

Effects of Kinesthetic Versus Visual Imagery Practice on Two Technical Dance Movements

A Pilot Study

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Abstract

Motor imagery is a type of mental practice that involves imagining the body performing a movement in the absence of motor output. Dance training traditionally incorporates mental practice techniques, but quantitative effects of motor imagery on the performance of dance movements are largely unknown. This pilot study compared the effects of two different imagery modalities, external visual imagery and kinesthetic imagery, on pelvis and hip kinematics during two technical dance movements, plié and sauté. Each of three female dance students (mean age = 19.7 years, mean years of training = 10.7) was assigned to use a type of imagery practice: visual imagery, kinesthetic imagery, or no imagery. Effects of motor imagery on peak external hip rotation varied by both modality and task. Kinesthetic imagery increased peak external hip rotation for pliés, while visual imagery increased peak external hip rotation for sautés. Findings suggest that the success of motor imagery in improving performance may be task-specific. Dancers may benefit from matching imagery modality to technical tasks in order to improve alignment and thereby avoid chronic injury.

Mental practice describes a category of training techniques used to improve movement performance in sports and dance. Motor imagery, a specific type of mental practice, refers to the act of imagining the body performing a specific movement without concurrent motor output.¹ It may be classified as visual or kinesthetic, based on the nature of the images practiced prior to movement performance. Visual imagery (VI) describes the process of visualizing one's own body performing the task. Kinesthetic imagery (KI) simulates the felt experience of performing the task.²

Dance pedagogy benefits from a rich and varied background of traditional imagery use already present in the culture. Dancers report using various types of imagery to improve sequence memory and qualitative and quantitative aspects of performance, but there is little research that delineates the effects of specific motor imagery strategies.³ Of special interest is the use of motor imagery to enhance trained dancers' alignment for the purposes of improving

technical capabilities and promoting injury prevention. The latter aim is of particular importance, given the relatively high incidence of injury in this population.⁴

Improper body alignment in demi-plié, a technical dance movement that prepares the dancer to push off and land from jumps, and sautés, a series of two-footed jumps, puts the dancer at considerable risk of injury due to exaggerated anterior pelvic tilt (forward rotation in the sagittal plane) and insufficient external hip rotation, resulting in knee and ankle instability.⁵ Therefore, the present study aimed to identify quantifiable kinematic effects of VI and KI practice on the performance of a series of demi-pliés and sautés. The two tasks were chosen as foundational movements in the classical ballet vocabulary that differ in their sensorimotor planning requirements. The plié is a closed-loop movement, which allows the performer to consider proprioceptive information, while the sauté is a ballistic movement that relies more heavily on feed-forward planning. However, the two tasks require similar relationships of the body to exterior space.

Different types of mental images may yield different mental representations and, therefore, benefit different types of tasks.⁶ Movements that require the performer to consider the relationship of the body to exterior space have been found to respond

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Table 1 Schematic Representation of Experimental Procedure Outlining Number of Trials of Physical (PP) or Mental (MP) Performance per Block

	Sample Session					
	Baseline (recorded)	Training		Practice		Outcome (recorded)
Block	1	1	1	2	3	1
PP trials	10	10	5	5	5	5
MP trials			20	20	20	

During the training block all subjects received augmented verbal feedback from the researcher pertaining to the task goals. No feedback was given during baseline, practice, or outcome blocks.

better to visual imaging. Conversely, movements such as the plié and sauté, for which the task goal emphasizes the relationship between various segments of the body (e.g., pelvis and femur), may benefit more from kinesthetic imagery interventions.⁷ Thus it was hypothesized that KI would yield significantly less sagittal plane pelvic tilt and more consistent peak external hip rotation than VI in consecutive series of both demi-pliés and sautés, and that these kinematic changes would be greater post-intervention compared to subjects using VI or no imagery.

Methods

Subjects

Three female dance students (mean age: 19.7 years) were recruited from the Barnard College dance department. Subjects gave informed consent prior to participation, and the study was approved by the Institutional Review Board at Teachers College, Columbia University. The subjects had trained in ballet for an average of 10.7 years (SD = 3.1). They were randomly assigned to one of three conditions: KI practice, VI practice, or a mental arithmetic task (MAT), which served as the control condition (modeled on Oishi and Maeshima⁸).

Tasks

The plié is a simple preparatory movement that starts with the feet in an externally rotated position with the heels together, then the dancer bends and straightens her knees. The sauté is a small jump that starts and lands in plié; the dancer takes off from and lands on two feet. Arms were held overhead in the classical ballet fifth position for both tasks. Subjects completed the entire protocol for pliés

before repeating the same procedure for sautés.

Procedure

All subjects completed baseline, training, practice, and outcome blocks as outlined in Table 1. Baseline and outcome trials were recorded with an eight-camera three-dimensional optical motion capture system (VICON, Lake Forest, CA), with 39 markers placed on bony landmarks (Plug-In-Gait model).

Mental Practice Instructions

Prior to mental practice, subjects in all conditions were instructed to assume a relaxed standing position and close their eyes. All subjects were reminded of the task goals of maintaining the pelvis level and opening the knees as wide as possible. The VI subject was instructed to see herself performing 20 repetitions of the task, while the KI subject was instructed to feel the sensation of performing 20 repetitions of the task. The subject in the control condition (MAT) was instructed to subtract the number 7 in her head from a continuously presented, random list of three-digit numbers (from Oishi and Maeshima⁸).

Measurements

Kinematic data were collected at 120 Hz and stored for off-line analysis. The plié and sauté are bilaterally symmetrical tasks; thus, analysis was performed only for the right side. Sagittal plane pelvic tilt excursion and peak external rotation angle of the hip in the transverse plane were calculated for each trial and averaged across blocks for baseline and outcome trials. Pelvic tilt excursion is considered a measure

of pelvic stability, with smaller values denoting more stability.

Results

No change pre- to post-imagery practice in sagittal plane pelvic excursion was found under any condition for either pliés or sautés (all < 0.4°). Likewise, the control task (MAT) had no effect on peak external hip rotation for either task (all < 0.04°). However, peak external hip rotation was affected differently by each imagery modality (KI or VI) and according to task.

Post-KI practice the subject initiated the plié from a more externally rotated position of the hip and maintained a higher degree of external rotation for over half the movement's duration. The KI subject increased her average peak external hip rotation 4.2°, from 20.8 (± 2.1°) at baseline to 25.0° (± 2.1°) at outcome during the plié, but there was no change during the sauté (< 0.4°).

Post-VI practice the subject initiated the sauté from a more externally rotated position of the hip and maintained a higher degree of external rotation throughout the movement. The VI subject increased her average peak external hip rotation 1.5°, from 20.0° (± 1.0°) at baseline to 22.5° (± 2.1°) at outcome, but no change occurred during the plié (< 0.1°).

Discussion

This pilot study, while inherently limited in its generalizability, indicates a feasible design for a larger-scale investigation. Findings support the proposal that the benefits of different modalities of motor imagery are task-specific. While neither modality of imagery substantially affected sagittal plane pelvic excursion, KI practice

increased peak external hip rotation for the pliés only, and VI practice increased peak external hip rotation for the sautés only.

As noted previously, the plié is a closed-loop task during which the performer can consider proprioceptive feedback concurrent to the movement and correct the movement based on this feedback. The usefulness of feedback is optimized when delays in the sensorimotor program are possible.⁹ Results from this pilot study suggest that kinesthetic imagery practice allowed the KI subject to evaluate proprioceptive feedback concurrent to motor output and compare this information to the representation strengthened by imagery practice. Corrections to the plié movement could then be incorporated into future trials, resulting in successful attainment of the task goal.

The sauté is an open-loop, ballistic task which requires the performer to rely largely on forward models of the movement prior to enacting the motor program.⁹ Timing requirements inherent to sautés would likely not allow the performer to evaluate and apply proprioceptive feedback concurrent to motor output. Visual

imagery practice may have provided the VI subject with more salient information with which to build a strong mental representation of the jump.

Applications of discrete, repetitive, task-matched motor imagery for dancers are vast and require further investigation. As this pilot study suggests, motor imagery practice may be a valuable technique to incorporate into dance training to increase performance accuracy, improve dynamic stabilization of the body, and prevent chronic injuries due to kinetically hazardous alignment. Thus, a full experimental investigation of the effects of motor imagery perspective on hip and pelvis alignment during demi-pliés and sautés is currently underway.

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