# Notating Action-Based Music

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# Notating Action-Based Music

*Juraj Kojs*

**ABSTRACT**

The author discusses the notation of action-based music, in which physical gestures and their characteristics, such as shape, direction and speed (as opposed to psychoacoustic properties such as pitch, timbre and rhythm), play the dominant role in preserving and transferring information. Grounded in ecological perception and enactive cognition, the article shows how such an approach mediates a direct relationship between composition and performance, details some action-based music notation principles and offers practical examples. A discussion of tablature, graphic scores and text scores contextualizes the method historically.

Action-based music entertains the idea that actions can define all aspects of compositional and performance processes [1]. The following hypothetical scenario exemplifies the idea. A temporally augmented gesture of a bow bouncing on a string can inform how the composition unfolds in time. A collection of such bouncing actions can guide the local decisions as well as the overall character of the music. The composer then foregrounds the work with physical properties of bouncing as opposed to investigation of sonic properties that are products of such actions. Since bouncing is centered on the tactile interactions between the performer and instrument, this relationship becomes deepened and more evident to the audience.

Identifying the act of doing as a model for creation and performance makes action-based music an artistic manifestation of enactive cognition [2–5]. Enactive cognition—in contrast to the cognitivist and emergence schools of thought—foregrounds mind as inseparable from the world and the way we experience it. It is through "a history of structural coupling that brings forth a world" that we acquire knowledge [6]. Enactive knowledge is attained and manifested through the act of doing, as can be observed in repetitive sport and music practices.

Enactive music cognition investigates the role of the body in music-making [7,8]. For example, the ancillary gestures in the performance of some common practice period and 20th-century concert repertoire have been studied to the end of understanding the relationship between physicality and expressiveness in music [9]. Action-based music takes a different approach, proposing that action itself can be a pure manifestation of expression impregnated with information and aesthetic meaning; action-based music uses actions as the building blocks of musical composition.

Action-based music is principally related to ecological perception, which shows that our understanding of our relationship with the world is based in understanding the action-perception cycle [10]. It frequently engages everyday objects and actions, bringing our grasp of that relationship more fully to the performance space. Ecological analytical methods have enabled investigations of meaning in music, emphasizing the relationship between music-making and everyday listening through identification of sound-producing sources and their *affordances* [11–15]. *Affordances* are opportunities, functions and values that define the relationship between the abilities and needs of an observer and the capacities of an environment. The everyday listening mode prioritizes a focus on non-psychoacoustic characteristics of sound, as in the example of recognizing a siren as a fire truck passing by as opposed to a frequency of 400Hz moving under the Doppler effect. Perception is an active process of seeking information while orientating one's body toward information sources and attuning oneself to them, which is precisely what has driven the creators to this genus of music.

Notation of action-based music reflects its unique nature, illustrating what to perform and how to perform it and detailing the sound-producing mechanisms and their operations. Such notation engages "symbols capable of suggesting at once the

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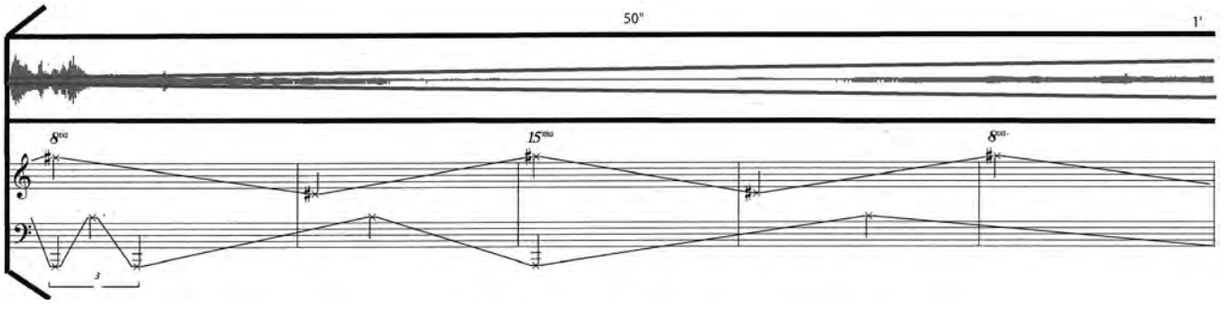
**Fig. 1. An excerpt from *Three Movements* (2004) for piano and electronics. (© Juraj Kojs)**

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means (hands, forearm, etc.) and the approach (open fingers, side of hand, etc.)" [16]. Action choreographies are frequently displayed through transparent graphics and verbal instructions. From the performer's perspective, such scores promote awareness of both the body and instrument. A number of performers have reported to me that performing action-based music has facilitated a better understanding of their instrument and informed their interpretation of the standard repertoire.

## Toward Action-Based Notation

Recent anthropological research suggests that the language of manual gestures preceded the development of vocal language. A manual sign language was the primary communication tool before early bipedal hominins freed their hands for activities such as carrying and manufacturing and before they developed cortical control over vocal expressions [17]. Visual displays on cave walls around the world indeed show actions and manual gestures of hunters and animals in sacred rituals that undoubtedly included music-making [18–20]. Media such as stone, skin and ceramic facilitated elaboration of the pictographic displays and expansion of their reach. As a way of understanding and communicating with the world, such pictographs laid the foundations for written languages such as Sumerian cuneiforms [21,22], Mayan hieroglyphs [23,24], Egyptian hieroglyphs [25–27] and Chinese logograms [28–30].

The graphemes of these languages, such as alphabetic letters, numerical digits and Chinese characters, would become the base for the phonetic music notations of the Sumerians, Babylonians, Chinese, Hindus, modern Arabs and ancient Greeks [31]. Cuneiform tablature on clay from the Old Babylonia period is considered to be the oldest notation specifically created for musical use (ca. 2000–1700 B.C., The Schoyen Collection, London-Oslo). Artifact MS 5105 features two ascending consecutive heptatonic scales to be played on a four-stringed lute tuned in ascending fifths. Preceding later notation systems, this tablature was a part of the music syllabus for educational institutions [32].

The tendency to make the signs compact to economize the use of space and to standardize them to facilitate common usage accelerated after the invention of the printing press. This development sealed the break with an earlier focus on tablature. Most of the efforts in this area focused on representing the sounds as they were heard, leading to the development of the sophisticated abstract symbol lexicon and grammar of what we now consider conventional notation [33].

Tablature systems, however, preserved the focus on the physicality of the music-making. Keyboard and string tablatures, for example, presented the musician with information about the placement of the fingers on particular strings or keys, rather than conveying the desired pitch or interval. Combination of signs and letters frequently identified the finger selection and position. For instance, 16th- and 17th-century lutenists drew six lines to represent their six principal strings as in Mace Lute Tablature, most frequently with the lower strings positioned lowest in the notation [34]. The strings were separated by frets into 54 or more divisions, each signifying a musical distance of a semitone. The numbers indicating particular frets to press would then be placed on a particular line. The letter or sign characters signifying the duration of the performed event would be placed above the lines [35]. Tablatures for the wind instruments would convey the opening and closing of the tone holes rather than the emitted sound [36].

Thus, tablature notation has prioritized eye-hand coordination. It is no surprise that this type of notation had been historically classified as direct or finger [37] or practical [38]. Willi Apel believed that tablatures relieved the player from investigating the theoretical aspect of music and enabled the shortest way to music-making, which was most effective with simpler instruments such as lutes, zithers, ukuleles and contemporary guitars [39]. However, some wind instrument graphic tablatures have continued in use in the early instructional stages and in the notation of complex multiphonics.

Tablature graphics are not the only graphics present in the history of musical notation. The 14th-century French composer Baude Cordier's ornamentally deformed chansons and canons are iconic examples of visually enriched notation—a style that became later known as *Augenmusik* (eye music) [40,41]. Later in the 19th century, novel notation systems suggested alterations in the line numbers, symbols and clefs, as in Pierre Galin's system [42]. However, it was not until the mid-20th century that the presently known myriad of novel notational systems were developed, regularly engaging expanded graphics and text to denote some action principles [43–48]. Contemporaneous trends in the visual arts influenced such experimentations [49]. For some, the notation reflected blurring of the boundaries between the sonic, visual and dramatic expressions in

**Fig. 2. An excerpt from Luciano Berio, *Sequenza V für Posaune*, 1968. (© 1968 by Universal Edition [London] Ltd., London/UE 13725)**

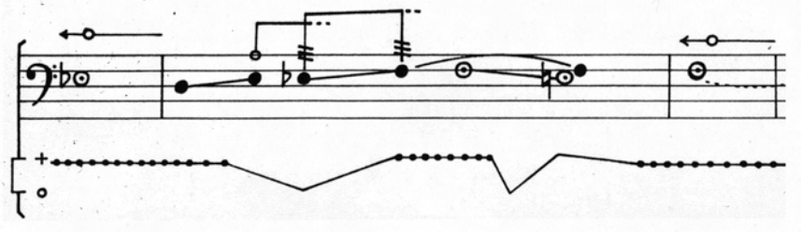
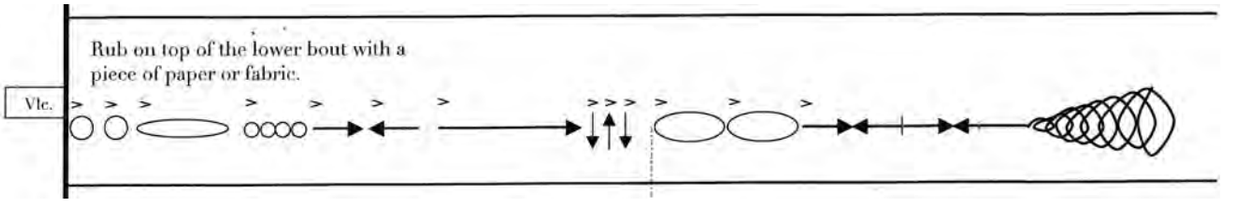


**Fig. 3. An excerpt from *E-clip-sing* for clarinet, guitar, cello, double bass and electronics, 2008. (© Juraj Kojs)**



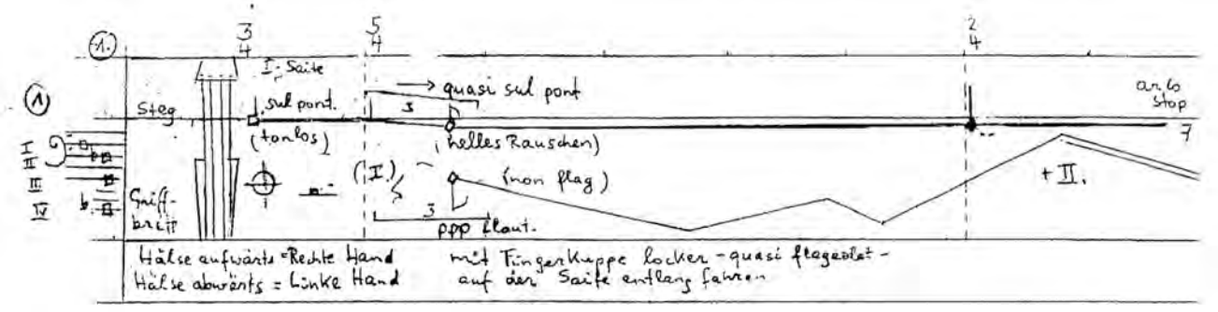



**Fig. 4. An excerpt from Helmut Lachenmann's *Pression* for cello solo, 1972. (© 1972 by Musikverlage Hans Gerig, Köln 1980, assigned to Breitkopf & Härtel, Wiesbaden)**

a performance. Introduction of everyday objects and actions onstage as musical means grew to be contemporary and genre-transcending [50].

While action-based music often makes use of graphic notation, not all graphic notations are action based. For example, the "neo-neumatic" score of John Cage's *Aria* (1958) for female voice uses colorful line contours to indicate the resulting sonic parameters in the time and pitch spectrum. Similarly, many other pieces, including Karlheinz Stockhausen's *Plus Minus* (1963) and *Spiral* (1968) and Roman Haubenstock-Ramati's *Mobile for Shakespeare* (1960), as well as Anestis Logothetis's *Maendros* (1963), utilize extensive graphics to express music parameters such as event duration, tempo, dynamics, pitch, articulation and timbre. Distorted staves and spatialization in compositions such as Stockhausen's *Refrain* (1959) for piano, cello and percussion, Bruno Maderna's *Serenata Per Un Satellite* (1969) and David Rosenboom's *And Come Up Dripping* (1968) for oboe and computer visually detail some of the resulting music parameters. In the 1960s, novel notational systems often presented combinations of conventional notation, tablatures, text and graphics for the purpose of establishing an enhanced communication with the performer [51,52].

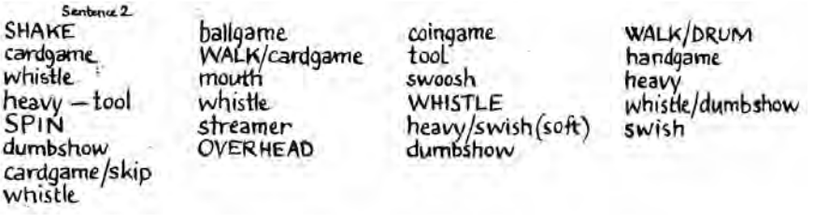



**Fig. 5. An excerpt from Cornelius Cardew, *The Great Learning, Paragraph 5, Action Score*, 1971. (© Horace Cardew. Courtesy of Experimental Music Catalogue.)**

## Action-Based Music and Notation Systems

Action-based music mediates the intrinsic relationship between composition, performance and listening, as shown in the variety of its notation methods. Composers such as Luigi Russolo, Luciano Berio, Helmut Lachenmann and Franco Donatoni (to name only a few) notated their actions using expansions to the conventional notation, such as invented symbols, graphics and text. In his infamous *Risveglio di Una Citta* (*Awakening of a City*, 1913) for *intonarumori* (mechanical noise-makers), Luigi Russolo used a five-line stave (with keys, time signatures and measures) onto which he graphed the speed and pressure of the cranks and levers as corresponding to the ascending and descending pitches. Franco Donatoni's *Black and White II* (1968) for two pianos shows the common notation grand staves and note heads. However, the stave lines suggest fingers of both the left and right hands, and the note heads (white or black) indicate the color of the key on which a particular finger should be positioned. No other musical instructions are included.

At the opposite end of the spectrum, Boguslaw Schaeffer's *Reading* (1979) for six performers is a pure action piece notated with non-action graphics. The performers (actors, dancers, musicians or singers) define and perform 88 complex actions, the durations of which span from 7 to 25 seconds. However, the graphics do not suggest actions at all; they are expansions of simple geometries, music articulation signs and tape-cutting techniques.

The example in Fig. 1 comes from my *Three Movements* (2004) for piano and electronics. The player quietly slides his or her fingers on black or white keys. The signals are tracked by two microphones and used to excite a choir of cyberstrings. Note that the distance between the boundary points defines the gesture speed. The electronic part of the composition displays some psychoacoustic properties of the signal and is therefore not action based. (As noted earlier, tablatures facilitate a direct translation of performance actions, yielding complete transparency. Action-based notation also shows such features, and the following sections detail some of its display parameters.)

Section 1.1 describes the capacity of this form of notation to ease access to music. Pure action-based scores in fact utilize images that suggest clear instructions at first sight and need no further explanation. Such scores could literally be sight-read! (Scores in need of additional clarification include a preface, legend or glossary.) The second section (1.2) turns to the temporal issues, such as duration units and framing time on the page. While a beat usually marks time in conventional notation, it is the second that frequently serves as a time unit in action-based notation. In some instances, the durations of actions themselves are defined as the counting unit, as discussed in the third section (1.3). The fourth section (1.4) addresses framing systems and grids that display grouped units on the page. These can be fixed or flexible in duration. The final section (1.5) discusses the image of the human body in this notation, discussing how

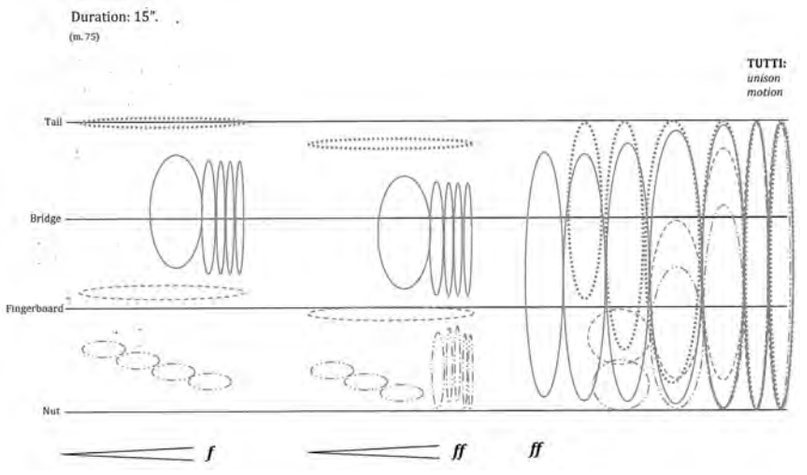



**Fig. 6. An excerpt from *SOL* for string quartet, 2009. (© Juraj Kojs)**

body action graphics have the capacity to further tighten the relationship between score reading and music-making.

## 1.1. Direct Access, Legends and Glossaries

Nelson Howe's *Fur Music* (1970) is an exceptional example of action-based music notation. The score includes both the instrument—strips of fur—and instructions consisting of simple geometries, lines and arrows (with minimal verbal explanations) for its use. The score clarifies the direction, pressure and motion speed of the performer's tactile interactions with the instrument.

Luciano Berio's *Sequenza V* (1966) for trombone solo is a well-known example of proportional notation, detailing the musical parameters. However, the mute part and its notation are also striking from the action-based perspective. Berio created a separate stave (below the main stave), showing the lower (open) and upper (close) limits of the physical mute positions (as seen in Fig. 2). The actions are then notated as full lines oscillating between the two limits (+ and o). Occasional rattling gestures of the mute inside the bell are notated with a dense pack of circles placed on the line.

Eleanor Hovda similarly notated music parameters such as pitch and time with expanded conventional notation while including some physical parameters such as bowing with graphic gestures and verbal instructions in her *Lemniscates* (1988) for string quartet. The graphic gestures mirror the movement of the bow on the string, enabling a direct mapping of the score onto the apparatus of the performer's arm.

Pure action-based notations are rare, however, due to use of novel instruments and corresponding graphics. In particular, if the pictographs are not readily translatable to actions, a legend prefacing the score often serves as a glossary of terms. In some cases, the legend will take up a large portion of the score, as in Mauricio Kagel's *Acustica* (1968–1970), or even function as the score itself, as in Alvin Lucier's *Gentle Fire* (1971).

In an extended preface to the score of his *Accidents* (1967) for electronically prepared piano, ring modulator, mirrors, actions, black lights and projections, Larry Austin described the piece as an exploration of accidental rather than deliberate actions. The pianist quietly depresses the keys, and hammers strike the strings only occasionally. Graphic gestures such as lines, rectangles and circles indicate the kind and number of depressed keys, with a keyboard image used as a clef.

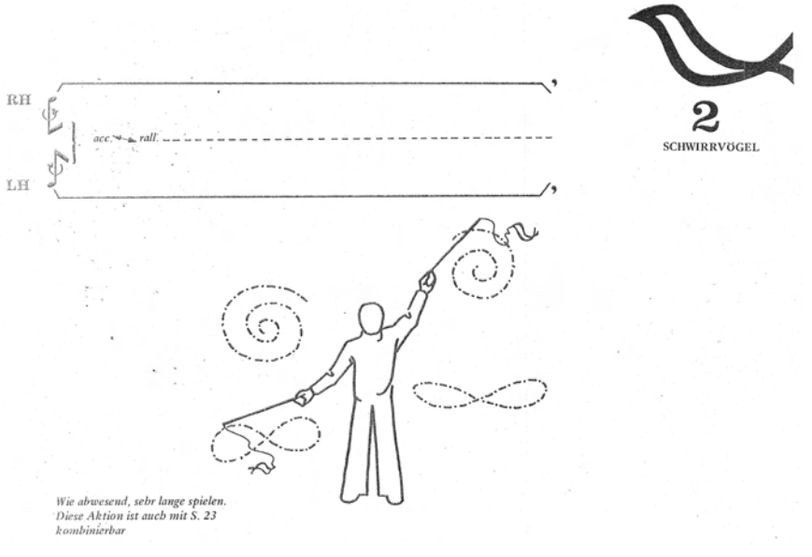
The example shown in Fig. 3 is from my *E-clip-sing* (2008) for clarinet, guitar, cello, double bass and electronics. Observe that the performer is quickly given access to the music through the text, which details the type and location of actions along with explicit action graphics. Their quality, articulation, direction and duration are embedded in the images.

## 1.2 Temporal Units

In contrast with the musical convention of measuring time in beats and measures, action-based music often exists in absolute time, with a *second* as its temporal counting unit. Clocks and stopwatches have served as timekeepers. Some "transitional" scores indicate a tempo mark of a quarter note equaling 60, which in actuality translates to the duration of one second.

Helmut Lachenmann's *Guero* (1969) for piano and *Pression* (1969) for cello are such transitional scores. In these works, the composer refined his concept of *musique concrète instrumentale,* which is based on the alienation of traditional instrumental sounds through unconventional performance modes. Except for a few sections in which pitches are notated on a staff with a clef, the score of *Pression* shows *what* actions to perform and *where* to perform them on the instrument (Fig. 4). Expanding the idea of a conventional pitch clef, Lachenmann designed clefs to indicate various parts of the instrument's

**Fig. 7. Page 24, Mauricio Kagel, *Acustica für experimentelle Klangerzeuger und Lautsprecher,* 1968. (© 1968 by Universal Edition [London] Ltd., London/UE 18429)**



body (which he also used in his string quartets). While the sustained events are notated with curves and lines, individual events use various note head types with flags, suggesting the brief or elongated nature of each event. All the events are organized to fit into a grid system. The rest signs indicate a lack of apparent action.

Lachenmann's *Guero,* on the other hand, uses proportional notation. Separated into three pitch registers, note heads of various shapes and fillings indicate the nature, direction and duration of the physical gestures. Gliding fingers quietly on the piano keyboard, tuning pegs and strings between the tuning pegs creates the base action vocabulary of the composition. The music is notated into a grid with a quarter-note time marker. The tempo is q = 60 (i.e. 1 second). Similarly to *Pression*, most of the dynamics, articulation (both graphical accents and verbal instructions in Italian) and rests are indicated in conventional notation. Lachenmann also utilized caesura signs, with the length of silence measured in seconds, in various places.

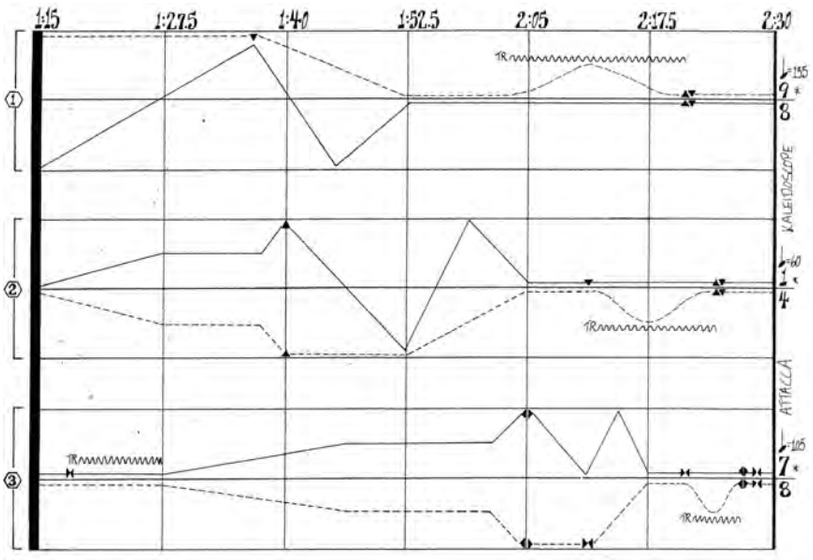



**Fig. 8. Page 2, Mark Applebaum, excerpt from *Tlön*, for three conductors, 1995. (© Mark Applebaum)**

## 1.3 Action as a Time Marker

In some action-based music, the duration of a performance action or gesture becomes the time marker, existing independently from any strict temporal framework. The duration of the grid units is not precisely defined. Rather, actions are precisely notated or suggested more freely, frequently using verbal indications.

Steve Reich's *Pendulum Music* (1968) for microphones, amplifiers, speakers and performers exemplifies the idea of a text composition for suspended and swung microphones. The piece opens with the performers unleashing the microphones and ends when all of the microphones come to rest. The piece's duration is fully dependent on the pace of the decelerating microphone trajectories.

*Paragraph 5* from Cornelius Cardew's *Great Learning* (1969–1970), for a large number of untrained musicians making gestures, performing actions, speaking, chanting and playing a wide variety of instruments**,** joins text lists and graphics to expressed actions to be performed. Framed around seven sentences, the chapter consists of sections featuring movement instructions, verbal action compositions, text chanting, an action score, a number score and 10 "ode machines." (The ode machines are the only ones to feature conventional notation.) The opening *Introductory Dumb Show* is a text detailing choreographic trajectories and vocalizations. The section *Compositions* consists of eight Fluxus-type word scores. In *Action Score*, the composer first defines the objects, such as coins, cards and whistles, in terms of their use for potential games in his *Action Score Interpretation* section. The *Action Score* itself consists of columns of actions, some in capital and some in lowercase letters (Fig. 5). The performer is asked to begin performing the action in capital letters and then keep adding neighboring actions positioned below and above. The initial action is dropped upon reaching another action marked in capital letters. When all the actions of a particular column have been executed or when the performer breaks with overload, they move to the next column. (There is a short song notated in conventional notation included in the score. Interestingly, the performer can opt out from the action score by singing the song.)

The score continues with the *Number Score* section, consisting of a matrix of categories such as "social," "scale," "actions," "parts of body," "states," "ideas," "positions," "object," "material" and "composition." Each category presents a series of descriptors that define the action selection in combination with a random 4-digit number sequence. The selection is then read through the *Number Score* as a filter.

Cardew does not reference duration or timing anywhere in the score. A particular section is done when all of the actions inside it are completed. Temporal cues can only be deduced from sequential instructions. The only temporal indication for *Paragraph 5* is a 2-hour duration reference in the *Great Learning's* preface.

Fluxus artists in particular have explored music performance actions as time units in their text pieces [53]. Dick Higgins prescribes a script of actions operating musical sources such as radios and pianos in the first of his *Constellations for the Theater (Number X)* (1965). The third *Constellation* details 10 physical instructions for constructing, superimposing and manipulating four tape layers, with particular speed relationships expressed in the final "theoretical scheme equation" [54]. Interestingly, the speed of the tape manipulation is the only time expressed and captured.

Alvin Lucier's *Gentle Fire* (1971) also completely avoids temporal instructions, instead having the performer record a myriad of everyday actions and then modulate them with technologies of his or her choice so that they sound like other actions. A possible instruction could read as follows: "record squeaking shoes and make them sound like purring cats." The act of recording and modeling becomes a performance within an unspecified period of time. Pauline Oliveros's *Sonic Meditations* (1971) are text pieces that prescribe particular actions (or the lack of them) to enhance awareness of one's body, mind and sonic environment, often calling for actions to be extended for as long as possible.

At the opposite end of the spectrum, Annea Lockwood's *Glass Concert*

*2* (1967–1970) for two performers is a text-notated composition that treats time with particular attention. The first performer is instructed to excite glass sheets, rods, fragments, panes, curtains, threads, bottles, tanks and bulbs with actions such as scraping, rolling, swinging, crushing, grinding and blowing in 40 scenes, while the second performer operates colorful spotlights to refract the light of the glossy objects. Each scene is described in detail verbally and carefully timed.

Cage's *Water Walk* (1958) for everyday objects such as a bathtub, toy fish, pressure cooker, mixer, goose whistle and five radios calls for a combination of absolute time and action duration: "Start watch and then time actions as closely as possible to their appearance in the score" [55]. The combination of natural time development of the actions with reference to the absolute time measurement enables constant bending of the musical flow.

## 1.4 Framing Time on the Page

There is no predefined relationship between time and space in the notation of action-based music. The relative size of an event can correspond to a relative size of action, as in the example from my *SOL* for string quartet (Fig. 6). The page of bowed material is framed as a projection of a string body existing in space and time (15 seconds). For clarity of reading, each instrument is notated with a different line type.

Further, the action's duration can either be dependent on or work independently of the graphic size. The gesture orientation on the page can expand in a multiplicity of directions, as in Silvano Bussotti's ballet *La Passion Selon de Sade* (1964), creating a series of separate and overlapping zones. The concern for spatial economy is minimal, especially if the composition is not restricted by a particular duration.

The time frame can vary from composition to composition. If precision is involved, the duration can be constant (e.g. 10 seconds per page) or vary from page to page. Duration can also be assigned locally, to individual gestures for instance. Cage notably used brackets to indicate varied durations of the phrases at the beginning of his *Theater Piece* (1960), thus loosening the time/space relationship. In addition, while most compositions call for left-to-right reading, some may disturb this time-space convention (as with the columns of text in Cardew and Lucier's scores).

## 1.5 The Human Body

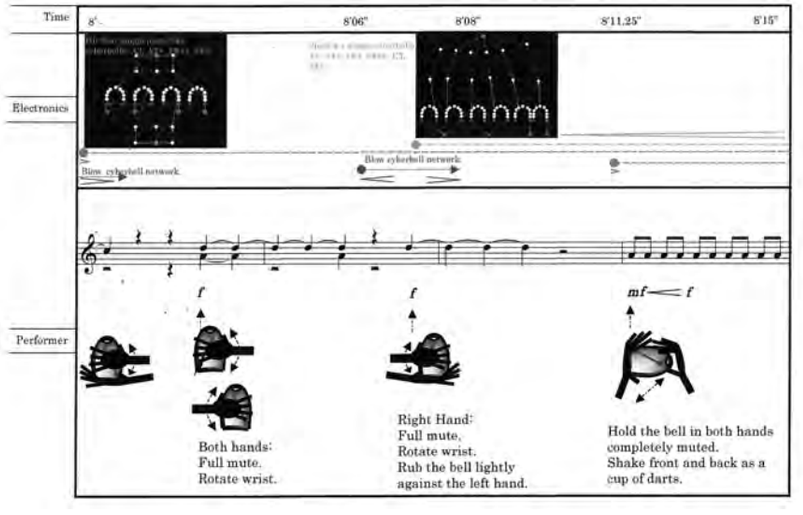
The presence of the human body and its parts in the score's graphics is one of the most powerful and suggestive tools for notating actions, as seen in M. Kagel's *Acustica* (1968–1970) for experimental sound producers and loudspeakers. The composition is written for two to five performers operating a multitude of everyday objects (e.g. gas blow-lamp, tissue paper and box of nails), toys (e.g. clockwork toy animal, balloon and hummingbird), musical instruments (e.g. trumpet, trombone and violin) and other sound-producing and amplifying technologies (a record player, microphone and loudspeaker-megaphone). The score is a pictorial-verbal glossary of instruments, each page detailing an object (the sound source) and prescribing particular techniques for its operation, often engaging a body in action figures. For example, Kagel's instructions for operating a hummingbird aerophone toy tied to an end of a whip (pp. 23 and 24) show a human figure holding the whip along with desired movement trajectories (see Fig. 7).

Jani Christou's *Enantiodromia* (1968) for orchestra combines proportional notation with graphic symbols. The final portion of the score includes graphic figures of the performers and conductor in particular movement choreographies. Theodore Antoniou's *Cheironomies: Conductor's Improvisation* (1971) for variable ensemble shows detailed choreographies of the conductor's gestures with body images and action trajectories. In the previously described *Paragraph 5* from Cardew's *Great Learning,* the composer defines a topology with six action centers, two mobility circles and a relay/rest point using a graphic body figure, which serves as an orientation map for the choreography of the opening movement.

The body may be implicitly present in the notation**,** as in the first movement of Mark Applebaum's *Tlön* (1995) for three conductors and no players. This silent action composition instructs three conductors to manage three imaginary ensembles. In the first movement (*Monolith*), the graphic line trajectories for each hand operate within a grid framing the vertical and horizontal arm stretches of the performers**,** as shown in Fig. 8. Palm rotations are notated with arrows. (The second movement, *Kaleidoscope,* shows music parameters such as the rhythm, meter, tempo, dynamics and articulation of the imagined music in conventional notation.)

Graphics featuring hands engaged in actions can be found in the score of my *At and Across* (2007) for Slovakian sheep bells and cyberbells (Fig. 9). While the conventional notation shows which tuned bells to use, the hand graphics provide instructions for the operation of the bells.

**Fig. 9. An excerpt from *At and Across* for Slovak sheep bells and cyberbells, 2007. (© Juraj Kojs)**




## CONCLUSION

Tablatures never became the basis for a universal notation language but they do reflect the intimate relationships between the instrument maker, composer, performer and notation, specific to a particular instrument and locality [56]. Expanding the tablature designs, novel notations (often invented for particular pieces) showed the extreme closeness between the music-making and arts of the 1960s [57]. More than that, unique expressions symbolized the zeitgeist and

creative freedom, for "to standardize notation is to standardize patterns of thought and creativity" [58]. Some composers have brought that spirit to the 21st century, as the wealth of approaches to novel music notations demonstrates [59].

While the imagination itself cannot be imprinted onto a page, methods of notating interactions among the instruments have the capacity to detail closely an abundance of musical expressions. The action-based notations precisely highlight the physical manifestations of sound and compositional work. Disclosing the music's inner workings through a focus on the actual mechanics of sound production can be both demystifying and inspiring. As Cardew wrote,

> What I am looking for is a notation (way of writing a text) where fidelity to this text is *possible*. Perhaps a notation of the way in which instruments "actually are played." This leads to the question: what actions *are* actually involved in playing? And here the concept of "hypothetically imagined sound" becomes dubious: — on what basis does the player imagine the sound? On the basis of understanding of notation? But the process of imagining cannot be included in the notation! [60]

Putting it another way, we should always remember that the notation of music is preceded by the creation of music, just as thought and speech came before written language [61]. Mapping the sonic data, whether prescriptively or descriptively, to visual representation, in the end requires an already-formed mental image about how the music works [62]. In action-based music, music is treated as a physical process, engaging our bodies and objects in actions. Experiencing music enactively—that is creating, notating and performing it through such lens and ear—enriches our musical imagination and connects it to our everyday world.

### References and Notes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