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Conceptual Models in Learning Theory

# The "Release Illusion": A Conceptual Model of Motor Skill Formation in Archery

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**Abstract**

**Background.** In archery, the final phase of the shot (release) is traditionally considered a controllable action. However, high-level performance indicates that attempts to consciously control this phase reduce stability and are associated with disruptions such as target panic. This creates a contradiction between the conventional interpretation of release as a controlled action and the actual mechanisms underlying effective performance.

**Objectives.** To develop a conceptual model of motor skill formation in archery that explains the emergence of release as an automated event, defines the conditions for stable shot execution, and identifies the mechanisms underlying skill disruption.

**Materials and Methods.** The study has a conceptual and theoretical character and is based on the analysis and synthesis of scientific and methodological literature in sport theory, motor learning, and movement psychology, as well as on the generalization of practical coaching experience in archery. A systems approach to movement analysis and conceptual modeling methods were applied.

**Results.** The shooting action is interpreted as an integrated functional system in which performance stability depends on the coordination of subsystems rather than the accuracy of individual elements. Two subsystems are identified: the aiming system and the execution system, whose functional separation is essential for stability. Release is not considered a discrete controlled action but emerges as an automated event when the execution system reaches a critical functional state. Skill disruption is explained as a transition from a program-based to a reactive mode of action due to conscious interference in the final phase. Follow-through is defined as a stabilizing phase that ensures the formation of sensorimotor feedback.

**Conclusions.** Shot stability is ensured by preserving the integrity of the motor program and maintaining the functional separation between aiming and execution systems. Release serves as an indicator of a correctly organized action rather than an object of control. Skill disruption is associated with a shift to a reactive mode of organization. The proposed model generalizes the principles of the Ukrainian school of archery and provides a framework for application in other complex coordination activities.

**Keywords:** archery, motor learning, motor skill, release, sensorimotor control, target panic.

## Introduction

In archery, shot performance is traditionally associated with the accuracy of individual technical elements, among which the final phase—the release—occupies a central position. In coaching practice, release is often treated as an action subject to direct control and expected to be executed at a specific moment (Ertan, 2009; Kalinichenko, 2020). At the same time, empirical observations indicate that attempts to consciously control this phase lead to decreased performance stability and the emergence of specific disruptions, including phenomena such as target panic (Hill et al., 2010; Nieuwenhuys & Oudejans, 2012).

This creates a contradiction between the conventional interpretation of release as a controllable action and the practice of high-level performance, where stability is achieved in the absence of direct intervention in the final phase (Masters, 1992; Beilock & Carr, 2001). Within existing approaches, this contradiction remains insufficiently explained, as analysis is typically focused on individual elements of technique rather than on the mechanisms underlying the organization of motor action as an integrated system (Kalinichenko, 1994, 1995).

Contemporary perspectives on motor activity conceptualize it as a hierarchically organized process in which performance outcomes are determined by the interaction of multiple levels of regulation (Bernstein, 1967; Wolpert et al., 2011). In this context, particular importance is attributed



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to the distinction between orientational and execution components of action, as well as to the role of automated mechanisms in ensuring stable performance (Galperin, 1969; Schmidt & Lee, 2019). However, these theoretical positions have not been sufficiently specified for the context of archery and do not adequately explain the mechanism of release and its disruption (Kalinichenko, 2008, 2009).

This necessitates a reconsideration of the structure of motor action in archery from a systems perspective, allowing the shot to be interpreted as the result of interaction between functionally distinct subsystems. Such an approach provides a framework for explaining both performance stability and the mechanisms underlying its disruption within a unified model (Anokhin, 1974; Shadmehr & Krakauer, 2008). At the same time, a research tradition has been established in archery that consistently develops a systems-based interpretation of motor action and is represented in international specialized publications (Kalinichenko, 1994, 1995, 2008, 2011, 2020; Kalynichenko, 2019, 2020). The practical relevance of this line of work is confirmed by its application in training athletes across different levels of expertise, from beginners to elite performers.

Within existing approaches, release is predominantly interpreted as an action subject to control or optimization within a specific technical element. The present approach revises this interpretation by treating release not as an action, but as an automated event that emerges when the execution system reaches a critical functional state. This perspective allows for a redefinition of the mechanisms underlying motor skill stability and explains skill disruption not as an execution error, but as a shift in the principle of action organization.

The scientific novelty of this study lies in the development of a conceptual model that explains the formation and disruption of motor skills through the principle of functional separation between the aiming and execution systems, and through the interpretation of release as an automated event. Within this framework, performance stability is understood as the preservation of the motor program, while disruption is interpreted as a transition to a reactive mode of organization.

The aim of the study is to develop a conceptual model of motor skill formation in archery that explains the emergence of release as an automated event, defines the conditions for stable shot execution, and identifies the mechanisms underlying disruption of the motor program.

## Materials and Methods

The study has a conceptual and theoretical character and is aimed at developing a generalized model of motor action organization in archery. The work is based on the analysis and synthesis of scientific and methodological publications in sport theory and methodology, movement psychology, and motor learning, as well as on the generalization of practical coaching experience (Schmidt & Lee, 2019; Wolpert et al., 2011). The source base includes scientific articles, instructional and methodological materials, coaching guidelines, and the results of long-term practice in training athletes of different qualification levels (Kalinichenko, 1994, 1995, 1999, 2008, 2011, 2020; Kalynichenko, 2019, 2020).

The selection of materials was carried out based on their substantive relevance to the problem of motor skill formation in complex coordination activities. The analysis included sources that allow motor action to be interpreted as an integrated functional system (Anokhin, 1974; Bernstein, 1967; Kalinichenko, 2008, 2011), as well as studies addressing the mechanisms of movement stabilization and disruption (Masters, 1992; Beilock & Carr, 2001; Kalinichenko, 2009, 2013). Sources limited to the description of individual technical elements without analysis of their functional role were not considered decisive for model construction.

The search and selection of sources were conducted using open scientific databases and libraries with keywords related to motor learning, movement coordination, action control, and archery technique. Additional sources reflecting the practical experience of the Ukrainian school of archery, represented in international specialized publications, were also included (Kalinichenko, 1994, 1995, 1999, 2020; Kalynichenko, 2019, 2020).

The methodological foundation of the study is the systems approach to movement analysis, according to which action is considered as the result of interaction among interrelated subsystems (Anokhin, 1974; Kalinichenko, 2011). The theoretical framework is based on the concepts of hierarchical organization of motor actions and stage-based skill formation (Bernstein, 1967; Galperin, 1969), which make it possible to analyze the relationship between orientational and execution components of action at different stages of its realization (Kalinichenko, 2009, 2012).

The main methods of the study were analysis and synthesis of scientific literature, comparative analysis of approaches to the interpretation of shooting technique, and conceptual modeling. Modeling was applied to construct a generalized scheme of motor action organization, allowing the mechanisms of stable performance and disruption to be explained (Shadmehr & Krakauer, 2008; Kalinichenko, 2011, 2013).

The limitations of the study are determined by its conceptual nature and its focus on generalizing functional principles of motor action organization. The study does not aim to provide quantitative analysis or systematic comparison of the effectiveness of different training methods. The primary focus is on the development of a theoretical model and its interpretation within a unified conceptual framework.

The generalization of the obtained positions was carried out through their integration into a conceptual model that reflects the interaction between the aiming and execution systems, the conditions for the emergence of release as an automated event, and the mechanisms of motor skill stabilization.

## Results

The results are presented in the form of a conceptual model describing the organization of motor action in archery through the interaction of functional subsystems and the mechanisms of their coordination.

### *1. Conceptual Model of Motor Skill Formation in Archery*

Motor skill formation in archery can be understood as the process of organizing an integrated functional system "archer–bow," in which performance outcome is determined

not by the accuracy of individual elements, but by the coordination of their interaction and the preservation of the integrity of the motor program (Kalinichenko, 2008, 2011).

Within this system, the shot is not a sequence of discrete actions executed under direct control, but the result of an unfolding organized process in which individual components perform different functions and are governed by different regulatory principles (Kalinichenko, 1994, 1995). Disruption of this organization leads not to local errors, but to a change in the mechanism of action realization.

The model distinguishes two relatively autonomous subsystems—the aiming system and the execution system—whose interaction determines both shot stability and the conditions under which disruption occurs (Kalinichenko, 2009, 2011). These subsystems are not interchangeable and perform different functions: one establishes the conditions for action, while the other ensures its realization.

Thus, motor skill formation in archery is not based on refining individual movements, but on establishing a mode of system organization in which the motor program can be realized without distortion, and its final phase emerges as a natural consequence of this organization (Kalinichenko, 2011).

### *2. Aiming System*

The aiming system is responsible for forming the spatial and dynamic conditions under which the motor program of the shot can be realized (Kalinichenko, 2009). Its function is not to execute the action, but to bring the "archer–bow" system into a state that allows stable completion of the movement without additional triggering influence.

Aiming includes visual alignment, stabilization of posture, control of oscillations, and reproducibility of reference points. However, the critical factor is not the list of components, but their coordinated organization. Functionally, the aiming system establishes an acceptable range of deviations within which further action remains stable under internal and external perturbations (Kalinichenko, 2009, 2010).

Importantly, the aiming system should not perform a triggering function. The use of visual signals as a basis for initiating the shot alters its role: from a system that establishes conditions for action to a source of a trigger, leading to interference in the execution process and disruption of its temporal structure (Kalinichenko, 2013).

Thus, the effectiveness of the aiming system is determined not by instantaneous precision of target alignment, but by its ability to create a stable system state within which the motor program can be executed without distortion and without transition to a reactive mode of regulation.

### *3. Execution System*

The execution system ensures realization of the shot as a continuous process in which the motor program unfolds without transition to a discrete triggering act (Kalinichenko, 2011). Its function is not to initiate the action, but to maintain a system state in which movement completion occurs as a natural consequence of prior organization.

A key element of the execution system is the "expansion" phase, which performs not only a biomechanical but also a regulatory function. It ensures continuity of the action, prevents its interruption at a critical point, and eliminates the need for conscious initiation of the final phase (Kalinichenko, 2013). In this state, muscular activity is organized in such a way that the system gradually approaches a threshold condition at which further удержание becomes unstable.

Within this logic, release is not initiated by a discrete command, but emerges as a consequence of the execution system reaching a critical functional state (Kalinichenko, 2020). Any attempt to deliberately influence the timing of movement completion disrupts process continuity, alters the distribution of muscular effort, and shifts the system from a program-based to a reactive mode of operation.

Thus, the effectiveness of the execution system is determined not by the ability to control the final phase, but by the ability to maintain continuity and integrity of the motor program until its completion, thereby creating conditions for the emergence of release as an automated event.

### *4. Principle of Functional Separation*

From the functional characteristics of the aiming and execution systems follows the principle of their separation: the formation of action conditions and the realization of action are governed by different regulatory mechanisms and cannot be effectively performed within a single conscious act (Kalinichenko, 2011).

The aiming system operates in an orientational mode and ensures stabilization of spatial parameters, whereas the execution system functions in a mode of continuous unfolding of the motor program. Attempts to combine these modes in the final phase of action lead to a regulatory conflict: visual control characteristic of aiming interferes with execution, which requires continuity and absence of a triggering act (Kalinichenko, 2009, 2013).

As a result, the system shifts from a program-organized mode to a reactive one, where the timing of the shot is determined not by the internal logic of the action, but by an external signal. This is accompanied by disruption of temporal structure, altered distribution of muscular effort, and loss of movement integrity.

Thus, functional separation of the aiming and execution systems is a necessary condition for motor skill stability.

### *5. Release as an Automated Event*

Within the proposed model, release is interpreted not as a response to situational afferentation and not as a purposeful action, but as an automated event emerging during the realization of a formed motor program when the execution system reaches a critical state (Kalinichenko, 2013, 2020).

The automated nature of release does not imply uncontrolled triggering of a dominant motor stereotype. Rather, it reflects the system's ability to maintain integrity of the selected action until its completion. In this case, the final phase is not initiated by a separate signal but unfolds as a natural consequence of prior movement organization (Kalinichenko, 2011, 2013).

In terms of stage-based action formation, the orientational basis ensures the creation of conditions for action during preparation and aiming stages. However, after reaching an automated level, it should not directly interfere in the final

phase. Reintroduction of conscious control at the moment of release leads to disruption of temporal and coordination structure or to a regression toward less adequate action patterns (Kalinichenko, 2009, 2013).

Thus, release functions not as an object of control, but as an indicator that the motor program is preserved and realized without distortion (Kalinichenko, 2020).

### *6. Mechanism of Disruption*

Disruption of motor skill arises not as a random execution error, but as a закономірний consequence of a change in the principle of action organization (Kalinichenko, 2009, 2013).

Under normal conditions, shot execution occurs within an automated motor program with preserved functional separation between aiming and execution systems (Kalinichenko, 2011). A critical factor in disruption is the return of conscious control to the final phase, where it does not perform an organizing function but alters the mechanism of movement realization.

In this case, an artificial triggering connection is formed, in which visual alignment with the target begins to serve as a trigger for shot initiation (Kalinichenko, 2013). Transition to this reactive mode leads to disruption of temporal structure, disorganization of muscular coordination, and loss of movement continuity.

The consolidation of such patterns has a cumulative character: repeated execution under reactive conditions strengthens maladaptive coordination structures and forms stable patterns of disrupted performance. In practice, this manifests as phenomena such as target panic, which should be understood not as isolated psychological reactions, but as systemic consequences of deformation of the motor program (Kalinichenko, 2013).

### *7. Follow-through*

Follow-through is not an external technical element or a formal completion of the shot, but a functionally necessary phase that ensures preservation of the integrity of the motor action after string release. Its absence or reduction leads to premature cessation of muscular activity, altering the structure of the final phase and retrospectively affecting shot quality (Kalinichenko, 2011, 2013).

Functionally, follow-through serves as a stabilizing continuation of the action, allowing the system to maintain the organization established in previous phases. This prevents abrupt transition from active state to relaxation, which is critical for preserving temporal and coordination structure (Kalinichenko, 2011).

At the same time, follow-through performs a sensory function. It is during this phase that proprioceptive and kinesthetic information about the executed action is integrated, forming the basis for performance evaluation. Unlike external results, follow-through provides access to internal parameters that determine reproducibility and stability (Kalinichenko, 2011, 2012).

Thus, follow-through acts as a mechanism of feedback formation, supporting refinement of the motor program rather than correction of isolated errors.

### *8. Generalization*

The results allow motor skill formation in archery to be interpreted as a process of organizing an integrated functional system in which performance accuracy is an emergent effect of coordinated interaction between aiming and execution subsystems and preservation of motor program integrity (Kalinichenko, 2008, 2011).

Performance effectiveness is determined not by the intensity of conscious control in the final phase, but by its functional appropriateness: the orientational basis organizes conditions at preparatory stages, while stable execution requires preservation of automated organization without additional intervention. Stability depends on the system's ability to maintain the selected motor program and realize it without distortion.

The proposed model reinterprets both the mechanism of skill formation and the causes of its disruption, and defines follow-through as a key element of feedback ensuring system stabilization and refinement of the motor program.

Conceptually, the results generalize empirically validated principles of the Ukrainian school of archery and interpret them within the framework of hierarchical organization of movement and stage-based skill formation, creating a basis for application to other complex coordination activities (Table 1).

**Table 1.** Conceptual Model of Motor Skill Organization in Archery

| Component | Functional Role | Key Mechanism | Stability Condition | Disruption Mechanism |
|---|---|---|---|---|
| Aiming system | Formation of spatial and dynamic conditions | Stabilization of system state | Maintains acceptable range of deviations | Becomes trigger for action (visual control → trigger) |
| Execution system | Realization of motor program | Continuous unfolding of movement | Preserves continuity of action | Interrupted by conscious control |
| Functional separation | Distribution of regulatory functions | Separation of orientation and execution | No interference between subsystems | Conflict between regulatory levels |
| Release | Automated event | Emergence at critical system state | Occurs without conscious initiation | Forced initiation disrupts timing |
| Disruption mechanism | Change in action organization | Transition to reactive mode | Program-based regulation | Trigger-based execution (reactive control) |
| Follow-through | Stabilization and feedback formation | Continuation of system organization | Preserves motor program integrity | Premature termination of movement |

## Discussion

The proposed model differs from existing approaches to motor skill analysis by shifting the focus from control of individual technical elements to the organization of interaction between functional subsystems. Within traditional interpretations, performance stability is associated with execution accuracy and control of critical phases, whereas in the present model it is determined by preservation of motor program integrity and functional separation between the aiming and execution systems.

The findings support the interpretation of motor action in archery as an integrated system in which the key determinant is not a specific technical element, but the mode of organization of interactions among its components. This perspective is consistent with theoretical frameworks of hierarchical motor control, where performance stability emerges from coordination across regulatory levels rather than from local control of isolated elements (Bernstein, 1967; Wolpert et al., 2011).

In this context, the principle of functional separation between aiming and execution systems can be understood as a specific operationalization of the distribution of functions within the structure of action. The aiming system performs an orientational role, establishing the conditions for action, whereas the execution system ensures realization of the motor program. This distinction aligns with the concept of the orientational basis of action (Galperin, 1969), which defines conditions for execution but, after automation, should not directly intervene in the final phase of movement. Violation of this separation leads to conflict between regulatory levels and to a transition from program-organized to reactive action (Masters, 1992; Beilock & Carr, 2001).

The interpretation of release as an automated event provides a more precise account of the final phase of movement. Unlike approaches that treat release as a discrete action subject to direct control, the present model conceptualizes it as the outcome of the execution system reaching a critical functional state. This is consistent with the theory of functional systems (Anokhin, 1974), where results emerge as integrated effects of component interaction rather than as responses to discrete triggering signals (Shadmehr & Krakauer, 2008).

Reconsidering skill disruption as a transition to a reactive mode of organization allows a reinterpretation of phenomena such as target panic. In this framework, such phenomena are not isolated psychological responses but reflect a change in the mechanism of regulation, in which visual information assumes the role of a trigger. This interpretation is consistent with research on performance breakdown in precision sports, demonstrating that excessive conscious control and attentional focus on execution destabilize action (Hill et al., 2010; Oudejans et al., 2011; Nieuwenhuys & Oudejans, 2012), as well as with findings in archery highlighting the role of coordination and muscular control in the final phase of the shot (Ertan, 2009).

A critical element of the model is the role of follow-through, which is interpreted as a phase ensuring system stabilization and feedback formation. This is consistent with concepts of sensory regulation and movement representation, according to which preservation of action integrity enables acquisition of information necessary for further refinement (Bernstein, 1967; Schmidt & Lee, 2019).

Overall, the proposed model does not contradict existing theoretical frameworks but specifies them within the context of archery. It clarifies the relationship between orientational and execution components of action, the role of conscious control across different stages, and the mechanisms underlying the transition from stable to disrupted performance.

The model has defined boundaries of applicability. It most adequately describes motor skill formation and execution in complex coordination tasks at stages of stabilization and high-level performance. Its applicability is limited at early stages of learning, where formation of the orientational basis is dominant, and in conditions of high variability requiring continuous restructuring of the motor program.

The proposed framework extends beyond archery and is relevant to other complex coordination activities in which performance depends on precise execution under time constraints and high sensitivity to interference in the final phase. This provides a basis for further research aimed at refining mechanisms of motor control and optimizing learning processes.

## Conclusions

Motor skill formation in archery should be understood as the organization of an integrated functional system in which performance outcome is determined by coordinated interaction between subsystems and preservation of the motor program, rather than by the accuracy of individual technical elements.

Shot stability is ensured by functional separation between the aiming and execution systems: the former establishes the conditions for action, while the latter ensures its realization. Violation of this separation leads to regulatory conflict and a transition to a reactive mode of execution.

Release is an automated event that emerges during the realization of the motor program when the execution system reaches a critical state. It cannot be considered a discrete action subject to direct conscious control.

The mechanism of motor skill disruption is associated with the return of voluntary control to the final phase of action and the formation of a reactive principle of organization, resulting in performance instability and persistent disturbances such as target panic.

Follow-through is a functionally necessary phase that ensures system stabilization and feedback formation, which is essential for further refinement of the motor skill.

The proposed model generalizes empirically validated principles of the Ukrainian school of archery and interprets them within contemporary frameworks of motor action organization, providing a basis for application in other complex coordination activities.

Practical implications of the model indicate that training should be directed not toward controlling the moment of release, but toward establishing a stable state of the execution system in which movement completion occurs automatically. Training should clearly separate the functions of aiming and execution, avoiding the use of visual signals as triggers for action initiation. Preservation of follow-through should be considered a mandatory component of training, ensuring the development of adequate sensorimotor feedback.

The presented framework can be used to optimize training processes, particularly in the development of

methods aimed at preventing reactive triggering patterns and promoting stable motor skill acquisition.

## Ethics Approval

The study is conceptual and theoretical in nature and did not involve human participants or animals; therefore, ethics approval was not required.

## Informed Consent

The study did not involve human participants or personal data; therefore, informed consent was not applicable.

## Data Availability Statement

The data supporting the findings of this study are available in publicly accessible scientific and methodological sources cited in the reference list. No additional datasets were generated or analyzed.

## AI Transparency Statement

Artificial intelligence tools were used in a supportive manner during manuscript preparation for language editing and structuring of the text. AI was not used to generate scientific ideas, interpret findings, or formulate conclusions. The author takes full responsibility for the content of the work.

## Conflict of Interest

The author declares no conflict of interest.

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# Ілюзія «релізу»: концептуальна модель формування рухової навички у стрільбі з лука

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 1 табл., 37 джерел.

**Актуальність.** У стрільбі з лука завершальна фаза пострілу (реліз) традиційно розглядається як дія, що підлягає безпосередньому контролю. Водночас практика висококваліфікованого виконання свідчить, що спроби свідомого контролю цієї фази знижують стабільність результату та пов'язані з виникненням порушень типу «паніка мішені». Це створює протиріччя між традиційним уявленням про реліз як керовану дію та фактичними механізмами ефективного виконання.

**Мета.** Розробити концептуальну модель формування рухової навички у стрільбі з лука, яка пояснює механізм виникнення релізу як автоматизованої події, визначає умови стабільної реалізації пострілу та розкриває причини порушення рухової програми.

**Матеріали і методи.** Дослідження має наративний характер і ґрунтується на аналізі та узагальненні наукових і методичних публікацій з теорії спорту, моторного навчання та психології рухової діяльності, а також на узагальненні практичного досвіду підготовки спортсменів у стрільбі з лука. Використано системний підхід до аналізу рухової дії та метод концептуального моделювання.

**Результати.** Рухову дію у стрільбі з лука інтерпретовано як цілісну функціональну систему, у якій вирішальним є не точність окремих елементів, а узгодженість взаємодії підсистем і збереження рухової програми. Виділено систему наведення та систему виконання, функціональне розділення яких є умовою стабільності дії. Показано, що реліз не є окремою керованою дією, а виникає як автоматизована подія при досягненні системою виконання критичного стану. Обґрунтовано механізм порушення рухової навички як перехід від програмно-організованої дії до реактивної внаслідок втручання свідомого контролю у фінальну фазу. Визначено роль післядії як фази стабілізації системи та формування зворотного зв'язку.

**Висновки.** Стабільність пострілу забезпечується збереженням цілісності рухової програми та функціональним розділенням систем наведення і виконання. Реліз виступає індикатором правильно організованої дії, а не об'єктом управління. Порушення рухової навички пов'язане з переходом до реактивного принципу організації дії. Запропонована модель узагальнює положення української школи лучного спорту і створює підґрунтя для їх застосування у інших видах складнокоординаційної діяльності.

**Ключові слова:** стрільба з лука, моторне навчання, рухова навичка, реліз, сенсомоторний контроль, паніка мішені.

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