emphasis on such features as economy, thematic unity or correctness. Attempts to explain creative operation, in chess or in other domains, through analyses of internal mechanics will always be limited. Chess problems go beyond being "aesthetically pleasing" because they not only "manipulate information of a certain complexity in a certain manner, regulated as to its amount and abstraction" (Myers 2012, 261) but fit into complex systems of thought, histories of ideas, personal dilemmas and ambitions of whole communities. Such ambitions include an aim to distill and advance common knowledge, to create and preserve masterpieces; generally speaking: to advance together … It is at this level of overarching epistemic flows that chess problems acquire their poignancy and can hope for longevity and impact. Nabokov suggested that chess problems "demand from the composer the same virtues that characterize all worthwhile art: originality, invention, harmony, conciseness, complexity, and splendid insincerity" (Nabokov 1970, 160–161). It is tempting to see in this reflection a distillation of the chess problem's potent essence. The process of consuming this essence, then, produces "pleasing results". However, an alternative reading is that Nabokov's sentence deliberately begins with the listing of some earnest compositional principles so as to lull the reader into an easy agreement before delivering the planned surprise of its last words. Nabokov's "splendid insincerity" is hardly classicist, nor is it formalist. Who is insincere here? Surely, not the game mechanics and their "procedural aesthetics". An automatic generator of chess composition cannot combine its "aesthetic principles" to achieve insincerity. In chess problems, composers and solvers delight in fulfilment of an idea that emerges through their *in absentia* competition (Gurvich 1955; Gezari and Wimsatt 1979; Wimsatt 1968), "just as in a first-rate work of fiction the real clash is not between the characters but between the author and the world" (Nabokov 1989, 290). The composer is not expected to win this competition but instead seeks to arrange for a meaningful (sincere or otherwise) search space linking the initial conditions and the solution. In the act of making, the composer acts for both sides. Thus, in a preface to a book of chess compositions Alekhine ([1928] 1929, translated by the author) wrote,

> I love the very idea of composition. It pleases me when I can create on my own, without the obligation, as in a game, to adjust my plan to that of another person, my opponent, in order to produce something durable.

It seems that here, as is compatible with many models of creativity, "something" becomes "valuable" when it is recognized as such within an existing epistemic community.

Indeed, the attitude toward chess composition can deliberately highlight its role in the overarching culture with its long-term ambitions. Such ambitions can be set for the whole community rather than for its individual participants and act on historical time scales that extend beyond individual careers. This way of valuing chess composition can have expressly ideological goals, or at least be shrouded in ideological rhetoric. For example, Romanovskiy, in the preface to a book on chess composition (Umnov 1954), suggests that chess problems should aim to attract a broad public and be connected to the field of practical chess, absorbing ideas from the game, expressing them in artistic form and establishing goals for the development of chess thought. In this case, the "realism" of the chess composition is intended to help solvers improve their "qualification" and raise their "chess culture". According to Gurvich (Gurvich 1955, 12, translated by the author), composition (or study):

> incessantly slights every template and routine of chess thought, jeers at the self-confidence and self-satisfaction of customary "common sense", demands a keen, fresh look that comprehends deeply concealed, unexpected possibilities of a position and, in this way, constantly enriching the initiative of the chess player, develops his combinative scent and abilities.

Here, chess composition is valued as way of distilling and sharing discoveries that can grow collective capability. This type of valuing emphasizes that chess is a living community, or a field, with its own literature, competitions and respected practitioners. According to institutional or social theories of art, a work of art is an object that someone, usually someone from the "artworld", names a work of art (Dickie 1969). Such art is distinguished as much by the collective activity that produces it as by its products (Becker 2008).

In agreement with such interpretations, this article's argument is that the automatic generation of beauty in the case of chess problems depends on the meanings and relationships within the extended and historically formed field of chess. The autonomous powers of artificial devices rely on large volumes of prior, and often hidden, labour. Constructed around common (and some would say trivial) formal principles derived from human practice and bounded by the cognitive constraints of human consumption, these powers are simultaneously indebted to and limited by their reliance on chess culture. Their self-directed capability for innovation, or creativity, is, thus, curtailed. In contrast, when such autonomous capabilities are integrated into existing field processes unexpected and innovative effects are likely to ensue. The most interesting consequences of automation emerge at the scale of whole fields rather than of individual objects, actors or events. The discussion of these effects will be resumed in the section on *Field Learning* which follows the notes on creativity positioned immediately below.

2. Notes on creativity

Existing literature on creativity is extensive and diverse. However, much of this discourse (Kaufman and Sternberg 2010a; Runco and Pritzker 2011; Thomas and Chan 2013) is concerned with human creativity: its psychological and cognitive aspects, its manifestations in groups and organizations, educational techniques that can foster creativity and explanations for its evolution. The contemporary context creates new circumstances that invite expansion and reconsideration of this existing scholarship.

One set of such circumstances is given by the troubled age of today, when human creativity is credited as the dominant, yet hugely destructive, influence on the planetary environment. The growing interest in the creative processes of nature motivated by the apparent environmental degradation is a fascinating topic that is crucial to the notion of post-anthropocentrism but it will have to be considered in another text. One thing to mention here is that in the context of the calls to such cures as "voluntary simplicity", the expansiveness of human creativity can appear evil. Creativity or ecology: this seems to be a binary choice (Gunter 1985). Recently, even China, the home to such celebrated expressions of architectural creativity as The Bird Nest (by Herzog and de Meuron) and The Big Pants (by OMA) have taken apparent moves to ban "oversized, xenocentric, weird" structures (Gan and Liu 2016). The tension is building.

Another set of circumstances emerges from the characteristics of contemporary technologies. Their pervasiveness, their rapid modification, multiplicity and simultaneity of the effects they produce, the speed with which they change, opacity of their core functions and their self-directing character are some of the prominent examples. These conditions not only produce new cyborgian configurations of living and artificial systems but undermine traditional models of cognition, action, expertise, learning and—consequently—creativity. Some manifestations of such symbioses are considered in this article.

To contextualize, this section offers its own characterization of creativity seeking to problematize its definitions in the light of post-anthropocentric concerns. Questions about the nature and value of creativity are large and complex; they are unlikely to be answered definitively, soon or within the work of one person. It would be unwary to attempt such answers here or to provide a tight definition that might omit unusual agents, processes and products.

Therefore, the understanding of creativity deployed in this article is deliberately inclusive. It is aimed at absorbing atypical examples, both those that exist and the ones that might become possible in the future. Even without such an expansion beyond the norm, the task of defining creativity is unyielding. In widespread literature, the concept of creativity is a utility that denotes a wide range of phenomena and behaviors. Typically, it refers to human rationalizations of observed affects, not unlike the properties of a person such as "aura", fields of study such as "graphology" and action strategies such as "neuro-linguistic programming". The inclination of some discourse on creativity to resemble pseudoscience is motivated by the yearning for extra capital that creativity gurus promise and "creative" practitioners boast to possess; in design or arts and, especially, in career advancement, business and governance. Some recognize the totality of such creativities as "designer capitalism" (Jagodzinski 2013), within predictable moral consequences.

In these conditions, the project of considering post-anthropocentric characterizations is less about finding a precise definition or a scientific explanation of creativity—as if it were a singular, objective, external entity—and more, at least initially, about a search for patterns that might be pulled under the umbrella of creativity and probed with an open mind. This activity can improve understanding because different communities practice creativity differently and these practices can generate very dissimilar conceptions, attitudes and negotiations (Thomas 2007). And yet, certain categories remain. One can focus on context—and creativity as adaptations to it; on process—and its purposes, structure and speed; or on product—and its novelty and value. Typically, such categorizations are applied to describe the flow of human maturation and the different shades of creativity that accompany it (Cohen 1989). However, these conceptions can also be ascribed to, or questioned within, "communities" of proteins, animals, artificial objects or hybrid ecologies.

Creativity as a transformation of society has been discussed by a number of researchers in application to human cultures (Bourdieu 1993; Csikszentmihalyi [1988] 2014; Feldman, Csikszentmihalyi, and Gardner 1994). Gradually, it is becoming more accepted that creativity is a communitarian (Seitz 2003), or a system (Barron 1995), phenomenon. While Barron does describe a creative individual as a "field within a field" (32) in his introductory pages and Csikszentmihalyi uses the concepts of domains (e.g. music) and fileds (e.g. musicians, critics and other "gatekeepers"), the focus of these authors is on the description and extension of existing creative processes, denoted as such within current human cultures. Yet, the benefaction of human impact in the age of Anthropocene is in doubt, encouraging the search for creative processes with better long-term credential, beyond the cultural, and human, mainstream. Glăveanu's (2014) view of objects as distributed agents is much closer to the aspirations expressed here as post-anthropocentric creativity. However, his discussion of co-constructing agencies still seeks to explore the nature of existing, human creativity. In extension to these views, this article seeks to ask how such collective and systemic processes occur in hybrid ecologies, in the presence on nonhuman actors, with unusual agencies and motivations. The examples discussed in this text are limited and further work is necessary before a more radical goal can be tackled: a demonstration of creativities that do not depend on co-construction with humans or where humans are afforded but secondary roles.

According to the most common definition, creativity is the production of something new and useful. This definition has been created to describe eminent adult humans whose "creative work" can be seen by their peers as "original" and "good" in comparison to some other work (e.g. see Kaufman and Sternberg 2010b, 467). Such definitions are insufficient to describe other forms of human creativity, for example the creativity of children. The need to provide the definition that could be useful to the pedagogical community led to the introduction of concepts such as "little c creativity". At the other end of the spectrum, are such concepts as over-creativity of nature: a "baroque" over-production of innovation manifested, for instance, in ecosystems "containing many more species than would be 'necessary' if biological efficiency alone were an organizing principle" (Prigogine 1980, 128). Prigogine finds the cause for this exuberance in self-organization, a phenomenon that can be observed in physical (e.g. spontaneous magnetization), chemical (e.g. reaction-diffusion) and biological (e.g. homeostasis) systems as well as in artificial models, mathematical or computational (e.g. in cellular automata). The results of self-organizing processes can be novel in comparison to the given system's history (or even to all of history) and have the potential to be useful to the host system, to other related systems and even to humans.…Can such products be described as the products of creativity?

One other type of distinction that can be mentioned in this section on definitions is that between the products of creativity. In some domains, for example in business management, creativity is distinguished from imagination, and from innovation, and from invention. This narrative goes something like this: imagination is thinking up something unusual; creativity is the capacity to do something about it; innovation is the implementation of something new and invention is the product with some unique insight. These distinctions are made to describe existing behaviors in the context of organizations and to formulate advice on how to improve business performance. They make sense within their communities of practice where a lot is known and automatically presumed: market interactions, employment structures, products to sell, problems to solve, competition and so on. For the purposes of this discussion, such distinctions can be collapsed. Or, at least, the attention to them can be postponed until some larger questions are tackled.

Instead, this article sees creativity as some kind of discontinuity between the past and the new. It is what Gregory Bateson, Bertrand Russell and Alfred North Whitehead described as a "jump in logical types" from the particular to the general. Piaget defined this leap as "reflective abstraction". This process of establishing relationships leads to new understandings not inherent in the original thoughts or events: "a reorganization of mental activity, as it reconstructs at a higher level everything that was drawn from the coordinations of actions" (Piaget [1972] 1977, 728). In fact, Piaget himself preferred the word "invention" to "creation" or "creativity". He would say that—using the title of his monograph—"to understand is to invent". One apparent paradox discussed below is that this kind of human "understanding" can be detrimental to performance. Humans require intuition and logic but these devices are shortcuts, they are essentially faulty. One of the paragraphs above suggested that "human creativity" might be evil, now it seems that it is also delusional.

3. Field learning

The section on *Automated Beauty* concluded with a promise to consider meanings and relationships within the extended field of chess. Discussing the situation almost thirty years ago, Aycock (1988) observes that standardization and formalization of chess has been continuing for a long time through regulation of the forms of play, introduction of standard rules, standard equipment, publication of journals and so on. An early and pervasive influence of computation can be observed in the introduction of methods for calculating the relative skill levels of players in competitor-versus-competitor games, such as the variants of the Elo rating operated by The Fédération Internationale des Échecs (World Chess Federation or FIDE). Introduction of the Elo formula allowed predictions of the outcomes of the games between players with known ratings (Elo 1978). Instillment of such ratings has diminished the influence of charismatic, but possibly questionable, schools and individuals instead numerically validating the chess elite. This led to legitimization of particular patterns of play by association with highly ranked players and the subsequent commodification of their creative output in books, courses and the like. Lower ranked players gained the capability to develop their personal goals, for example by being able to predict their performance in a particular tournament or adopting their style of play in response to their opponent's ratings. Thus, ratings encouraged players to modify their identities and behaviors in reference to the numerical evaluation of their strength.

Since that time, the accessibility of computation in its various guises has increased dramatically. Previously, only "serious" players, those who regularly participate in sanctioned tournaments, would have national or international ratings. Now, even the most casual player is likely to have many ratings. All common Internet sites provide their own rating systems and various facilities exist for conversions between systems. New types of ratings proliferated along with many types of play that are supported online: standard chess with longer time controls, blitz (rapid chess), bullet (very rapid chess), chess960 (with random initial placement of pieces), online equivalents of correspondence chess and so on. Such ratings are associated not only with human or computer players but also with other activities that can resist solvers, such as lessons with tasks or tactics problems. An encounter with such an object on a popular chess site is automatically social along several dimensions: one stakes one's rating against the rating of the puzzle, with both ratings set to change depending on the correctness of the solution; one can see how the puzzle was categorized by the members of the community and contribute new categorizations; one can see who has attempted the puzzle before; read or make comments and so on. Ratings for such activities demonstrate personal progress and allow matching of task difficulty to user skills. The entry into the field is made much easier. Participation is easier too as it can happen in any place, in smaller time intervals and spontaneously, around the clock, especially with the proliferation of mobile devices. Such systems make more apparent the gaps in quality, for example, between casual and professional participants while, at the same time, rendering access to players outside of one's rating range more difficult because participants with similar ratings are matched automatically and overrides of this matching are unusual without some form of renumeration. Longer time controls and the deeper consideration that comes with them are also uncommon in online play because the majority of players do not regard online play as serious and instead treat it as opportunistic entertainment, similar to what Mason (1900) called "social chess". Longer online games are more likely to be interrupted when players join in unfavorable circumstances (the school bus arrives, the toilet is needed, kids wake up and start crying) or because of technical glitches. Anonymous online players are also more likely to misbehave, cheating by consulting computers, disconnecting when loosing or stalling in bad positions by not moving, in the hope to force the opponent to abandon via boredom, thus avoiding the loss and the associated decrease in the rank. These brief examples are intended to show that the actual effects of computing on the field of chess are complex, nuanced and contradictory; they are hard to interpret without concrete studies conducted with specific groups of participants, in specific settings. While some ethnographic or psychological studies of chess do exist (Desjarlais 2011; Fine 2013; de Groot [1965] 1978; Pawluch et al. 2005; Puddephatt 2005), the techno-social ecology of the game has not been systematically tackled in research. Nonetheless, even the abbreviated examples discussed above illustrate that evolving patterns of learning, training and playing—and it is impossible to play well without being creative, especially at the elite level—are produced through interoperation of human and nonhuman entities, with complicated, multi-layered agencies and motivations.

Such interweaving with technology is nothing new. Preservation and publication of chess games and the introduction of tools such as chess notation or deployment of such tools in multiplying dissemination channels (books, journals etc.) were instrumental to the advancement of the field from early on. For example, the late nineteenth-century shift from romantic chaos to organized order, initiated and enforced by the first world chess champion Wilhelm Steinitz, was only possible as a culmination of and resistance to past practice. As Anand (2008) observed, "[p]reparation for a world championship was always an arms race, in previous times with books, then with seconds, today with computers".

The effect was multiplied with the introduction of comprehensive chess databases. Even the use of an early database on a 1987 Atari could made a major difference. Thus, Kasparov explains the difference between two chess matches in 1985 (lost 3.5–4.5) and 1987 (won 7–1) by the newly acquired ability to rapidly look up and analyze opponents' games. At the time, he claimed that database lookup was "the most important development in chess research since printing" (Kasparov and Greengard 2007; Kasparov and Trelford 1987).

Accessibility of past play in the databases has dramatically enhanced the work that has started with the first publications of classified games in organized and cross-referenced encyclopedias on openings, middlegames and endgames in the 1970–1980s by the publisher called Sahovski Informator, or Chess Informant (Matanović 1980, 1974–1979, 1982–1993). The resulting generation of players, dubbed the "Children of the Informant", contributed participants to the analytical brigades assembled to study and prepare openings for championship matches (Dvoretsky 2007) and has now been replaced by the "database kids" (Desjarlais 2011, 87) who always have all available information. Today's chess databases are examples of "pseudo-neural" (Clark 2003) extensions of players' bodies that can hold memories and are integral to decision-making procedures. In these conditions of immediate access to comprehensive databases, an organism whose wetware has greater processing and recall capacities will outperform the one that has greater internal memory or the superior mental image of the whole system. As Sveshnikov (Barskiy and Fominykh 2010, translated by the author) reports, "it is not very pleasant to play with young lads, who simply read everything that has been written, use the computer, and we find ourselves on unequal terms: they have better memory and more energy".

In serious play, the first ten to twenty moves, and sometimes more, are known for all reasonable openings. The effect is the information overload and the standardization of play that were observed as a very rapid development within the first ten years since the publication of the encyclopedias (Aycock 1988). Most players specialize in a subset of openings that they know well. An ability of many players to maintain maximum strength within the first half of the game encourages the emergence of alternative approaches that, paradoxically, accept slightly suboptimum play at the beginning of a game for the benefit of taking the opponent out of their theoretical preparation, especially by those who believe themselves better players.

Contemporary chess software aims to support multiple functions acting as a playing partner, an arbiter, a trainer, an external memory, a place for playing with others and so on. These individual functions acquire specific meanings in the context of the overarching chess ecology. Within this extended and hybrid field, some agents produce artifacts such as gamescores or commentaries; others collect knowledge, patterns, statistics; same or other agents analyze, categorize, conceptualize and sort/rank/tag this content by theme, popularity, difficulty and other properties. Still, others eulogize, retell myths, pursue fashions and cast information or events into useable chunks for specific audiences (as books, courses, face-to-face tutorials or local tournaments).

Aycock (1988, 1990, 1998) discusses this phenomenon as metaculture, a concept that is similar to those of creative communities, communities of practice, epistemic communities or what this article calls fields. The metaculture is distinguished from "common" culture and from "sub-culture" by its universalizing tendencies. The degree of participation in the metaculture by individuals can vary but metaculture retains its identity and procedures as a distinct community. Similar formations can be identified in other fields, for example those around "digital architectural design" and the Grasshopper software in architecture or those around "creative computing" and tools such as OpenFrameworks and Processing or vvvv and MAX.

Creative progress in such metacultures belongs as much to the whole field as to its individuals. However, this redistribution of authorship introduces its own problems in regard to the ethics of production, quality of material or acknowledgment and compensation for creative effort. For example, after successfully deploying a particular combination found during computer analysis, Kasparov suggested that an engine called Deep Junior deserved "coauthorship" for the novelty. As a contrasting example, a well-known theoretician Sveshnikov is one of the players who advocate copyright restriction on gamescores that are routinely submitted to the tournament organizers and later appear on the Internet, in the databases or in books and magazines. Such sharing is beneficial to the popularization of chess and growth of the collective knowledge but can be harmful to the individual players who lose opportunities to benefit from their creative efforts. When only publishers profit from distribution, players can be left without means to earn a living, a situation that has been linked to depression and even suicide. Of the two cases Sveshnikov initiated up to 2010, only one was successful, and the dilemma on whether creative efforts of the players should be protected remains unresolved (Naumov 2009).

The improvement of chess engines' playing strength is an interesting topic in the context of field creativity (and as a contrasting approach to the programs for automatic generations of chess compositions discussed earlier). Engine strength can grow with improvements in or better utilization of hardware. Making the software stronger is more difficult, especially because the playing strength of contemporary chess engines has surpassed that of humans. One of the standard ways to check if any software performs well is via so called "unit tests". A unit test takes one part of a computer program and determines whether it is fit to use. However, it is difficult to assess the quality of moves made by chess engines beyond compliance with rules and basic blunders. In response, developers of one engine, the open-source Stockfish, have introduced a distributed testing framework called Fishtest. This framework invites volunteers to donate their computers' processing cycles to conduct multiple games between different versions of the engine. Changes to the engine are accepted or rejected based on statistically accessed results. From 2013 to January 2015, more than 245 million games were played within this framework, with total CPU time spent on calculations exceeding 370 years (Stockfish 2016). These resources were used to conduct approximately 10,000 individual tests containing concepts, ideas, features or parameter tweaks introduced by human developers. If changes lead to better performance, they might be merged into the core code. After this testing system was first implemented with Stockfish 3 in 2013, the engine saw an impressive improvement in playing strength of more than 320 Elo points (ComputerChess 2016) and placed first or second in the last three seasons of Top Chess Engines Competition (TCEC 2016), regarded as an unofficial engine championship. Statistical testing is powerful in determining the efficacy of a particular change but cannot demonstrate why such a change leads to certain results. In this symbiotic development, the generation of ideas and the judgment on the mechanics of their operation remains with humans, while testing of performance is done by the engines. This example demonstrates how the field can advance even though its individual actors might the lack the understanding of the available knowledge (machines) or have limited capacity to implement it in practice (humans).

Most experienced human players use computers to organize information drawn from existing games and to analyze specific chess positions. However, the amount of information and the speed with which it changes lead to epistemic anxiety (Desjarlais 2011, 88), or a permanent feeling of not knowing enough. The constant flow of information means that professional players must work continuously to keep up with viable openings and middlegame positions. Given that the information on their past play is also available, they need to be changing their own repertoire to make preparation against them more difficult. As Aronian (Schwager and Lotter 2008) observes,

> [s]ometimes you feel you are in a spy thriller. Not long ago it was important to have the best databases of archive games. Then it becomes important to have [grandmaster] games that were played the day before. Today we are trying to find games that were played minutes ago in some backyard somewhere in the world.

This reliance on the existing knowledge leads to the elimination of spontaneity and the curtailment of creative over-the-board play. As Dvoretsky (2007) puts it, "the contestants simply present their 'documents' to one another and then disperse". Furthermore, the younger generations of chess players are learning the game more quickly and playing chess differently. Desjarlais (2011, 88) reports a common impression that while today people play better because they have immediate recourse to computer analysis, they understand less about the philosophy and logic of chess including harmony between pieces or particular combinations. In Kasparov's words (Vijaykumar 2009) "[n]owadays, a 13-year-old would probably know more than Bobby Fischer knew when he retired. … But that does not mean they are special". Nakamura (2014) similarly believes that Fisher at his peak would certainly lose to him, Carlsen (the current world champion, as of 2016) or Kasparov, but could possibly catchup after several years with computers. Indeed, while some lament the loss of understanding of fundamental principles, others feel that pre-computer knowledge of chess has been superseded and many positions that have previously been considered unplayable or ugly can now be demonstrated as viable. As a result, the contemporary, pragmatic, attitude toward competitive play rejects the validity of human logic, theory and strategy as frequently unsound and sometimes deluded. Instead, the creative process of discovering and deploying new possibilities emerges from an effort to empty one's mind from bias:

> The machine doesn't care about style or patterns or hundreds of years of established theory. It counts up the values of the chess pieces, analyzes a few billion moves, and counts them up again. (A computer translates each piece and each positional factor into a value in order to reduce the game to numbers it can crunch.) It is entirely free of prejudice and doctrine and this has contributed to the development of players who are almost as free of dogma as the machines with which they train. Increasingly, a move isn't good or bad because it looks that way or because it hasn't been done that way before. It's simply good if it works and bad if it doesn't. Although we still require a strong measure of intuition and logic to play well, humans today are starting to play more like computers. (Kasparov 2010)

All people have the tendency to see and delight in patterns, even where they do not exist. Given that, some say, the human mind is essentially a pattern-finding tool, it is to be expected (Baumeister 2005). This is a problem that makes traditional principles, books and learning methods outdated. Indeed, many contemporary players report not using books or chess "theory", only training with computer engines. Conversely, patterns can have their own intrinsic value, apart from the pursuit of the strongest play. They can be useful and rewarding in learning, understanding and in providing unique histories of ideas. Some argue that even in the age of computers, it can be valuable to understand chess theory, especially openings, in historical terms. A historical progression of an opening reveals multiple layers of experimental effort not only aiding understanding and memorization but also casting chess as a valuable pursuit rewarding in ways that extend well beyond its identity as a game.

For a human, being good at chess is to a large extent a challenge in pattern recognition. Very new ideas are increasingly rare, especially at the highest levels of play. As a consequence, the process of learning chess increasingly focuses on reshaping the learner in the image of some preexisting recipes rather than on achieving creativity at the board. In this context, computer programs do not simply enhance the perceptual and analytical capacities of the players, they are rewiring the actual human brains, training them to recognize, memorize and recall specific positions or tactical combinations. In this sense, computers are not tools, prosthetic devices or even collaborators—instead, they—or their attributes and procedures—emerge as templates for the attitudes and behaviors of future humans. This effect is similar to the one produced by other devices, such as instructional books on chess, but—at the same time—very different. Books and other media aim to condense the best of human insight. Computers win with no insight whatsoever.

* * *

> *A doctor adjudged his patient incurable and the patient turned to another doctor who got him on his feet. Half a year later the patient meets his first doctor. The doctor is pleased and surprised: "What, you are still alive? Who treated you?"— "Doctor Schmidt."— "Just what I thought! Such a hack!"—says the doctor.— "With correct treatment nothing could have saved you!" A joke that Lasker liked to retell, as documented by Maizelis. (Mayzelis 1973, 127, 128, translated by the author)*

This article used examples from the field of chess to tempt out some trends and paradoxes that, at least to its author, seem suggestive in regard to developments in other fields. One of its main contrasts is between anthropocentric and non-anthropocentric approaches to what some call "intelligence" and others—"problem solving" or what this article sees as a form of transformation, not necessarily "progress", but definitely "learning" and—even—"creativity".

One of these approaches tends to take seriously structures deduced from human practice: rules of thumb governing beauty in chess composition or mental models of human intelligence informing the construction of automated chess-playing systems. The other one uses abstract algorithms (minimax …) that explore the nodes of game trees. Such algorithms can be optimized with many ingenious techniques (alpha-beta pruning, negascout, iterative deepening, history heuristic, quiescent search …) that lead to dramatic increases in speed and efficiency. Such pragmatic approaches to task completion are not based on understanding and are, often, applicable in a variety of settings (different games, problems from other domains). They can be further empowered through the use of extensive databases of past practice coupled with statistical evaluation of success rates for different strategies (for situations what cannot be fully calculated). Further, they can be made truly God-like though their use of table bases that include fully precomputed solutions for simpler situations (such as those involving a limited number of pieces).

All of these approaches receive enthusiastic or vitriolic receptions, acquire multiple meanings and result in unexpected outcomes when they are immersed into and operate within extended socio-technical ecologies, or fields. Agencies and roles within these fields are unstable and, given recent and current rates of change—unpredictable.

This article seeks to call attention to and encourage further serious study of such phenomena and such hybrid communities. It does not intend to provide detailed answers or define emerging forms of creativity. Instead, it attempts to suggest the kinds of closely knit interrelationships with computing that emerge when digital technology is released into the wild and permeates particular domains. Computing is interesting in the context of post-anthropocentric creativity because it links, supports, modifies and creates multiple forms of agency. The experience in the field of chess shows that computing affects the field in many, often unobvious ways and forms, at all levels of expertise, geographical locations and modes of participation. It undermines the primacy of human creativity in very direct ways, by generating positions that are too difficult for humans and by impoverishing the space of unknown combinations. At the same time, it shifts the emphasis from the strongest play toward additional, communal, forms of participation with alternative values and goals. Some individual actors become deemphasized or suffer. Others amplify themselves toward narrow objectives and succeed through emulation of superior machine play. Neither have much scope for individual creativity in a gradually depleting field. And yet, the total knowledge of chess is increasing. The immediate future promises further radical novelties, positive or otherwise, in many domains as effects of computation will propagate through the automation of various tasks, total indexing of whole domains or standardization and blackboxing of common procedures. Will deskilling of individuals in parallel with increased capacity of the system lead to relegation of human expertise and virtuosity to niche entertainment? How do these developments in computing relate to other radical innovation in nano, bio and geo technologies? What strategies can be adopted for the exploration of possible futures resulting from such developments?

The mistakes are all there, waiting to be made.
A proverb, first impounded as a chess adage by Tartakover (1924, 90, common translation)

Notes

1. As the proofs of this article are being corrected, an artificial intelligence program called AlphaGo is leading 2-0 in a five-game match against one of the predominant professionals of Go (Weiqi), Lee Sedol—a sensational result in the world of this other major intellectual game where computers, until now could only play as well as average amateurs. This software, by Google's company DeepMind, takes an alternative approach based on the utilization of machine learning via "deep neural networks" (Silver et al. 2016). Some features of the gradual improvement deployed for this system are similar to the one used for Stockfish, as discussed in this article. Whether

such approaches can result in understanding is an open and intriguing question.

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