FROM GESTALT TO PATTERN IN POST-WAR AMERICAN AESTHETIC THEORY: THE WORKS OF RUDOLF ARNHEIM AND GYÖRGY KEPES

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ABSTRACT

The following article is an inquiry into the aesthetic valences of the concept of pattern as informed by the contrasting frameworks of Gestalt psychology and information theory. On the trail of its object, it evokes the historical context of the Post-War American aesthetic theory and technological culture and enters into a critical dialogue with texts by its main interlocutors Rudolf Arnheim and György Kepes. The article demonstrates that both theorists grapple with the challenges issued by advances in computation and the epistemological implications of visions of data processing (even machine learning research) ascendant in their time. The discussion has a philosophical orientation in paying particular attention to matters of abstraction underlying patterns, the temporality of pattern formation, and the dimension of subjectivity; it highlights the fundamental oppositions between discrete and holistic coding, as well as quality and quantity. Finally, in its departure from Kepes's intervention in the relationship between science and art, the article situates the question of pattern in the context of the history of science, putting it in contact with influential treatments of objectivity in the discourse of Lorraine Daston and Peter Galison, but more critically, in the work of Donna Haraway.

Key Words: *pattern, pattern recognition, perception, visuality, isomorphism*

Savaş Sonrası Amerikan Estetik Kuramında Gestalt'tan Örüntüye Geçiş: Rudolf Arnheim ve György Kepes'in Çalışmaları

ÖZET

Bu makale örüntü olarak bilinen kavramın ortaya çıkardığı estetik sorunları tanımlamaya çalışıyor ve bu projede karşısında iki rakip kavram çerçevesi ya da kuram buluyor: Gestalt psikolojisi ve enformasyon teorisi. İkinci Dünya Savaşı sonrası Amerikan sanat kuramı ve teknoloji kültürünü bağlam olarak alarak, Rudolf Arnheim ve György Kepes'in metinleriyle eleştirel bir diyaloğa girişiyor. Makale iki kuramcının da tanığı oldukları bilişim alanındaki ve veri temelli bilgi kuramlarındaki ilerlemelerle (makine öğrenmesi dâhil olmak üzere) ciddi bir hesaplaşmaya girdiklerini gösteriyor. Felsefi sorunlara vurgu yaparak örüntünün temelinde yatan soyutlama meselesinin, zamansallığın ve öznellik boyutunun üzerine eğilirken, temel karşıtlıklar olan ayrık ve bütünsel kodlama ile nitelik ve niceliğin oyununa da dikkat çekiyor. Son olarak, Kepes'in sanat ve bilim arasındaki ilişkilere müdahalesinden yola çıkarak, örüntü sorununu bilim tarihi alanında yürütülen nesnellik tartışmaları bağlamına yerleştiriyor, bu noktada da Lorraine Daston ve Peter Galison'ın; ama özellikle de Donna Haraway gibi yazarların önemli çalışmalarından yararlanıyor.

Anahtar Kelimeler: *örüntü, örüntü tanıma, algı, görsellik, izomorfizm*

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Introduction

Directly or indirectly, Gestalt theory helped make significant contributions to aesthetic theory. Nowadays, any radicality that might have characterized The Berlin School of Max Wertheimer, Wolfgang Köhler, and Kurt Koffka, is hard to readily discern from a contemporary position, but in its beginnings, the theory was launched into a cultural context where it would find strong resistance: the influential German scientific psychology of memory and perception research dominant right before Gestalt often depended on quantitative thresholds and analytical breakdown as datum and method, often lending support to an atomism and objectivism of the human sensorium as the most scientifically reliable picture of the psychology of perception. Arraying innovatively designed experiments and articulating new laws for perception and memory, Gestalt theory argued for the primacy of a sense for wholes: they argued that instead of building up wholes from the association of atoms of quantitatively coded sensory data, perception had a native orientation to often meaningful wholes. Max Wertheimer expressed what he called "the fundamental formula" of Gestalt this way: "There are wholes, the behavior of which is not determined by that of their individual elements, but where the part processes are themselves determined by the intrinsic nature of the whole" (Wertheimer, 1950: 2). A part-whole philosophy is known as mereology; and Gestalt came up with one of the last coherent versions of the mereological lineage within the European philosophical tradition, producing it from the concrete exempla of an experimental psychology.[1]

In its far-reaching generality, the so-called formula first allowed the theorists of the Gestalt school to intervene in the debate on perception, crystallizing in Wolfgang Köhler's equally famous dictum that it is the object as a total form that confronts perception, thus giving rise to the fundamental figure-ground distinction: "A visual object is a total form bounded by definite contours enclosing a surface and this whole is experienced as set off against the surroundings" (Köhler, 1950: 23). But, Gestalt thinkers also made interventions in the larger philosophical debates of their time, spurning to take a side on the opposition between mechanism and vitalism, but recasting problems and producing new positions in philosophy of biology, extrapolating from the basis of their conclusions on perception. While looking back to a precursor like Goethe and his studies on morphology, they often borrowed from the contemporary physical sciences, making progressive use of concepts like the "field", originating in the observation of electrical and heat phenomena. In extension, Gestalt theory delineated an approach to living organisms that recognized their power to "organize" their perceptual milieu and aesthetic universe, a solid alternative to any objectivist dismissal of qualitative concerns. This work has in turn been recognized by researchers studying areas ranging from animal perception (eg. ethologists like Konrad Lorenz and Niko Tinbergen) to social scientists who felt the need for a language of wholes to describe social phenomena. Last but not least, however, is the material and inspiration Gestalt offered to aesthetic theory, its approach to form, space, and overarching insistence on structure and organization finding strong echoes in architectural thought, abstract painting, music, and even film.

1 The radicality of the philosophical underpinnings of Gestalt theory found one of its best expositions in an unlikely quarter, namely, the French phenomenologist Merleau Merleau-Ponty's work: "If (...) we want to give an unprejudiced definition of gestalt psychology's philosophical meaning, we would have to say that, by revealing "structure" or "form" as irreducible elements of being, it has again put into question the classical alternative between "existence as thing" and "existence as consciousness," has established a communication between and a mixture of, objective and subjective" (Merleau-Ponty, 1971: 86). For a persuasive rehabilitation of Gestalt theory's vision of perception, memory, creative thought, and overall experimental rigor, see the work of Esra Mungan (2023).

Now there is one invariant across all these investments and exchanges of concepts, and that is the indissoluble bond established between a whole and a form. Terms like pattern, and lately, pattern recognition also emerged precisely to address such a connection, and it would be a rewarding exercise to see whether there is something beyond linguistic —on the order of an "anglicization" (Helmling, 2003: 7)—in the overlap between Gestalt theory and concepts like pattern and pattern recognition. It bears pointing out that pattern recognition (as distinct from a "pattern" per se) emerged as an offshoot of the intellectual ascendance of cybernetics and information theory in the 1950s, right when the influence of Gestalt theory seemed to be ebbing. The relay-like nature of this relationship is not an accident.

While similar cases of uneasy coexistence can be made for other pairings that include cybernetics (its relation to psychoanalysis for instance), with Gestalt, there is a level of attraction and similarity-in-disparity unlikely to be found elsewhere. The convergence is best captured in a definition of pattern given by Norbert Wiener, the leading proponent of cybernetics. As he wrote, "one of the most interesting aspects of the world is that it can be considered to be made of patterns. A pattern is essentially an arrangement. It is characterized by the order of the elements of which it is made rather than the intrinsic nature of these elements" (Wiener, 1950: 3). In its similarity to the characteristic Gestalt idea of a whole that precedes its parts, such a definition must have created a retrospective discomfort in Wiener, and as the good mechanist that he was, he seems to have dropped it from the further editions of his celebrated *The Human Use of Human Beings.* Similarly, As Geof Bowker noted, certain cyberneticians considered theirs to be a "science of form", not unlike the most classical definition of Gestalt theory (Bowker, 1993: 111).

Before such a more information-theoretically couched "pattern" was on the horizon, the Berlin school produced a fundamental statement on organized wholes and structural integration that would be determining for the cultural dissemination of "patterns" and "pattern recognition" later. It bears asking, then, what happens in the contact zone between Gestalt preoccupations and the necessary alliance constituted by cybernetics and information theory. In the following, I present two case studies departing from this context and follow the traces of the encounter in the work of two aesthetic theorists who both had dealings with, and had to negotiate the context of tension between Gestalt and cybernetics. The first case concerns Rudolf Arnheim, a second-generation Gestalt theorist who not only raised the profile of visuality and visual learning as a form of cognition but also made highly influential connections between aesthetic theory and art education on the one hand, and Gestalt principles of perception, on the other. The next case is György Kepes, whose work has become the subject of a recent revival in design discourse, with the majority of reference being devoted to his massively ambitious project of breathing a new life into the visual culture of modernity in *The New Landscape in Art and Science*. In addition to the quality, magnitude, and influence of the works, it is the common historical status of these two thinkers that justify such a pairing: European émigrés to America both, these theorists are responsible for transplanting not just themselves but their formative discourses to the new context of Post-War American culture: Arnheim with Gestalt and Kepes with his somewhat informationally modified Bauhaus vision. The other historically important theorists that come to populate this account—such as Marshall McLuhan and Herbert Simon—whose contributions to a renewed understanding of pattern recognition hugely matter, are placed in relation to the context of problems raised by these central figures.

Rudolf Arnheim on Pattern Recognition

The influence of Gestalt theory on perceptual theories of art and art education is direct, and this conjunction finds one of its strongest representatives in Rudolf Arnheim. When

someone like Arnheim responds to ideas of computational pattern recognition "in the air", instanced in technologies of scanning and character recognition machines as well as machine learning in general, he is not free of reservations, which inform the distinctions he makes between human perception and machine recognition. In *Visual Thinking* (1969), the difference between Gestalt perception and pattern recognition is neatly marked as an opposition between the human and the machine, or "mind versus computer", in favor of certain features possessed by the former terms: "What then, is the basic difference between today's computer and an intelligent being? It is that the computer can be made to see but not to perceive. What matters here is not that the computer is without consciousness but that thus far it is incapable of the spontaneous grasp of pattern —a capacity essential to perception and intelligence" (Arnheim, 1969: 73). It may not be surviving in exactly the same terms, but this is not a terribly outdated proposition and contemporary cognitive science is capable of making similar statements, despite all the improvements in machine learning technologies.

The concept of pattern recognition appears here as the relevant contrast to "the spontaneous grasp of pattern" proper to human perception. Referring to "pattern recognition by machine" (Arnheim 1969: 43, 75), Arnheim is responding to an influential paper by Oliver Selfridge and Ulric Neisser (1960) that appeared in a popular venue like *Scientific American*, and which explores these very problems from a computationally more optimistic angle. While Neisser is one of the early proponents of the emerging discipline of cognitive psychology, Selfridge is a pioneer of machine learning.[2] Their paper generalizes pattern recognition from the side of an engagement with the possibility of a computerized perception. In the larger scheme of the tension between Gestalt theory and the "bits" of information theory (Heims, 1991), computational pattern recognition rediscovers the territory often claimed by Gestalt, no less than by basing its own definition on the figure-ground distinction: "Pattern recognition is the extraction of the significant features from a background of irrelevant detail" (Selfridge, 1955: 91). Perhaps an awareness of such an intimacy is what drives Arnheim to insist on a check on the illegitimate extension of perception to the machine, which would elide the distinction between the spontaneously human and the machinic. Here a useful concept would be "discretization"[3]: In line with his Gestalt predecessors, Arnheim argues that perception is a holistic process that cannot be faithfully performed or matched by processes relying on discretization into units that would have no holistic sense or any semantic import of their own, no matter the serial combinations thereafter introduced.

The divergence here is explained by one of the key aspects of Gestalt psychology in its attempt to explain the interaction between the mind and the world and goes back to a concept first articulated by Arnheim's teacher Wolfgang Köhler: isomorphism. Part of an attempt to ground psychology of forms in the activity of the brain, or at least an attempt to include the brain in an adequately expanded Gestalt framework that connects the phenomenal and the physical world, the theory of isomorphism rests on the claim "that neural processes and perceptual experiences share some common form or structure" (Verstegen, 2005: 38). As to the common form or structure that is pressed into service to establish this link between the neurological and the perceptual, it is the *field*, borrowed from the physical sciences. According to Köhler's model, later adopted by Arnheim, there are field processes commonly characterizing the energy distributions in the brain, and the distributions in the perceptual form; these shared processes amount to a correspondence theory that "actual consciousness resembles

2 Which in turn trails along a certain conception of the mind, as Oliver Selfridge stresses in a late interview with Peter Selfridge (1996): "the nature of learning-how it works, what it is-has always been my primary intellectual motivation…a mind without learning is no mind at all" (1996: 86).

3 I borrow the term from Zeynep Çelik Alexander's discussion (2020) of early character recognition machines.

in each case the real structural properties of the corresponding psychophysiological process" (Köhler, 1950: 38).

Perception in Arnheim's sense assumes a similar primacy of "field processes": "Only perception can solve organizational problems through sufficiently free interaction among all the field forces that constitute the patterns to be manipulated" (Arnheim 1969: 78). For Arnheim, spontaneous organization across simultaneous field processes is lacking in the machine, which needs sufficient rules-input from the programmers and algorithmic elaboration first to carry out its discriminations of shape in a predominantly discrete-quantitative and serial mode. In this sense, his understanding of mechanical significance is similar to the one—also influenced by Gestalt theory-- the philosopher Gilbert Simondon offered ten years previously: "whenever it is possible to replace a complex operation by a greater number of simple operations, this procedure is used in the machine" (Simondon, 2017: 141).[4]

Finally, there is an affective element to human perception and the kind of analogical reasoning based on it. While it seems to be a marginal part of Arnheim's argument, it is capable of posing a challenge to bids of simulability of human perception in the way Gestalt theory understands it: there may be a capacity of organic systems not likely to appear in the machine unless the machine goes through the kind of psychological development they go through. Presenting a simple puzzle as an experiment in geometric pattern perception, Arnheim characterizes its successful resolution along the lines of what Gestalt theory calls an "a-ha" experience: "It is, in a small way, an exhilarating experience, worthy of a creature endowed with reason; and when the solution has been found there is a sense of dis-tension, of pleasure, of rest. None of this is true for the computer—not because it is without consciousness but because it proceeds in a fundamentally different fashion" (1969: 77).

To Arnheim's—and Gestalt theory's as well—credit, here the distinction is not made in substantialist terms, in the sense that the human mind is not furnished with some unique stuff irreducible to the physical. Arnheim differentiates pattern recognition by the machine and human perception operationally while granting the possibility that computers can access "field processes" in the future; his objection to a computerized perception is not on the level of principle: "Few scientists still believe that organic mechanisms possess physical qualities that cannot be replicated eventually by man-made contraptions. If some day the replication is made, the machine can be expected to display the kind of intelligence found in the perceptual behavior of man and animal. This would support rather than refute my argument" (Arnheim, 1969: 78).

Whether Arnheim was right about this aspect of the requirement of computational simulation of perception or not, the direction in which Selfridge and Neisser worked continued to attract attention. There were other sides to the debate around the achievability by computational processes of cognitive feats dear to Gestalt theory and its preoccupations: a-ha experience, insight, and intuition. A significant example is Herbert Simon and Allen Newell's paper "Heuristic problem solving" (1958) which refers to Selfridge's machine learning based on pattern recognition to illustrate its titular problem solving beyond the human: "Intuition, insight, and learning are no longer exclusive possessions of humans: any large high-speed computer can be programmed to exhibit them also" (Simon and Newell, 1958: 6). Later, in another paper entitled, "The Information Processing Explanation of Gestalt Phenomena", Simon suggested a characteristically pragmatic resolution of this simulation problem, especially as it concerned these "high level" phenomena: "the real test, of course, is not whether computer

4 This comment is part of an extended contrast between human and machine memory in light of early forms of digital computer memory (Simondon, 2017: 135-141).

programs are "holistic" systems by some a priori criterion of what that means. We do not have to accept this article of Gestalt faith as a system specification. The real test of programs is whether they can simulate the actual human behavior that they purport to model" (Simon, 1986: 252).[5] Simon's response to this question is affirmative: "If the programs are in fact able to behave just like intuitive, insightful, understanding human beings, then we have no choice but to conclude that they provide successful theories of the phenomena of intuition, insight, and understanding" (Simon, 1986: 252). Such arguments that "black box" the operation and abstract outcomes from larger conditions provide strong motivations to model in artificial media the capacities humans exhibit, but when models are taken as explanations of human pattern recognition with its embedding in multiple contexts, they all too easily sideline a certain level of phenomenological depth—including the possible affective underpinnings of pattern recognition—and the possibilities of reflection on problems of historicity *within* perception.

György Kepes's Ecumenical Approach to Pattern Seeing

Another important witness to the friction between the Gestalt and pattern recognition paradigms was György Kepes, an émigré like Arnheim with strong ties to European currents like the Bauhaus and Gestalt psychology itself. A lot has been written about the social and institutional circumstances of Kepes's intellectual and pedagogical interventions as well as the "organicist" ideological underpinnings of his work; from this background, it is not always easy to decide whether he was a visionary stirring up change or a minion of Post-war corporate/military-industrial research and development. Whatever position one takes on this question, Kepes's work is essential to broaching dimensions of Gestalts-fading-into-pattern recognition that I have not addressed so far, such as the question of time, the relation between subjectivity and objectivity, and, in conjunction with the latter, the relation between aesthetics and science. Before I tackle these dimensions of "pattern seeing" as Kepes calls it, it would be good to round out the Gestalt background with the way Kepes negotiates the Gestalt perception-pattern recognition relations as overlap and switchover.

Starting from his early work *The Language of Vision*, Kepes shows an appreciation of Gestalt principles and shares Arnheim's conviction that they can be profitably used in guiding artistic technique and as a toolbox for reasoning on the aesthetic effects of visual art and design products. On the other hand, he also has an attitude to technological and scientific modernity (urban experience and the pace of industrial transformation) that leads him to conclusions similar to Marshall McLuhan's regarding information overload. As is well-known, McLuhan is one of the first cultural theorists to pick up on the significance and promise of the computational concept of pattern recognition, which he appropriated to speak of the rapid reception of signals and stimuli in electronic media. Such factors charge Kepes's mission of unifying the seemingly incompatible practices of artistic creation and technologically enhanced scientific observation with additional significance and, combined with a set of personal values, offer the perfect conditions for his valorization of patterns and pattern-seeing.

Kepes's major statement on pattern-seeing is *The New Landscape of Art and Science*, an album of discussions and images endorsing a new sensibility that hinges on the aesthetic appropriation of the world of invisible, microscopic, or temporally undecidable events disclosed by science and technological instruments of observation: "a collage of instruments and agents,

5 As Orit Halpern points out, Simon's reframing fits in an overall tendency toward pragmatic explanation in the Post-War scientific landscape in the U.S.: "If social scientists reframed their truth claims in terms of operability and pragmatism rather than making causal and fundamental claims about the nature of people or circuits, then, rather than focusing on the nature of the subject, the scientist could focus on the structure of the experiment" (Halpern, 2014: 169).

a subjects-objects collectivity within which 'pattern-seeing' would spring forth" (Vallye, 2013: 171). The book preserves an anchor in Gestalt theory in defining patterns: "A visual pattern, the first perceptual contact with the world outside our bodies, is an organization by outline, the creation of a figure against a background" (Kepes, 1956: 205). Kepes also often refers to other Gestalt principles like "isomorphism" or the correspondence of structure between the physical and the psychological/cognitive (Kepes, 1956: 206; 252). But *The New Landscape* also draws heavily from cybernetics, information theory, and systems science discourses, such that there are aspects of this work only possible thanks to a "data-driven" vision depending on "agglomerat(ing) information and retroactively discover(ing) patterns" (Halpern, 2014: 95). The cybernetician Norbert Wiener's contribution to this work is a good sign of this orientation. In a way, the Gestalt departures are overshadowed and, as Reinhold Martin notes, although Gestalt was an "important source" for Kepes, ultimately, *The New Landscape* "sought to supersede a perceptual aesthetics based on the recognition of figural Gestalten" (Martin, 2005: 52). Pattern-seeing remains charged with implicit value as it often is in Gestalt psychological accounts, but it is more often articulated in the language of scalability of structure, energy, and information systems. Indeed, Kepes seems to have a sense of the fundamental difference—not fully elaborated—between perception on the gestalt model with its qualitative grounding on the one hand, and an information-theoretical emphasis on the quantity of signals on the other.

A fruit of these not quite resolved tensions and exchanges, and a historically significant formulation of his notion of pattern-seeing is found in the section "Thing Structure Pattern Process". The following discussion addresses problems of time, materiality, and subjectivity-objectivity, using their intertwinement in this particular section of Kepes's book as a springboard. These problems govern the conceptual movement from gestalt to patterns and help us see how Kepes's work symptomatically points beyond itself both to its own historical matrix and to the promises and impasses of pattern seeing as pattern recognition in general.

Kepes's broad, analogical sense of pattern, and its dynamic and temporally charged quality finds a characteristic expression in the following:

> Although we see it as an entity—unified, distinct from its surroundings—a pattern in nature is a temporary boundary that both separates and connects the past and the future of the processes that trace it. Patterns are the meeting-points of action. Noun and verb must be seen as one: process in patterns, pattern in process (….) Patterns can be primary events: cells, crystals, bubbles or animal bodies. They can be mere secondary effects: shadows, the color patterns of sunsets, mirror images or perspective transformations. They can be generated from within, as in growth, or built from without and joined mechanically, as in coral deposits (...) They can reach their unique configuration through a forming process, like perceived images created through the excitation of brain cells; or they can gain separate and distinct existence as the boundary of other events, like snowdrifts. When we perceive, our perceptive structure is itself a force diagram of interacting systems—of optical stimulus and our sensory apparatus, of optical image and our store of memory images, of our immediate experience and our inner picture of ourselves or of the world. Leading us away from the system of fixed things, and toward the system of spatiotemporal patterns, the newly revealed visible world brings us to the threshold of a new vision. (Kepes, 1956: 205-206)

The arc from thingly fixity and stasis to a perception based on process and relationships taken together is a key feature of Kepes's patterns, which seem to combine elements of Gestalt theory's brand of visuality and the kind of interactions essential to Norbert Wiener's cybernetic patterns.

Patterns have diverse relations to time, from the material formation of natural structures to the place of memory and prediction in pattern recognition. Creative scenarios of being able to see a state of affairs or a figure otherwise—as in multistable images—by the emphasis on different structural relationships also require a reference to a time of reorganization. Lastly, the

interaction between humans and their environments is characterized by problems of synchronization: subjectively and objectively patterns are gained in time and trained on time. The natural formation version of pattern finds a good expression in Lars Spuybroek's more recent intervention (reminiscent of Kepes in certain respects) in design theory: "patterns are true expressions of formation as time-dependent; the spatial forms are only the final products of such periodicity, the remnants carrying all the information as a graph of the process" (Spuybroek, 2020: 72). While such a vision at once opens out to questions of repetition or variation across nature and the world of technics, it can also point to problems of form and function: "To know form requires freezing a thing in space; for its function one needs information about its activity, in other words, its pattern in time. Thus a bridge of common conceptual ancestry may link the pairs of space & time and form & function" (Volk, 1996: 78). Finally, in an often useful counterpart, Marshall McLuhan, too, offered an account of pattern recognition in which the element of time was dominant, in the guise of rates of historical change: "The pattern recognition that is quite impossible during processes of slow change becomes easy when the same changes are speeded up" (McLuhan, 1967: 165). If we also recall the on-the-fly, "but not too fragmentary" nature he assigned to pattern recognition in his seminal *Understanding Media*—"in order to cope with data at electric speed in typical situations of 'information overload,' men resort to the study of configurations" (1964: vii)—it is easy to notice how time-ridden both uses are: whether we define a historical rate of change as the optimal case for pattern recognition, or decide on a quick pattern recognition itself as a proper response to a phenomenon such as information overload, both are temporal adaptations first.

A certain active abstraction of patterns from particular materials also needs to be noted. The images in Kepes's *The New Landscape* constantly underscore this point: beech trees, glaciers, haddock scales, and strip cropping can manifest the same visual patterns regardless of their materials (Kepes, 1956: 214-5). The flow of examples from disparate realms, natural and artificial, and their aesthetic unity also find contextual support in a certain indifference to materiality in information-theoretical and cybernetic discourse. However, complete mathematical abstraction from the singularity of materials is only a limited aspect of the relation of pattern to materiality. It is more accurate to speak of different kinds of materiality in abstraction. While there are good precedents for a strong association between mathematical abstraction and pattern, it would be hasty to turn this into an exclusive identity. Sharing Kepes's interest in the patterns formed by natural phenomena like mudcracks and crystallization, the design theorist Lars Spuybroek, again, suggests that pattern can be conceptualized not as a cognitive and human abstraction, but as a *self-abstraction of matter in nature*. He argues that "pattern is the main expression of a self-abstracting capacity of matter, as we find it in the wrinkling of a face, the ribbing of sand, or the striping of a zebra, that is, the organization of surfaces by lines .... pattern is an abstraction that can never be idealized, never fully subtracted from matter; on the contrary, it gives direction to matter's potential to become many forms, depending on the actual forces at work during the transition" (Spuybroek, 2020: 55, 71). Perhaps such a vision is better grounded in the empirical than just positing an indifference to materiality and alerts us against equating the existence of pattern and its mode of abstraction with a straightforward dematerialization.

In a way that confirms Vallye's formula "subject-object collectivity", Kepes acknowledges patterns to be acting across what he calls "primary" events and "secondary" effects, recalling to mind what Alfred North Whitehead dubbed the modern "bifurcation of nature", the pervasive modern drive to place a wedge between sensible qualities and intelligible ones. Kepes seems to offer patterns as a way to repair this bifurcation. He states, "in pattern-seeing, we do not refer everything to our narrow subjective life, we trace the interplay of processes in the world. We do not give up objective nature but where we formerly saw only

things we are now mobilized to see action patterns" (Kepes, 1956: 205). Although Kepes does not offer a full-blown account of the subjective ability to see action patterns, "the tracing of the interplay of processes" is credited with expanding what would otherwise be a narrow subjective vision: a "force diagram" provides an abstract, not-fully-representational rendering of systemic interactions that are not always on human perceptual scales. It is probable that a model of aesthetic participation or correspondence is in question: the objective transforms into the subjective through a continuous modulation and information relay. Kepes indeed talks about "the continuous physical transformation of original physical patterns into experienced patterns..." (Kepes, 1956: 258). In this cybernetically informed version of aesthetic cognition, the Gestalt correspondence inherent to an isomorphism, however modified, remains. Contiguity and interaction replace similarity as the coordinator of perception in a way not unlike Marshall McLuhan's sense of how "we become what we behold" in new media environments, both formulas of an environmentally slanted account of correspondence through perception.

Isomorphism is a limited move along the total spectrum of approaches to the epistemological problem of pattern-seeing as pattern recognition; other aspects not directly expressed by Kepes are also important. In the background, there is the long history of accepting "the ability to recognize form" as something that is "crucial to the integrity of the subject"—a point Zeynep Çelik Alexander makes in her overview of early character recognition and scanning technologies and their posthuman implications. According to Çelik Alexander, before the efficiency of discrete and quantitative models became evident, most researchers studying perception thought that "creating and recognizing formal unities was a uniquely organic capability" and their likeliness to entertain a mechanically achieved, discretizing, and non-semantic recognition of form was hampered by its disquieting posthuman implications (Çelik Alexander, 2020: 88). According to this narrative, the exclusive possession of form-seeing has a conciliatory and ego-flattering effect on humans: "form's magical power to achieve wholeness" dovetails with more ideological hang-ups on unity and wholeness.

Nowadays it is rare for any account of pattern recognition to make such a direct appeal to its psychologically integrating capacity. But a necessity, post-Kantian and post-Gestalt, to accommodate a correlation between subjectivity and objectivity remains. For instance, there seems to be a Kantian "cinnabar" moment in the cultural history of pattern recognition that extends to our present, after Kant's example for the consistent bundling and synthesis of attributes in objects: "If cinnabar were now red, now black, now light, now heavy (...) then my empirical imagination would never even get the opportunity to think of heavy cinnabar on the occasion of the representation of the color red" (Kant, 1998: 229). The conditions for identifying cinnabar as a particularly qualified cinnabar are not solely in the subject, strictly speaking, but in the unity of the object: that way cinnabar is a consistent datum not just for one person and their different evaluations, but for everyone. This is a little like the worldly regularity Daniel Kahneman thinks to be the first condition of intuition: "you cannot have intuitions unless the world is sufficiently regular…when you live in a regular world you have an opportunity to develop intuition" (Tavakoli-Far, 2019, 5:25). Similarly, patterns of pattern-seeing are often not taken to be fantasies unresponsive to what is happening in the world even if they do not have the status of objective facts. Recently, Larry Busbea rephrased this correlation in a more environmental mode: "for there can be no environment without the subject to call it into being, to topologically confirm its manifold structures, smells, pheromones, touch screens" just as "there is no such thing as a subject free from these interactions" (Busbea, 2020: 259).

If Kepes is often situated in a post-war narrative of the transformation of the structure of knowledge, this is because he admits a similar correlation while mediating objectivity by

what the human observer does with images: "The best, which is to say most objective, system for Kepes was the one that allowed the most conditions of possibility for seeing to emerge from recombining data. His work gestured to a wholesale relocation of objectivity away from unearthing a perfect record to the management and organization of patterns and the construction of dynamic structures out of vast data fields in the most effective manner" (Halpern, 2014: 94). The figure and background structure surviving from Gestalt theory takes on a more data-centric form in this organization of patterns, figures becoming data figures and backgrounds data backgrounds, even when, or rather, especially when it is not mechanical pattern recognition that is in question.

Others like Donna Haraway would be more suspicious of the scale shifts Kepes attributes to new technologies of visualization. In her larger critique of the image of objectivity as a view from nowhere that masks its essential partiality, Haraway took to task visual ideals like Kepes's, speaking of an "ideology of direct, devouring, generative, and unrestricted vision". In her "Persistence of Vision" she even singled out a publication driven by goals and strategies almost identical to Kepes's *New Landscap*e (the centennial survey of The National Geographic Society, 1988): "Here, the reader is brought into the realm of the infinitesimal, objectified by means of radiation outside the wave lengths that 'normally' are perceived by hominid primates, i.e. the beams of lasers and scanning electron microscopes, whose signals are processed into the wonderful full-colour snapshots of defending T cells and invading viruses. But of course that view of infinite vision is an illusion, a god-trick" (Haraway, 2004: 192).

To be fair, there are certainly aspects to Kepes's work that could not easily be reduced to such National Geographic-style exhibits and their unsubtle ideological underpinnings. Kepes cherished the techniques of photomicrography, high-speed cameras, and stroboscopes as sources of images that both gave access to phenomena below and above the scale of human perception and as witnesses to the primacy of relationships over the fixity of things: "The products of the oscilloscope, stroboscope, and interferometer, the images on radar screens, radiographs, and spectrographs, were diagrams of events, rather than descriptions of 'things' or 'properties'" (Vallye, 2013: 163-164). The combinatory agency that brought together multiple diagrams of events in this sense was the real attraction of images for him. What is also remarkable is that the MIT research labs that supplied Kepes his images were places where a "retraining of the eye" (Bishop and Beck, 2020: 58) was felt to be as urgent as Kepes made it out to be, with a concomitant shift away from an ideal of the perfect record. A better understanding of this aspect requires taking a look at another famous revision of objectivity in science studies.

In their renowned work on history of science *Objectivity* (2007), Lorraine Daston and Peter Galison describe how human vision was endowed with a new and paradoxical sort of authority at the very time computer-sourced or -assisted representations and simulations were becoming central to scientific activity. Operations like "modifying, selecting and accentuating" Kepes attributes to an artist's relation to their "visual data" (Kepes, 1956: 258), also turn out to be paramount in this context, where scientists retain similar prerogatives of selection and emphasis on inscriptions from technological instruments, like scans and photographs. This context assumes a particular relation to evidence and documentation, and also requires subjective dispositions that would contrast with an objectivity understood as taking the subject out of the picture: "Only images interpreted through creative assessment—often intuitive (but trained) pattern recognition, guided experience, or holistic perception—could be made to signify. Only through individual, subjective, often unconscious judgment could pictures transcend the silent obscurity of their mechanical form" (Daston & Galison, 2007: 346). Daston

and Galison distinguish a knowledge structure defined by the recognition and organization of patterns from the objectivity proper to the 19th century, on the basis of the different norms of verification and conceptions of the self involved: "These 'subjective' decisions about what was real were explicitly active; they were just the sort of intervention that had no place within the nineteenth-century scientific self, with its obsession with the self-discipline needed to create the possibility of objective depiction" (Daston & Galison, 2007: 349). The rise of such an emphasis on "trained judgment" coincides with the rise of machine learning and pattern recognition paradigms and their larger cultural reception. An instructive scene from this contemporaneity is in Daston and Galison's account of the physicist Luiz Alvarez, who was convinced of the superiority of human "scanning" for his purposes: "More important than [my] negative reaction to the versatile pattern recognition abilities of digital computers is my strong positive feeling that human beings have remarkable inherent scanning abilities. I believe these abilities should be used because they are better than anything that can be built into a computer" (cited in Daston & Galison, 2007: 330). Alvarez and Kepes, a physicist working with images and an aesthetic theorist inspired by science, together indicate a common milieu in which "scanning" or pattern seeing is in a certain sense a strength of human perception even if this conviction only finds its weight when measured against machine vision as accomplice and rival. It is not an accident that the documents of what Daston and Galison call "trained judgment"—from geology, particle physics, astronomy, and medicine—almost coincide with the kind of visual documents of science on which Kepes bases his pattern seeing: in each case we have "a celebration (not denigration) of the human (rather than mechanical) ability to seize patterns" (Daston & Galison, 2007: 335).

Going back to the oscillations of the cinnabar moment, an alternation of the kind Kepes suggests between subjective and objective which gives up on neither is a common phenomenon around pattern recognition in its media ecological version, too. To repeat, McLuhan hoped pattern recognition could be a proper response and orientation in the face of information overload. There is an emphasis on the "beholder's share" (the term is Ernst Gombrich's) that is necessary for pattern recognition: "Pattern recognition relates to formal cause in that the pattern or form is recognized by the individual, and therefore in the eye of the beholder" (Strate, 2017). And yet Lance Strate, a scholar who paid close attention to the implications of McLuhan's use of pattern recognition, believes such a formulation needs to be complemented with its other side: "That patterns are recognized rather than simply constructed suggests that for McLuhan the homologies are not merely in the mind of the beholder but have objective existence" (Strate, 2017). Strate denies the beholder's agency a "constructive" role, out of an unwillingness to slight objectivity. In human pattern recognition a pattern is recognized as it is, and not an arbitrary projection, but it is not as simply given as to exclude a condition of formal agency in the subject either, which makes it possible to introduce properly aesthetic considerations.

This point brings this article to the threshold of an antinomy, on which it would seem to depend whether pattern recognition is a mode of cognition that can be valorized from an aesthetic perspective: that of agency. After Strate's "patterns are not constructed" it has to be acknowledged: they are not simply found ready-made either. The question of agency becomes more urgent in the conceptualizations of perception on the passivity-activity axis. This is not alien to Kepes: as Reinhold Martin (2005) pointed out, he also prized "the creative act of integration" (Martin, 2005: 52). It is easier, however, to bring out this aspect by coming full circle and returning to one of its champions, Rudolf Arnheim, who already made an appearance earlier. Arnheim makes a distinction between passive reception and active perceiving and argues that "perceiving shapes is an active occupation" (Arnheim, 1974: 43). For Arnheim, the given as one finds in simple "retinal projection" is one thing: "It exists by itself without my

having done anything noticeable to produce it" (Arnheim, 1969: 14). An active co-production is another: focused vision, directing attention, following movements, or the exploratory scanning of shapes, are examples of such a more active orientation, "the most characteristic aspect of perception" (1969: 14). These tweaks for getting a certain handle on perceptual data need not always be voluntary or conscious, but they do bring in something enactive, placing perception on the level of living. As such, selectivity bespeaks an active production of sense and an undeniably subjective element in perception, which should be understood in the contingencies of its emergence, which is historical in both a personal and collective sense. While selectivity makes room for a certain kind of inequality or divergence of perception in a common world, it also raises a question of possible empowerment that starts on the level of an inventive segregation of perceptual unities. Arnheim brings us to an appreciation of phenomena of perceptual learning/historicity of perception, which should perhaps be the real ground on which to pose the question of the presumptive difference between pattern recognition in the machinic sense, and that in a human natural-historical sense.

Conclusion

This article has given an overview of a highly specialized juncture from the history of aesthetic theory: the tensions between Gestalt conceptualizations of perception and the reception of information-theoretical ideas as registered in the work of theorists Rudolf Arnheim and György Kepes, who represented European theoretical traditions in the American milieu and responded in different ways to the technological developments in the second half of the 20th century.

I identified the two leading stakes of the encounter as the irreducibility of human perception to mechanical terms on the one hand (Arnheim's emphasis) and the temporal or processual significance of human pattern seeing (Kepes) on the other. As I tried to demonstrate, however, what emerges from such a specialized juncture, are questions that directly appeal to our computationally saturated present, as well. Arnheim's polemic with the pioneers of a generalized pattern recognition paradigm like Selfridge and Neisser underscores this very clearly, even if it seems slightly quixotic to our ever more AI-humbled perspective.

Kepes's own enterprise of overcoming the compartmentalization of human knowledge and healing the fragmented human subject with the visual project of a cultivation of pattern seeing, seems no less quixotic perhaps. The salient aspects of the interventions of both these thinkers revolve around the connections to be established between aesthetics and cognition. An overarching question with profound stakes emerges from this composite picture, that of whether it is possible to argue for a historicity of perception without running into the arms of an ideological holism flattering for humanity. As I tried to show by a comparison between Kepes and the contemporary architectural theorist Spuybroek, if the formation of pattern is posed on a level inherent to natural processes of abstraction, such an impasse can be circumvented.

To ask about patterns is nothing less than to ask about the philosophical fate of subjectivity in the identification of form and the division between the sensible and the intelligible attendant on this question. Since this also involves interrogating the contemporary dispositifs of doing science with images, a look at the science studies context and the debate around the resort to human scanning was necessary in the last part of this article. From a commitment to "trained judgment" of a visual kind Daston and Galison identified in the sciences in the 1960s to data figures and backgrounds, to finally end up in the visionless or "invisual" realms of today's algorithmic pattern recognition, the direction of the historical trend is obvious (Mackenzie & Munster: 2019). The theories propounded by Kepes and Arnheim between information theory and Gestalt's qualitative orientation offer a genealogical blueprint for the latest stages of this trend and indicate a space of possibilities for contemporary aesthetic

strategies dealing with such invisuality of image processing, placed as they are at the prehistory of its advance.

Overall, this discussion acknowledged but has not committed to either side of the binaries surrounding the status of pattern recognition: qualitative human perception and quantitative machinic, the analog and the digital, or the continuous and the discretizing. While these divisions and divergences are decisive and promise to constrain any future outcomes, the possibility of one particular conceptual convergence deserves equal attention: the learning that underpins pattern recognition in both machinic and human versions and even their respective forms of aesthetics.

Information Note

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