Improving Postural Control in the Battement Tendu

One Teacher's Reflections and Somatic Exercises

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Abstract

The battement tendu is introduced early in dance training, remaining integral to a dancer's vocabulary. Although appearing relatively simple to execute, the tendu aesthetic takes years to master. One reason might be that efficient performance requires complex coordination of postural balance. Known as postural control, this coordination appears in development first in the trunk as a set of neuromuscular activation patterns that evolve throughout the life span. Trunk control is a prelude to postural organization necessary to support articulation of the limbs. Historical methods for teaching the tendu progression from barre to center floor have emphasized visually-acceptable body placement and limb articulation over postural control fundamentals. Using the battement tendu center floor as an example, the author opens an inquiry into the role of postural control in dance technique. The effect of dance or any other training on postural control and balance is conjectural, and no one method has emerged as the most effective for any age or population. Yet, much can be learned theoretically from the scientific literature on the role of trunk control of balance. From a practical point of view, somatic approaches offer insight into this issue, as well. The author deconstructs the tendu, exploring various movement phases out of their habitual context through a somatic lens. Building an entire class around a somatic focus may not be realistic for many dance educators. Practicing elements of the tendu through somatic awareness, however, can illuminate the role of the trunk as a foundation for support and articulation of the limbs.

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The battement tendu is a basic step in dance vocabulary that clearly separates dance from pedestrian movement. While many locomotor movements involve weight shifting and targeting of the foot in space, proper execution of the tendu takes years of training to meet technical and aesthetic demands. The tendu requires that the dancer: 1. demonstrate focused and lively attention; 2. maintain an upright and stable trunk; 3. express fluid, coherent energy through all limbs; and 4. properly utilize the ground reaction force from the floor during weight shift and weight transfer to support the gesturing leg—a highly complex motor skill, indeed! The term "battement tendu" comes from the French, meaning "stretched beating"[1] and refers in ballet to an advancement of the leg to the front, side, or back. The gesturing leg is extended along the ground until the pointed toes stretch so far that they barely touch.[1] While providing an accurate and momentary glimpse of the movement, any definition of the tendu conjures up an image of a disembodied leg without referencing the basic support required for limb gesture—the trunk.[2]

Postural control of the trunk is important in building the foundation for more articulated action of the limbs. While both the development and the effects of postural control within dance training still are conjectural, much can be gained from the scientific literature on the role of trunk support as a baseline for postural control. Preliminary research also suggests that postural control can be modified by somatic and other methods of training.[3,4] The battement tendu performed center floor will be used as example of a dance step where balance typically is challenged. Using an exploratory, somatic approach to movement observation, the tendu will be deconstructed into movement phases and explored through a somatic lens. This emphasis is designed to help dance educators better understand how elements of somatic education can shed light on important elements of motor skill learning that often remain obscured in traditional dance contexts. This somatic-based tendu exercise provides an experiential basis for exploring various postural control components underlying this basic step in the dance vocabulary.

Issues in Teaching

The tendu traditionally has been taught through a conditioning model employing demonstration, imitation, and repetition for reinforcement.[1,5] This model of motor learning is based mainly on *external* cueing (visual, verbal, and auditory) to promote proper neuromuscular coordination. The young dancer watches the teacher demonstrate, then attempts to execute the same leg movement through comparing his or her movement with the external reference. Visual external references also include the mirror, the teacher, and other students executing the same step standing at the barre or center floor. Which body parts to attend to and correct depends largely on which verbal cues the teacher employs. "Brush the floor with the foot" is one of the more dynamic verbal imagery cues designed to bring kinesthetic awareness to the foot-floor interface. This helps facilitate the appropriate neuromuscular control needed to utilize ground reaction force, convey the proper spatial trajectory and quality of movement of the gesturing leg, and strengthen the postero-medial muscles of the lower leg.[6] Other common verbal cues include keeping the pelvis "level" to maintain proper static placement of the trunk against moving limbs and to avoid excessive weight shifts over the standing leg.[1,5] Finally, auditory cues include rhythmic music along with the teacher's verbal counting and clapping—designed to reinforce placement, timing, and quality of effort within the learning context.[1,5]

Common errors observed in student performance include:

1. An inability to maintain upright alignment (placement) while executing the step (e.g., hanging on the barre);
2. Forced turnout leading to improper foot-to-floor interface (e.g., not "brushing" the floor properly or gesturing properly with the foot—as well as a host of other problems);
3. An inability to maintain a "neutral" pelvis (e.g., leading to pelvic rotation in tendu en avant or en dedans, or pelvic tilt to the side);
4. An inability to extend the energy line of movement fully out through the foot or knee, distorting the aesthetic line; and
5. Heavy-looking, unexpressive arms.[7]

These movement errors can result from a number of biomechanical and neuromuscular causes, including:

1. Inadequate trunk stabilization and balance reactions against gravity and the forces of movement (e.g., inadequate postural control development or coordination);
2. Improper use of ground reaction forces (e.g., using excessive tension to hold body weight up against gravity, as in improper "lifting");
3. Muscular imbalance in the "stirrup" muscles, resulting in a "sickled" foot (e.g., weakness or bony mal-alignment);[6] and
4. Lack of axial vertebral glide (movement of the upper thoracic spinal vertebrae upward along the central axis) when the arms are raised (e.g., inadequate neuromuscular control of the head-neck, combined with soft-tissue stiffness or poor sequencing of vertebral motion in an upward direction). Lack of axial glide can lead to excessive compression forces on the middle back, leading to an inability to support the arms statically during long phrases. Many of these errors can result from inadequate postural control organization.

Postural Control

Postural control (PC) is fundamental to successful execution of goal-directed movement.[8] It is the foundation of our ability to balance while we stand still or move, (whether initiating, continuing, or terminating movement).Postural control underscores our ability to remain upright and stable because of the fast neuromuscular responses to balance disturbances. These disturbances can either be external in nature, perturbations coming from the environment (e.g., tripping over the edge of the Marley floor), or internal, coming from voluntary movement (e.g., performing a port de bras).[9-11] In order to balance, our brains must constantly update the status of our body posture.[12] Yet, no one PC "center" exists in the brain to do this job.[13] Rather, a complex set of neurological and other processes interacts with the environmental conditions and the task to promote anti-gravity responsiveness for proper orientation, verticality, and balance.[9-11,13] Balance "emerges" from the interaction of multiple body systems,[14] a confluence of at least 13 different systems at last count.[15] Sensory integration of proprioceptive, visual, and vestibular input, righting and equilibrium reflexes, biomechanical properties of musculoskeletal tissues, and focused attention are just some of the processes that interact moment-by-moment to maintain balance.[13,16] These elements emerge differently at various stages of growth and development, training, and experience.[12,17,18] Flexible and adaptive postural responses evolve throughout our lives as we learn to "master" balance in wide-ranging experience throughout development.[14]

Postural Control Development

Postural control, then, is a lifetime achievement.[17-19] This process of learning to balance begins in infancy and continues into old age.[8] Postural responses to external balance disturbances can be elicited in infants during the first year of life, suggesting that they are to some degree innate[20,21] and that muscle synergies therefore are hard-wired in the nervous system.[20] These synergies are shaped by many types of experience throughout growth and development[20-22] and are not stereotyped. Adaptive and flexible postural responses are far from mastered in children or adolescents, however,[17,18] the ages when most start dancing.

Tendus performed center floor, for example, require a high degree of PC development to support both postural balance and locomotion requirements. Muscular coordination in the trunk must be rapid and flexible enough to handle both static gestures as well as weight-shifting and weight-transferring activities. The dancer must learn to balance at the barre and center floor while advancing the gesturing in different directions and changing legs with seamless fluidity regardless of changing tempos and efforts. In early development, the neuromuscular frame of reference for balance control to support locomotion begins in the lower trunk and pelvis, where it remains until puberty.[22,23] Head and upper trunk stabilization for complex motor skills takes longer to mature.[23] Up to age ten, for example, arm movement usually is coupled tightly with trunk movement, often unable to move in differentiated patterns.[19,24] Dance teachers observe this phenomenon, for example, when children's arms mimic their leg movements during pliés or other steps.

One challenge facing dance teachers is to design effective approaches for facilitating optimal growth and development of motor performance. The key for developing postural control in children is not so much to learn the "right" postural control strategy, but rather to build a repertoire of postural strategies throughout the lifespan, and also to facilitate the selection of appropriate postural strategies depending on the balance demands within the task context.[19] This implies that pedagogical approaches different than those emphasizing mimicked, rote methods might be explored.[25,26]

Postural Control Ingredients

Trunk organization depends on four major ingredients for adequate PC. Each of these develops differently in terms of when they emerge and the organizational characteristics.[21,22,27] The first ingredient (and the only one discussed here) is the development of fast-acting responses in the trunk known as muscle "synergies."[11,16,18] These muscular responses are global in nature (involving tight timing of activation of several muscle groups) and require little conscious control.[24] Muscle synergy patterns activate very fast in response to predictable ("anticipatory") and unpredictable ("reactive") balance disturbances.[11,15] In essence, postural synergies simplify things,[28] enabling the nervous system to process enormous amounts of information quickly and efficiently that are coming from the body, the environment, and the task.[22] These rapid activation patterns enable us, for example, to walk automatically in any number of different environments without thinking about it and readily change our walking pattern or direction—even while talking on the cell phone—without falling down.

The second ingredient in PC is coordination of the superficial and deep muscles of the trunk. These muscles have different functions.[12,29,30] The deepest spinal muscles assume the main task of postural support, while the more superficial trunk muscles perform large range voluntary movements.[29,30] This functional organization allows the trunk to mold fluidly to various postures and movements while preserving overall stability.[12] While postural control patterns characteristically are global, rapid muscular responses in the trunk, dancers also need to train these different functions to achieve both range and articulation. The last two ingredients in achieving trunk control are proper eye-head coordination[16] and a lifetime of varied experience to challenge balance in novel contexts to foster flexibility in PC responsiveness.[8,11]

The onset and pattern of recruitment of postural synergies also depends on context—where, when, and in what conditions the movement is being executed. A tendu performed at the barre, for example, does not activate the exact same postural responses as one performed center floor. Analysis of the tendu from a biomechanical perspective shows that the muscular and joint kinematics are context-dependent. Those occurring at the barre (an external support for body balance) differ from those center floor (where balance is more challenged).[31,32]

In most postural tasks, recruitment of reflex muscle synergies in the trunk precedes voluntary movement of the limbs to accommodate and control for movement in space.[33] When a dancer prepares to tendu, trunk muscle synergies activate milliseconds before the onset of leg advancement to maintain balance. Trunk muscles activate in anticipation of the leg moving forward (anticipatory control) to help keep the trunk from moving backward—a counterbalancing reaction to limb advancement. Without this "feedforward" signal to the muscles to stabilize the trunk, the dancer might readily fall when shifting weight onto the stabilizing leg. The dancer must be able to modulate the changing demands proximally (e.g., through stabilizing the head and trunk) while negotiating different motor demands peripherally in the arms and legs.[9] Poorly coordinated or underdeveloped PC is seen in excessive agonist-antagonist fixation (coactivation) of the trunk or other limb muscles, resulting in lack of differentiated movement between trunk and limbs and awkward movement transitions.

Training Postural Responsiveness

Dance technique, conditioning methods (e.g., Pilates), and select somatic education approaches help train PC responsiveness.[15] In comparison to limb patterns, trunk patterns are notoriously hard to re-educate or modify with training.[12] It seems much easier, for example, for novices to learn a fingering pattern on the piano than to learn the subtleties of trunk movements required in gymnastic balance.[12] Preliminary evidence, however, supports the concept that postural control strategies can be modified through training[3] and that somatic education may play a role in retraining.[4,25] More seasoned dancers commonly study somatic approaches such as Ideokinesis, Alexander Technique, and the Feldenkrais Method®. What these methods have in common is the use of sensory awareness of movement removed from its usual effort context as a tool for training and re-educating coordination. Theoretically, attending to augmented sensory information rather than focusing on performance (achieving a movement goal) helps to refine the details of the motor program.[34,35] These dancers report that somatic approaches help them learn to uncover and alter maladaptive movement habits and postural responses.[36] Attending to augmented sensory information while removing the usual effort of a movement facilitates change. Altering the movement task in this way shifts the focus from faster and more challenging balance tasks to slower, quieter movements that facilitate motor control processing. For example, the dancer can: 1. visualize the whole or part of the movement instead of executing it (Ideokinesis); 2. limit the range of movement, paying exquisite attention to the sensations involved in movement initiation (Alexander Technique); or 3. playfully explore components of the movement with the goal of the action entirely hidden (Feldenkrais Awareness Through Movement).

Somatic Suggestions from the Field

A playful, novel context in which paying attention more to sensation (the means) rather than to the goal[34,37] (end product) of the action offers a unique window into identifying postural responses. My observations have been that simply dividing the tendu into phases and practicing these phases with somatic awareness fosters a better understanding of the PC elements needed for trunk and limb support. A good place to start is by placing the dancer in a novel context (lying face down on the floor), much as might occur in a Feldenkrais Awareness Through Movement lesson, where learning through attending to movement feedback of components of a whole movement frequently occurs out of gravity.[38] One objective is to help dancers discover maladaptive postural habits and movement patterns that go unnoticed within the context of the usual space-time-effort values in the dance class.[34,38] Dividing the tendu into a number of phases for observation and directing the dancer's attention to the sensory elements within the movement experience assists in achieving this objective. As stated, these postural habits are triggered within milliseconds of movement onset and remain fluid throughout the movement. A great deal of muscular action happens in every phase of movement—the conception, the intention to move, the initiation, the sequencing, the reversing, the descending into rest, and finally resting. Learning to attend to the sensations embedded in these different phases is the first step in the practice.

It is important to frame the sensory exploration of these phases in a quiet environment that fosters relatively effortless "non-doing" (i.e., moving with attention to process rather than goal achievement). This unique somatic practice environment enables a better understanding of: 1. the physical feeling state of trunk stabilization throughout the entire movement phrase; 2. the magnitude and degree to which these reactions affect the muscular tone of the whole trunk during different phases of movement; and 3. options for altering unsupportive trunk stabilization by applying conscious awareness to the way in which habitual reactions can be sensitive to change. Dancers can find value in as little as 10 minutes of focused, appreciable attention to exploring these phases. Further, teachers can "explode" each phase (the way one might explode a search on the Internet) into a mini-module adding variations in movement and timing. The progression you build can become increasingly more task-specific so that ultimately a tendu is built out of threaded elements built on mindful attention. The process does not stop here, however. Dancers need to challenge themselves beyond the usual time-space-effort factors in which tendus traditionally are taught to strengthen whole body balance responses.[39]

Baseline Somatic Practice

Begin by checking in with your baseline of sensation by performing a free-standing tendu (center floor, first position, arms á la seconde). Assume first position and alternate each foot for 4 repetitions in forward (en dehors), sideward (á la seconde), and backward (en dedans) directions. Go slowly enough to observe and try for yourself to identify as many different phases as you can that go into executing the step, from assumption of first position to the termination of the whole movement series. Suggested questions to help frame the experience might be:

1. What shifts does the trunk make when you assume first position? Does your trunk go down and forward, up and back, or rotate slightly as you lift the arms and begin to advance your leg?
2. What do you feel in your neck and upper back when you come into position and raise the arms? A pulling down in the chest? An arching of the lumbar spine?
3. What happens when you begin to gesture with the right leg? Do you sense the trunk muscles "ramping up" as the movement continues?
4. How are the weight shifts accomplished? For example, do you shift at the ankles to adjust the body over the feet to the new position of arms?
5. What happens in your body on reversing the movement?
6. What muscles release as you let go of the movement and rest?

Once you have gathered some baseline information, see if you can make a list of the different phases of the movement. You can check your list against the one described later.

Now lie on your stomach (prone), and put your forehead on your hands so your head is in midline and your feet in parallel or in a comfortable, symmetrical outward or inward rotation. Take a full minute to notice the buzz inside your head as you just let your thinking settle down to focus quietly on the next set of sensations. Quiet your thinking and sense your breathing, its location, rate, rhythm, depth within the phases of inhaling and exhaling. Notice the directional pulls in your body in relation to breathing and to the contact with the floor. Think that you are going to lift your left leg toward the ceiling (hip extension). Just *think* the movement first. Notice all the elements that go into awareness of the movement. Then, let go of the thought. It might take some time to stop thinking of the imagined movement goal and the associated sensations of muscular effort. Compare the muscle activation effects of imagined action (intending to move) to baseline (having no intention to move).

Now, actually initiate the movement slowly by lifting your leg no more than *one inch* off the floor. Do not try to lift your leg higher. Acquaint yourself with what it feels like to lift just enough to feel and know that you are moving. Lower your leg and then spend at least 30 seconds to one minute actively sensing movement feedback. What are all the sensations that occurred in your body from that one movement?

Once you have some preliminary insights, repeat the movement slowly and easily, but deliberately, with the aim of discovering how the whole of your trunk can best garner support. Paying attention to the stabilizing leg is also interesting. Note that as you lift one leg, you may actually feel as if the opposite leg is moving in the opposite direction (into the floor) to counterbalance. Rest for at least 30 seconds after repeating the movement three or four times.

In the next set of repetitions, add eye movement. Slowly scan from right to left with the eyes closed as you seamlessly lift each leg in a slow, alternating pattern. Moving the eyes in non-habitual patterns may illuminate how easily our eyes habituate to various patterns in helping stabilize balance.

Figure 1 A playful approach to challenging postural responses in the tendu.

Notice the next time you go to technique class if you readily want to assume the same place at the barre or center floor, and readily "lock" your eyes in specific patterns as balance is challenged.

Once you have spent about 15-30 minutes exploring this baseline exercise, stand and repeat your free-standing tendu. What differences do you sense? Write down the phases you experienced and compare them with the list below:

- Assumption of first position (lying down on the floor on your stomach, or sidelying, as another option);
- Sensory attunement—the shift from "busy brain" to focused sensory awareness;
- Body scanning (sensing the base of support—e.g., what's touching the floor);
- Pre-initiation (having the intention to move and noticing how the body reacts);
- The onset of initiation—slow, small-range (the first awareness of effort and refinement of effort);
- Lifting the leg (hip extension);
- Sequencing to the decided end range of the movement;
- Weight shift and transfer to facilitate the advancement of the gesturing leg;
- Sequencing of the foot to the end of the full gesture;
- The moment of reversing the movement and coming back to first position;
- Sensing the descent of the leg;
- Finishing the desired number of repetitions (movement termination);
- Resting (defined as the time it takes to let go of any lasting sensation of the movement); and
- Shifting to the opposite leg.

Repeat the exercise now with fuller awareness of the different components, and begin to identify the different sensations associated with postural habits and the strategies you use to move through the various phases.

Taking it into Real Time Contexts

Once familiar with this process of slow, deliberate sensing of movement phases, try a host of other novel contexts for the tendu to bring the movement back into more familiar effort territory. Make it playful. For example, you can try various body contact explorations, such as trying the tendu in sidelying or putting partners back-to-back. Or, another organizational challenge might be trying the tendu upside-down. For safety, start with the familiar yoga position known as "downward facing dog." Try a few tendus from this position. By going upside-down, you can now experience the ground reaction force into the upper body and arms, a great way to find better support for the upper body and arms. As you move to the wall, make sure you have a partner to spot you as you assume the 90° jackknife position with your feet on the wall (Fig. 1). Once stabilized on your hands and arms, try a small tendu here. You should be able to breathe, talk, and sing with ease. Once you have tried a couple tendus with this challenge, check in with your baseline tendu again. What has changed? Improved? As you re-enter the technique class, see what you can recall from these somatic-based practices that can assist you as your explore various tendu themes and variations.

Summary

Good postural control is the baseline of balance and coordination in both pedestrian and skilled activity, but training elements that enhance PC are still unknown, especially for dance. Preliminary research suggests that the neuromuscular coordination underlying PC in the trunk can be altered with training and that select somatic methods might provide a window into the process of re-education. Somatic approaches can help inform dance about aspects of PC that can become obscured in skilled movement during normal space-time-effort execution. Using Somatic practices to help with classical dance steps offers dancers a refreshing approach to motor learning that can add to the already rich pedagogy.

References

1. Kassing G, Jay DM: *Teaching Beginning Ballet*. Champaign, IL: Human Kinetics, 1988.
2. Massion J: Postural control systems in developmental perspective. Neuroscience and Biobehavioral Reviews 22:465-472, 1998.
3. Jacobs JV, Horak FB: Cortical control of postural responses. Journal of Neural Transmission 114:1339-1348, 2007.
4. Cacciatore TW, Horak FB, Henry SM: Improvement in automatic postural coordination following Alexander Technique lessons in a person with low back pain. Physical Therapy 85:565-578, 2005.
5. Paskevska A: *Ballet: From the First Plié to Mastery, an Eight-Year Course*. New York: Routledge, 1993.
6. Clippinger K: *Dance Anatomy and Kinesiology*. Champaign, IL: Human Kinetics, 2007, pp. 315, 337-338.
7. Batson G: Dance technique through a somatic lens. Presented at the Annual Conference of the American Association of Health, Education, Recreation and Dance, Georgia Chapter, Atlanta, GA, November, 2007.
8. Assaiante C, Mallau S, Sebastien V, et al: Development of postural control in healthy children: A functional approach. Neural Plasticity 12:109-118, 2005.
9. Nasher LM: Adapting reflexes controlling the human posture. Experimental Brain Research 26(1):59-72, 1976.
10. Horak FB, Nashner LM: Central programming of postural movements: Adaptation to altered support-surface configurations. Journal of Neurophysiology 55(6):1369-1381, 1986.
11. Shumway-Cook A, Woollacott M: *Motor Control: Theory and Practical Applications*. Baltimore: Williams & Wilkins,1995, pp.239-268.
12. Smania N, Picelli A, Romano M, Negrini S: Neurophysiological basis of rehabilitation of adolescent idiopathic scoliosis. Disability and Rehabilitation 30(10):763-771, 2008.
13. Horak FB: Postural orientation and equilibrium: What do we need to know about neural control of balance to prevent falls? Age Ageing 35(Suppl 2):ii7-ii11, 2006.
14. Thelen E: Motor development: A new synthesis. American Psychologist 50(2):79-95, 1995.
15. Krasnow D, Monasterio R, Chatfield SJ: Emerging concepts of posture and alignment. Medical Problems of Performing Artists 8:12-20, 2001.
16. Massion J, Alexandrov A, Frolov A: Why and how are posture and movement coordinated? Progress in Brain Research 143:13-27, 2004.
17. Woollacott M, Shumway-Cook A: Changes in postural control across the life-span: A systems approach. Physical Therapy 20(12):799-807, 1990.
18. Assaiante C, Amblard B: An ontogenetic model for the sensorimotor organization of balance control in humans. Human Movement Science 14:13-43, 1995.
19. Latash ML, Krishnamoorthy VK, Scholz JP, Zatsiaorsky VM: Postural synergies and their development. Neural Plasticity 12(2-3):119-130, 2005.
20. Ting LH, McKay JL: Neuromechanics of muscle synergies for posture and movement. Current Opinion in Neurobiology 17:622-628, 2007.
21. Woollacott M, Assaiante C: Developmental changes in compensatory responses to unexpected resistance of leg lift during gait initiation. Experimental Brain Research 144:385-396, 2002.
22. Thelen E, Smith LB: *A Dynamics Systems Approach to the Development of Cognition and Action*. Cambridge, MA: Bradford Books/MIT Press, 1994.
23. Assaiante C, Woollacott MH, Amblard B: Development of postural adjustment during gait initiation: Kinematic and EMG analysis. Journal of Motor Behavior 32:211-226, 2000.
24. Hodges PW, Cresswell AG, Daggfeldt K, Thorstensson A: Three dimensional preparatory trunk motion precedes asymmetrical upper limb movement. Gait and Posture 11(2):92-101, 2000.
25. Green J: Somatic authority and the myth of the ideal body in dance education. Dance Research Journal 31(2):80 -100, 1999.
26. Lakes R: The message behind the methods: The authoritarian pedagogical legacy in western concert dance technique training and rehearsals. Arts Education Policy Review 106(5):3-18, 2005.
27. van der Fits IB, Klip AW, van Eykern LA, Hadders-Algra M: Postural adjustments accompanying fast pointing movements in standing, sitting and lying adults. Experimental Brain Research 120(2):202-216, 1998.
28. Bernstein N: *The Co-ordination and Regulation of Movements*. Oxford, UK: Pergamon Press, 1967.
29. Hodges PW: The role of the motor system in spinal pain: Implications for rehabilitation of the athlete following lower back pain. Journal of Science and Medicine in Sport 3(3):243-253, 2000.
30. Moseley GL, Hodges PW, Gandevia SC: Deep and superficial fibers of the lumbar multifidus muscle are differentially active during voluntary arm movements. Spine 27(2):29-36, 2002.
31. Wieczorek N, Casefolt JB, Lambert CR, Kwon YH: Resultant joint movements during a degágé with and without a barre. Presented at the 17th Annual Meeting of the International Association for Dance

Medicine and Science, Canberra, Australia, 2007.
32. Wilmerding M, Heyward VH, King M, et al: Electromyographic comparisons of the developpé devant at barre and centre. Journal of Dance Medicine and Science 5(3):69-74, 2001.
33. Horak FB, Macpherson JM: Postural orientation and equilibrium. *In*: Roswell LB, Shepherd JT (eds): *Handbook of Physiology*. New York: Oxford University Press; 1996, pp. 255-292.
34. Buchanan PA, Ulrich BD: The Feldenkrais Method: A dynamic approach to changing motor behavior. Research Quarterly for Exercise in Sport 74(2):116-123, 2003.
35. Handford C, Davids K, Bennett S, Button C: Skill acquisition in sport: Some applications of an evolving practice ecology. Journal of Sports Science 15:621-640, 1997.
36. Batson G, Schwartz RE: Revisiting the value of somatic education in dance training through an inquiry into practice schedules. Journal of Dance Education 7(2):47-56, 2007.
37. Smith LB, Gasser M: The development of embodied cognition: 6 lessons from babies. Artificial Life 11(1-2):13-30, 2005.
38. Reese M: A dynamic systems view of the Feldenkrais Method. Somatics 12:18-27, 1999.
39. Pie-Fang C, Woollacott MH: Inefficient postural responses to unexpected slips during walking in older adults. Journal of Gerontology Series A, Biological Science and Medical Science 53A:M471-M480, 1998.