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MECHANISMS OF TACIT PROFESSIONAL KNOWLEDGE TRANSFER IN HIGH-RISK CIRCUS DISCIPLINES

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ABSTRACT

The article examines the transfer of tacit professional knowledge in the training of Wheel of Death performers. The aim of the study is to develop a conceptual model explaining how a coach's embodied experience becomes accessible to a student without reducing a complex motor skill to a set of verbal rules. The methodological basis combined a practice-oriented integrative review with analysis of a training sequence developed by the author. The findings indicate that knowledge transfer involves identifying a critical cue, temporarily externalizing it, acquiring it through movement, and evaluating performance against an observable criterion. Tape marking the grip point during the flag element is considered a material anchor linking hand position, the phase of wheel movement, and the sensation of load. It is shown that progression to the next stage should take into account the ability to control the apparatus and maintain functional vigilance. Initial fear requires redistribution of attention, whereas excessive confidence after basic actions have been mastered requires a return to wheel control and stopping. The proposed Externalization–Embodiment–Criterion–Vigilance Model integrates initial training conditions, the skill-transfer cycle, and continuous attention regulation. The outcome of the cycle is a justified progression to the next stage of training.

Keywords: Tacit knowledge, Embodied learning, Wheel of Death, Circus pedagogy, Apparatus control, Professional vigilance.

1 INTRODUCTION

This article is based on professional practice in performing and teaching the Wheel of Death, including the training of artists in Japan, Colombia, the United States, and Germany. Within this practice, a training sequence, criteria for progression between stages, approaches to managing fear, and requirements for apparatus control have been developed. The execution of elements depends on rotational speed, body position, weight distribution, grip point, and the timing of force application. An error disrupts the coordinated movement of the performer and the wheel, creating a risk of falling, collision, or loss of

control. The Wheel of Death is classified as ground acrobatics involving the performer-driven movement of an apparatus [6]. Circus injury epidemiology confirms the need to account for discipline-specific characteristics and training exposure [7].

Professional cues often exist in the form of embodied knowledge that is applied without sequential verbal analysis. The mechanism of its transmission is understood as a coaching action that makes a particular element of experience perceptible, learnable, and assessable. Practical circus know-how may remain poorly represented in formal training [1]. The acquisition of motor skills is associated with demonstration, repetition, and directed attention [4]. A specific cue acquires meaning after being integrated into the overall action [8]. An object-based cue can transmit sensory information between coach and student [13]. In the training sequence considered here, this function is performed by tape marking the grip point during the flag element: the marker links hand position to wheel movement and to the sensation of pressure on the body. Training also includes early mastery of stopping, progression based on observable criteria, and adjustment of coaching intervention as initial fear gives way to increasing confidence.

The aim of the study is to develop a practice-based conceptual model of tacit professional knowledge transfer in high-risk circus disciplines using the Wheel of Death as the focal practice. To achieve this aim, the following objectives were defined:

- to identify mechanisms of tacit professional knowledge transfer;
- to describe the Wheel of Death training sequence;
- to determine the functions of external cues and embodied repetition;
- to formulate criteria for progression between stages;
- to distinguish work with fear from the prevention of reduced vigilance.

The research hypothesis is that the transfer of tacit professional knowledge in the Wheel of Death is ensured by a combination of an external cue, embodied acquisition, and criteria-based assessment. Verbal explanation, demonstration, or a marker placed on the apparatus makes a significant element of the action perceptible, after which it is consolidated through movement under the coach's guidance. The nature of coaching intervention depends on the student's condition. Initial fear requires redistribution of attention, whereas established confidence requires the maintenance of vigilance and respect for the apparatus.

The scientific novelty of the study lies in integrating, within a single model, the object-based externalization of an embodied cue, its acquisition through movement, criteria-based progression between stages, and continuous regulation of vigilance. No comparable explanation applied specifically to the Wheel of Death was identified in the available literature. Early mastery of stopping is treated as a prerequisite for further training, while reduced vigilance after several months of preparation is considered a distinct coaching problem.

2 MATERIALS AND METHODS

The study was conducted as a practice-oriented integrative narrative review followed by the development of a conceptual model. The unit of analysis was the mechanism through which a professional cue becomes available for perception, embodied acquisition, and assessment.

The literature search was conducted in Google Scholar and Crossref, while full texts were verified on journal websites. The search formula used was ("Wheel of Death" OR circus) AND ("tacit knowledge" OR "embodied knowledge" OR coaching OR injury OR "safety learning"). The terms sport, swimming, and dance were used to identify related studies. Of 42 publications, 15 met the established criteria: publication between 2022 and 2025, peer-reviewed status, and substantive relevance to circus training, injury, embodied knowledge, coaching pedagogy, or occupational safety.

The practical basis of the study was the training sequence used for Wheel of Death performers. The analysis covered student selection, requirements for the apparatus and rigging, mastery of stopping, progression between stages, tape marking of the grip point, redistribution of attention under fear, and restoration of vigilance after basic skills had been developed. This practice was used to construct the model and was not treated as a separate empirical sample.

The reviewed publications were analyzed for methods of externalizing professional cues, incorporating them into movement, assessing student readiness, and regulating attention. The identified mechanisms were mapped onto the Wheel of Death training sequence and then integrated into the Externalization–Embodiment–Criterion–Vigilance model. Quantitative indicators were retained in their original units and analyzed separately, without calculating an overall effect.

The corpus was purposive and did not cover the entire body of relevant literature. Training logs, measurement protocols, and individual-level statistics were unavailable. The number of trained performers is estimated at more than 20 and reflects the scale of professional practice rather than the sample size. No original empirical measurements were conducted; therefore, reductions in injury rates, acceleration of learning, and improvements in safety were not tested. Confidential circus company documents and incident data were not used. The applicability of the model to other circus disciplines was not empirically evaluated.

3 RESULTS

In the analysis of the flag element, the main difficulty is associated with the grip point. An experienced performer recognizes it within the movement, whereas a student has not yet connected hand position with the phase of rotation. For this reason, tape is placed on the wheel tube. It marks the point that must be gripped so that the movement of the apparatus brings the body back upward.

The tape transfers the cue from embodied experience to the apparatus. At first, the student sees the marker and places the hand in the indicated position. During execution, the spatial cue becomes linked to the timing of the grip. The correctness of the position is confirmed by the pressure of the wheel on the body. This is the sensation the coach expects when assessing the action.

The verbal instruction addresses a specific parameter on which successful execution of the flag depends. The remaining relationships are formed through movement. The student must feel the momentum of the wheel, coordinate body position with it, and recognize the moment when force should be applied. The ability to reproduce these relationships freely indicates embodied acquisition of the skill [8]. The pressure of the apparatus becomes a shared sensory cue for both the student and the coach [9]. Table 1 presents selected methods of motor-skill acquisition reported by 91 participants. The quantitative indicators show that practice, demonstration, explanation, attention, and internal representation are used in combination.

Table 1: Selected learning processes reported in "Show Me, Tell Me: An Investigation into Learning Processes Within Skateboarding as an Informal Coaching Environment"(Compiled by the author based on source [4])

Learning process	Number of respondents	Percentage
Practice	90	99%
Imagery	85	93%
Demonstration	80	88%
Explanation	78	85%
Attention	78	85%
Analogy, feel, and internal representations	44	48%

Note. The study included 91 respondents. Participants could report more than one learning process; therefore, the percentages are not expected to total 100%. The table presents selected categories from the original study.

The data in Table 1 cannot be transferred directly to the Wheel of Death. They provide a quantitative context for the combination of several learning channels. In the flag element, explanation defines the task, the tape provides a spatial coordinate, movement adds a temporal cue, and bodily pressure confirms the result. Without the external marker, the grip point could remain part of informalized circus know-how [1]. The tape makes one critical element accessible while preserving the embodied nature of the skill. Once the skill has been acquired, the student relies on the movement of the wheel and bodily sensation, while the marker retains a verification function.

Wheel of Death training is organized as a sequence of progression criteria. Student selection is conducted first. The apparatus and rigging are then inspected. Their proper condition and suitability for the upcoming exercise are mandatory prerequisites for beginning training. The wheel configuration also takes venue limitations into account: for facilities with low ceilings, a reduced version without a central axle was developed.

The first actions are learned inside the wheel. The student becomes familiar with the movement of the apparatus, coordinates stepping with it, and learns to maintain the required body position. The coach monitors the coordination between the performer and the wheel. Progression is postponed as long as the apparatus determines the student's actions

more strongly than the student controls its movement. Deceleration and complete stopping are introduced at an early stage, separately from trick technique. The student must dissipate the momentum and bring the wheel to a stationary position. Controlled stopping becomes the first independent progression criterion. Further work inside the apparatus and subsequent movement to the outside are permitted only after this action has been consolidated.

New elements are introduced one at a time. For each element, an observable outcome is established: the required body position, correct timing of action, and maintenance of control over the wheel. In the flag, progression is confirmed by gripping the marked point, coordinating the action with the phase of movement, and experiencing the expected pressure on the body. Training duration does not substitute for meeting these requirements. The sequence reflects knowledge of the abilities the student will need at the next stage [15].

Early mastery of stopping integrates safety into the technique of apparatus control itself [10]. The student gains a means of terminating movement before progressing to elements in which the consequences of error are more serious. At the same time, the method does not associate early stopping with a measured reduction in injury incidence; stopping is defined as a prerequisite for further progression. Mastering the pendulum generally does not present major difficulties. The main coaching problem may emerge several months later, once the basic skill has already been developed. Confidence increases, respect for the apparatus decreases, and familiar movements begin to be performed with less vigilance. The apparent ease of circus performance can conceal physical strain, pain, and the actual level of risk [11]. Therefore, successful execution of an element alone does not complete the assessment of readiness.

When vigilance decreases, progression is suspended. Attention is redirected to wheel speed, body position, and the timing of force application. The working requirement remains unchanged: the performer must control the wheel and must not allow the apparatus to determine the performer's movement.

Strong fear requires a different intervention. The wheel is fixed in a stationary position, and the student is positioned at the top or on one of the sides. In this position, squats and arm movements are performed. The additional task is used to redistribute attention between height, body position, and the movement being performed. As confidence increases, the task changes: the coach then focuses on maintaining vigilance and respect for the apparatus. Table 2 presents indicators of training exposure and injury frequency for selected groups of circus activity. During the observation period, 187 injuries were recorded during training.

Table 2: Activity-specific exposure and injury rates reported in "Untangling Risk Factors Including Discipline-Specific Exposure for Injuries in Preprofessional and Professional Circus Artists in the USA" (Compiled by the author based on source [7])

Activity group	Mean sessions per person per week	Injuries per 1,000 sessions
Entire cohort	7.75	3.82
Aerial disciplines	2.50	4.26
Combined aerial and ground disciplines	0.56	5.93
Ground apparatus disciplines	0.06	2.08

Note. The ground apparatus rate was calculated from one recorded injury and a mean exposure of 0.06 sessions per person per week. It represents the broader ground apparatus category and is not a Wheel of Death-specific estimate.

The Wheel of Death is classified as ground acrobatics involving the performer-driven movement of an apparatus [6]. The indicators in Table 2 cover the broader category of ground-based apparatus disciplines. The value of 2.08 injuries per 1,000 sessions is not an injury rate for the Wheel of Death and does not confirm the observation regarding the later decline in vigilance. Progression between stages is determined by the ability to perform the required action, maintain control over the apparatus, and sustain task-focused attention. At the beginning of training, attention is redirected away from fixation on fear. Once basic movements have been mastered, it is redirected toward parameters that familiarity may have made less noticeable.

4 DISCUSSION

The transfer of Wheel of Death skills requires distinguishing between cues that can be explicitly explained and relationships that can only be acquired through movement. Conscious control of every component can disrupt the integrity of an already formed action [3]. Therefore, the coach isolates the parameter that directly affects the outcome and temporarily makes it accessible to the student.

In the flag element, this parameter is the grip point. The tape transfers the selected cue from the coach's embodied experience onto the apparatus. The student receives an exact spatial coordinate without having to reconstruct it from demonstration or verbal description. Isolating a single operational feature corresponds to the principle of selective extraction of expert knowledge [5]. The decision as to which feature requires external marking remains a matter of the coach's professional judgment and depends on the conditions under which the element is performed [15].

The spatial marker acquires temporal meaning during the movement of the wheel. The student links the grip point to the phase of rotation and to the resulting pressure on the body. This transition cannot be reduced to memorizing hand position: the cue must become integrated into the embodied schema of the action [8]. Kinesthetic recognition develops through repeated interaction with the apparatus [9].

The tape extends the pedagogical connection between the coach's explanation, the student's action, and the mechanics of the wheel [13]. It fixes one parameter, while weight distribution, body position, and the timing of force application are acquired during performance. The tape can therefore be defined as a temporary material anchor for embodied learning. As the skill is acquired, the visual marker ceases to guide the action. The student begins to rely on the movement of the wheel and recognizes the correct grip through the character of the load. A continued need to search for the tape indicates that the spatial coordinate has not yet become a kinesthetic criterion. Partial externalization fulfills its function when the external cue is reintegrated into the complete movement.

Vigilance changes together with skill development. At the beginning of training, attention may be dominated by fear of height and the possibility of falling. Later, technical confidence may weaken the perception of danger. The concept of vigilance recalibration refers to adjustment of coaching intervention in accordance with the student's current attentional state. Under fear-dominated attention, additional motor tasks redistribute attention between height, body position, and the action being performed. The coach assesses the student's ability to maintain an appropriate working relationship with the apparatus while part of the student's attention is occupied by another task. Once fixation on fear decreases, further acquisition of the movement becomes possible.

Functional vigilance is characterized by perception of feedback from the wheel and maintenance of control. The student coordinates actions with the movement of the apparatus, is able to slow it down, and can bring it to a complete stop. This attentional state supports progression to subsequent stages.

Under excessive familiarity, basic competence begins to be perceived as complete mastery of the wheel. The author's professional observation that the pendulum is usually mastered relatively calmly, while respect for the apparatus may decline after several months, indicates that risk does not decrease linearly as skill increases. Its source shifts from fear to overestimation of one's own control. At this stage, progression is suspended, and the student returns to wheel-control and stopping exercises.

Specifying the consequences of an error links the warning to a situation that the student is already able to recognize [2]. Coaching feedback is directed toward the action in which loss of control or attention occurred [14]. This makes it possible to correct the cause of the deviation rather than only its visible outcome.

Early mastery of stopping expresses the principle that apparatus control must precede trick acquisition. The ability to terminate movement constitutes the first level of professional autonomy. The student gains the capacity to control the development of the action before progressing to more complex elements. Safety is incorporated into the structure of the skill and acquired within the professional task itself. Vigilance regulation takes into account the characteristics of a moving apparatus, training exposure, and the circus norm of tolerance for pain. The student's working state is determined by the relationship to the movement of the wheel. Fear must not block action, while confidence must not displace control. The coach adjusts the intervention when attention deviates in either direction.

The relationship between external cues, embodied acquisition, progression criteria, and regulated vigilance is integrated into the Externalization–Embodiment–Criterion–Vigilance Model, or EECV Model. The model was developed on the basis of the sequence used in training Wheel of Death performers.

The Foundation level defines the initial conditions of training. It includes student selection, readiness of the apparatus and rigging, mastery of wheel control, and the early ability to stop it. Once this foundation has been established, the Core Transfer Cycle begins: the coach selects a meaningful cue, gives it a perceptible form, organizes embodied acquisition, and assesses the result using an observable criterion. The Continuous Vigilance Regulation level accompanies the entire cycle. The state of attention is assessed during external cueing, guided practice, and criterion-based evaluation. Fear leads to redistribution of attention, functional vigilance supports continued training, and excessive familiarity returns the student to control exercises. Figure 1 presents the structure of the EECV Model and shows the feedback loops between regulatory actions and embodied practice.

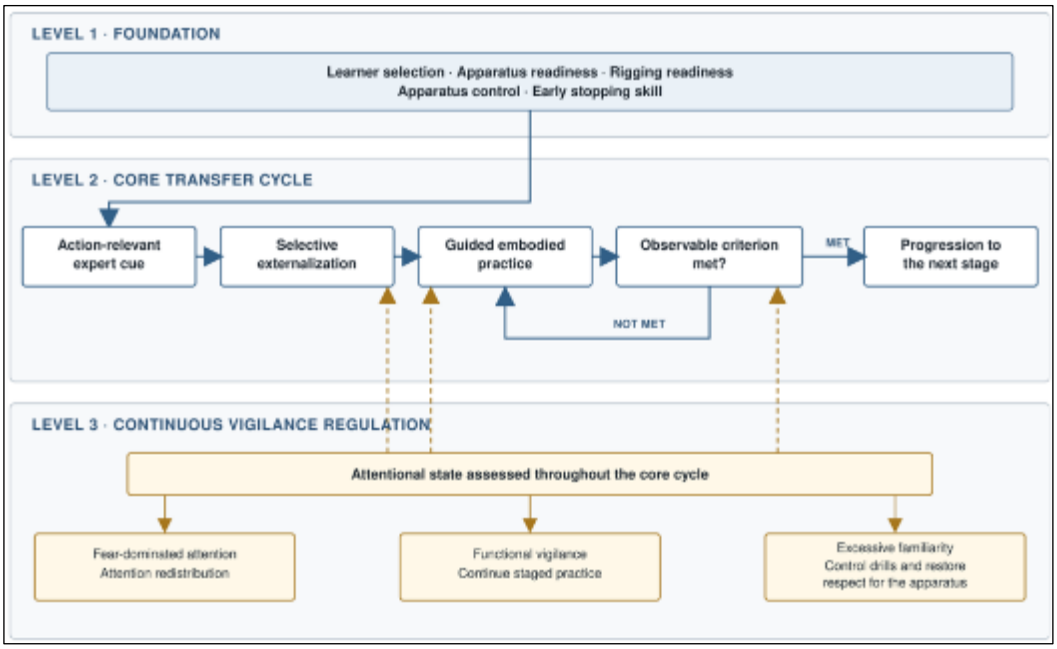


Figure 1: EECV Model of Tacit Knowledge Transfer in Wheel of Death Training (author's development)

The validity of the model is determined by the connection of each block to a specific coaching decision. Foundation addresses the readiness of the student and the apparatus. Externalization identifies which element of experience must be made perceptible. Embodiment translates the cue into action, while Criterion provides the basis for either progression or return. Vigilance adjusts this process according to the student's attentional state. The model contains no categories that cannot be related to an observable action of either the coach or the student.

The functioning of the core cycle can be traced through the example of the flag. After basic control has been confirmed, the coach identifies the grip point and marks it with tape. During guided practice, the student links the marker to the movement of the wheel and the sensation of pressure. Mastery is demonstrated when the element is performed in relation to the movement of the apparatus without dependence on visually searching for the marker. If the criterion is not met, the student returns to practice; if it is met, progression to the next stage is permitted. All operations within the cycle form a coherent sequence of coaching decisions.

The Vigilance loop operates according to the same principle. When attention becomes fixated on fear, the content of the exercise is modified, after which the student returns to guided practice. Under functional vigilance, the cycle continues without additional intervention. The emergence of excessive familiarity leads to renewed emphasis on control and reassessment of the ability to manage the wheel. Attention regulation is embedded within training and influences progression decisions regardless of how familiar the performed action has become.

The EECV Model can be applied to an individual training stage if that stage includes a meaningful cue, a method of external representation, a form of embodied practice, an observable criterion, and an assessment of the current attentional state. The absence of any one of these elements leaves the coaching decision without sufficient justification. An external cue without

practice creates dependence on instruction. Practice without a criterion does not provide a clear basis for progression. Technical execution without attention control may conceal either fear or excessive confidence.

The model preserves the embodied nature of professional knowledge while simultaneously making its transmission manageable. The coach formulates critical cues and progression criteria, but actual mastery of the wheel emerges through action. Through feedback loops, training is structured as a sequence of verifiable decisions rather than as an accumulation of completed tricks. The final outcome of the cycle is a justified progression to the next stage.

5 CONCLUSION

Tacit professional knowledge in the Wheel of Death becomes transferable once a cue that is critical to the action is identified and given a perceptible form. The tape placed on the apparatus confirms the partial nature of this process: it fixes the grip point, while coordination of the body with the wheel's momentum is developed through movement. Acquisition is complete when the spatial marker becomes a kinesthetic criterion and performance no longer depends on visually locating it.

Professional autonomy begins with the ability to control the wheel and bring it to a complete stop. Therefore, the duration of training and successful execution of an individual element do not in themselves provide sufficient grounds for progression. Advancement to the next stage requires reproducible performance, maintenance of control over the apparatus, and a functional attentional state. Early mastery of stopping integrates safety into the structure of the skill itself.

Risk changes over the course of training. Initial fear narrows attention, while increasing familiarity may reduce sensitivity to the movement of the apparatus and to the consequences of error. These states require different coaching decisions: redistribution of attention under fear and a return to basic control under excessive confidence. Functional vigilance therefore serves as an independent readiness criterion alongside technical execution.

The EECV Model formalizes skill transfer as a closed sequence of coaching decisions. Initial readiness provides entry into training, selective externalization makes a cue accessible, embodied practice integrates it into action, an observable criterion determines progression, and vigilance regulation accompanies the entire cycle. The model preserves the embodied nature of professional knowledge while making its transfer manageable. The outcome of the cycle is a justified progression to the next stage of training.

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