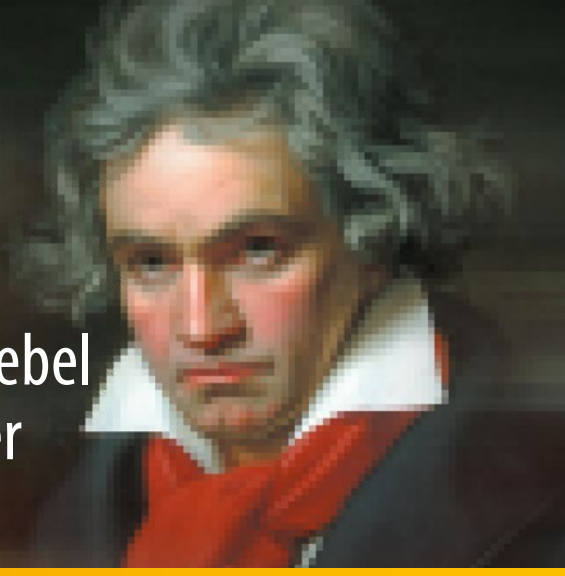
Computational Music Science

Guerino Mazzola
Alex Lubet
Yan Pang · Jordon Goebel
Christopher Rochester
Sangeeta Dey



Making Musical Time

Springer

Computational Music Science

Series editors

Guerino Mazzola
Moreno Andreatta

More information about this series at http://www.springer.com/series/8349

Guerino Mazzola • Alex Lubet • Yan Pang
Jordon Goebel • Christopher Rochester
Sangeeta Dey

Making Musical Time

Springer

Guerino Mazzola
School of Music
University of Minnesota
Minneapolis, MN, USA

Alex Lubet
School of Music
University of Minnesota
Minneapolis, MN, USA

Yan Pang
School of Music
University of Minnesota
Minneapolis, MN, USA

Jordon Goebel
School of Music
University of Minnesota
Minneapolis, MN, USA

Christopher Rochester
School of Music
University of Minnesota
Minneapolis, MN, USA

Sangeeta Dey
School of Music
University of Minnesota
Minneapolis, MN, USA

ISSN 1868-0305 ISSN 1868-0313 (electronic)
Computational Music Science
ISBN 978-3-030-85628-1 ISBN 978-3-030-85629-8 (eBook)
https://doi.org/10.1007/978-3-030-85629-8

Mathematics Subject Classification (2020): 18Bxx, 18Fxx, 00A65, 97M80

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Dedicated to Emilio Lluis-Puebla

Photo and © by Luis Solórzano

Preface

It is time now to talk about time, more precicely: time in music. Why? Because within the complex topic of time, musical time plays a very special role. It is not identified as a type of time, which we encounter in the general existentiality of humans, but reveals a constructive character that transcends the general context and proves also a precise mechanism which represents more than a passive perception of a given ontology as often and typically conceived in physics and the neuroscientific cognitive perspective.

Such a project must first of all deal with the concepts of time which are set forth in overarching contexts of time theories. We are forced to elaborate the musical time reality as a specific expressivity that differs from non-musical ontologies. Such a project has to focus on musical time as a very special form that relates to other conceptualizations, and to elaborate its distinctive and characteristic attributes. But our analysis of time in philosophy, physics, and cognitive sciences reveals a number of important commonalities and roots, which put into evidence a convergence of time concepts, which induce its musical ontology.

This book follows a set of approaches to music theory, and more precisely: mathematical music theory, which include our universal setup as developed in *The Topos of Music* [94, 95, 96, 97], the discourse about gestures in *Flow, Gesture, and Spaces in Free Jazz* [99], the analysis of *Musical Creativity* [101], and the theory of *Musical Performance* [100]. These theories all deal with time, but never set the focus onto analyzing and understanding the in-depth ontology of musical time.

In this book, we now elaborate a temporal ontology of musical time that follows an explicit theory of how musical time is constructed. We contend that *musical time is a construction*, this is our first basic thesis. But we also propose and develop the idea that *musical time is constructed from a sophisticated interaction of musical gestures*. Musical time is presented as a result of a "distributed identity" that appears from a mathematically conceived mechanism involving projective limits of gestural diagrams.

This endeavor is developed not only from the mentioned philosophical, physical, and cognitive perspectives, but also from existing approaches to musical time as developed by well known musicological models. In particular, we analyze Jonathan Kramer's creative concept of a vertical time, which will be embedded in our model that comprises imaginary time, which was proposed by Stephen Hawking and Izak Bars in cosmology.

We then apply our model to several experimental compositional approaches that are being realized by composers Yan Pang, Jordon Goebel, and Chris Rochester. We also acknowledge Renan Madeira's precious comments concerning Merleau-Ponty's perspectives and South-American time cultures.

The cultural spectrum of musical time proves the dominance of a gestural genealogy through many important geographic and historical loci. The delicate construction of musical time from its gestural mechanisms is discussed and made evident in a subtle professional analysis of handedness by Alex Lubet in the performance of string instruments. The deep tradition of Asian time cultures is covered beautifully by Yan Pang (Chinese/Japanese approaches) and Sangeeta Dey (Indian approaches).

This book is an interdisciplinary perspective, but a necessary one that makes evident the central role of musical time construction in human existence. Musical time is probably the most human achievement, and we claim that our model sets forth a precise and realistic model of this substantial creation.

We have abstracts for chapters and sections, represented in short "summary" paragraphs. We also add concluding paragraphs at the end of chapters and sections, under the title of "impact", where we connect the contents to other sections or chapters, and, most importantly, draw a vector to the global thesis of this book that musical time is a gesturally embodied construction.

We are pleased to acknowledge the strong support from Springer's science editor Thomas Hempfling for writing such a demanding treatise in covid19 pandemic.

Minneapolis, October 2020

Top left to right, zoom view: Guerino Mazzola, Yan Pang, Jordon Goebel.
Bottom left to right, zoom view: Christopher Rochester, Alex Lubet, Sangeeta Dey.

Contents

Part I

Ontological Orientation

1

Ontology, Oniontology, and the Artistic Presence

Summary. This short chapter introduces first the global architecture of ontology of music, which this book is going to use extensively. It then presents an ontological model of artisic presence, which is an essential background architecture for the construction of musical time.

– Σ –

1.1 Ontology and Oniontology

This section is about ontology of music, including three dimensions: realities, semiotics, and communication. It also includes the extension of ontology to the fourth dimension of embodiment. We call this extension "oniontology" for reasons that will become evident soon.

1.2 Ontology: Where, Why, and How

Ontology is the science of being. We are therefore discussing the ways of being that are shared by music. As shown in Figure 1.1, we view musical being as spanned by three 'dimensions', i.e., fundamental ways of being. The first one is the dimension of realities. Music has a threefold articulated reality: physics, psychology, and mentality. Mentality means that music has a symbolic reality, which it shares with mathematics. This answers the question of "where" music exists.

The second dimension, semiotics, specifies that musical being is also one of meaningful expression. Music is also an expressive entity. This answers the question of "why" music is so important: it creates meaningful expressions, the signs that point to contents.

The third dimension, communication, stresses the fact that music exists also as a shared being between a sender (usually the composer or musician), the

G. Mazzola et al., *Making Musical Time*, Computational Music Science,
https://doi.org/10.1007/978-3-030-85629-8_1

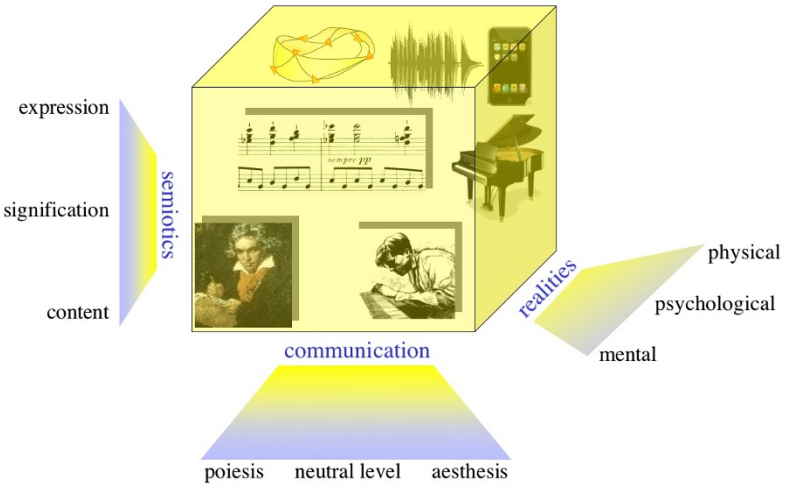


Fig. 1.1: The three-dimensional cube of musical ontology. ©Guerino Mazzola

message (typically the composition), and the receiver (the audience). Musical communication answers the question of "how" music exists.

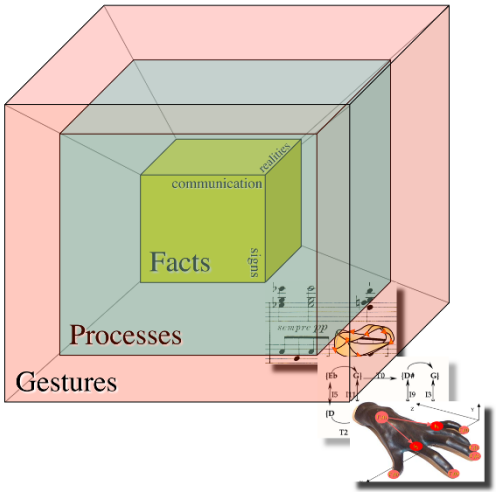


Fig. 1.2: The hypercube of musical oniontology. ©Guerino Mazzola

1.3 Oniontology: Facts, Processes, and Gestures

Beyond the three dimensions of ontology, we have to be aware that music is not only a being that is built from facts and finished results. Music is strongly also processual, creative, and living in the very making of sounds. Musical performance is a typical essence of music that lives, especially in the realm of improvisation, while being created. The fourth dimension, *embodiment*, deals with this aspect; it answers the question "how *to come into* being?" It is articulated in three values: facts, processes, and gestures. This fourth dimension of embodiment gives the cube of the three ontological dimensions a threefold aspect: ontology of facts, of processes, and of gestures. This four-dimensional display can be visualized as a threefold imbrication of the ontological cube, and this, as shown in Figure 1.2, turns out to be a threefold layering, similar to an onion. This is the reason why we coined this structure "oniontology"—it sounds funny, but it is an adequate terminology.

1.4 A Short Characterization

The four dimensions of musical oniontology can be put together to present a short characerization of music:

Music embodies
meaningful communication
and
mediates physically
between its
emotional and symbolic layers.

1.5 The Artistic Presence: A Processual Unfolding of Oniontology

Although we shall develop the technical details of structure and rationales of time performance later in this book, it seems important to draw a compact image of the existential focus, which is embraced by an engaged performer. There are two reasons for this preliminary setup:

1. We would like to sketch an aspect of time in performance that is vital to the understanding of the living artist, and
2. we want to give a first hint to every performer who isn't happy with a merely technical understanding of his/her artistic life. It is only a germinal hint, since the existential shape of a performing artist is far from being understood, and it is not the target of this book to complete research on this complex topic. We are, however, targeting the temporal aspect thereof.

Let us briefly digress on the very difficulty of such an enterprise and have a look at the philosophy of dance as it has been addressed by Paul Valéry in [160].

A dancer is a performer *par excellence*, since the dancer's score, written in Laban notation or any other dance score language, is known to be a poor reference to dance in action. This was analyzed in detail in [55]. Valéry in his treatise recognizes that dance is more action than every other art, that it is an art of time, and that it is an art in which the artist's life is taken in its full extension as the dancer's body is fully engaged in the unfolding of dance.

But then, instead of proceeding to a valid definition of dance (what he explicitly wants to achieve), he looks into the philosopher's mirror and recalls that Aristotle, Nietzsche, and in fact all philosophers are dancing with their words and thoughts. What a pirouette of thought: Valéry, instead of writing a philosophy of dance, makes philosophy dance. This dancing philosophy seems to miss the point: You usually do not represent knowledge about an object by making it. Valéry's approach does not give the expected definition of the concept of dance. However, he says that dance, as an art of time, pertains to a fundamental quality of human existence, namely time. And he recalls that Saint Augustin admitted that he knows what time is, but when asked about time cannot define it. Dance for Valéry is a similar phenomenon: Impossible to define, you have to live it, and he lets us know that thinking is a way of dancing.

This insight might seem precious, but we cannot accept the answer "Let's dance, and you will know!" to the question "What is dance?" Of course, the answer reminds us of that famous saying that dancing is a way of thinking. And for our concerns it is also true that performing music is a way of thinking. But here lies the problem: If it is a way of thinking, in what sense is it a special way, and different from other ways of thinking? The performer thinks music in very specific ways, radically different from the way a music theorist thinks music—see Martin Puttke's paper "Learning to dance means learning to think!" in [130]. So let us try to describe those characteristic coordinates of this way of thinking music.

It is a logical necessity to locate the performer's (oni)ontology in the framework of multi-agent communication since a performer should focus on communication among *all* agents. A performing musician cannot limit his/her interaction to a unidirectional messaging from composer to audience. This is an outdated casting of performative creativity as slavish service for the ingenious composer, an all-too-narrow perspective propagated by Arnold Schönberg and resonating in a casted performance education that produces only robots, not musicians. It is a sad fact that even in standardized jazz education, the slavish messaging of jazz on the basis of lead sheet changes replaces creative interaction of improvisers and disseminates that "whitened jazz" catechism, against which—apart from more general social and political motives—free jazz in the 1960s of the 20th century was rebelling.

Within the three dimensions of musical oniontology that complement the communicative dimension, namely realities, embodiment, and semiotics, the performer realizes a crossing of a singular type. In what follows, we stress the characteristic features (which does not mean that other aspects are absent).

The most characteristic feature on the axis of realities is the interaction of two bodies: the musician's body and the body of physical sounds. Their interaction is generated on the interface of the musical instrument, whose bodily manipulation produces the music's sounds. For an acting performer, this coupling of bodies is the core neutral niveau. All other levels of neutrality might be implied or subsumed, but this one is the manifest neutral building block. The confrontation of the musician's body with the body of sound along the instrumental interface is a factual reality: this is *the resulting fact* of a performer's action, it answers the question of *WHAT?* is being the fact.

On the axis of embodiment, corresponding to the reality of instrumentally interacting bodies, the performer's focus is on gestures. It is these gestures that are communicating musical formulas or processes. It is the highest quality of musical expressivity to deploy compact musical formulas into gestures. It answers the question of *HOW?* the facts are being produced. Gestural embodiment does not populate given spaces but creates them, defines their extension and thereby enables fellow musicians' gestures to resonate with one's gestures in these shared spaces. "Understanding is catching the gesture and being able to continue." This deep insight by the French philosopher and mathematician Jean Cavaillès [18] is what happens in the gestural interaction among performers: Their gesturally spaced vibration is what drives their bodies to move and to shape the "body of time."

Relating to semiotics, the (successful) performer organizes the future of the music being performed with reference to the music's past. The meaning of the music played to this present moment is connected to the shaping of the meaning of the next musical signification in a flow of thoughts. Such a transfer of structures is a processual item, it connects the gestural vibration and the factual display of bodies. It answers the question of *WHY?* the gestures are being produced to generate the factual output.

In order to achieve this in a coherent and persuasive way, we have to identify an environment where such a strong shaping activity is executed. On the level of physical events, we cannot realize such a program, since physical time presence is a real number t_0, past is the interval $t < t_0$, and future is $t > t_0$. Therefore classically conceived physical presence reduces to a single time point, and nothing can really happen in such a vanishing point.

This perspective is not satisfactory from the performer's point of view since the concept of presence in the time-sensitive arts cannot be reduced to zero. We do not embark in a neurophysiological model of performer's presence, because to our knowledge there is no such model. We rather want to postulate such a reality of artistic presence independently of a neurophysiological modeling. The fact is that the time-space of presence in artistic creation and shaping of structures is a huge environment where all the logical decisions upon

performative actions are made: gestural strategies, receiving and processing the structures of past musical events, the contributions from other agents in the multi-agent network, the knowledge from the symbolic score and its prefabricated analyses, etc. We need such a time-space that conceptually is independent of the physical time point of presence. Let us call this time-space "imaginary" for two reasons. On the one hand, it is an environment that pertains to the psychological reality and as such is imagined. On the other, and this is a speculative thought, it is known that modern physics—in the research of Stephen Hawking [54] in Big Bang cosmology, and also in contributions of Itzhak Bars [12] to the unification of gravitation and quantum mechanics—has introduced a second time dimension. We shall discuss complex time in depth in Chapter 12.1.

Offering to the artist the concept of imaginary time-space is a completely different affair: It opens a huge environment where the artist's consciousness can evolve and construe complex architectures and highways of shaping musical structures. The gestural complex is driven in this time-space; the flow from past to future music that is being played is driven and lived in this imaginary realm. The overall image is drawn in figure 1.3.

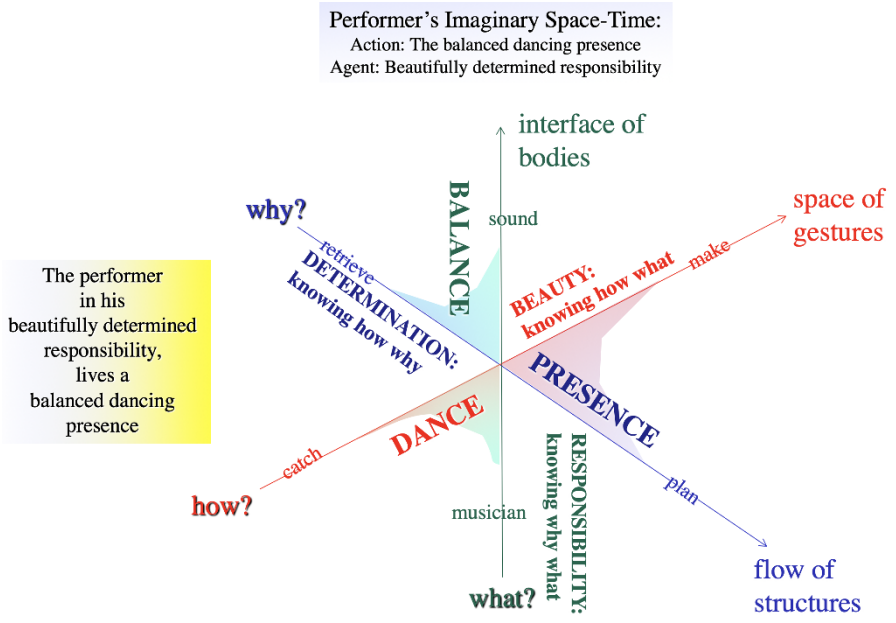


Fig. 1.3: One could conceive musical performance as being the balanced dancing of presence, an existential intensity in three directions, facts (bodies), processes (structural transport), and gestures (gestural interaction), of communicative activity. ©Guerino Mazzola

Let us discuss this image in detail. Let us first focus on the processual flow process connecting past music instances to the shaping of future ones. This aspect can take place in very different ways. To begin with, the performers may rely on different extensions of the past music's structure. An improviser might only listen to one other fellow musician or he/she might listen to many of them when shaping the next sounds. But these future sounds might also be shaped by a more or less strong reference to pre-conceived structures, independently of the actual performance, such as the reference to a given score that tells me which notes to play next *independently* of how and what has been played to the moment. These factors in the shaping of future sounds are more or less distributed processes: They define an identity of the performed piece of music that is distributed among the multiplicity of agents. This is why we call this process one of a distributed identity. And why we would define the quality of the present performance as being defined by the coherence and strength of this flow as a distributed identity. We shall discuss distributed identity as a generator of musical time in detail in Chapter 10.

Putting the three components of performance together, we see *first* that the pairing of body-instrument-body and of gestural space vibration could be conceived as the aspect of dance, and as such, knowing how what is done, expressing beauty. Combing the respective rationales, a *second* pairing, body-instrument-body and the flow of structural unfolding, answering the what and why questions, would then be seen as the balance in a bodily realm, a concept that is akin to what classical Greek aesthetics called "kairos"—the perfect balance in the body's dynamics of presence, and expressing the musician's responsibility. And *third*, the pairing of gesture and structural flow would be understood as a shaping of the body of time, the dynamics within the imaginary time-space that defines our imaginary body of time; we might call this the presence in performance, it answers the questions of knowing how what is performed. Putting these three pairings together, one could then conceive *musical performance as being the balanced dancing of presence*, an existential intensity in three directions of communicative activity.

Part II

General Time Concepts

2

Time in Philosophy

Summary. This chapter summarizes philosophical perspectives on time. Our choice starts from Plato, includes Chinese aspects, but also deals with modern approaches by Paul Valéry and Maurice Merleau-Ponty, for example. The point of starting with philosophy is that time has always been a deep concern in philosophy. It is fascinating that from early philosophical days, there has been a consciousness of the double nature of time: its linear objective and its self-referential subjective reality.

– Σ –

2.1 Plato

Summary. In classical Greek philosophy, time is a double concept: Chronos vs. Kairos. Chronos signifies the given flowing time of the universe, while Kairos is the delicate balance of the presence between past and future. For Plato, time was a parameter of projection of his Platonic ideas, which live outside of temporal categories, in the existential cave of human existence.

– Σ –

Chronos was a child of the heavenly god Uranus and the earth goddess Gaia. It expresses itself in nature from blossoming to withering, in the lifetime of mankind or the existence of the universe since the Big Bang. Just as we often judge our time, the god Chronos was cruel, hard, tormenting, , see Figure 2.1. According to mythology, he killed his father Uranus to have sole power. In order not to be murdered by his own children, he devoured all his children, with one exception: Zeus. He was born and hidden in the shadows of Rhea. Zeus was thus considered a symbol of the fact that anyone who takes responsibility for his own life can escape Chronos' clutches. This means that everyone should define time as his time and become aware of his own lifetime. Those who tend to let themselves drift, leave decisions to others, assign blame to others, will

G. Mazzola et al., *Making Musical Time*, Computational Music Science,
https://doi.org/10.1007/978-3-030-85629-8_2

then become chronically exhausted, chronically overstrained, chronically ill and die. By the way, when Zeus was great, he made Chronos spit out the devoured siblings Hestia, Demeter, Hera, Hades and Poseidon. Zeus married his sister Hera and had four children with her, as well as with his loves, among others, his daughters Helena, Aphrodite, Athena, Iris or also Heracles, Hermes and Donysos.

Fig. 2.1: Chronos TBD (Giovanni Francesco Romanelli, National Museum in Warsaw, a 17th century depiction of Titan Chronos).

Chronos was for Plato (and also for Netwon) the a priori empty container that exists independently of its content, the world's objects. But chronos time was not the fundamental existence, the world of humans was only a projection into the cave of our existence stemming from atemporal ideas. Chronos time is in Plato's philosophy only an attribute of our existence, not a basic ontological entity.

The youngest son Kairos of Zeus is the second of the Greek gods of the time. He represents the right moment in Greek mythology. Kairos is figuratively described as a young man with little wings on his feet, always scurrying around on tiptoes, never standing still, see Figure 2.2.

Nobody knows when he will be where and when he is there, he is already gone. Very striking is his mop of hair and his bald skull, as well as the razor sheep in his hand. Kairos coined the phrase "seizing the opportunity by the hair", which means that you should be prepared for the right moment, then

Fig. 2.2: Kairos TBD (Fourth century BCE marble representation of Kairos by Lysippos from the Museo Archeological in Turin).

you can grab it (grab the hair). If not grabbed in time you can slip off the bald back of your head. Kairos gives time a completely new dimension. With courage and decisiveness, one goes into joyful action. Take a risk, make mistakes, gain experience, take responsibility for yourself, your thoughts and feelings, your own life. The key to happiness lies in Kairos and thus the right moment, the responsible courageous action.

This concept goes way beyond Plato's chronological concept of time. He considered Kairos as a merely rhetorical technique, not as an ontological dimension, he condemned its usage. In modern terms, Kairos is the first conceptualization of presence, the only aspect of time which we actually experience. Refer to our general architecture of artistic presence as described in Section 1.5.

Impact. The duality of Chronos vs. Kairos is an early insight into the two ontologies of time: Chronos is, similar to Newtonian time, that line where we are embedded in a fundamentally passive way. For Plato, this is characteristic of the platonic cave, where we subsist as shadows of atemporal platonic ideas. Typically, for Plato, the Kairos time was not an ontological category, he did not understand that the presence in time as described by Kairos is ontologically substantial, not just a rhetorical construction. In the perspective of our book's basic thesis of musical time being a gestural construction, Kairos is a dancing reificton of time, your existence in time unfolds from your balanced dancing

presence, that delicate inner substance as embodied from your active gestural existence. Existence in the Latin etymology means *ex sistere*, "to step out" from the simple being that would also be shared by a stone.

– Θ –

2.2 Aristoteles

Summary. Aristoteles is the first Greek philosopher who has ever stated an explicit and concise definition of Time. Opposed to Plato, Aristoteles considers time as the amount of motion on a continuum of pre and post (before and after) other than the motion itself. Time for Aristoteles is a global order in which all things get related.

– Σ –

Fig. 2.3: Aristoteles, the realist.

Aristoteles, Leibniz, and others have argued that time does not exist independently of the temporal events. This theory is called “reductionism with respect to time” or “relationism with respect to time,” since from this perspective, all time talk is reduced to talk about temporal relations among things and events. This means that in this understanding of time, only the events among objects reify time, it cannot exist in an empty space without events and objects. The interesting news here is that time is the result of a construction among events. Not only human events, but any events. This shift from a “divine” Platonic chronos to a secondary category that is derived from events is remarkable and will be in the focus of many philosophical and cognitive approaches. And yes: our main thesis is about the construction of time in music, a radical extension of Aristotelian ideas.

Aristoteles agreed on the ontological status of Kairos with Plato as a merely rhetorical device.

In both, Platonic and Aristotelian time concepts, the ontological status of time is arcane. In particular, in the Aristotelian approach, the temporal order between events is not explained: where, in which layer of ontology does this order appear? In what events and objects?

Impact. The interesting impact of Aristoteles' time concept is the introduction of events as substantial components of temporal experience. Despite of Aristoteles' agreement with Plato's (dis)qualification of Kairos as a merely rhetorical category, we now perceive the introduction of an explicitly gestural understanding when basing time on event-related phenomenology.

$$- \Theta -$$

2.3 Kant

Summary. For Kant, and opposed to Newton, time is not an external parameter, but an a priori form of our perception/representation, like space. It is critical here to understand the *conditio humana* of this approach.

$$- \Sigma -$$

Immanuel Kant, in his *Kritik der Reinen Vernunft*[1] [65], writes:

> *Die Zeit ist nichts anderes, als die Form des inneren Sinnes, d. i. des Anschauens unserer selbst und unseres inneren Zustandes.*

Which tranlates to:

> *Time is nothing else than the form of the inner sense, i.e., the view of ourselves and our inner state.*

Fig. 2.4: Immanuel Kant argued that time is an a priori inner human sense.

This approach is in sharp contrast to Newton's (and Plato's) idea of time being a "container" of things out there. For Kant, time is a human a priori way

[1] Critique of Pure Reason.