Georg Hajdu

KEYNOTE SPEAKER

Director
**LIGETI CENTER (LABORATORIES FOR INNOVATION AND GENERAL-AUDIENCE
EDIFICATION THROUGH THE TRANSLATION OF IDEAS)**

Professor
HAMBURG UNIVERSITY OF MUSIC AND DRAMA

From Ligeti to the Ligeti Center: How Music and Curiosity Inspired a Center for Innovation
SATURDAY, JUNE 14, 2025 3:30PM – 4:30PM
BRIGHT FAMILY SCREENING ROOM, EMERSON COLLEGE

ABOUT THE SPEAKER

Georg Hajdu is a distinguished German composer, multimedia artist, and educator, renowned for his innovative contributions to contemporary music, multimedia composition, and interdisciplinary research at the intersection of music, science, and technology. Born in 1960 in Göttingen, Germany, Hajdu initially pursued studies in molecular biology and composition in Cologne, reflecting his lifelong interest in bridging scientific and artistic disciplines.

He later deepened his expertise in computer music at the Center for New Music and Audio Technologies (CNMAT), completing a Ph.D. in 1994 at the University of California, Berkeley.

Hajdu's compositional output is diverse, encompassing instrumental, vocal, and electronic works.
A significant highlight of his career is the opera Der Sprung – Beschreibung einer Oper, created in collaboration with librettist and filmmaker Thomas Brasch. The opera explores themes of human experience and tragedy through innovative musical and narrative structures.
In 2002, Hajdu premiered his groundbreaking networked performance environment Quintet.net during a multimedia opera production at the Munich Biennale for Contemporary Opera. This tool, which enables real-time networked music performance, exemplifies Hajdu's pioneering work in interactive and

collaborative music-making. That same year, he was appointed Professor of Multimedia Composition at the Hamburg University of Music and Drama (HfMT), where he founded Germany's first Master's program in multimedia composition in 2004, solidifying his role as a leading educator in the field.

Throughout his career, Hajdu has been involved in numerous national and international projects, including the European Union's Culture 2007 initiative CO-ME-DI-A, which focused on collaborative music performance technologies. He also served as Artist-in-Residence at the Goethe-Institut in Boston in 2010 and as a visiting professor at Northeastern University, where he continued to foster international collaborations and explore the frontiers of music and technology.

In addition to his academic and compositional achievements, Hajdu has developed influential software tools that have shaped contemporary music practice. These include Studie II, Quintet.net, MaxScore (co-developed with Nick Didkovsky for music notation in Max/MSP), and DJster, based on Clarence Barlow's algorithmic composition program Autobusk. These tools reflect Hajdu's commitment to expanding the possibilities of music creation and performance through technology.

As a composer, Hajdu's works have been performed extensively across Europe, the Americas, Asia, and Australia, earning him a reputation for innovation and artistry. His music often explores the boundaries between traditional and experimental approaches, integrating acoustic and electronic elements with precision and imagination. He has published numerous articles that delve into the interplay of music, science, and technology, further establishing his influence as a thought leader in the field.

Hajdu is also the founding director of the ligeti center in Hamburg, dedicated to exploring contemporary music and fostering interdisciplinary research. His contributions to the world of music and multimedia composition continue to inspire new generations of composers and technologists.

FROM GYÖRGY LIGETI TO THE *LIGETI CENTER*:
How Music and Curiosity Inspired a Center for Innovation

Dear Participants,

I'm Georg Hajdu, the founding director of the *ligeti center* in Hamburg, a research and translation center at the juncture of art, science and technology. I had the great fortune to first meet György Ligeti in 1984 and had exchanges with him throughout the 1980s and 90s. When I became professor of composition and music theory at the university he taught at for 16 years, I was immediately made aware of his 1973 idea to found a computer music center, a plan that was laid to rest in 1977.

I'm grateful for the opportunity to present my thoughts about the 50 years between Ligeti's idea and the inauguration of the center named after him, a gap spanned by the life and work of John Chowning, the exceptional pioneer of computer music and friend of Ligeti's.

My keynote consists of 6 short essays spelling out the last name of György Ligeti, which also serves as an acronym for Laboratories for Innovation and General-audience Edification through the Translation of Ideas.

L AS IN LABORATORIES

When György Ligeti undertook a residency in the Bay Area in 1972 at the invitation of the Stanford Music Department, he found himself at the frontier of a burgeoning technological revolution. His visits to the Artificial Intelligence Laboratory, where John Chowning was conducting pioneering work in digital sound synthesis and the spatialization of sound—left a profound impression. Ligeti, then 49 years old and arguably at the height of his creative powers, was not merely dazzled by the novelty of what he encountered. Rather, as a composer deeply attuned to the structural and philosophical underpinnings of music, he recognized the far-reaching implications of this research.

Unlike many of his peers, Ligeti had the intellectual and aesthetic breadth to understand what digital sound offered: not simply new timbres or compositional tools, but a fundamentally different musical ontology. Digital music was not just an extension of analog techniques—it represented a rupture, a shift in the very substrate of music creation. Having already explored electronic music at the WDR studio in Cologne between 1957 and 1959, Ligeti had firsthand experience with the laborious, tactile processes of working with magnetic tape, filters, and oscillators. It was these experiences that fertilized the compositional soil from which works like

Atmosphères, premiered in 1961, emerged—a piece that would have been unthinkable without the spatial, temporal, and textural awareness electronic music had cultivated in him, and he wished to apply the knowledge absorbed at Stanford to his future compositions.

Inspired by what he had witnessed there, Ligeti envisioned establishing a mirror lab in Hamburg when he, in 1973, joined the faculty at the Hamburg University of Music and Drama. He wanted to make the resources and intellectual stimulation of a computer music center available to a new generation of European artist and researchers. Unfortunately, this vision was thwarted when the German Research Foundation (DFG) declined to fund the initiative.

But even in the absence of his hoped-for lab, Ligeti remained an ardent supporter of technological experimentation. He encouraged students who began to work with personal computers, MIDI setups, and emerging microtonal synthesizers.

When I joined the Hamburg faculty in 2002, Ligeti had already returned to Vienna for the final years of his life. Yet his legacy lingered in the air—an unfinished vision, a blueprint for something that had yet to be built. In 2004, I helped establish the master's program in Multimedia Composition (now ably led by Alexander Schubert), followed by the creation of a center for multimedia and microtonal music, the first doctoral program in music in Germany, the *ligeti center*, and most recently, the ARTILACS program—dedicated to exploring *artistic intelligence in latent creative spaces*. These initiatives were not attempts to replicate Ligeti's vision exactly, but to extend it into a new century, one defined by hybrid creativity and human-machine collaboration.

This brings me to the broader question: Why are laboratories so essential in the context of artistic research?

While the term "lab" often evokes white coats, petri dishes, and the sterile rigor of scientific protocol, the artistic lab is something altogether different. In fact, artistic research may share more with alchemy than with analytic chemistry. Its laboratories are closer in spirit to the Renaissance workshop than to the standardized lab environments of the modern university. In those early workshops, artistic, scientific, and mystical inquiries were deeply entangled. Alchemists sought not only to transmute lead into gold but to understand and master the hidden forces of nature.

Today's artistic research labs continue that tradition, often without acknowledging it explicitly. They are spaces where intuition, experiment, and theory intermingle; where failure is as informative as success; and where technology is not merely a tool but a philosophical interlocutor. This is particularly true in domains such as sonification and musification of scientific data, where art translates empirical observation into artistic experience. Here, the aesthetic and the analytic converge.

One might even argue that the current enthusiasm for artificial intelligence echoes older myths and metaphors. The desire to animate the inanimate, to imbue clay or code with life, finds expression in the legend of the Golem. Its supposed creator, Judah Loew ben Bezalel of Prague, was not just a mystic but also a mathematician and philosopher.

In the work of artists like Adriano Claro Monteiro and Rafaela Blanch Pires, we see this Golem-like aspiration brought into the biological and ecological realms. Their use of sensors to "breathe life" into bioplastics speaks to a growing desire to create artworks that are not only responsive but symbiotic. Similarly, Rama Gottfried's digital puppetry animates inanimate forms through code and gesture, pointing toward a future where the line between organism and artifact, nature and technology, continues to blur.

Artistic laboratories, then, are not mere sites of production—they are crucibles of transmutation. They enable us to turn code into choreography, noise into structure, data into emotion. They allow us to interrogate the conditions of possibility for art itself. And in the best cases, they bring us full circle: back to that Ligetian impulse to challenge, rethink, and reimagine the foundations of music in light of the world we now inhabit.

I AS IN INNOVATION

Ligeti was acutely aware of the transformative potential that digital technology held for the future of music. He glimpsed, perhaps more clearly than many of his contemporaries, the ways in which computing could open up unprecedented possibilities for the composition, perception, and dissemination of sound. Yet, despite this foresight, he never fully embraced these technologies in his own compositional practice. This abstention was not born of resistance or dismissal, but rather a complex mixture of practical constraints, aesthetic commitments, and perhaps a generational distance from the tools emerging around him. Nevertheless, Ligeti maintained a profound respect for those who did venture boldly into the digital realm and forged new paths within it.

Among those he supported and admired was his student, the Japanese composer Kyoshi Furukawa and Clarence Barlow, the Indian-born composer who played a pivotal role in the evolution of algorithmic composition and computer-assisted music. I encountered Barlow under serendipitous circumstances—living, as we both did, in Cologne, a city that pulsed with artistic innovation and experimental fervor. At a formative stage in my life, Barlow's expansive ideas left a deep impression on me.

Barlow was not just a composer; he was a systems builder, a thinker who operated with the mindset of an engineer and the sensibility of an artist. He approached composition with the rigor of a scientific researcher and the curiosity of a polymath. During a time when computers bore little resemblance to the accessible, user-friendly systems we have today—when working with them meant directly interfacing with low-level code, punch cards, or command-line environments—Barlow created his own tools from scratch.

His most influential project emerged in connection with his 1979 piano piece *Çoğluotobüsişletmesi*, a formidable work whose title alone reflects his delight in linguistic and conceptual complexity. The compositional thinking that led to this piece ultimately gave rise to *AUTOBUSK*, a generative probabilistic real-time music system. *AUTOBUSK* was more than a tool; it embodied a philosophy of composition that eschewed direct authorship in favor

of algorithmically mediated structure—composition as the design of a system rather than the specification of fixed results.

This approach anticipated and inspired the emergence of the composer-researcher model that would take hold in the 1980s, particularly at institutions such as IRCAM (Paris), CCRMA (Stanford), and the MIT Media Lab (Cambridge). These centers epitomized the hybrid figure of the artist-technologist—someone equally at home in concert halls and code libraries. Barlow exemplified this paradigm well before it became fashionable, and his work remains a touchstone for those who view music not just as sonic expression but as epistemological inquiry.

His thesis, *Bus Journey to Parametron*, is a testament to this vision. Spanning over 100 pages, it presents a rich interweaving of personal narrative, theoretical reflection, and technical documentation. In many ways, it is an early exemplar of what we now call Artistic Research—a field that insists on the interdependence of practice and theory, experience and method.

AUTOBUSK continues to evolve. Rebranded as *DJster*, it has been integrated into contemporary artistic research, most notably in the *ligeti center's Healing Soundscapes* project. Launched roughly a decade ago, this initiative explores the therapeutic potential of music and sound design within hospital environments—spaces often marked by stress, sensory overload, and acoustic neglect. The goal was not simply to make waiting areas more pleasant but to actively transform the psychological and physiological states of those who occupy them.

The choice to use Barlow's generative engine was strategic. *DJster*'s probabilistic, style-agnostic architecture makes it ideally suited to such sensitive contexts. It avoids the pitfalls of musical prescriptiveness—offering sound that is neither overly familiar nor emotionally coercive. Its non-intentionality proves a virtue in two key respects: first, by sidestepping the problem of individual taste and cultural specificity, it becomes more universally acceptable; second, by generating endlessly varying textures and sequences, it avoids the cognitive fatigue that repetition induces—something particularly important in environments like emergency departments, where waiting times are long and anxiety runs high.

But *Healing Soundscapes* is more than an application of generative music. It exemplifies the power of interdisciplinary collaboration. Drawing from music therapy, composition, sound design, experimental and Gestalt psychology, cognitive neuroscience, software development, and hardware engineering, the project represents a new kind of Gesamtkunstwerk—one in which the boundaries between disciplines blur in the service of human well-being. The custom-built immersive sound diffusion systems used in the project are designed not just for fidelity but for emotional resonance.

In this sense, Barlow's legacy lives on—not only in the tools he built or the music he composed but in the broader vision he articulated: of music as an exploratory medium, composition as research, and technology as a platform for poetic invention. And while Ligeti may not have directly harnessed the tools of digital composition, his appreciation of figures like Barlow and Furukawa signals his openness to these directions.

G AS IN GENERAL-AUDIENCE

Innovative solutions born from interdisciplinary collaboration are of little consequence if they remain confined to specialist circles. They must be communicated, shared, and opened to broader publics—not only for the sake of dissemination but as a means of reciprocal exchange, fostering a culture of involvement and participation. This notion of "giving back" is not a charitable afterthought but a structural necessity: it reflects the ethical imperative of public scholarship and creative practice that is both rooted in and responsive to society at large.

Within the field of contemporary music, however, we have grown accustomed to speaking primarily to one another. Many new music aficionados have internalized the idea that their audiences will be small, deeply informed, and aesthetically aligned. This insularity risks becoming a self-imposed marginalization.

In the current climate—marked by the rise of populist movements around the globe—there is a growing, often orchestrated resentment toward elite cultures. As creators, educators, and researchers, we must confront this challenge not by diluting our work, but by rethinking how it reaches people.

For decades, we have relied on social media to foster professional and intellectual communities—safe spaces of *elective affinity*. But these ivory towers may no longer suffice. If our work is to remain vital, relevant, and sustainable, we must develop strategies to scale it—to democratize our outputs and build bridges to diverse audiences without compromising the complexity of our ideas.

This requires collaboration with communication specialists who can translate complex concepts into digestible, resonant, and accessible forms which we might call *epistemic objects*—hybrid forms of knowledge designed for multimodal dissemination. Drawing from Lev Manovich's concept of "new media objects," which are fluid, iterative, and adaptable, epistemic objects similarly exist in various formats tailored to distinct audiences: academic journals, books, YouTube videos, social media threads, program notes, immersive games, sound installations, and even aural storytelling.

An example of such scaling emerged from my work in networked music performance. In 2019, a large-scale participatory music event took place in Hamburg's historic St. Pauli Elbe Tunnel. A total of 144 musicians performed works by 19 composers, arrayed along the tunnel's length of nearly 900m in an arrangement that blurred traditional spatial hierarchies. Rama Gottfried and I developed a distributed conducting system using *Drawsocket*, a web server built in Max. This system allowed us to send individualized scores—graphical, proportional, or metered—to browser-based devices in real-time over a wireless network.

This approach offered an unexpected but important benefit: many participating musicians expressed their relief and delight at being able to perform in an orchestral context without having to navigate the dual cognitive demands of following a conductor and reading complex parts simultaneously. Our system, by tailoring the experience to the needs of each performer, turned a technical innovation into an inclusive practice. It has since been adapted to a variety

of contexts, from chamber music to a piece for large choir and organ and even multimedia performances in the Bohlen-Pierce scale.

[VIDEO 1: https://www.youtube.com/watch?app=desktop&reload=9&v=BXlaSBo0KXs]

The use of alternative tuning systems such as Bohlen-Pierce scale offers a compelling metaphor—and practical framework—for engaging with principles of diversity, equity, and inclusion (DEI). Unlike standard Western tuning systems, BP and other microtonal scales sit outside the canonical training of most musicians. As Psyche Loui has shown, these scales are learnable by novices, yet their notation and conceptual framework demand new strategies for access. The conventional five-line staff does not suffice. Instead, performances must accommodate diverse skill levels, learning styles, and instrumental approaches, using hybrid notational systems—tablatures, visual symbols, and the six-line Bohlen-Pierce notation with its own clefs and solmization.

Here, once again, technology plays a critical mediating role. Conductors and performers need to interface with materials that match their cognitive and technical capacities. To this end, I contributed several years to the development of the *MaxScore* environment—a notation system that can dynamically translate between different representational formats in real time. While this is a technical achievement, its deeper meaning is symbolic: it affirms that all participants deserve tools suited to their ways of making sense of music. And in doing so, it models a politics of inclusion.

Everything we do as artists and researchers—every system we build, every method we choose, every interface we design—carries political meaning. Whether we affirm the status quo or subvert it, we are always making choices that reflect values. The challenge ahead is not just to make new things, but to make them matter in the lives of others. This begins not with compromise, but with generosity—a willingness to meet people where they are and to invite them into the strange, beautiful, and exhilarating spaces we have spent our lives exploring.
[VIDEO 2: https://youtu.be/-2TCAVtklrQ]

E AS IN EDIFICATION OR EDUCATION, ENTERTAINMENT, EMPOWERMENT

When we began searching for an appropriate German backronym for **LIGETI**, we found, for the letters **G** and **E,** the term *Gesellschaftliche Entwicklung*—"societal development"—a phrase that encapsulates the broader mission we envisioned for the project. It not only speaks to a collective process of progress and transformation but also invokes the kinds of structural, cultural, and intellectual shifts that institutions like the *ligeti center* aspire to initiate.

Yet, we also needed an English-language counterpart—something that could convey a similar breadth of meaning while remaining semantically coherent. After much debate and trial, we settled on the phrase **General-audience Edification.**

General-audience serves as a semantic bridge to *societal*, implying inclusiveness and accessibility rather than specialization or elitism. *Edification*, on the other hand, is a beautifully layered term. It invokes the idea of *building*—both in its Latin roots (aedificare, to erect or construct) and in its contemporary metaphorical use: to uplift, to enlighten, to cultivate. It echoes education, empowerment, and even entertainment, yet transcends them by suggesting a synthesis of learning, engagement, and elevation.

To me, György Ligeti's music embodies the very essence of edification. His works are intellectually rich, technically challenging, and aesthetically adventurous. They entertain—albeit in deeply sophisticated ways—they educate listeners and performers about the frontiers of musical form and perception, and they empower musicians by pushing the boundaries of what is technically and expressively possible. Pieces such as *Continuum* for harpsichord and his piano etudes craft illusions of complexity that invite performers into a virtuosic interplay between control and chaos. Ligeti's ability to layer simplicity beneath apparent density creates a powerful metaphor for edification itself: deep meaning emerging from surface intricacy.

This intersection between the intuitive and the scientific is also evident in the book *Motorische Intelligenz* co-authored by Ligeti and neurobiologist Gerhard Neuweiler. Neuweiler underscores the extraordinary cognitive, sensory, and motor demands placed on performers of Ligeti's music. Ligeti's own contributions to the volume reveal a fascinating duality in his self-conception: on the one hand, he identifies as a vessel for musical intuition, an artist receptive to mysterious inner impulses; on the other, he places great emphasis on the role of natural science in shaping his compositional thinking. This seeming contradiction—between inspired intuition and scientific rigor—is not a paradox, but a key to understanding the nature of creativity itself.

It is precisely this fusion that we ought to cultivate in interdisciplinary research hubs: the presence of individuals who are not only creative but capable of articulating the mechanics of creativity in scientific terms. Centers like CNMAT (Center for New Music and Audio Technologies) under the visionary direction of David Wessel exemplified this model. Wessel, whose early composition *Antony* was directly inspired by Ligeti, embodied an extraordinary integration of disciplines. CNMAT was a place where cognitive psychology, computer science, electrical engineering, music composition and improvisation were represented under one roof.

Whether we call our efforts *edification, education, empowerment,* or *entertainment,* they all increasingly depend on digital infrastructures. These technologies make it possible to reach global audiences, personalize learning experiences, and document creative processes in unprecedented ways. But they also introduce new risks. The ubiquity of information—its perpetual availability on devices we carry, wear, or may soon even *become*—threatens to flatten knowledge. In a world where learning can be replaced by a swipe of a screen or blink of an eye, there is a danger that depth will give way to convenience.

The image of humans encased in a knowledge exoskeleton—outsourcing cognition to digital tools—provokes both awe and unease. Perhaps it is a necessary evolution, a safeguard against the rise of autonomous systems that could surpass us in sheer processing power. But it also reminds us that what truly matters is not the storage of knowledge, but the cultivation of *understanding*. And understanding—rooted in embodied experience, creative experimentation, and collaborative inquiry—remains, for now, a uniquely human achievement.

T AS IN TRANSLATION, TRANSFER OR TRANSDISCIPLINARITY

Transfer and translation are such fundamental principles in nature that one could reasonably claim life itself would not exist—let alone proliferate—without them. These mechanisms lie at the heart of biological systems and permeate every layer of our perception, cognition, and creativity. In molecular biology, the very engine of cellular activity revolves around acts of translation: DNA is *transcribed* into mRNA, which is then translated into proteins through the intermediary machinery of tRNA and ribosomes. These processes are not only chemical but also semiotic—they are nature's own way of inscribing meaning into matter.

An intricate back-and-forth between domains—electrical to mechanical, mechanical to acoustic, acoustic to symbolic—lies at the heart of both biological function and technological emulation, such as in robotic interfaces, sensor networks, and human-computer interaction.

This interplay of modalities is perhaps nowhere more fascinating than in the realm of perception and artistic imagination. Synesthetes experience involuntary sensory translation—seeing colors when hearing music, tasting flavors when reading words. For the non-synesthetic majority, associative phenomena like the *Bouba-Kiki effect* reveal the innate wiring of our cognition, illustrating an implicit translation between sound and shape embedded in human psychology.

Artists have long exploited and expanded this cross-modal sensibility. Ligeti drew inspiration from visual structures—spider webs, Islamic tile patterns, fractals. This practice aligns him with figures like Scriabin, Messiaen, and Kandinsky, who viewed sound, color, and form as deeply intertwined. But in artworks we also find *translation* at deeper, more sublimated levels. While program notes and manifestos may explicitly articulate a work's intent, much of what art communicates remains unspoken, unconscious, and layered. Artistic research seeks to unravel *hidden agendas*—not merely interpreting what art says, but investigating how it says it, and why it had to say it that way.

A striking contemporary example of cross-modal translation is Konstantina Orlandatou's *Moving Sound Pictures* project at the *ligeti center*. Drawing on Kandinsky's theories of synesthetic aesthetics, Orlandatou creates immersive virtual environments where two-dimensional shapes on a canvas expand into three-dimensional musical instruments. These hybrid objects are not merely visual representations of sound—they are interactive, playable entities that invite participants to navigate and produce music through physical engagement. Here, translation becomes exploration; painting becomes performance; viewing becomes listening.

This paradigm of visual-to-sonic translation finds a historical precedent in graphical scores. Typically, composers use visual abstractions—lines, shapes, patterns—to *prescribe* musical actions. But these scores can also *describe* sound, as in Rainer Wehinger's iconic transcription of Ligeti's *Artikulation*, where an electronic soundscape is rendered into a richly symbolic visual language. Composer Mark Applebaum encapsulates this dual nature in the title of his sprawling collection of hand-drawn scores: *Prescribe/Describe*—a nod to the ambiguous role of notation as both instruction and representation. In Greg Beller's Spatial Sampler project, live recordings of sound samples become an interactive score in Virtual Reality.

Digital scores expand these possibilities exponentially. Freed from the constraints of paper, they can respond in real time, morph based on user interaction, and integrate multiple modalities—symbolic, graphical, audio, and tactile. Our own contributions—particularly through the development of MaxScore and the concept of the interactive score—have sought to reimagine notation as a central interface for distributed creativity. By allowing scores to control their performative periphery—lighting, visuals, robotics, sound processing—they become nodes in a network of interdependent artistic agents.

These networked digital scores—deployed in the St. Pauli Elbe Tunnel Project and elsewhere—enable participation across skill levels, sensory modalities, and spatial divides. They empower musicians and non-musicians alike to co-create in distributed environments, translating musical intention into accessible interfaces.

[VIDEO 3: https://youtu.be/1VpPdRuZtCU]

This brings us to another "T" that undergirds much of this work: **transdisciplinarity**. MS Word rejects the term with a red squiggly line, as if it were a typo. But transdisciplinarity is not a misstep—it's a necessity. Whereas *interdisciplinary* practices occur between disciplines within institutional structures *transdisciplinary* practices cross boundaries to engage with contexts outside academia: communities, homes, YouTube channels, hospital waiting rooms. They demand **translation**, not just in the linguistic sense, but in the epistemological and technological sense: the reshaping of knowledge into accessible, relevant, and engaging forms.

I AS IN IDEAS BUT ALSO (ARTIFICIAL OR ARTISTIC) INTELLIGENCE

In his 1991 essay R*hapsodic Thoughts on Music, Especially on My Own Compositions*, György Ligeti foresaw the potential of a future where technology and artistry could become mutually constitutive. He wrote: "*As soon as real artistic personalities have mastered the necessary technology, a valid 'artificial art' will also emerge—whether computer music or 'artificial music' will then still have something in common with the valid formations according to previous compositional norms remains to be seen.*" These words read as both prophetic and ambivalent, capturing the tension between artistic integrity and technological possibility—a tension that has only grown more urgent in the age of artificial intelligence.

When I first met Ligeti in Hamburg in 1984 to seek his opinion on my compositions, I was affected by his ambivalence. Though he had a profound interest in mathematics and the sciences, his compositional identity was grounded in a deep engagement with music theory, history, and ethnomusicology. At the time, computer science and digital sound synthesis were beginning to reshape music, yet Ligeti appeared torn: Should a young composer pursue traditional mastery or explore the frontier of machines and algorithms? He handed me a paradox and, in doing so, nudged me toward forging my own path.

Today, that path leads through a rapidly shifting landscape. The apparent dichotomy that Ligeti presented—between the rigor of historical compositional practice and the potential of technological innovation—may no longer hold. The arrival of universally accessible artificial intelligence tools marks a paradigm shift that blurs boundaries and invites hybrid methodologies. We are no longer speaking of tools in the periphery of artistic practice; these systems are becoming co-creators, entities that not only mimic but often reshape human intentions and aesthetics.

Yet, as Theodor W. Adorno cautioned in his 1964 essay *On Difficulties*, such technological relief—*Entlastung*—comes at a cost. He warned that the use of technology to circumvent the inherent challenges of advanced artistic materials leads to a dominance of "dead matter"— elements that remain alien to the artist's subjectivity. While early pioneers like Clarence Barlow simulated subjectivity through algorithmic models—constructing probabilistic systems that generate instructions and events—there remained a clear separation between the agency of the composer and the role of the machine.

That boundary is eroding. The latest generation of deep language and diffusion models already demonstrate behaviors that we, for lack of better terminology, call subject-like. While it remains debatable whether these systems possess consciousness or intentionality, they now occupy a space in which they can not only respond to queries but, as Anna Huang has shown, generate coherent, contextually informed, and even emotionally resonant artifacts.

But this is where a critical distinction must be made: between *functional music* and *art*. Functional music—designed to soothe, entertain, or ambiently decorate—is where AI can and will act autonomously. In contrast, art music and sound art remain domains where human agency is not just desirable but essential. These forms ask difficult questions, provoke reflection, and resist easy consumption. And it is precisely in this space that we must reconsider the inner mechanics of AI systems and their relation to artistic expression.

The very nature of deep learning neural networks (DLNNs)—which operate by training on massive datasets and producing outputs that cluster around statistical norms—inevitably draws their creations toward the mean. Hito Steyerl has referred to AI-generated images as *mean images*: not only average in the statistical sense, but sometimes disturbingly aligned with the biases and violences latent in the data. While Steyerl emphasizes their potential malevolence, I would add that these machines also possess significant benevolence—contributing breakthroughs in medicine, climate modeling, and accessibility. But as artists, we must confront the existential question: What is left for us to do?

The answer may lie in embracing what AI cannot easily reach: the underrepresented, the obscure, the marginal. We must explore the fringes of artistic practice—whether through alternative tuning systems, endangered musical traditions, or deeply personal iconographies. These are domains insufficiently represented in training data, and therefore rich with potential for genuine innovation.

Yet even here, we must remain vigilant. The machine is always learning. As we expand the margins, it follows us. This is the paradox of contemporary artistic practice: the need to stay ahead of an entity that never sleeps, never tires, and continually adapts. Eventually, the pursuit

of marginality may become futile as the machine internalizes even the most arcane techniques. This is not a reason for despair, but a call for reinvention—a game of perpetual becoming.

It is in this spirit that the ARTILACS project (Artistic Intelligence in Latent Creative Spaces) was founded. A joint endeavor between artistic/scientific research institutions in Hamburg and Lübeck, ARTILACS explores the nature of co-creativity in an age defined by machine collaborators. Central to its philosophy is the notion of *affirmative critique*—an engagement with AI that neither naively celebrates nor categorically rejects, but seeks to understand and shape its potentials and pitfalls. In doing so, ARTILACS affirms the nature of AI as a double-edged sword.

And what about Ligeti? In *Rhapsodic Thoughts*, he compared the niche of "serious" music to a soap bubble—infinitely thin, yet infinitely expansive. It is a poetic image, fragile yet resilient, shimmering on the cusp of visibility. With the advent of artificial intelligence, we may wonder whether this bubble will finally burst under the pressure of mass automation, or whether it will stretch even further—its surface now reflecting not only the soul of the artist but the gaze of the machine.

The future is uncertain. But if we are to remain artists, scholars, and scientists in any meaningful sense, we must engage this moment with the same restless curiosity, rigor, and complexity that Ligeti himself embodied. In doing so, we may yet find new forms of expression that are not merely artificial, but authentically human—and in that fragile space, infinitely expansive.

Thank you very much for listening!

GEORG HAJDU