

An Analysis of the Effect of Integrating Artistic Elements into Routine Sports Training on Improving Movement Quality

Nan Ren*

Tianjin University Of Technology And Education, Tianjin, 300222, China

*Corresponding author: rennan19840328@126.com

Abstract: The sports training has turned from outcome evaluation towards process analysis; artistic quality characteristics in movement performance such as rhythm, space and force began new explorations theoretically. Artistic elements were classified into three groups (rhythmicity, spatiality, and force effectiveness), setting up its multidimensional assessment framework which demonstrated the theoretical logic of integrating artistic elements with routine training. Three types of elements can optimize temporal structure, improve spatial configuration, and enhance the level of force-effectiveness regulation respectively. In application, we constructed a three-level integration model of perception-execution-integration, proposed a dynamic adjustment scheme on the proportion of artistic elements through training cycles, and established a dual-channel explanatory framework for transfer effects according to the common elements theory and cognitive strategy transfer theory. Complementary functions of artistic elements and routine training offer an effective theoretical path for systematical improvement of movement quality.

Keywords: artistic elements; sports training; movement quality; rhythm; spatial configuration; force-effectiveness regulation

Introduction

Quality of movement has always been one of the key issues in both theory and practice of sports training. Existing evaluation system relies primarily on the biomechanical parameters and athletic performance indicators: such a quantitative approach could only describe the external features of movement, lacking a good description/explanation about the quality aspects (overall coordination, rhythmic rationality, subtlety of force change) when executing movements. The high-level athletic performances usually possess some artistic characteristics like a sense of rhythm, space aesthetic, and hierarchical changes in force which are closely related to the biomechanical efficiency of movement and the level of neuromuscular control. Routine training focuses on physical fitness elements and specific techniques of sport without systematic training intervention methods regarding the artistic quality dimensions of movement performance, which is a structural bottleneck for further improvement of the movement quality. Our research intends to clarify theoretically how artistic elements integrate with routine training from its internal logic, reveal the mechanism that three types of artistic elements affect movement quality and construct an operationally-oriented applied theoretical framework so as to provide a new perspective for developing sports training theory.

1. Theoretical Basis for the Integration of Artistic Elements with Sports Training

1.1 Forms of Existence and Classificatory Interpretation of Artistic Elements in Sports Performance

Inherent art elements exist in manifestations of sports movements. They are not added on the movement but they are intrinsic to it. Three kinds of artistic elements which includes when we examine them from three fundamental aspects of time, space, and force; namely: (i) Rhythmic elements, (ii) Spatial elements, and (iii) Force-effectiveness elements. First type is represented by the order and periodicity of movement concerning time axis such as duration, interval allocation, and overall rhythm pattern for each sub-movement. Second concerns about the geometric direction of movement trajectory, spatial positioning of limb segments, and configurational characteristics of dynamic posture. Third element represents the temporal patterns of force release, including various modes of outputs like

increasing force, decreasing force, sudden change in force or maintaining force. All three types of elements co-exist in a composite form during movement that are mutually influencing and constraining – adjusting in one dimension will result in corresponding changes in others^[1].

Classification of such artistic elements will help us to know what is the movement quality from the perspective of structure. Although there are different emphases between the three kinds of elements in various sports events, none of them can exist completely in a complete motor skill; disturbance in rhythm leads to deviation in spatial position, unreasonable spatial configuration affects the normal transmission of force effectiveness, while proper regulation of force effectiveness needs the support of rhythmic framework as well as spatial pathways. Systematic classification of artistic elements aims at targetingly using such elements when doing training that gives a conceptual basis for further exploring their pathways of action.

1.2 A Multidimensional Reference Framework for Movement Quality Assessment in Sports Training

Measuring movement quality is not limited by measuring one indicator. Result-oriented metrics like completion time, displacement distance or hitting accuracy are easy to measure, however, they cannot reflect the coordination quality when executing movements. A good movement not only indicates that the predetermined movement goals have been achieved, it also means that there should be good temporal organization, spatial rationality, and force appropriateness during the whole execution process. We therefore need to evaluate the movement quality from three aspects: the temporal dimension, the spatial dimension, and the force-effectiveness dimension. For the temporal dimension, it emphasizes the rhythmic stability of movements and fluid transition between different segments; for the spatial dimension, it aims at examining the smoothness of movement trajectory and precision of postural positioning; regarding the force-effectiveness dimension, it examines whether the timing and magnitude of force change meet the inherent requirements of the movement task^[2].

The relation between the three dimensions is close; an inadequacy in any one affects all other. The distortion of spatial trajectory can manifest as deviation in movement rhythm whereas improper control of force disturbs the rationality of temporal arrangement. We should integrate them within our assessment framework with a unified reference system – analyzing not just the individual performance of each dimension but paying attention to its coordination. A multidimensional assessment approach changes the way of judging movement quality from assessing a single outcome to organizing process analysis which gives us a reasonable evaluative criterion to locate the role of artistic elements.

1.3 The Theoretical Logic of Integrating Artistic Elements with the Routine Training System

Regular sports training has as its basis repetitive movement practices and increasing load. The benefit results in forming stable coordination patterns for the neuromuscular system with quantity accumulation. Improvement on the quality level (rhythmic precision, spatial discrimination, a layered sense of force), however, occurs without repeated practice – which is exactly what the artistic elements point towards. Incorporation of artistic elements does not reduce nor replace routine training; it supplements and expands it. Guaranteeing the basic specifications and repeatability of movements via routine training and emphasis on optimizing regulating movements via artistic element training complement each other rather than conflict regarding their training goals.

As regards the neural mechanism of motor control: Rhythm identification, spatial orientation and force grading required by artistic elements depend on the refinement of encoding and regulation of motor output by the central nervous system; Embedding artistic elements organically in the routine training process is similar as providing the motor system with additional perceptual reference and regulation target so as to help the motor control go through the change from coarse range regulation to precise fine-tuning -- it's exactly such an inherent path which can effectively improve the quality of movements. Meanwhile, Integrating artistic elements into the training system depends on its functional complementarities between them. Routine training serves as a stable carrier for the exertion of artistic elements while artistic elements serve routine training with quality-oriented regulatory impetus. They mutually support each other forming the theoretical basis for the integration^[3].

2. Mechanism Analysis of How Artistic Elements Act on the Improvement of Movement Quality

2.1 The Optimization Mechanism of Rhythmic Artistic Elements on the Organization of Movement Temporal Structure

Temporal structure of movement: Sequence, duration distribution and transitions in sub-movements on the time axis which determine the overall coordination of movement and efficiency of energy transfer. Rhythmic artistic elements play the most important role by providing a stable temporal frame for integrating disparate sub-movements according to the optimal temporal proportion (when considering the perception of rhythm during training) - standardization of the start times of movement, duration of each phase as well as transition nodes reduces redundancy of movements and energy dissipation caused by temporal confusion. From the perspective of neuromuscular regulation, the continuous action of rhythmic elements makes the alternation of agonist muscle and antagonist muscle activities has a clear periodic pattern and the boundary between contraction and relaxation tends to be distinct. Reducing regulatory load of the central nervous system through rhythmic optimization from the aspect of temporal arrangement bring the execution of sequence of movement close to an automatic state.

As the rhythm perception ability improves, the sensitivity of the mover towards time error increases which is an essential condition for fine regulating movements. The temporal discrimination threshold of the mover gradually narrows down by being repeatedly stimulated with external beat signal or internal rhythmic imagery to prompt perceiving and correcting minor deviation in the duration of the movement, and its capability gradually sinks from conscious judgment to subconscious level, establishing a stable temporal preference. Optimization of temporal structure refers to changing the movement rhythm from rigid isochronous to elastic rhythm rich in variation, enabling the mover to flexibly regulate the speed and pause of each phase according to the specific requirement of the movement task so as to balance the adaptability and expressiveness of movement and ensure the stability.

2.2 The Influence Pathways of Spatial Artistic Elements on Movement Trajectory and Postural Configuration

Spatial art elements are based on the geometry features of movement trajectory and spatial layout of body posture. The definition of movement trajectory refers to the path of limb endpoint or the center of gravity in space when moving; the degree of curvature, the frequency of direction changing as well as the smoothness of turning determine the spatial quality of movement. By integrating spatial elements, the mover perceives that the form of trajectory goes from vague to clear, where path deviation and redundant oscillation fall within their scope of attention and get targeted correction. After systematic training, the mover can easily control the limbs' endpoints to follow an optimal path, reduce lateral oscillation and redundant circumduction such that the trajectory tends to be smooth and conforming to mechanical principles. Optimization aims at achieving a balance between spatial utilization and power transmission efficiency whilst keeping fluency^[4].

Postural Configuration: The positioning relationship between body segments in space and its change over time is closely associated with the stability of movement and force transmission efficiency. Spatial elements distinguish the spatial position of torso core and endpoint limbs that enables proximal segments to have a stable base while distal segments has flexible degrees of freedom of movement. Mover can better represent spatially their body schema so they perceive the spatial coordinates of each segment and their relative orientation in real-time when executing movements without compensating for postural instability. By continuously intervening through spatial elements, posture of movement offers necessary stability at critical nodes as well as sufficient regulatory margin on non-critical phases. Selective spatial constraint is one of the qualities of high-level movement.

2.3 The Pathways of Action of Force-Effectiveness Artistic Elements on the Regulation of Movement Force and Energy Distribution

Artistic aspect of force-effectiveness is variation in time but not magnitude of force. The basic content of force effectiveness includes: timing, rate of change, peak position and decay curve of force output. Some common problems when using force for training might be caused by timing deviation, improper release rates or too slow decay which belongs to the scope of force-effectiveness regulation. Pathway of action of force-effectiveness elements firstly manifest themselves through improvement of

the perceptual discrimination ability of the mover about force application pattern so as to better discriminate the subtlety between different force level and choose proper form of force change according to movement task. Improved perception of this kind of discrimination ability shifts the use of force from coarse two pole mode into continuous graded regulation, tending to refine and flexibly regulate the force output.

As regards energy distribution, the effect of optimization through force-effectiveness elements is realized via rationalization of time of muscle activation and reduction of unnecessary co-contraction: if the mover has mastered the force-effectiveness pattern matching the movement task, then the agonist muscles will act earlier compared with the antagonists which relax completely and move smoothly down the kinetic chain; possessing higher force effectiveness awareness during training allows the mover to rationally distribute his energy reserves across various stages of movement, paying attention to force release at explosive moments, correctly saving physical capacity for non-critical phases postponing the onset of local muscle fatigue. The role played by force-effectiveness elements also involves phase transitions between movements – smooth transition from one force exertion to another, avoid disjunctions/interruption of momentum due to sudden change in force, increasing overall coherence and economy of movement.

3. The Applied Theoretical Framework for Integrating Artistic Elements into Training to Improve Movement Quality

3.1 The Hierarchical Construction of Integration Pathways and Their Intrinsic Relationships

Artistic element integration in daily training proceeds from shallow to deep. This conforms with the fundamental law of motor skills which is perception before execution and integration after. Three layers of classification of integration pathways such as the perception layer, the execution layer, and the integration layer. Perception layer means establishing the mover's capability to perceive and discriminate rhythmic signals, spatial forms, and force changes. Based on this, the execution layer converts the result of discrimination into adjusting some movement parameters so that movements display temporal order, trajectory, and force conforming to the requirement of artistic elements. The function of the integration layer is to coordinate various existing simultaneous elements in a single movement, not resulting in functional inhibition of other dimensions due to over-reinforcement of one dimension. They are gradually dependent on each other: the discrimination ability of the perception layer constitutes the regulatory basis for the execution layer; the stable output of the execution layer constitutes the prerequisite for the integration layer to achieve multidimensional coordination; the degree of mastery at previous level constrains the advancement effect of the next level^[5].

With maturity of integration level, it will have downward regulation with respect to the functional mode of perception and execution component. The perceptual discrimination of Mover become more selectivity; Execution regulation lean towards overall coordination instead of local correction. Unidirectional linear drive turns into bidirectional feedback loop between these two levels form. Organizers should match the integration strategy based on the hierarchical stage where the mover stands: Perception layer rely on diversified stimuli input as their main method; Execution layer stress targeted correctives for movement parameters; Integration layer focus on comprehensive regulation practices within whole movement context. Cross-level training arrangement follows the natural order of ability development.

3.2 Theoretical Model of the Proportion of Artistic Elements in the Training Load Structure

Proportion of artistic elements requires restructure of training load structure. Assuming that the basic framework of current physical fitness training and technical training does not change, there must be a reasonable proportion and time arrangement for new content. According to training cycles, the proportion of artistic elements dynamically adjusts with the advancement of training. Setting a relatively high proportion of perceptual discrimination content in the early training stage lays down the basic framework for discriminating artistic elements; focusing on execution reinforcement when the mover's perceptual ability increases. Increasing the proportion of integrative practice in middle and late stages of training can achieve better integration of the requirements of artistic elements into sport-specific technical training. Never exceeding too much throughout the whole cycle: It usually maintains within 15%-25% of the total training duration, occupying enough room for basic physical fitness and technical practice.

There is also a regularity regarding the combination of artistic elements during one training session. The activation of rhythmic arousal and spatial perception content through their respective perceptual channels during integration in the warm-up phase; artistic elements combined with sport-specific technical practices via embedding instead of isolated practice in the main training phase; arranging content for regulating force-effectiveness and relaxation perception in the cool-down phase prior to the end. Attention needs to be paid to the proportion relationship between these three kinds of artistic elements: rhythmic elements need to predominate at the early perception stage, the proportion of spatial elements should be appropriately increased in the mid-term technical correction stage while force-effectiveness elements will gradually increase in the later refinement stage. This dynamic adjustment conforms to the basic skill formation sequence which perception comes first then regulation and structure comes first then performance.

3.3 Explanatory Framework for the Influence of Artistic Elements on Motor Transfer Effects

Whether the improved movement quality obtained by artistic element training can be transferred into new movement tasks is another important theoretical problem for testing the training value of artistic element training; and the existence of transfer depends on the level of similarity of both perceptual and regulatory requirements in these two movement contexts. The common elements theory states that there are some overlapping requirements (rhythmic structure, spatial configuration, force-effectiveness characteristics) in different motor tasks if the overlapping elements reach a certain number with high specificity so that the already established neural adaptation patterns can work in the new task. Transfer of rhythm perception ability is easier than transfer of spatial positioning and force-effectiveness regulation depending on how similar the new task is compared to the original training content. Another explanation about transfer effect comes from the cognitive strategy transfer theory: artistic element training has developed the mover's habit of constantly monitoring his/her own movement process and being aware of actively adjusting. Once this strategic ability is formed it could work across contexts allowing the mover to have more acute self-diagnosis and flexible regulatory means in new movement learning.

Through integrating the above two mechanisms, a dual channel consideration including element overlap and strategy transfer is able to cover the conditions and mode of action of transfer effects better. Two kinds of transfer channels should be consciously activated in training: Select training content that has higher element similarity with the new task to facilitate direct transfer; Pay attention to cultivating the mover's self-monitoring and regulation strategies to improve the capacity reserve for indirect transfer. The coordinated operation between these two kinds of channels makes transfer effects go from occasional presence to predictable training benefit.

Conclusion

Artistic elements are not decorative factors externally attached to sports performance, but qualitative attributes inherent in the structure of movement. They can be grasped from the dimensions of time, space, and force as three types of elements: rhythmic, spatial, and force-effectiveness elements, and there is a clear corresponding relationship between these three types of elements and the dimensions of movement quality assessment. The integration of artistic elements with the routine training system is established on the theoretical basis of functional complementarity. Routine training ensures the basic specifications and stability of movement, while artistic element training points toward refined regulation and quality optimization; the two support each other rather than replace each other. At the level of mechanisms of action, rhythmic elements reduce the central regulatory load by providing a stable temporal reference, spatial elements improve spatial quality by strengthening trajectory perception and postural schema, and force-effectiveness elements enhance the refinement of force regulation by improving the level of force application discrimination and optimizing muscle timing. At the level of applied theory, the three-level model of perception-execution-integration reveals the sequence of ability development, the principle of dynamic adjustment of training proportions provides an operational reference, and the dual-channel explanatory framework of transfer effects explains the conditions for cross-context extension of training effects. Subsequent research may focus on effect verification at the neurophysiological level, differentiated needs of different event types, the dose-effect relationship of long-term intervention, and the moderating role of individual difference factors.

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