SCALE BEYOND ILLUSION: AESTHETIC WAYPOINTS

A B S T R A C T

Infinity is intellectually incomprehensible to the human mind. Yet visual and acoustical illusions create the impression of infinite staircases and endlessly rising sequences of tones. Through the conscious use of proportion, the perception of extremes of scale can be induced in the viewer or listener, yet their effect is achieved subconsciously. Likewise a work of art can play with our sense of scale or proportion and influence our perception of time and space. There is a fundamental difference between the common illusion and the visual and acoustic shifts that can occur with our perception of a work of art. With the artwork, the recipient is co-creating aesthetic impressions of repeatable quality and not simply following the effect of an illusion. The article examines the ontological differences between illusions and the pursuit of art that explores the perceptual preconditions of space and time. The aesthetic perspective incorporates two major approaches to its discipline: the reflection of art as well as perception in general.

Lars Straehler-Pohl
contact@lars-straehler-pohl.com
Freelance Researcher

KEY WORDS

TIME AND SPACE PERCEPTION
SCALE IN MUSIC AND ART
VISUAL AND ACOUSTIC ILLUSIONS
SHEPARD TONE
INTRODUCTION

All creation myths and each and every human life begins and exists within the framework of space and time. The appearance of light in the Book of Genesis marks the point from which both spatial and chronometrical extension is manifested. It is not surprising that creation myths start with this point as it corresponds to the basic framework of human life. No move or thought can be made without a direct or indirect reference to space and time; classifying these as the preconditions of perception is a major essence of Immanuel Kant’s *Critique of Pure Reason*.¹ To be capable of action, humans must be familiar with and have a relationship with space and time. Obviously, space and a progressive sense of time are factors humans must be able to rely on to move about without injury and to draw up future plans. We do not encounter these in an empty abstract way, but rather we encounter them naturally and only in such a way that they correspond to our perceptual apparatus. Within the facilities of logical thinking it is impossible to experience an infinite sense of time, an infinite extension of space, or a separation of these two units from themselves or from us. To experience Kant’s categories of perception they must be complete. They embody our relationship to the world. This is the framework within which all relationships are defined. Our own body and our own temporality exist in proportion to all other entities in the world. A definition of proportion as the relation between parts of an entity and the relation of these to the entity as a whole has to also be considered, and that we are in relation to Kant’s preconditions of perception; that we are built in but cannot experience them directly. While proportion is a static state, scaling is a process, a relational change. Both are a part of everyday life as a general frame of perception and occur in art as a part of the interplay between an artwork and the viewer.

Proportion becomes obvious when it is experienced in the extreme or when mismatches between expectation and manifestation occur. The incongruity of this basic perceptual guideline touches the sphere of mental diseases as well as that of art. The psychological terms of *depersonalisation*² and the *Alice-in-Wonderland syndrome*³ describe this shift away from the familiar relation. What appears as frightening on the one hand offers at the same time the experience of the potential of scale and proportion both in the visual arts and the performing arts. This potential does not just apply to the inherent principles of an artwork, but also to the general handling of proportion within the preconditions of perception. This manifests an epistemological strength of art. The relation between the artwork and the viewer is driven by a mutual process and can be understood in the classical categories of aesthetics as theory of art, beauty and the reflection of perception in general.⁴
TIME RELATIONS AND REPRESENTATIONS IN SPACE

In order to show the similarities of proportion and scaling in both space and time more clearly, I will present a few basic thoughts to mind. It is interesting that time is depicted in conjunction with the principles of space. The attempt to objectify time goes hand in hand with its spatial representation. The chronometric measurement primarily serves to organise everyday life; although it offers intersections at perceived times, it does not exhaust them. The measurement of time is bound to a process of nature: the atomic oscillation of caesium 131 is the authoritative movement that underlies the course of the world clock. Abstract time, however, manifests itself in something that can be experienced. Moreover, it becomes obvious how our understanding of time is built up anthropologically. The idea of an objective time that courses universally through the universe has given way to the idea of a subjective time, hence Einstein’s Special Theory of Relativity. Nevertheless, the relativisation of time and its subjectivisation are not to be confused with each other. On the one hand is the physical time proper of the subject, on the other, subjectively experienced time. Movement is essential for our relationship as a prerequisite for measuring and experiencing time, but the course of time, it should be noted, is not congruent with our perception of it. Thus I speak here of the perception of time as a phenomenon. The number and intensity of experienced events determine the perceived duration of a temporal event. Our linguistic conventions bear witness to this effect in expressions such as ‘time flies.’ Thus, the dichotomy between chronometric time and perceptual time is not only a part of musical experience, but also takes place here in its most intensive form. Aristotle stresses the significance of movement for time:

Moreover, we not only measure movement by time but we also measure time by movement, because (measured time and movement) determine each other.

The Aristotelian concept is very modern. In fact, as described, time is measured in a fixed manner with the aid of a movement. It is no surprise that primarily spatial-based and primarily time-based arts share analogous phenomena.

Coming back to the question of how our thought process is affected: In such a situation of great atmospheric force leading to an intensive response of mind and body, it is unlikely to have clear thoughts, keeping a rational perspective. The beholder is affectively agitated and absorbed in the experience.
VERTICAL SCALING IN AN ILLUSION

The strangeness of M. C. Escher’s impossible buildings is familiar to us and is a part of our cultural heritage, attracting those with a strong interest in mathematics, less so those with an interest in arts, and very much those interested in popular culture. One of Escher’s most famous works, the lithography Ascending and Descending from 1960, shows a multi-level building crowned by seemingly infinite stairs. This illusion is further expanded on in the so-called Penrose stairs.11 The pseudo depiction of a seemingly three-dimensional structure on a two-dimensional sheet of paper tricks the eye. The building in the Penrose illusion is imaginary and does not exist. As Penrose explains, its parts are logically constructed and understandable, but in the totality of the constellation logic fails. The illusion is effective because the start and end points are not fully processed at first sight; the irritating sense of illogic only comes later. This same feeling induced by the Penrose stairs is used in Christopher Nolan’s movie Inception from 2010, as a sign whether the protagonists are moving within a dream or a waking state.

The principle behind the Penrose stairs is analogous to the acoustical illusion known as the Shepard effect. First identified in 1964 by Roger Newland Shepard, it describes the phenomenon of a barber pole-like sequence of notes that seem to endlessly rise or fall (Fig. 1). In fact, the listener is just hearing the same sequence of sinewave tones repeating over and over. The effect relies on the use of multiple tones spaced an octave apart that carefully fade in and out.

Fig. 1. Shepard Tone presented in a sequencer. Visual progress appears close to the barber pole effect. (Illustration by author)
as they are repeated. Despite an awareness that our hearing is limited to a range between 20 Hz and 20 kHz, it seems to us that the tones are infinitely rising or falling.

Both of these illusions demonstrate spatial extension, the sense of a larger space than in fact exists. Our sense of space ‘scales’ and for a moment it seems that this scaling is infinite, much like the illusion of the revolving barber pole,\textsuperscript{12} whose rotating stripes seem to endlessly rise. What the three phenomena have in common is that they blur the discernible beginning and end of space and sequence. The unconscious impression is the one of infinity, though we recognise that it is rather a question of infinite repetition. In moments of uncertainty, however, the brain fills in gaps, including the gaps between beginning, ending, and new beginning. Indeed, we follow these illusions for a moment and scale the dimensions of our perception from a limited to a seemingly unlimited space. Still, after discovering that something is wrong we distance ourselves from the reality of this scaling, and of course our proportional sense of it. We sense irritation and remain at a certain (emotional) distance.

The illusions described here give hints as to how our sense of perception addresses the issues of scaling, but not necessarily how this functions with a work of art. What is the difference? How is the use and perception of scaling in a work of art different from an effect of these illusions? First, in these illusions we are looking at separate phenomena that can be a part of an artwork, but not necessarily fulfil artificial capacities on their own. This is connected to a key second point – instead of following an illusion, an artwork is usually made complete in an act of co-creation, in the interplay\textsuperscript{13} between the artwork and its audience. Scaling in art goes beyond everyday experience in this process without following an illusion; this will be shown with a musical example after a short remark on musical materiality

SCALING IN MUSIC - MATERIALITY AND PROCESSUALITY

Much like the use of enlargement and reduction in spatial art, in music we find the potential to accelerate or slow time. Whereas space is the material of architecture, time is the material of music. The essential aspect of immediate musical materiality, its extension in space, refers to the air that is brought to vibrate, the sound. Upon its impact on the eardrum, the spatial mechanics and the following acoustic impulses are translated into electrical stimuli that are introduced to the brain as the processes of cognition and understanding. As the German composer Karlheinz Stockhausen (1928-2007) notes on the
physical level of music, time not only determines the sequence of tones, but also their height as the pitch is determined by the oscillation interval and the musical material for this purpose. With the vibrations of the air the materiality of music seems to be reduced to the minimum. Nevertheless, its materiality is also a part of the aesthetic quality of music. Thus, the overtones of a particular frequency assign different sounds to its character. The resulting timbre makes the trombone sound distinguishable from the sound of a bassoon. This aspect of materiality is analogous to the brushwork in painting or the material finishes of architecture. In this sense, I speak of a residual materiality in music. The characteristic relationship between time and music is described by this thought. The relationship between listener and music starts exactly here.

Man finds himself more fundamentally exposed to time than to space. The existential space-time asymmetry lies in the fact that the here can be influenced by one's choice, the now not; no active time change analogous to the change of location is possible.\(^{14}\)

It is not a peculiarity that music takes place in time, since every form of apprehension and thinking occurs \textit{a priori} in time. And yet, music is able to modify our sense of time without resorting to extra-musical devices; thus, it exists in a unique relation to time.

The organisation of music takes place within its metre and tempo. The musical tempo, in addition to the temporal forms of manifestation of rhythm, is also dependent on melody and harmony, in particular their cyclical effect. These include tonal movement, contrapuntal processes, dynamics, articulation, and aesthetic factors such as the increase and decrease in instrumentation. In the range of directly quantifiable factors, tempo is determined by the increase in musical event density at the rhythmic level or by the acceleration of the tempo (e.g., the change from an \textit{andante} of 76 beats per minute to an \textit{allegro} at 120 beats per minute). The tempo can be represented by a metronome indication or a verbal instruction that combines both character and tempo (e.g. \textit{andante con moto} - walking with motion). Prior to the seventeenth century, music was a product of the notation and the effects of the music, and the tempo was to be read from the form of the music itself. Examples of this are dance forms such as the courante or the minuet. In addition, there are musical instructions that show a successively changing tempo. \textit{Accelerando} accelerates the musical pulse; a deceleration is expressed as \textit{ritardando} or \textit{rallentando}. The degree of this tempo change is determined by the performer. The deliberate variation of the metre is called \textit{agogics}.\(^{58}\)
MAHLER’S RESURRECTION: SLOWING DOWN TIME

The excerpt below from the score of Gustav Mahler’s second symphony Resurrection (Fig. 2) comprises six bars from the last section before the beginning of the quasi-reprise - the modified repetition and processing of the thematic material from the beginning. The section is notable here for a tempo modification carried out at both the rhythmic and the metric level. To simplify matters, only the percussion and string instruments are shown. The line of the first timpani (Pauke), in particular, is instructive, as it most easily illustrates the temporal relations.

Fig. 2. Gustav Mahler, Symphony No. 2 in C minor, first movement, bars 325-331.

To define the basic pulse, the first bar is marked with the articulation and tempo molto pesante\(^5\). The bars 325 to 327 are played in the same meter and tempo. Although measure 328 begins with the same metronome number as the previous measures, it is provided with the additional notation “Rit.” (ritardando) or gradually slower. The indication of tempo primo in bars 329 and 330 tells us that here we return to the faster tempo of the beginning section. The tempo slows in bar 328 and then in the next bar picks up again. The metric structure of these measures is thus divided into three bars of the same tempo, one transitional measure and two bars of a new, faster tempo. At the level of rhythm and counting, the number of pulses in bars 325 and 326 is the same, but they differ in their rhythmic organisation. Although the bars are subject to the same meter and tempo, they create an impression of a different time flow through the rhythm. The change between duplet and triplet units\(^6\) is decisive for the
tempo effect of these bars. In bar 325, quarter notes alternate with three eighth-note triplets. A quarter note and three triplets each have the same chronometric extent but at a different density of momentum. With the quarter note as the basic pulse, the three rhythmic figures are subject to the same pulse. The same applies to the figure eighth-sixteenth-rest sixteenth in the following bar 326. In each case, they fill the temporal space of a quarter note. The figure eighth-sixteenth-rest semiquaver gains its accelerating effect in contrast to the eighth note triplets of the previous measure.

At the same time, the rhythm in these bars prepares for the change in tempo. Especially in bar 328, tempo and rhythm intermesh to an intense striving into each other. The slowing of the tempo, with simultaneous acceleration on a rhythmic level in the change of the note values of duplet and triplet structure, forms the impressiveness of this change of tempo for the listener. Rhythm and tempo are slowed down at the beginning of bar 328. The basic measure is slowed down, the triplet become duplets. The tempo becomes progressively slower while the density of the rhythm increases, i.e. becomes faster. Further striving causes the rhythmic superimposition or opposition of the duplets in the timpani and the triplets in the strings that already fall on the first beat.

The sense of time here is constituted by contrasts and the resulting tension. Listening expectations and momentary perception strive for dissolution. The ear wants to perceive a tempo as established and, as a result, strives for a new order. In his book ‘Sweet Anticipation,’ David Huron describes this from a cognitive perspective:

Music plays with our expectations. Because it runs differently from other art in time, the brain is constantly speculating on how to proceed, and its tremendous fun. The correct prediction of the immediate future was vital to our ancestors and man developed a veritable sense of the future.\\(^{17}\)

OPENING ROOMS – SCALE BEYOND

Within the frame of time and space, artworks are created by human minds for other human minds. The architect or the composer is the initial source of an artwork, but as a vital entity the work is recreated in the moment it is confronted with by an audience. The audience, of course, bring its own contexts and experiences when approaching a work of art.\\(^{18}\) Roger Scruton points out these cultural circumstances and traditions in human relation towards the
arts. In this process of interaction between the artwork and audience – which has been characterised in the history of aesthetics as a game, for example, by Schiller19 and Gadamer20 – both spatial and chronometrical space can be scaled and expanded. A time span of x minutes is extended or shortened by the musical events taking place within that span. This happens with and through the listener, who is swept forward or even given pause, with the impression that time has for a moment briefly stopped. Likewise, the now in music is a mutual now. As illustrated in the example of Mahler, the listener cannot pass by the moment but submits to its temporality. Of course, listening to a symphony requires a chronometric framework that the listener and composition share together. The listener requires as much time to listen to the symphony as its chronometric length manifests. In addition to this simple fact, the shared pulse to which the musical work and listener come together plays a more essential role. The proportion and scaling of perceived time, which is accelerated or decelerated, places the subject on the experience level in an intense relationship with their preconditions of perception. Subjective time clearly splits from chronometric time. It is characteristic that this contrast is achieved by means of a brief chronometric dilatation, as otherwise might only happen in extreme situations such as traffic accidents, when our perception of time greatly deviates from its norm. Art opens up rooms and increases awareness of our perceptual framework. In this sense a work of art scales beyond illusion.

CONCLUSION

We saw that the process of scaling is able to create an awareness of time and space, the preconditions for perception. This occurs both as an effect in everyday life as well as within the artistic experience. Some effects of scaling are able to provoke illusions, both optical and acoustical. While our example of the Shepard illusion seemingly extends the vertical tonal space toward infinity, the example of Mahler’s symphony (one of many hundreds of musical examples that would be possible) is based on the mutual structure of the interplay between musical work of art and audience. How do these illusions differ from each other and what does this mean ontologically for a work of art as an entity?

The Shepard illusion is based on the inattentiveness of the human brain. Looking at the effect in the Mahler Symphony as a form of art, two characteristics become obvious: co-creation and repeatability. The artwork is ontologically composed through the co-creative relationship between the work itself and the listener. Elements of illusion might appear in this relation, but this is not yet exhaustive
for the relationship, which moves forward within the ability to extend the moment or in general: to scale beyond. Here the ability of repeatability comes into play. An optical or acoustic illusion is not able to sustain its full effect when one has understood how it is derived. This might be compared to a magic trick whose ‘magic’ has been exposed by someone in the audience. The magical component vanishes, while the expansion of the ‘now moment’ in Mahler’s second symphony can take place again and again; regardless of the number of repetitions, it maintains its aesthetical quality and veracity. The development of play is not exhausted and remains up-to-date. This is one major aspect Gadamer has in mind when he writes about the timeliness of the beautiful.
For a holistic understanding, particularly in the context of this paper, two of Kant’s major works have to be considered: Kant, Immanuel, *Critique of Pure Reason* (New York: Cambridge University Press, 1998) and Kant, Immanuel, *Critique of Judgment* (Cambridge: Hackett Publishing Company, 1987).

ICD Classification: ICD-10 / F48.1. Affected patients experience a distance to various basic reference points of their life. This may include their own feelings, but also their relationship to surrounding objects.

ICD-10 / H53.1. occurs as part of the group of sight disorders.

In particular, the early conception of aesthetics by Alexander Gottlieb Baumgarten is emphasised by the role of aesthetics for the general reflection of the sensual perception and its own character toward knowledge that is only based on the mind. The criticism that has been produced toward this determination can be summed up in the formula: not every form of perception is an aesthetic experience and, of course, the question must also be clarified whether, in fact, every aesthetic experience is, conversely, a perception experience. Independently from this, Baumgarten’s concept forms the basis for the further conceptual differentiation of the term aesthetics. See also: Alexander G. Baumgarten, *Aesthetica* (Hamburg: Felix Meiner Verlag, 2007).

In the context of intersubjective commensurability, time should also be conveyed symbolically. In the management of time two ideas come into play: those of the linear and that of the cyclical course of time. Linearity is depicted in the timeline, while cyclicity finds its representation in the circle of the clock. The sundial, known since the Babylonians, may serve as an example of the connection of temporal manifestation through movement and temporal symbolisation in space. The cyclical path of the sun is revealed in this early clock as the shadow of a staff in a circular space. The first sundials used in the northern hemisphere explain the mathematically negative direction of rotation of clock hands. The shadow cast wanders right around its centre. Against this background, the time shown in the clock is not a representation of time, but an illustration of movement and thus a temporal illustration. In this sense, the concretisation of time, namely its movement, finds an abstraction in space. On the other hand, the visualisation of the linear representation of time in the timeline has no direct connection to a concrete movement process, but rather is already conceived in geometric space as an extension between two points. Here is the idea of an irreversible (quasi vectorial) directionality. An example is the use of the timeline to illustrate historical epochs between event points. Although the suggestion of linear directionality evoked here is incompatible with determinations since the dawn of quantum physics, it is decisive for its perceptual dimension insofar as anthropological causality-based thinking is reflected here. These ideas are also reflected in the portrayal of music. Just as historical events in the timeline are represented by epoch, year and date, the score forms the scale of horizontal and vertical musical events. Bar lines establish the optical cyclicalty of music. It is part of the reality of our world that time is symbolised both in intersubjectively action-oriented everyday life and in dealing with music.

The determination of their units is bound to movement, predominantly cyclic movement. This is common to concepts of measurement. Thus, the tropical time
finds its orientation in the orbit of the earth around the sun, the sidereal time its reference to fixed stars, while the latter refers to the approximate duration of a heartbeat. The SI unit of time is the second defined by the Bureau International des Poids et Mesures as ‘the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of caesium 133 atom.’ Resolution 1 of the 13th CGPM (1967/68).

Henri Bergson’s 1922 publication Durée et simultanéité. A propops de la Théorie D’Einstein explains the physical entity time as a phenomenon of human perception. The publication’s title already marks the direct reference to Albert Einstein’s thinking.

First published in his paper Zur Elektrodynamik bewegter Körper.

The meaning of the highly influential works The Phenomenology of Internal Time-Consciousness by Edmund Husserl (lectures from 1893-1917) and Being and Time by Martin Heidegger (1927) should be only brought to mind here.

Richard Hope, Aristotle’s Physics (Lincoln: University of Nebraska Press, 1961), 83.

First described by Penrose in: L.S. and R. Penrose, ‘Impossible objects: A special type of visual illusion,’ British Journal of Psychology, 1958. I underscore the role of the Swedish artist Oscar Reutersvärd (1915-2002), who was creating such impossible objects before Penrose. Also, the cooperation of Penrose with Escher has to be considered in the history of the Penrose figures in this context.

Named by coloured, rotating poles in front of barbershops in the United States, the effect is based on the disturbance of apparently vertical moving lines that are physically driven horizontally. Described by Joy Paul Guilford in 1929 and further by Hans Wallach in 1935.

The idea of playful connection between artwork and audience is prominent in Schiller’s On Aesthetic Education of Man as well as in Hans-Georg Gadamer’s conception of Art in The Relevance of the Beautiful: Art as Play, Symbol and Festival.


Molto pesante = very heavy.

Three notes fill the timespan that would regularly be filled by two notes.

Quoted from the weekly newspaper Die Zeit, 26.08.2010, No.35 (translation by author).

See Roger Scruton’s Introduction Chapter from Understanding Music.

Friedrich Schiller: On Aesthetic Education of Man. (s. Footnote 13).


The German title, Aktualität des Schönen, translated by Nicholas Walker as The Relevance of the Beautiful, could perhaps also be translated as The Topicality of the Beautiful to emphasize its reference to time.
BIBLIOGRAPHY


Einstein, Albert. ‘Zur Elektrodynamik bewegter Körper.’ In: *Annalen der Physik und Chemie* (pp. 891-921), Nr. 17 (Jg. 1905), Leipzig: Verlag Johann Ambrosius Barth, 1905.


GEOMETRIJSKI ISKORAK U SAVREMENOM ARHITEKTONSKOM DIZAJNU: METAMATERIJALNOST I FRAGMENTACIJA

Mila Mojsilović, Jelena Mitrović, Vladimir Milenković

Studija povezuje dve istorijske kategorije koje ranije nisu bile povezane na ovaj način. Jedna se tiče uloge geometrije u transformaciji prostora u gotici, gde je geometrijska linija prvi put učinila položaj fizičkih sila vidljivim. Druga transformacija koja oslobađa anksioznost u osporavanju perspektive učinjena je u manirizmu instrumentalizacijom metafore pomoću vizuelnih sredstava deformacije i figuracije. Danas oba istorijska momenta doživljavamo u modifikovanom pojavnom obliku, i dalje pokušavajući da pitanju materijalnosti damo formalni karakter. Kako to nije moguće, ovaj pristup je rezultirao fragmentacijom u odsustvu jedinstvene radikalne kritike modernosti. Fragmentacija i metamaterijalnost savremene arhitekture danas predstavljaju moguću konceptualizaciju prostora, pozivajući se na sve poznate oblike dematerijalizacije i nestajanja sveta, uključujući i digitalizaciju. Pozivajući se još jednom na mit o Vavilonskoj kuli, Ikarovom padu i Čarobnjaku iz Oza, mit i diskurs opstaju zajedno u ovom eksperimentu, pretvarajući se u drugog i nalazaju se u drugom. Izgradnja arhitektonske pozicije između ekstrema metamaterijalnog i fragmentarnog je stvar razbijanja geometrije forme i ideje o njoj.

Ključne reči: form, geometrija, materijalnost, meta-materijalnost, nedovršenost, fragmentacija

RAZMERA IZVAN ILUZIJE – ESTETSKE REFERENTNE TĀČKE

Lars Straehler-Pohl

Beskonačnost je ljudskom umu intelektualno neshvatljiva. Ipak, vizuelne i akustičke iluzije stvaraju utisak beskonačnih stepenica i beskonačno rastućih nizova tonova. Kroz svesnu upotrebu proporcija, percepcija ekstremna razmera može se izazvati kod gledaoca ili slušaoca, ali se efekat postiže podsvesno. Isto tako, umetničko delo može da se igra sa našim osećajem za razmere ili proporcije i utiče na našu percepciju vremena i prostora. Postoji fundamentalna razlika između uobičajene iluzije i vizuelnih i akustičnih pomeranja do kojih može doći u našoj percepciji umetničkog dela. Sa umetničkim delom, primalac je su-tvorac estetskih utisaka ponovljivog kvaliteta, a ne samo neko ko prati efekat iluzije. Članak ispituje ontološke razlike između iluzija i traganja za umetnošću koja istražuje perceptivne preduslove prostora i vremena. Estetska perspektiva uključuje dva glavna pristupa svoje discipline: refleksiju umetnosti kao i percepciju uopšte.

Ključne reči: percepcija vremena i prostora, razmera u muzici i umetnosti, vizuelne i akustične iluzije, Šepardov ton