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Transformations

The Representation of Movement in Notation and Digital Processing

Abstract

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1. **Introduction: Movement notation systems in the digital age**

As opposed to other artistic or scientific fields until today, our culture has failed to develop a single unified system for recording, documenting and communicating the art of dance's basic material – which is movement. Yet numerous attempts have been made to create such systems in the history of western dance culture. In this research project two of the contemporary notation systems are examined closely: *Kinetography Laban/Labanotation* (KIN/LN) and *Eshkol-Wachman Movement Notation* (EWMN). KIN/LN was first published in 1928 by Rudolf von Laban and has being developed and distributed since. EWMN was created in the 1950s by Noa Eshkol and Avraham Wachman in Israel, where it is primarily used. Both systems have established limited fields of usage and have successfully proved their functionality within these boundaries. However, none of these systems is being used as widely as e.g. musical notation in the tradition of western music, although the systems' authors frequently claim a similar range of functionality and importance.

The motivation to create means and devices for recording movement was primarily rooted in the need for documenting dance in previous centuries. In the 20th century analytical aspects became a more dominant factor, which may be recognized to various extents in the two systems examined here. Increasing availability of film and video recording caused the interest in the documenting capabilities of notation to diminish, although in specific situations notation can still prove advantages in quality. Film and video are limited to a two-dimensional exterior description of the motion phenomenon, while notation includes detailed movement instructions and can such reflect an interior view. Notations are even today superior to purely visual means of recording in their standard of detailed documentation and reconstruction. However, on a broader scale notation cannot compete e.g. with the ubiquitously available video technique that can reproduce a visual representation of motion instantaneously.

The increasing influence of New Media and recent developments in computer technology evoke various visions and scenarios for the future role of movement notation to play. Computer animation in contrast to the traditional visual reproduction techniques of film and video captures movement as a three-dimensional phenomenon and can create views from different perspectives. With these obviously superior capabilities a closer examination of a possible wider analytical potential seems vital. If a profound analytical potential was found in
computer animation, it could function as a visual notation and might replace traditional notations altogether.

Another scenario envisions the complete integration of movement notation within possibilities of digital processing. Editor applications facilitating the production of scores already exist for various notation systems and may replace the tiresome process of drawing and writing with ruler and pencil. They are capable to produce high quality printouts and to perform standard editing procedures known from word processing or graphic programs. But this is only regarded as the basis to further developments that are bound to change the approach to notion radically. The next step comprises an interpreter in order to translate the digitalized notation data into computer animation automatically. Even though this stage has only been realized in experimental settings, plans for a far more complex mode of translations already exist. The computer is supposed to generate a notation score out of digitalized movement data automatically. Even if this scenario does not question the importance and the existence of notation, the urge for automating the transformation process between notation and visual representation touches central topics of movement description that have almost been neglected until today. The striving for automation expresses that certain difficulties are obviously connected with these transformations, which the computer is expected to ease. It should be noted though that basic principles of transformation have never been defined theoretically. But without clearly defined rules and principles a successful implementation of automated translations seems highly unlikely.

2. **Evaluating notation and computer related processing**

The connection between movement notation and recent technical developments offers a new perspective to be worked out in the present study. Not only could the recent developments be examined critically; it gives the opportunity to describe the character of notation systems and their inherent concepts of understanding movement up to a previously unknown high degree of precision. Including the most widespread notation systems in context with their corresponding computer applications, this comparative study creates an additional external level of perception. Internal structures of notation as well as information on movement are represented in digitalized computer data. This process of transforming forces information to
crystallize into the higher structural degree of digital representation, which in turn is examined to gain insights on the original phenomena of movement and notation.

3. Results

3.1. Notation systems
Evaluating and analyzing the two notation systems EWMN and KIN/LN in view of the aspects mentioned leads to the following results:

KIN/LN is built upon a synthetic-compact structure. Graphic primitives, each corresponding to a certain spatial concept, are merged to basic symbols. Thus, the smallest discernible graphical elements already contain numerous pieces of information comprising the notation's compact character. The meaning of the basic symbols may be altered and differentiated by certain modifiers. As the single modifying or modified element cannot exist separately or only in a different semantic context, the basic symbol and modifier tend to form another synthetic-compact unit.

Movement instructions in KIN/LN are goal-orientated. A movement description corresponds to instructions which may also be expressed and experienced without notation. Generally, they focus on limb directions to be reached, marked by distal end points in relation to a fixed joint. The limb sections described by KIN/LN may be complex, for they may comprise several skeletal parts (e.g. the whole leg containing thigh, lower leg and foot). The resulting mechanical movement paths might be indicated by additional information, but cannot be described explicitly.

In contrast, EWMN follows an additive-parametric principle in its graphical and syntactical structure. A small number of informational elements are combined into sequences on different hierarchically connected levels. Sequences of basic symbols form expressions corresponding to a movement of a single skeletal limb section. These expressions in turn are combined to describe the movement of the entire body. The syntactical approach is in a certain way similar to the Latin alphabet, apart from the striking difference that in EWMN the graphic appearance consists of non-linear, horizontally and vertically built symbol sequences. The digital representation of this structure is optimally encoded by employing a tree-like data format.
Depending on the context movement may be described in full detail as well as reduced to create formulas to express distinctive movement patterns. In the latter mode some elements of a movement description are transformed into variable parameters, which may be in- or excluded as far as necessary. On the semantic level EWMN defines the changing geometrical relationship between single limbs related to time and space. This information corresponds with the – mainly subconscious – functions of human motor control regulated by the kinesthetic sense.

3.2. Movement – Notation – Communication

The acquired knowledge on notation systems and their methods of encoding may be applied and compared with processes of human motor control. Psychology and Movement Sciences have created theories describing these processes in detail. Some relevant aspects should be mentioned in this context.

Movement processes are controlled by hierarchically connected levels of which only the topmost and the bottommost as counteractive polarities should be mentioned here due to reasons of simplicity. While regulative control functions work subconsciously on the bottom level, volitional movement actions are controlled by consciousness on the top level. Processing information supplied by various systems of reception plays an important role in motor control. Being able to recognize position and motion of limbs through receptors in muscles, tendons and joints the kinesthetic sense forms the most important component of the sensory system. However, this is only partly accessible to consciousness. Usually it is not necessary to process kinesthetic information on a conscious level, although it may reach such a level under certain circumstances.

In contrast, movement information provided by the visual sense reaches conscious awareness more easily. Furthermore abstraction abilities related to movement actions generally reside in consciousness. The numerous kinesthetic impressions of the sensory control system merge into verbal and metaphorical terms to which conscious processing has full access in a very effective way. It has already been mentioned which type of information notation conveys and how this concerns processes of motor control. On a theoretical level it is possible to think of different scenarios:
A notation or movement representation may carry information mainly connected to the conscious level of processing (see Illustration 1). This type of information should be labeled as *direct information*, in contrast to the implicitly communicated *indirect information* of the subconscious level. This structure offers the advantage that information may be received quite easily. Its elemental blocks correspond with existing terms on the conscious level, and therefore may be identified without difficulty. The analytical potential remains limited, as the mechanical structure of movement is merely described implicitly.

Visual representation techniques for movement are based on this model, but to a certain degree KIN/LN's goal-orientated movement instructions consist of this kind of information, too.

In case the movement description refers to the underlying structure of movement, e.g. the geometry of single limb movements, the content related to the subconscious level is communicated directly (see Illustration 2). The character of goal-orientated action has to be deduced from this information indirectly. Therefore, complex translation processes have to take place. The information has to be lead over the topmost, intellectual levels as there is no channel of communication between sensory motor control and the encoded movement information. Despite the far more complicated mode of communication this approach bears considerable advantages:
First, only by splitting whole actions into their mechanical components relevant structures needed for analysis are revealed. Second, it may be reasoned from practical experience with notation that parallels between the geometric-mechanical criteria of analysis and human neuro-physiological structures exist. Third, in order to manage this kind of complex translation highly developed skills of conscious processing have to be learned. Movement sciences have repetitiously claimed the need to optimize motor learning by developing such skills.

The information transport in EWMN is closely related to this model, but some elements of KIN/LN may follow this approach, too.

To summarize, special skills of conscious processing have to be acquired for the successful application of movement representation techniques. Mental links between encoded notational information and the inner representation of movement must be created. Methods conveying information about the sensory motor control system require active shifting between the levels of consciousness. Detailed knowledge on where lie limits and potentials of these methods is required for an optimal and integrative application of all mentioned approaches.

4. Conclusions

The extended possibilities of conscious movement processing represent an enormous potential for the employment of notations. Reasonably applied technology may further expand their ranges of application through support rather than by replacement of the mental processes involved. In dance composition, notation might succeed to establish its analytical
potential if structure and material of movement gain acceptance as the basic elements for choreography. This interest in the structure of dance is opposed to artistic approaches employing movement as means of performance, while its structure is only derived from stylistic conventions or e.g. improvisation. Various limited periods of developmental thrust could be observed during the 20th century, which prove an interest in these very structures of movement. The transition from Classical Ballet to early Modern Dance may be interpreted as the first step away from a strictly visual, exterior perspective on movement. It was freed from the limiting conventions of Classical Ballet and the resulting movement experience must have released a distinctive amount of new kinesthetic impressions, even if those were mainly communicated through expression and emotion in an indirect manner. It is interesting that Laban created his notation right during this period, which may be seen as an attempt and urge to communicate this newly discovered kinesthetic potential. During the 1960s and 1970s dance styles and improvisation techniques emerged in the United States recognizing kinesthetic impressions of movement as such unprecedentedly. They gained importance within educational and therapeutic techniques and formed the basis of dance forms like Contact Improvisation. However, different levels of consciousness were not actively linked as opposed to the theoretical models discussed previously. On the contrary, a radical change of priorities eliminated the conscious, volitional control of goal-orientated actions in favour of impulses originated in the subordinate regulative systems.

Noa Eshkol – the inventor of EWMN – and her dances are an example for the integrating implementation of different levels of consciousness in an artistic process. She composed her dances with the aid of notation and her work is available through published notational scores. Her dances may be highly regarded and critically acclaimed, but are unfortunately not very well known to a popular audience. The means for a broader presentation are non-existent as common dancers are not educated in the required complex notational skills. They would not be able to perform the complex coordinative tasks involved, which demand active transformation and integration of information related to the different levels of consciousness. Nevertheless, tendencies towards other artistic approaches may be observed with choreographers like Merce Cunningham or William Forsythe, who focus on structural aspects of movement in their work. Even if they do not employ the tool of notation and do not integrate
the levels of consciousness as consistently they use notation-like aids in the form of visualizing computer programs.

Practical research on dance and theatre could employ these techniques, especially notation, to examine and objectify the basic material of dance that determines the aesthetics of performance. The analysis of technical, stylistic and compositional aspects of dance requires profound methods of research, which might be influenced by notation systems or even be based on them. An increasing interest in these aspects and an integration of notation in analysis will inevitably force perspectives of observation to change: away from the position of an external audience focused to the stage, towards an observer, who fully understands movement and its inner dependencies on multiple levels. The perception of dance will shift from a visually to a kinesthetically determined level of processing. As an analogy to processes of motor learning, this shift from visual to kinesthetic perception may be seen as a necessary step of cultural development. This step can only be done, after a solid basis has been established on the first developmental stage. The current interest in visual representation techniques and technology indicates that this stage of change has not been reached yet. However, the existence of adequate and potent notation systems as well as an awakening interest in movement structures create the prerequisites for further development already today.