

Understanding Balance

Applying Science to Dance Training

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Watching a ballet pas de deux or the gymnastic gyrations in a ballroom dance competition suggests that dancers possess supra-normal balance. By the same token, daily balance itself is a miracle. We can dash down a flight of stairs while maintaining a lively conversation on a cell phone, nursing a full cup of coffee, or fumbling for our car keys at the bottom of a large handbag – a testimony to our brain’s ability to stay upright and stable in a world of constant motion. Balance is, simply put, the ability to stay stable and not fall as we move within and beyond our base of support (normally our feet in everyday navigation). In dance, this base of support changes constantly – such as when the dancer piqués from two feet to one foot, and even to no feet when airborne. The dancer’s base of support also can shift to the pelvis when rolling, the arms during handstands, and the head

when break dancing.

Balance is a lifetime achievement, a process of learning to navigate in the world that begins in infancy and continues into old age.¹ We are upright skeletons with many joints and muscles, tottering over a small base of support (our 52 foot bones). Add our high center of gravity, and we oscillate like an inverted pendulum. At the same time, balance is much more than a mechanical phenomenon. Even from the perspective of neuroscience there is no one balance “center” in the brain. Rather, balance emerges from the interplay of many body systems and the task at hand (Figure 1).^{2,3} The brain stays busy, constantly updating the status of our body and solving three balance problems: 1) “Where am I now?” 2) “Where am I going?” and 3) “What am I going to do next?”³

Our brains are in essence “embodied,” processing online

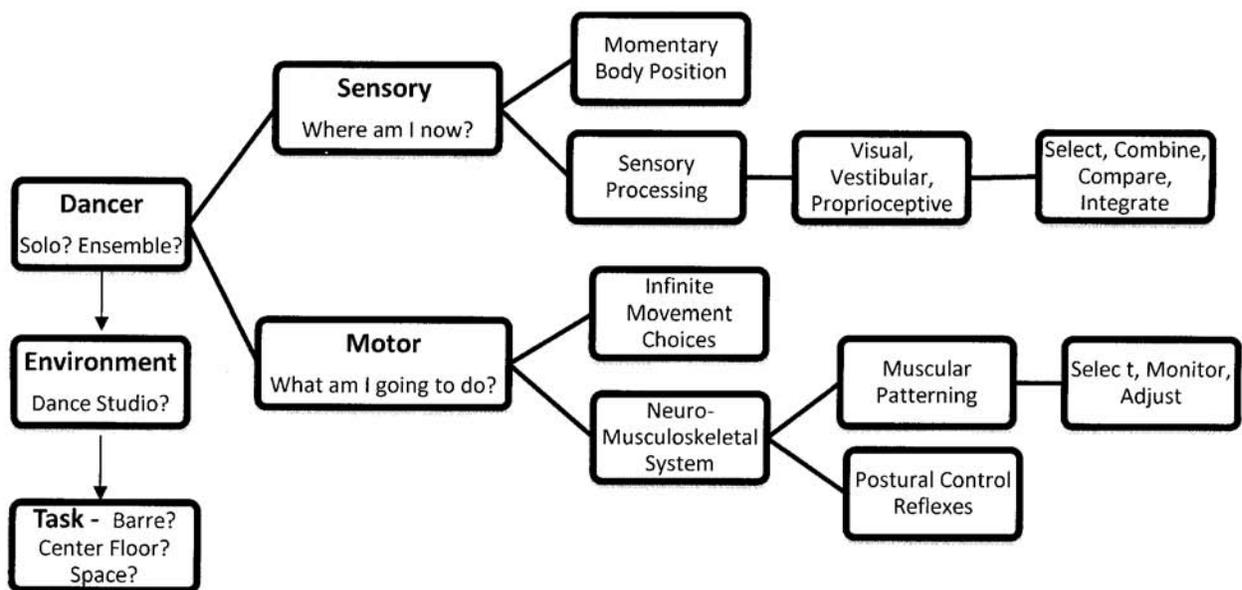


Figure 1 “Balance” – A Complex System of Support Combining Person, Place & Movement Task. (Batson G, derived from *Resources on Balance*, http://resourcesonbalance.com/clinical_info/BalanceControl.aspx.)

information moment-by-moment from the body senses and the world. Brain processes for balance are constantly working, attuning to bodily needs for stability as environmental and task conditions change. Whether practicing alone in a studio or on stage performing with a large corps of dancers, the dancer's brain is busy processing a lot of input. The brain integrates multiple mechanical forces coming from our moving body, the ground, and any other objects we are carrying or touching, as well as our perceptions, thoughts, intentions, and emotions. In addition to handling sheer volume of input, we also need for our complex balance system to handle prediction and the actual outcome of our experience. Our intentions influence our current balance status, but may be altered at any moment by spontaneous, unanticipated changes in the original plan. Our ability to perceive *in action* helps the brain process both anticipated movement and the actual outcome, especially when dancing. Perceiving in action involves the integration of a wealth of cutaneous, proprioceptive, visual, and vestibular inputs with our conscious intentions, as well as many other non-conscious neurological and mechanical inputs. To accomplish this extraordinary task our brains use a flexible "map" of our body,⁴ which functions as a unified program linking body to space and context. Dance training ideally expands our body map's capabilities, promoting clarity and differentiation of body part relationships for skillful balance and coordination.

Balance Within the Dance Context

To handle the complexity of balance, our nervous systems must act fast. For this we have evolved "postural responses."⁵ Postural responses are whole body neuromuscular reflex patterns that activate quickly, either in response to our decision to move or when we are inadvertently thrown off balance. In ballet, for example, balance reactions often are anticipatory, coming mainly from the dancer's own body. When dancers "prepare" for a port de bras while standing center floor in first position, the anticipated movement of the arms disturbs the static standing body. The brain "senses" this intent to move and activates the muscles of the trunk and legs shortly before the onset of arm movement to prevent falling. Similarly, when preparing to tendu, the reflex muscle synergies in the trunk and standing leg activate to maintain balance milliseconds before the gesture leg moves forward. These quick, whole body reactions are necessary to support limb movements without excessive disturbance to the center. Without these anticipatory control signals to the muscles to stabilize the trunk, the dancer might sway excessively or even fall while shifting weight onto the standing leg. The dancer's brain must be able to modulate changing and multitasking demands—stabilizing the trunk while facilitating movement of the arms and legs—for expressivity and mastery of technique. How different this example of anticipated postural response is from the unexpected postural disturbances seen in contact improvisation, when a dancer suddenly flies spontaneously into another dancer's unsuspecting arms!

Implications for Teaching

Postural responses are evident in infants, implying that balance is something innate and hardwired in the nervous system. These responses are far from universal, however, even in infants and children. Rather, postural responses are highly variable and flexible throughout growth and development, influenced not only by genetics but also by experience and training.⁵ They are not at all mastered in children or adolescents,⁶ the ages when many children start dancing. Poorly coordinated or under-developed postural control responses are characterized by excessive muscular "holding" and fixation. Evidence of signs that balance is in jeopardy include awkward transitions, lack of differentiated movement between trunk and limbs, excessive mini-hopping or weight shifting on one leg, flailing arms, and finally, falling.

One challenge facing dance educators is to provide an environment for learning that facilitates optimal growth and development of any aspect of motor skill. The main take home message for balance is that it is not so important for novice dancers to learn the "right" postural control strategy, but rather to build a repertoire of postural strategies throughout their dancing lives. Since dance requires a multiplicity of strategies to handle changing space, time, and effort dynamics, the key to teaching balance is to facilitate adaptive readiness and responsiveness. In this vein, the range of possibilities in dance for exploration and discovery of balance is infinite. Virtually any dance style challenges balance. Dancers can and do routinely face different types of balance challenges that test sustained static balance, such as dynamic quick weight shifts and changes of direction at center floor, and changes in whole body base of support. Examples of each of these include, respectively: one legged stance with eyes moving or closed at the ballet barre; leaping with quick directional or level changes with arms opposing legs in modern; and falling or rolling in contact improvisation or other dance forms. Again, the key is to explore a variety of unexpected and unfamiliar balance challenges within the style.

Since dance teachers already have available a range of good options for learning balance, the best advice for teaching balance is not *what to do*, but rather *what not to do*. One main pitfall in teaching is to interfere with automatic balance processes. Finding balance is an ongoing, exploratory process in which trial and error is a function of learning. The art is in finding the (metaphorical) balance between allowing movement exploration to activate automatic processes and providing instructional guidance that eliminates excessive error. Striving for balance mastery too soon can interfere with the nervous system's automatic processes. Using a one legged balance on demi-pointe center floor as an example, repetitive, redundant exercises and cues to achieve the "right" point of balance can make the dancer anxious and self-conscious as he or she searches for the elusive anatomical element that will make this possible. To paraphrase Martha Graham on the variability of the plié, every act of balance is "a different song." The goal in

learning to balance is not to become “self” conscious, but to refine sensory capabilities that help calibrate and control forces both within the body and in space.

A related way that automatic balance mechanisms can be disrupted is by emphasizing cues focusing on one body part isolated from the total action of the body in space. Motor learning experts refer to attending to these body-based cues as “internal focus of attention,” as opposed to attending to cues that connect the body to space, called “external focus of attention.”⁷ Examples of poor cueing choices might include emphasizing a single body part while balancing on one leg: “Pull up on the knee caps!” or “Rotate, rotate, rotate the hip!” Dissonant cues such as “pulling up” while simultaneously attempting to “drop the weight through the tail to the floor” can also create conflict between stylistic demands and the body’s need as a whole to explore gravity and ground reaction force. Such singular body-focused cueing removes the dancer from the spatial context, interrupts the complex neuromuscular coordination needed for integrating the entire limb, and in the end interferes with automatic balance mechanisms.⁷

In summary, when it comes to balance we are training the dancer to become a creative problem solver within the

moment, rather than chasing the elusive perfect placement. Creating an environment of exploration where dancers can practice “error” to find their way to balance before adding stylistic flourish might be a smart option toward the growth and development of the autonomous dancer.

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