The Kaleidoscope Constraint: The automation of arts, seen from its dead ends

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Since Renaissance Lullism, the history of computational and computer-generated literature has been a history of dead ends, reflected among others in Jonathan Swift, Georges Perec, Italo Calvino, Franz Josef Czernin, and more recently in the fields of Internet and machine learning-based literature. These crises and impasses are rooted in what I would propose to call the kaleidoscope constraint of literary computation. The historical development of computational methods and technologies, from simple combinatorics to Markov chains to neural networks, has not removed this constraint, since it has only brought (to borrow from finance) a quantitative easing of a qualitative problem. – In the course of sketching this history, I would also like to put some question marks behind common understandings of "digital" and "creativity".

Seit der frühneuzeitlichen ars combinatoria ist die Geschichte der generativen und computererzeugten Literatur eine Geschichte von Sackgassen und Krisen, die u.a. von Jonathan Swift, Georges Perec, Italo Calvino und Franz Josef Czernin beschrieben wurden und sich in jüngster Zeit auch auf Netzliteratur und machine learning-basierte Texterzeugung erstrecken. Diese Krisen haben ihren Ursprung in dem, was ich "kaleidoskopischen Formzwang" berechneter bzw. generativer Literatur nennen möchte. Dieser Formzwang wurde in der historischen Weiterentwicklung von Rechenmethoden und -techniken – von der einfachen Kombinatorik über Markov-Ketten bis hin zu neuronalen Netzen – nicht aufgehoben, sondern (in der Sprache des Finanzmarkts) nur quantitativ gelockert. Im Zuge dieser skizzierten Geschichte möchte ich auch Fragezeichen hinter gängige Begriffe des "Digitalen" und der "Kreativität" setzen.

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Dead ends and crises in computational poetics

The likely reason for my invitation to this conference is my previous work on the automation of literature, including my 2006 dissertation, in which I attempted to write a history of computational literature from Renaissance ars combinatoria to contemporary Internet art, including its antecedents in ancient and medieval poetry and mysticism. I have only sporadically revisited this topic since then, because my thesis ended in a dead end: that throughout its long but often overlooked history, computational poetry has been characterized by a structural discrepancy between the speculative imagination of the powers and potentials of computational language and the fragmentary and often disappointing results of these experiments.

In other words, the poetics of automated literature was more interesting than its poetry. With Renate Lachmann, I therefore read this history and genre of literary writing as fantastic literature, implicitly as belonging to a literary anthropology of speculation (to borrow a term from Gert Mattenklott). The speculative surplus of this poetics meant that the rather simple act of shuffling words in a poem took on very different meanings in different centuries and different poetics: as ecstatic mysticism or as technocratic constructivism, as rules or as randomness, as formalist regimes or as aleatoric anarchy, as satanic or as Christian, as classicism or as anti-classicism, to name but a few.

Lullism

The speculative poetics of medieval and Renaissance ars combinatoria and lullism are summarized in Jonathan Swift's *Gulliver's Travels* as follows:

> "The first Professor I saw was in a very large Room, with Forty Pupils about him. After Salutation, observing me to look earnestly upon a Frame [...] by his Contrivance, the most ignorant Person at a reasonable Charge, and with a little bodily Labour, may write Books in Philosophy, Poetry, Politicks, Law, Mathematicks and Theology, without the least Assistance from Genius or Study. He then led me to the Frame, about the Sides whereof all his Pupils stood in Ranks. It was Twenty Foot Square, placed in the Middle of the Room. The Superficies was composed of several Bits of Wood [...]. They were all linked together by slender Wires. These Bits of Wood were covered on every Square with Papers pasted on them; and on these Papers were written all the Words of their Language [...]. The Professor then desired me to observe, for he was going to set his Engine at work."[1]

Swift's satire is effective because it does not actually exaggerate Renaissance Lullism, but describes it very factually. In the 17th century, the German polymath Johann Joachim

[1] Swift, Jonathan. *Gulliver's Travels.* Edited by Herbert Davis, Basil Blackwell, 1965.

Becher had constructed an almost identical apparatus for machine translation from Latin into modern languages,[2], and the poet and mystic Quirinus Kuhlmann had envisioned nineteen combinatorial and automated arts and sciences, including an automated "ars magna librum scribendi" that would be "of such perfection that no mortal being would be able to write a book that wasn't already contained in our Ars scribendi".[3]

The poetic and scientific Lullism of the 17th century failed because its machines never amounted to more than theoretical sketches or prototypes that overpromised but underdelivered. By the early 18th century, when scholasticism was replaced by empirical science and, in the arts, rule-based poetics by the new paradigm of aesthetics, the Lullist project of automated creativity had logically come to an end. Swift only had to summarize it to make fun of it. In a classic paradigm shift (as defined by Thomas Kuhn), ars combinatoria and automated creativity were marginalized and lived on in the niches of games, children's books, humorism, and the occult.

When Raymond Queneau revived the literary ars combinatoria in 1961 with his *One Hundred Thousand Billion Poems*, this was still in the spirit of ludics and children's games.[4] The poems initiated the Oulipo group of literary writers and mathematicians, including Georges Perec and Italo Calvino. The group formally operated as a section of the Parisian Collège de Pataphysique, which was modeled on Alfred Jarry's poetic-absurdist science of pataphysics. The new automation of literature in the twentieth century thus did not erase Swift's epitaph, but confirmed his framing of literary combinatorics as organized silliness.

The Oulipo began its collective work in the same years that Marshall McLuhan's book *Understanding Media* was published.[5] McLuhan defined media, broadly synonymous with technology, as "extensions of man". This discourse has since dominated the discourse of media and technology where new technologies are understood as progressive function updates. The poetics of Oulipo, however, was the opposite, understanding techniques and technologies, including computation and algorithms, as "constraints" rather than extensions.

In 1968, Georges Perec wrote a radio play for the German Saarländischer Rundfunk, "Die Maschine" ("The Machine") in which a simulated computer processes Goethe's *Wanderer's Nightsong* using the very formal text processing methods developed in the Oulipo.[6] This processing anticipates much of the algorithmic text processing done today in the Digital Humanities. But it ends up as an ultimately futile and pointless exercise in constraining a literary text.

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[2] Becher, Johann Joachim. *Character pro notitia linguarum universali.* Frankfurt, 1661

[3] "tanta perfectione, ut nullus Mortalium librum edere posset, quem nostra Ars scribendi non comprehenderet", Quirinus Kuhlmann, *QUIRINI KUHLMANNI PRODOMUS.* Amsterdam: Lotho de Haes, 1674.

[4] Queneau, Raymond. *Cent Mille Milliards de Poèmes.* Gallimard, 1961; English translation in Mathews, Harry, and Alastair Brotchie, editors. *Oulipo Compendium.* Atlas Press, 1998.

[5] McLuhan, Marshall. *Understanding Media: The Extensions of Man.* 1964.

[6] Perec, Georges. *Die Maschine.* Stuttgart: Reclam, 1972.

Since 1959 and parallel to the Oulipo, the *Stuttgarter Schule* ("Stuttgart School") of experimental poets around Max Bense, Helmut Heißenbüttel und Reinhard Döhl had created computer-generated poetry which it called "artificial poetry".[7] The dead end in Perec's *Machine* ended up becoming the dead end of artificial poetry, too. According to Döhl, Perec's radio play had such a crushing effect on the *Stuttgarter Schule* that it gave up computer generative poetry:

> "A radio play, which […] seemed like a preliminary end point to us, who had come from writing to computers. […] We didn't pursue these approaches further at that time, except in lectures and discussions, but rather broadened our interest in artistic production using new media and writing systems in other directions".[8]

In his 1967 lecture *Cybernetics and Ghosts*, Oulipo member Italo Calvino saw computer-generated literature at a similar impasse when he concluded that "the style of a literary automaton" and "its true vocation would be for classicism", in the sense of "traditional works, poems with closed metrical forms, novels that follow all the rules".[9] In the same year, the American novelist John Barth criticized experimental poetry in general as a *Literature of Exhaustion* which exhausts itself in the material creation of proteic variations rather than more simply imagining them, as for example in the prose of Jorge Luis Borges – or, one might add, Jonathan Swift.[10]

The history of literary computing and generative poetry thus can not only be told as a history of impasses, but perhaps must even be told from the perspective and vantage point of its periodic crises since the collapse of the ars combinatoria at the turn of the 17th and 18th centuries. More recent examples include the attempts and ultimate frustration and failure of the Austrian experimental poet Franz Josef Czernin to write computer-aided poetry with the experimental language processing software "POE" in the 1990s,[11] the short-livedness of various schools of electronic literature since the invention of the World Wide Web, including German-language "Netzliteratur" and its collapse in the early 2000s. Contemporary electronic literature suffers from the problem that its scholars either outnumber its writers or, as Álvaro Seica has analyzed, are even identical with them.[12]

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[7] Lutz, Theo. "Stochastische Texte." Augenblick, vol. 4, no. 1, 1959, pp. 3–9.

[8] "[E]in Hörspiel, das […] uns, die wir ja vom Text zum Computer gekommen waren, wie ein vorläufiger Schlussstrich erschien. […] Wir haben diese Ansätze außer in Vorträgen und Diskussionen damals nicht weiter verfolgt, sondern unser Interesse an künstlerischer Produktion mit Neuen Medien und Aufschreibsystemen in andere Richtungen ausgedehnt". Döhl, Reinhard. "Vom Computertext zur Netzkunst. Vom Bleisatz zum Hypertext". *Liter@tur: Computer – Literatur – Internet*, Hansgeorg Schmidt-Bergmann and Torsten Liesegang (eds.), Bielefeld: Aisthesis, 2001, 27–50.

[9] Calvino, Italo. "Cybernetics and Ghosts." *The Uses of Literature*, Harcourt, 1982, pp. 3–27.

[10] Barth, John. "The Literature of Exhaustion." *The Friday Book*, 1984, pp. 62–76.

[11] Czernin, Franz Josef, and Ferdinand Schmatz. *Teller und Schweiss. Gedichte aus POE*. Pakesch & Schlebrügge, 1991

[12] Seiça, Álvaro. "Digital Poetry and Critical Discourse: A Network of Self-References?" 2182-8830, Centro de Literatura Portuguesa Imprensa da Universidade de Coimbra, 2016. Many scholars formerly active in this area have moved on to such fields as computer game studies, digital humanities

It remains to be seen whether the current boom of artificial intelligence text generation using neural networks and machine learning will produce similar frustrations. A recent "Guardian" op-ed article written by the currently most advanced artificial intelligence language generator GPT-3, suggests that the technology does not resolve the issues stated by Calvino and others.[13] Realistically, this form of automated creativity is destined to take over major parts of vernacular text production (from articles to reports and helpline chat bots) and thus find indirect ways into literary writing.

Structural issues

From Lull to GPT-3, there have been two, maybe three major modes – or techniques – of language computation and machine-generated literature:

1) synthetic computation of pre-defined elements according to pre-defined (or "hard-coded") rules, in a period from the 13th to the 20th centuries – with historical origins in the medieval Kabbalah and Lullist combinatorics and continuing up to so-called Symbolic Artificial Intelligence ("Symbolic AI"). Examples include the word permutation poems of the Renaissance period, the machine described by Swift in *Gulliver's Travels*; computational poetry of the Oulipo including Raymond Queneau's 100.000 Billion Poems; but also more recent machine translation systems such as the Internet service *Babelfish*.

2) analytical computation of arbitrary text input by pre-defined rules or algorithms, in the 20th and 21st centuries. It began with Andrei Markov's invention of Markov chains and his processing of Pushkin's *Eugene Onegin* in 1906, continued with Tristan Tzara's 1920 instructions to create Dadaist poetry by cutting out and shuffling words from any newspaper article, Brion Gysin's and William S. Burroughs' cut-ups in the 1950s, and literature written with the help of Markov chains such as Max Bense's *Der Monolog der Terry Jo* (1968), Jackson Mac Low's "diastic" poems from the 1980s, Charles O. Hartman and Hugh Kenner's *Sentences* (1995) and Ray Kurzweil's *Cybernetic Poet* from 2001.[14]

3) analytic computation of arbitrary input through dynamically adapted rules – such as in machine learning -, with the present-day example of GPT-3.

While language computation has arguably become more sophisticated with each new technique, none of them has changed the fundamental structure and constraint of language computation: mathematical shuffling of predefined (textual) material. This is

and cultural studies of computing and technology.

[13] https://www.theguardian.com/commentisfree/2020/sep/08/robot-wrote-this-article-gpt-3 . Not only leaves the text much to be desired, it also turned out that it needed to be heavily edited by human editors: https://www.theguardian.com/technology/commentisfree/2020/sep/11/artificial-intelligence-robot-writing-gpt-3

[14] Hartman, Charles O., and Hugh Kenner. Sentences. Sun and Moon Press, 1995.

what I propose to call the *kaleidoscope constraint* of generative literature, and of automated creativity in general. But before I explain it in more detail, let me first digress on the notions of "digital" and "creativity".

Digression: digital, creativity

In the history I have presented, electronic computer technology plays an important but not decisive role, since most literary computations do not fundamentally depend on it. But this is not to deny digitality. Digitality simply needs to be placed into a larger historical perspective. Since the standardization of alphabets and the equation of letters with numbers in the Greek and Hebrew antiquity, writing in Western culture has been digital; not in a metaphorical sense, but in the literal scientific definition of "digital" as information encoded in discrete, countable units.[15] The early digitization of language into alphabets was a necessary precondition for any combinatorial poetics, including the calculation of names as numbers in the Kabbalah and older schools of mysticism and magic.[16]

Second, with Oulipo's concept of the constraint along with the observation that automated literature boils down to shuffling linguistic units, one might ask whether computational poetics is *uncreative* rather than creative. Here I borrow from the poet Kenneth Goldsmith.[17] Conversely, the notion of "automated creativity" risks reinforcing a problematic romanticist, and nowadays neoliberal,[18] concept of art as creativity.

Kaleidoscope constraint

Constraints, exhaustion and dead-ends of generative systems are not only a matter of poetics, but above all of aesthetic experience. This experience kicks in soon enough when reading permutation poems or robot journalism, watching algorithmically generated visuals and listening to computer-generated music.

Whatever the technique or technology, 'automated creativity' not only boils down to remixing, but to remixing as an aesthetic end in itself – unless these computations are being tactically used outside their own logic.[19] The constraint of any generative system

[15] This is also how Goodman, Nelson. *The Languages of Art.* Hackett, 1976, defines digital as opposed to analog.

[16] As described in Dornseiff, Franz. *Das Alphabet in Mystik und Magie.* Teubner, 1925.

[17] Goldsmith, Kenneth. *Uncreative Writing: Managing Language in the Digital Age.* Columbia University Press, 2011.

[18] Such as in the policymaking concepts of the "creative class" and "creative cities" in Florida, Richard. *The Rise of the Creative Class* Hachette UK, 2002 and Landry, Charles. *The Creative City: A Toolkit for Urban Innovators.* Earthscan, 2012.

[19] As for example by the YesMen for their spoof of the World Trade Organization website: Bichlbaum, Andy, et al. *The Yes Men: The True Story of the End of the World Trade Organization.* Disinformation, 2004.

is that the recombination of elements means almost infinite possibilities in theory, but quickly becomes dull and pointless in practice.

As a result, the promise of extension conflicts with the reality of constraint. This concerns not only automated literature, but any programmed system. It is the same aesthetic effect as watching the visual shapes generated by a kaleidoscope – an instrument whose early history is part of the ars combinatoria of the 17th century since it was co-invented by the Lullist polymath (and later correspondent of Quirinus Kuhlmann) Athanasius Kircher. Machine-generated art and automated creativity are, effectively, glorified kaleidoscopes. Therefore, I propose the concept of the "kaleidoscope constraint" for computational poetics and aesthetics, and use it to explore a poetics that does not exhaust itself in it.

The history of computational poetics could be told as a history of quantitative easing of the kaleidoscope constraint: that is, burying a structural problem by throwing more resources at it. Since the emergence and institutionalization of computer-generative arts on a larger scale, this quantitative easing has masked a much smaller degree of qualitative (e.g.: aesthetic and hermeneutic) "gains". In doing so, it has also perpetuated the McLuhanian and techno-Hegelian narrative of extension rather than constraint, and fostered a collective failure to think of any extension as simultaneously a restriction.

Postscript on machine learning

What are the foreseeable limits of neural-network-based "machine learning" algorithms (which are now often, but problematically, understood as synonymous with the larger field of "artificial intelligence")?

First and foremost, they are pattern recognition systems; algorithms that find regularities in unstructured data sets. They are therefore primarily perception systems, not creation systems. However, when using their pattern recognition for information synthesis, they reconstruct information that is not actually contained in a data set, such as object details in a blurry photograph or, hypothetically, missing words in a fragmented text.

Machine learning algorithms are therefore likely to become part of ordinary word processing software, where they could, among other things, auto-complete sentences that consist only of a beginning or a few keywords. Their "learning" is based purely on heuristics – probabilities found in the training material. As a result, these algorithms construct the present from the past; or, more simply, they constantly stereotype.

An advanced machine learning system trained on nineteenth-century realist novels as a data set would forever write novels in the style of nineteenth-century realism (or rather, remixes of those novels), but it would never be able to write *The Making of Americans*, to take one example. Italo Calvino's diagnosis of classicism, or conservatism and conventionalism, probably applies even more to machine learning than to the combinatorial poetics he studied with the Oulipo in the 1960s. [Added in 2023:] Paradoxically, the

extension of the capabilities of generative systems seems to have led to even greater aesthetic limitations than fifty years ago; just like the kaleidoscope, which – having "matured" into today's AI image generators – no longer generates abstract shapes but photorealistic images.