

The IADMS Bulletin for Teachers

Volume 1, Number 2, 2009

Editors-in-Chief

Gayanne Grossman, P.T., Ed.M., and Marliese Kimmerle, Ph.D.

Associate Editors

Ruth Solomon and John Solomon

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How Dance Teachers Can Benefit From Learning
About Positive Psychology**

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Dear Teachers,

The “Letters to the Editor” column hopes to encourage a dialogue with the teaching profession by answering practical problems sent in by dance educators. Please focus your questions on teaching methodology, physical training, or locating resources in the form of literary references or personnel. The *IADMS Bulletin for Teachers* is not a medical forum, and IADMS would direct those questions elsewhere. Letters can be sent to media@IADMS.org

We sincerely hope this column will be useful.

The Editors

Thank you and what is the best way to approach hyperextension?

I've just discovered your free newsletter geared to us teacher types. Thank you soooo much. Really, thank you. What a treasure trove the first issue is. I look forward to future editions...and by the way, what is the best approach to hyperextension (in knees particularly)?

Vicki Rennaker Peck
Ballet teacher, Snohomish, WA

Dear Vicki,

Generally speaking I encourage the student with hyperextension to limit movements of extension, until stability matches mobility and active movement is similar to passive movement ranges. In practice, this means not indulging the very mobile dancer to show off an extreme range of movement, but to only take the leg in grand battement, as high as it would go in a *développé*, for example. The general body type of the hypermobile dancer is of glorious range of movement, prized amongst many dancers and choreographers, but in actual fact, it is a difficult physique to train.

The classic highly arched foot tends to be pretty in tendus, and glissés, but perhaps not as effective at jumping and sustained landing as a less mobile foot. This foot needs to be trained to work the muscles under the arch of the foot

with pressure against the floor to increase strength. Guard against starting pointe work too early and ensure that the foot does not go too far over the shoes with poor ankle support.

Knees with any large degree of hypermobility should not be allowed to let the weight of the lower leg hinge on the back of the knees. Rather the bones of thigh and lower leg must take the weight of the body and this can only be done by changing the alignment so that the central line of gravity falls from the femur to the tibia, and not allowing the knees to ‘lock’ backwards. A student with a high degree of hyperextension of the knees should ideally work with the heels together when in first, and by sensing a downward pressure through the heel into the floor of the supporting (or standing) leg, they can feel the line through the leg. The dance student needs to be educated in this technique from a very early age, and it is very worth spending the time and effort to get this right so that true anatomical alignment of the leg (bone to bone) can take place. A great way for students to practice this is a technique taught by Janet Karin of the Australian Ballet School, who teaches the dancer with sway back knees to sit on the floor with the legs out straight out to the sides, then to use one hand to pull the toes of the foot on the same side upwards as far as possible. Most dancers with sway back knees will have the heels several centimeters off the floor. Then, lower the heels until the hip joint, knee and ankle are in a straight line. A partner or teacher or parent should then gently apply pressure to the heel of the foot while the dancer tries to match this pressure. When the dancer feels a lengthening sensation from the sit-bone to the heel and beyond, both hands should be gently removed while the dancer maintains the lengthening sensation through the leg. This way, all the whole leg muscles can be re-educated to feel a straight line down the inside leg and through the heel. Once standing up, this imprint of how the leg should work in good alignment will remain with the student and a much more stable base will occur. I have used Janet’s technique with many dancers with sway back legs and all have found it incredibly

helpful.

Finally, a word about hyperextension of the spine; again, mobility must be matched by stability and much work must be done on strengthening core muscles to support the huge range of movement sometimes found in the lumbar curve. Particular attention should be paid to establishing reliable postural good habits and not allowing the pelvis to tip backwards. It is also important to check daily ordinary use of posture as many bad habits remain outside the dance studio and good spine health relies on good core strength.

Whilst artistic directors and choreographers find the highly mobile body a great beauty, it may be prone to in-

jury. Careful training and plenty of education and plenty of time spent early on in training to develop good habits is vital.

To sum up:

- Match flexibility with strength
- Good alignment means bones transmitting weight, not back of knees
- Posture, posture, posture.

Rachel Rist

Chair of the IADMS Education Committee (and ballet teacher)

Standing on the Shoulders of a Young Giant

How Dance Teachers Can Benefit From Learning About Positive Psychology

Sanna M. Nordin, Ph.D., and Ashley McGill, M.Sc., Laban, London, UK

Dancers often endure long hours of physical exertion and push their bodies to extreme limits in order to advance technically. The importance of physical health and fitness is not news to dancers and dance educators; however, psychological health and well-being are not discussed as much, yet play a crucial role in dancers' lives. This article will suggest ways in which dance teachers can help their students achieve optimum psychological well-being by utilizing research in positive psychology, a relatively new field that we believe has great relevance to dance.

Dance psychology typically looks to sport psychology for evidence and inspiration, but we suggest that a new emerging giant of a field, namely positive psychology, is another useful source. Therefore, this article will briefly introduce three positive psychology topics: *self-determination*, *creativity*, and *flow*. With an understanding of some key terms and how to apply them in class, teachers may be able to nurture healthy intrinsic motivation and thereby raise self-esteem and lower body dissatisfaction. Furthermore, by focusing on psychological factors that underlie excellence in performance, such as flow and creativity, instructors may be able to help their students reach higher levels of achievement.

Self-Determination: Nurturing Autonomous Dancers

Dancers often compare themselves to their peers. While such comparison may serve as motivation to work harder and promote friendly competition for some, it can also create unnecessary pressure.¹ Common psychological issues that dancers may face as a result include low self-esteem, high levels of anxiety (about their bodies and about performing), and problems with body dissatisfaction and eating.^{2,3} Fortunately, however, there are simple tools at our disposal that can help dance teachers minimize such problems. These focus on nurturing dancers to become **self-determined**. Self-determination is defined as a state of thriving reached when needs for *autonomy*, *competence*, and *relatedness* are fulfilled.⁴ *Autonomy* is experienced when a dancer takes part in dance out of free will and finds mean-

ing and purpose in the activity. *Competence* is when dancers feel that they have the necessary skills to accomplish tasks effectively—in other words, they do not feel incompetent. Lastly, *relatedness* occurs when dancers form social relationships and feel a sense of belonging.^{4,5} Research shows that dancers who feel that their teachers provide *autonomy support* (e.g., supplying rationale; being democratic) and *relatedness support* (e.g., treat dancers as people, not “performance machines”) are also more self-determined.⁵ In turn, more self-determined dancers report higher levels of self-esteem, as well as lower levels of worry and dislike about their bodies. Given that other research suggests that dancers often suffer from low self-esteem, body dissatisfaction, and eating problems,^{2,3} the dance environment could perhaps benefit from supporting dancers *autonomy*, *competence*, and *relatedness* more directly. What follows are some guidelines for how this might be done.

1. *Autonomy*. The first step is to help students feel in control of their learning so that they gain a sense of autonomy and link it to their individual goals. This starts *before* the class: it is important that dancers dance out of choice rather than because they feel like they must. Choices should also be incorporated into each class, further supporting autonomy. For example, after teaching a piece of choreography or a combination, let dancers decide on different ways in which it could be performed. The need to attach meaning and purpose to an activity is also crucial, so justify *why* exercises are done the way they are. Teachers could also try suggesting that the dancers perform small routines with an emotion attached to a memorable situation (“Remember a time when you were truly excited about something. Now, dance the piece with that same emotion”).
2. *Competence*. One way in which instructors can support a sense of competence for all students is by emphasising **effort** over **talent**. It is easy to praise those students who have mastered a skill; however, those who do not achieve mastery as quickly as others may feel left out, having received no recognition for their efforts.

Teachers should therefore emphasize the importance of effort; because effort is controllable, this will help all students feel that improvement (and competence) is within their reach.

3. *Relatedness*. Humans are social animals, and sensing that they are among friends will help dancers to feel good, take risks, and put in effort with a sense of joy and camaraderie. Thus, emphasize cooperation within groups that vary in size and nature, and give dancers a chance to get to know each other – and the teacher!

An emphasis on democracy over autocracy, effort over talent, and on collaboration over rivalry will encourage healthy forms of motivation whereby dancers are focused on the artistic process and on improving themselves, rather than on end results and on outdoing others. It is even the case that very talented dancers do better with feedback centered on factors within their control, such as effort.⁶ Why? This is likely due to feeling in control and in charge of one's improvement. Because the very word *talent* is typically seen as something we cannot control (i.e., "you either have it or you don't"), some dancers worry even in response to comments that are meant as positive feedback.⁶ Even if they feel flattered upon being told that they are talented, they may worry that the talent only goes so far and is something they cannot work to improve. All of this contributes to a dancer feeling out of control. Far better, then, to give all dancers feedback focused on what to work on and the joy of dancing, rather than on faults, problems and other people. This intrinsic focus is essential for allowing things like creativity and flow to occur.

Creativity: Nurturing Freedom of Expression Within the Dance Setting

Traditional dance teaching has emphasized the importance of discipline and compliance with the instructor. Dancers practice and repeat the same steps and sequences time and time again in an effort to reach an ideal, and many schools implement set programs based on a specific syllabus, with rigorous examinations. But in parallel to this emphasis on discipline and rigor, *creativity* is a valued characteristic in dance, and the foundation for choreography and artistry. Creativity theorists suggest that talented young people are nonconformists and independent thinkers, with one author describing 'the creative personality' as "...*independent, nonconformist, unconventional, even bohemian, and they are likely to have wide interests, greater openness to new experiences, a more conspicuous behavioral and cognitive flexibility, and more risk-taking boldness.*"⁷

How can teachers reconcile the seemingly contradictory sets of attributes of creativity and discipline? Fortunately, we may not have to choose; it has been suggested that creativity is best nurtured within a setting that *does* provide rules and a domain with skills to be mastered – but it does so in an open-minded way, with a focus on learning over the achievement of a specific outcome, choice within the boundaries (e.g., of the syllabus), and avoidance of a strict authoritarian approach.⁸

To nurture creativity teachers may want to look at including more improvisation and choice of movement in their classes. Although dancers sometimes feel intimidated by improvisation, as though they are putting themselves on display, there are ways of making dancers feel comfortable while allowing them to explore creative movement. Specifically, you may want to use *structured improvisation*, setting specific guidelines and frameworks for the dancers to explore. An example is the simple idea of using a specific body part to lead you around the room, using different levels in the space. Similarly, the teacher may want to come up with a situation (e.g., getting changed in the morning; meeting a person you admire for the first time) and encourage dancers to explore the many ways this can be expressed, using different movement qualities and tempos, gestures and facial expressions. Such 'freedom within limits' complies with recommendations from self-determination research⁸ for how to support dancers' autonomy. By giving choice to the dancers teachers are respecting individuality and stimulating creative thinking. Having a clear knowledge of what is expected while also feeling competent and in charge of one's own expressions are concepts that are part of the *flow* experience.

Flow: Nurturing Dancers Toward Optimal Experiences

When dancing is at its best, dancers lose themselves in the moment, becoming one with the sensation and experience. This psychological state, called flow, is characterized by deep concentration and the feeling of going onto autopilot.⁹ This is a desired state for dancers because while in flow, movements are performed naturally and with ease, enjoyment is high, and there is no self-consciousness standing in the way of self-expression. It is typically what performers describe as the best moments in their activity.⁹ One of the main elements that must be present for flow to occur is that the *skill level* should match the *challenge level* for that specific activity. This means that dancers who are being asked to repeat skills over and over without specific feedback are likely to get bored (*skill* being greater than perceived *challenge*), while dancers pushed too far out of their comfort zone are likely to get anxious (*skill* being perceived as insufficient for the *challenge*). Either way the flow experience is unlikely to occur, as is optimal performance. It may be difficult to create lesson plans that enhance the potential for every student to experience flow, as oftentimes dancers at a variety of levels are training together. Teachers who are faced with this challenge may want to include modifications for each exercise so that those who are not challenged enough have something more to work on while students who find some exercises too difficult may work at a more comfortable pace for their skill level. Teachers can also encourage their students to come up with progressions themselves, and get them to help each other by working in pairs. Clear feedback focused on *what to do to improve* (in learning situations) and on *the intrinsic experience of movement and communication*

with an audience (in performance situations) will also make flow more likely. Hence, try to tell dancers what to focus on in order to get things right rather than simply telling them what they are doing wrong. It is also clear that dancers will only achieve flow if they feel comfortable – that is, they have a sense of competence and self-esteem, and are not feeling overly anxious or self-conscious. Therefore, it stands to reason that more self-determined dancers (who dance because they want to, feel competent doing so, and have a sense of meaningful belonging) will be more likely to reach flow.

Acknowledgment

This article stems from a conference presentation made at IADMS in 2007. Nordin SM, McGill A. *Standing on the Shoulders of a New Giant: How dance teachers can benefit from learning about positive psychology*.¹⁰ However, while that presentation focused on how positive psychology may inspire research in dance, this article focuses on implications for dance teaching.

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IADMS Education Committee

The IADMS Bulletin for Teachers Handout 1(2) 2009

Optimizing Dance Performance and Well-being **Suggestions for Dancers from Research in Dance and Positive Psychology**

- Effort is more important than talent—focus on your personal improvement as a dancer rather than focusing on whatever talent you feel you have or lack compared to others (you can't measure it anyway!)
- Work with different dancers on different days—you can learn something from everyone, and cooperation is both more enjoyable and productive than rivalry.
- Focus on the feelings of movements rather than on how they look. And try not to let the mirror distract you—you don't need to look like everybody else (at least not all the time!)
- Use imagery as it can help you learn skills, communicate artistically, and more. Try rehearsing in your head daily, imagining the feel of movements, music and creative expression as well as how things look.
- Be in control of your own development, taking classes and doing exercises that link in with your own goals. If you are not sure why an exercise is done the way it is—ask!
- Work with structured improvisation and give movements your own “flavor” or “voice.”
- Value your creativity. Both discipline and open-minded creativity are valuable to the dancer: try to make sure you get practice in both, and value your individuality.



Dynamic Alignment, Performance Enhancement and the Demi-Plié

Peter Lewton-Brain, D.O., M.A., Ecole Supérieure de Danse de Cannes Rosella Hightower, France

A primary goal of dance science is to produce healthier and better dancers. It's a win-win situation for dancers when improved technique allows for greater freedom of expression. While studies and experience have shown that incorrectly performed dance movements increase the risk of overuse injuries^{1,2} we often forget how some of the most basic movements in dance need optimal attention and care. The demi-plié, with its fundamental role in many dance steps, is one such movement (Fig. 1). A study by Couillandre, Portero and Lewton-Brain³ with dancers from the Ballets de Monte-Carlo has given us insights to improve the function of the demi-plié and reduce stress on the foot, ankle and spine when performing this movement. By applying a correction using principles of anatomy, biomechanics and movement intention we can influence jumps, turns, and probably any steps requiring explosive takeoffs from a demi-plié. It is a simple yet effective way of improving not only the foot in the demi-plié but also full dynamic alignment (the body's placement during movement). This is of special interest in creating the illusion of *ballon*, an essential element of ballet where the dancer appears to float in the air.⁴

Placement or alignment in static positions (attitude, passé, etc.) is a first step in creating the body awareness nec-



Figure 1 The demi-plié.

essary for *ballon*, but achieving optimal alignment for *ballon* during movement preceding jumps (dynamic alignment) is much more difficult. One of the clearest examples of this is going from demi-plié to jumping. A frequent error is a “bucking” motion of the torso when taking off, as a result of which the dancer only achieves dynamic alignment on the way down. This leaves little time for the audience to appreciate the position in the air. Some teachers consider this error to be due to a lack of abdominal muscle strength, but our study investigated a simple three-minute correction that dealt only with movement intention, not strength. The decisive factor seemed to be one of coordination. The illusion of *ballon* results from coordinated movement rather than jump height. By giving dancers an alternative movement intention in the demi-plié we were able to show that bucking could easily be corrected.

The correction appeared to create a constant muscle chain interconnecting the legs and torso and improving the foot's biomechanics by aligning the heel bone in the demi-plié. The firing of the hamstring muscles going down into plié and then from plié to the jump demonstrated a direct link to the diminished bucking motion in the torso. Researchers have already found that improving technique through muscle coordination is normally associated with the reduction of injury rates,⁵ leading us to consider if the correction could have an influence on injury prevention as well as performance enhancement.

The Correction The Foot

The supporting weight of the foot is ideally divided equally into three points of contact with the floor, the first and fifth toes and the heel bone (Fig. 2). This position helps prevent, among other things, pronation (rolling over) and lifted heels. However, what can make it a notably better correction, affecting not only the foot but also the whole body, is appreciating the body's inherent anatomical structures inside the heel bone, known as trabeculae (Fig. 4). We can see in the images the direction of these internal structures

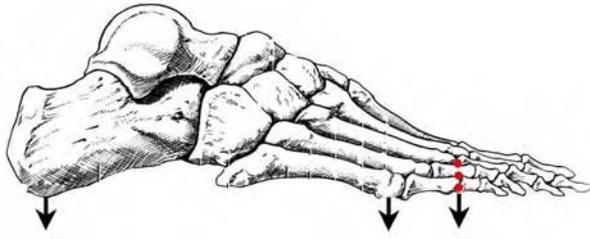


Figure 2 Three points of pressure in the foot.

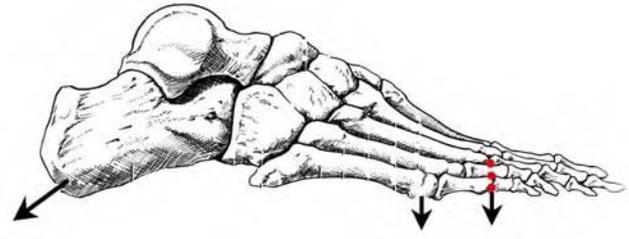


Figure 3 Adapted direction of force.

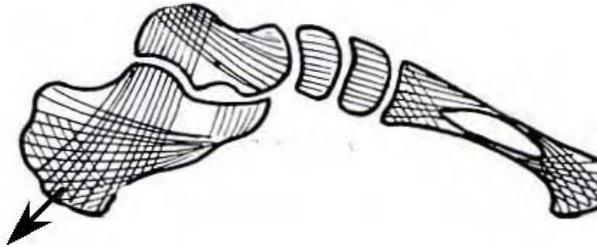


Figure 4 The trabeculae lines of force inherent in the heel bone.

within the bone. What we propose is sending the force of the plié into the foot via the three points on the floor, but the posterior point is sent into the heel (down and back) at a 30 degree angle (Fig. 3). By setting up biomechanical efficiency in the bones of the foot, long muscle chains can be engaged and interconnected to facilitate improved dynamic alignment throughout a movement.

The Leg

Before initiating the actual bend (plié) of the knees, the force being sent through the back of the heel has to be such that the hamstring muscles moderately engage (Fig. 5). Once engaged, the plié movement can follow its course while keeping the direction of the force going back and down out of the heel. It is recommended to practice this initially with students standing in sixth position, so they can understand the lower and backward movement; also,



Figure 5 Indicating the direction of force in first position.

they can place their own hands on the uppermost attachment of the hamstring muscles to feel if they are engaging. When this is understood, change to first position, and now send the force in opposing directions while keeping the hamstrings firing moderately (Fig. 6).

What Happens?

By sending the weight of the body into the foot, directed back and down at a 30 degree angle, the heel bone spirals into an optimal position, pulling the foot much like a suspension bridge, protecting the plantar vault. This also helps the foot keep its rebound quality in jumps. At the same time as the heel bone spirals, the hamstring muscles engage and stabilize the pelvis via their attachments on the sit bones. The pelvis, now anchored, subsequently stabilizes the whole spine. This interconnecting of the torso and legs eliminates the bucking motion in jumping, turns, échappés, etc. (Fig. 7).

Tips

Think of practicing just 1/4 of a plié. It will feel less deep than usual, as respect for the plantar vault maintains more pull on the calf muscles.

Think of the heel bone acting like a ship leaving the port, slowly pulling back before starting the plié. This mental imagery can produce a slow, powerful, yet microscopic sensation of movement.

Conclusion

This correction, developed from several years of refinement in the dance studio and lab tests with human movement scientists, offers a solution to the long-standing problems of “bucking” and collapsed arches. We have underlined the importance of movement intention and biomechanical precision needed in the demi-plié at the barre before

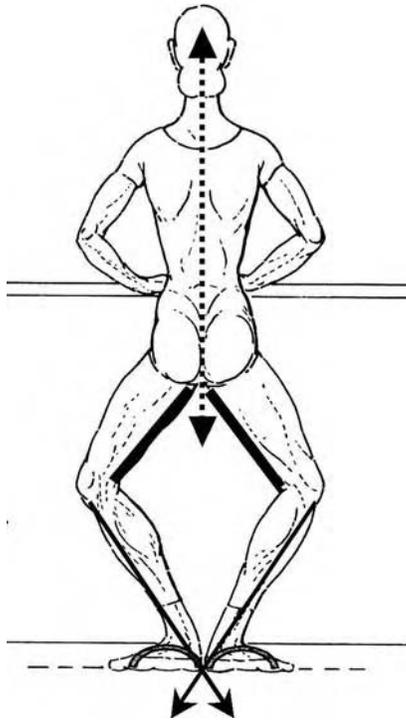


Figure 6 The lines of force follow in the correction.

developing technical brilliance in the center or on stage. The ability to create the appearance of *ballon* or arrive in *passé* or *échappé* in time with the music depends upon mastering the preparatory movements before the actual steps. Even if it is only a reinforcement of your own instinctive knowledge, this groundwork on preparatory movement may help you go further in developing your own expertise.

Acknowledgment

This paper is adapted from: Couillandre A, Lewton-Brain P; Portero P. Exploring the effects of kinesiological awareness and mental imagery on movement intention in performance of *demi-plié*. *J Dance Med Sci.* 2008;12(3):91-8.



Figure 7 A dancer jumping following the correction during our research with the measuring equipment attached to her legs and spine.

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Applying Biomechanic Research in the Dance Studio

Margaret Wilson, Ph.D., Department of Theatre and Dance, University of Wyoming

The training of dancers is both an aesthetic and scientific pursuit. Dance teachers train their students to develop both artistry and skill, relying on their innate understanding of the body moving through space. Biomechanists identify and quantify elements of human movement, focusing on the mechanical principles of a particular skill. Whereas dance training is characterized by a systematic progression of repeated motions, biomechanics observes forces acting on the body, which contributes to an understanding of the technical demands and artistry of dance. The goal of this article is to show how biomechanics can enhance and augment an understanding of dance training.

In a biomechanical perspective the body is observed as segments linked at the joints; these joints and joint motions are the building blocks for analysis. Biomechanics looks at measureable aspects of movement (such as speed and force), and it can define and describe elements of skilled action. Biomechanical analysis of movement requires the use of specific measurement tools which are employed to describe muscular activity, understand forces acting on the body, observe movement of the center of mass, and examine movement either in the whole body or individual segments. Biomechanic research is conducted in a laboratory, wherein the movement is measured in accordance with specific guidelines; however, information obtained from biomechanical analysis can be used to clarify and enhance the teaching of dance and dance performance. An emerging subsection of biomechanics, dance biomechanics, looks specifically at the complex movements of dance, with the goal of understanding the mechanical principles for the enhancement of training and performance.

The goal of this paper is to demonstrate how information gained from research in biomechanics can be useful in the dance studio. Each of the following sections focuses on a particular dance movement. The skill is introduced with a general research question, a brief summary of pertinent research is provided, and

the section concludes with information directly related to teaching.

Grand Plié: Balancing Range of Motion with Strength

Grand plié is a vital part of most dance technique classes. In a movement such as grand plié, where the range of motion and physical exertion is of sufficient difficulty, looking at the movement “from the inside out” sheds light on how it should be taught. Biomechanists and dance teachers have been studying the grand plié for a long time, trying to understand how to optimize the benefits of this movement while minimizing the potential risks to the knee. Grand plié is used in a dance class to strengthen the legs and to warm up the hips, knees, and ankles. However, the extreme flexion of the knee required in this movement is something that requires proper coaching for safe execution. Trepman and colleagues, using electromyographic analysis (where surface electrodes monitor electrical activity in the muscles), found that performing grand plié at the barre reduces stress at the knee, while doing the movement without the barre requires greater quadriceps strength.¹ For modern dancers, in particular, learning grand plié at the barre is an important recommendation. Barnes recommends incorporating grand plié at the end of the barre section of class rather than at the beginning, to maximize the benefits of the movement and to diminish the potential for incorrect execution.² With the muscles properly warmed, the benefits of grand plié are more fully realized.

Grand plié is important for strengthening the legs and increasing the range of motion of the lower body, and is most effectively practiced when the body is “warm.” As a recommendation to the teacher, the barre should be used for practice of this movement until sufficient strength is attained, and placing the grand plié at the end of the barre will maximize the benefits available from this movement.

Développé Devant: Developing Strength in the Gesturing and Standing Legs

Many dance movements are practiced at the barre to help the dancer develop focus and strength without balance concerns. Dance biomechanists are interested in how working at the barre increases strength in the moving or gesture leg and in the supporting or standing leg. Using electromyography, Wilmerding identified different muscular responses in the supporting leg for développé devant at the barre and in center floor work. She noted that use of the barre helped the dancer address action in the gesture leg, but did not provide sufficient stimulus to develop the supporting leg musculature.³ In other words, the barre replaces some of the work of the standing leg. Strengthening of the standing leg is augmented when working in the center. As a recommendation to the teacher, this research confirms the importance of repeating movements learned at the barre in the center for training both the gesture and standing legs.

Jumping: Understanding Forces Acting on the Knee, And Contribution of the Upper Body

Dancers move through space vertically and horizontally, jumping both for height and to travel through space. Dance biomechanists are interested in the forces acting on the knee in jumping. When jumping straight up and down (sauté in first position) dancers are incurring a force that is anywhere from three to five times their body weight. With jumps that travel through space, such as grand jeté, the dancer is also incurring a horizontal force upon landing. There is a “braking” action in the anterior thigh muscles (quadriceps group) that creates a shearing force at the ankle and knee. This force occurs between the upper and lower leg, as they are moving in different directions, with the greatest force seen at the muscles and soft-tissue of the knee. Simpson and colleagues note that excessive use of the quadriceps muscle group relative to underutilized hamstring muscles creates an atypical force in landing from a forward moving jump.⁴ Strengthening the hamstring muscles is an important way to improve the jumps and limit overuse of the quadriceps. This is extremely important for maximizing power and minimizing unbalanced strain. A simple way to strengthen the hamstrings is to have a dancer move from a parallel tendu back to parallel attitude, flexing the knee against gravity or a mild resistance.

Beyond the issue of strength and muscle recruitment of the leg muscles, additional focus on the action of the whole body is an important consideration in jumping. Poggini and associates looked at young novice dancers and noted the need for additional training to help them maintain proper body position in the air.⁵ Specifically, dancers need to control movement of the head, shoulders and hips in both the take-off and landing from the jump, keeping the body from buckling forward or arching back. Understanding that jumping is a whole body motion refocuses our thinking on training for this dynamic movement.

As a recommendation to the teacher, these studies point out the need to find ways to balance the work in the leg

by strengthening the hamstring muscles, and improve the aesthetic quality of jumping by focusing on the position of the whole body.

Grand Rond De Jambe En L'air: Understanding Segment and Joint Motions

Most dance movement can be categorized as one or two body parts moving in relation to, and supported by, the rest of the body. The movement of one segment has an effect on the rest of the body, as well as the movement as a whole. Dance biomechanists have been interested in how this interaction is seen in movements with a full range of motion in the spine, such as grand rond de jambe en l'air.

Wilson and coworkers, looking at the interaction between the gesture leg and pelvis, found that skilled dancers had greater range of motion in the pelvis accompanying the range of motion for the gesturing leg. In other words, after the leg has reached a certain height the pelvis *must* move to accommodate further range of motion. Movements to the front and side (devant and à la seconde) past 90 degrees of flexion involve the pelvis in three-dimensional movement. To the back, anterior tilting of the pelvis is seen after 15 degrees of hip hyperextension (arabesque). This research clarifies the role of the pelvis in movements at the hip joint that require large ranges of motion. To move the leg fully the pelvis must follow the leg, even though the illusion advocated is to keep the pelvis immobile.⁶

A follow-up study investigated the role of the pelvis in facilitating gesture leg motion, and the related “cost” of the muscles involved.⁷ For skilled dancers the effort in the gesture leg is smaller than in the standing leg. This was reversed in less skilled dancers. The investigators concluded that the skilled dancers are working more efficiently in their standing leg to support the pelvis and gesture leg, whereas the less skilled dancers are mostly using the muscles in the gesturing leg.⁷

A recommendation to the teacher: when working on movements where one leg is moving fully, a strategy to focus on the standing leg will help balance the necessary movement in the pelvis and spine. Not allowing the pelvis to move commensurately with the gesturing leg will decrease the potential range of motion and place unnecessary stress on the hip joint and lumbar spine.

Balance and Practice: Understanding Vertical Orientation and Variability in Performance

Dance researchers have an interest in strategies that dancers use for balance, and what variability in movement skill is telling us about learning and performance. Strategies that dancers use for balance and counterbalance are based on neuronal and reflex adjustments that develop with dance training. Mouchnino and colleagues found that dancers use a (subconscious) motor program to maintain the vertical orientation of the head when the leg is moving. They accomplish this by counter-rotating in the trunk, and by moving the spine and pelvis around the hip joint to keep the body vertical. This helps dancers maintain the vertical

line that is often desired in ballet.⁸ In addition, Monasterio and colleagues found that postural adjustments precede voluntary leg movements. The systematic training that dancers receive actually re-programs many motor patterns involved in balance and limb control.⁹ As demonstrated by Monasterio and colleagues' research, the admonition that dance teachers give to their students to "move from the core" is clearly valid.

Although issues of motor control may not be at the forefront of pedagogical discussions, understanding the neural underpinnings of movement helps to clarify our analysis and teaching of movement. One of these concepts has to do with muscle recruitment patterns. Electromyography (EMG) documents patterns of muscular recruitment that illuminate an individual dancer's strategy for performing movement. These patterns of muscle recruitment often demonstrate variability between dancers performing the same action. In fact, data collected in many studies using EMG data have shown variability between subjects. Chatfield notes that even for a highly skilled performer no two performances are exactly the same. Observing multiple trials for the same individual over time generates information regarding neuromuscular activity that can be combined to understand the consistency and variability in the performance.¹⁰ Consistency is a measure of learning, whereas variability shows that there are fluctuations in neural and muscular timing for any given movement.

These articles identify two very important concepts. First, training the dancers to maintain a vertical orientation in the trunk and head develops important neuromuscular patterns that are integral for balance. Second, variability is a useful measure of learning and performance. A recommendation to the teacher is to understand that in order to develop the correct neuromuscular patterns in class, consistency (doing movement the same way every time) and variability (doing it in a different tempo or combination) are both important to development of a specific skill.

Summary and Conclusion

Employing technology to augment the trained eye of the teacher and the innate understanding that dancers have of their own bodies, biomechanical analysis has illuminated many intricacies of specific movements often invisible in the real-time execution of the movement. Without

reducing skill to a numerical formula or graphed pattern, expert performance can clearly be seen and described using biomechanical tools. Both quantitative and descriptive information are generated that provide rich detail of a given movement. This is relevant to teaching, as it not only validates but clarifies what we do in the dance studio for the betterment of the training of dancers and the future of performance.

Acknowledgment

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Testing for High Intensity Dance Fitness

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There has been much concern recently about dancers' fitness, and many educators are now realizing the benefits of weekly fitness classes in dance training programs. In order to determine whether dancers are getting fitter and whether a fitness training regimen is working, it is useful to monitor improvements in dancers' fitness through regular fitness assessments. These can also help maintain the dancers' motivation by providing tangible feedback about their progress.

The development of activity-specific and precise methods of evaluating an athlete's performance is of interest to many sports scientists. Previously, most fitness monitoring has been undertaken within standardized conditions such as laboratory settings, rather than "in the field." This was to ensure that the tests remained valid, reliable and objective. However, questions often arise as to the relevance of such tests with regard to specificity. The debate between laboratory and field-testing is on-going; while laboratory tests are more likely to yield accurate results, they may be less representative, and while field tests are more relevant and specific, they have the potential for being less accurate. This predicament has led to the development of activity-specific measuring tools in sport, like kayak ergometers and swimming flumes.

There is currently a validated dance-specific exercise method of measuring aerobic fitness (DAFT)¹ which is being used by several dance companies and schools to monitor changes in aerobic capabilities across time. However, dance is an intermittent activity that utilizes both the aerobic (with oxygen) and anaerobic (without oxygen) energy systems and comprises a combination of low, moderate and high intensity levels.^{2,4,5} More specifically, dance class appears to be undertaken at lower to moderate intensities utilizing mostly the aerobic energy system, while dance performance tends to be carried out at higher intensities utilizing both the aerobic and anaerobic systems.⁴ Dance technique classes by themselves however do not sufficiently challenge either the aerobic or anaerobic fitness needs faced in performance situations.

Until our study, there was no validated high intensity dance-specific fitness test available that provided a way of evaluating the ability to dance at the higher intensities representative of stage performance. Dancers' anaerobic fitness has been previously measured using the Wingate Anaerobic Test (WAnT), usually involving a cycle ergometer.^{2,3} While the WAnT is a recognized standard laboratory test, it does not use a mode of exercise that is familiar to dancers. Firstly, dancers are not used to working to volitional exhaustion (probably due to the high skill factor in dance and the fact that choreographers set the intensity by virtue of the choreography).² Secondly, the cycle ergometer is a non-impact mode of exercise that utilizes specific muscle groups repeatedly, which is again something unfamiliar to dancers. The concept of specificity, whereby methods of assessment are designed to allow dancers to be tested in an environment with which they are familiar, should be encouraged in the field of dance science. Today it would be almost unheard of, for example, to test a swimmer on a cycle machine or treadmill.

The purpose of our study was to develop an intermittent high intensity dance-specific fitness test. We designed the test so that educators can measure changes in dancers' heart rate across time, as well as observe visual improvements in performance at these high intensities.

We developed the test over several rehearsals with professional dancers and teachers based at a leading UK dance training institution. The dancers were asked to make a one-minute phrase using movement material that was representative of contemporary dance (sometimes known as "modern dance"). It was important for the intensity to be similar to the intensity levels previously noted in dance performance.^{5,6} This meant that the test tempo/speed, size, and type of movement were taken into consideration. Movement phrases were developed that mimic the intermittent 'stop-start' nature of dance.^{2,4,5} The work-to-rest ratio was set at 1:2 (one minute dancing followed by two minutes resting). It was also important to keep the movement phrase as simple as possible, so that any changes across time would

Table 1 The Dance Fitness Test Protocol

1 minute dancing
2 minute rest
1 minute dancing
2 minute rest
1 minute dancing
2 minute rest
1 minute dancing

Tempo throughout each 1 minute dancing: 106 bpm

be due to an improvement in fitness (i.e., physiologically based) rather than movement economy through practice.

The completed test protocol (Table 1) consists of jumps in first and second position, rolls to the floor, weight transference from feet to hands and back to feet, circular hops with an arm pattern, and a parallel jump forward in space using an arm swing. The phrase is completed three times within one minute at a tempo of 106 beats per minute, and repeated again after two minutes of rest. The sequence occurs four times.

We then asked an additional 16 professional dancers to undertake the fitness test (12 females and 4 males). They performed four trials of the test, following a thorough warm-up. Our results showed that the dancers' blood lactate increased beyond the physiological indicator meaning that the intensity of the test was high enough to stress the anaerobic energy pathways following each trial.

Results also showed that the test is reliable and valid, as seen by the consistency in heart rate across trials. The dancers were working near their maximum capacities, as their results from the dance fitness test were comparable to the scores they obtained during a standard maximal oxygen uptake treadmill test.

Previous research⁷ has found that dancers often perform at 80% of their maximum, which is at least the case in this study. Interestingly, in all but one case the dancers seemed to push themselves harder when dancing than running on the treadmill (probably because of their familiarity with the movement), which further substantiates the argument for more activity-specific assessments for greater accuracy.

It is important to be aware that the range of contemporary dance performances can be quite diverse; one contemporary dance performance may be high in intensity while another is lower in intensity. Further research is needed to determine the energy demands of the range that exists in contemporary dance. However we think it would be fair to suggest that contemporary dancers need to be both aerobically and anaerobically fit in order to be prepared for the many different demands of the genre.

Previous research has shown a discrepancy between class, rehearsal and performance in terms of cardiovascular demands.⁴ A dance fitness test such as this can be used for both testing and training purposes as part of a dancer's training regimen, to ensure that both the higher intensity demands and the gap between class and performance are addressed. Observations can be made across time, not

only through quantitative means such as heart rate but also through qualitative means, such as the observation of movement proficiency.

One of the main reported causes of injury in dance is fatigue, and a high level of physical fitness will delay the onset of fatigue.^{7,8} A test of this kind will help provide information about a dancer's physiological capabilities through relevant and applicable means. As a result, effective dance training programs may be devised to help reduce the risk of injury.

There is an argument for dance genre specific fitness tests. Given that the research in sports science recommends activity-specific testing techniques in sport, perhaps the diversity shown between dance genre styles may also warrant genre-specific ways of assessing physical fitness in dance. Dance science is a relatively new area of research, and there is a need for more research into dance-specific field tests. The Research Committee of the International Association for Dance Medicine and Science has been advocating standardized techniques for measuring dancer capabilities.

The development of the dancer's physical fitness seems traditionally to be more a by-product of skill acquisition than focused fitness training. Fortunately, supplementary fitness training is now being recommended in dance training to prepare the dancer for the demands of rehearsal and performance.^{9,10}

The results of this study indicate that the high intensity dance-specific test is a reliable and valid means of assessing and monitoring the cardiovascular fitness of dancers.

The test allows dancers to be assessed within an environment they are used to (the studio), with a mode of exercise that is relevant (dance), and at an adequate intensity to be representative of some contemporary dance performance.

Acknowledgement

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Abstracts from the Current Literature

Edited by Gayanne Grossman, P.T., Ed.M., and Marliese Kimmerle, Ph.D.

Batson G. Update on proprioception: considerations for dance education. *J Dance Med Sci.* 2009;13(2):35-41.

Postural control and balance are foundations of dance skills. In this article, the author explains the science of proprioception and reviews the latest research on proprioceptive training to improve overall balance and coordination. Proprioception refers to the sensation of the position of the body or its parts, while static and in moving through space. This 'kinesthetic' awareness is critical in dance for controlling movement and maintaining balance, particularly when balance is challenged. While some studies suggest that dancers have a better kinesthetic sense than non-dancers, others show that they do not necessarily perform better on laboratory balance measures, and therefore tests for proprioceptive deficits, and specifically a balance battery, should be included in dance screening. A resource paper on the IADMS website titled "Proprioception," by the same author, is a useful companion reading, directed specifically to teachers. It provides examples of screening items and dance-specific exercises that could be incorporated into dancers' training.

Bronner S, Ojofeltimi S. Gender and limb differences in healthy elite dancers' passé kinematics. *J Motor Behav.* 2006;38(1):71-9.

Do a dancer's gender and preference for gesture and support limb affect proficiency in performing a lower limb dance skill? Those are the questions the authors studied with twelve elite professional dancers (six male, six female) via an analysis of passé performed in first position turn out. The dancers identified their preferences for the gesture leg in développé, and performed six passé movements with each leg. The kinematic analysis of data from body markers on the hip and lower limbs produced no differences in kinematic variables on the right versus left and preferred versus non-preferred limb. There was a high degree of consistency across each repetition. Only one gender difference, greater hip flexion in women than men, was found. This gender difference was expected, as women tend to have greater joint mobility than men. The consistency in skilled performance was also expected in highly trained dancers. The lack of lateral differences is explained by elite dancers performing a simple movement, well practiced due to many years of symmetrical training of the passé. The

authors suggest that further exploration is needed to identify whether gender and limb differences do exist in novices that diminish with training.

Van Staden A, Myburgh CPH, Poggenpoel M. A psycho-educational model to enhance the self-development and mental health of classical dancers. *J Dance Med Sci.* 2009;13(1):20-8.

From a review of relevant literature, the authors suggest that the professional ballet environment may be a contributor to difficulties encountered in both the personal and professional lives of dancers, such as self-identity and body image issues, eating disorders, perfectionism, defense mechanisms, relationship issues and problems with career transitions. In a pilot study they interviewed nine professional classical dancers, concluding that dancers were indeed strongly influenced by their environment and that the study provided justification for developing an intervention program for pre-professional dancer in a vocational setting to promote mental health, balanced functioning, and self-actualization as individuals. To that end they created an intervention model as a systematic approach to enhancing dancers' mental well-being. Key components of that model are the creation of a trusting environment, and the role of a trained facilitator who can guide the dancer through stages of self-awareness, self-regulation and self-development.

Escamilla RE, Babb D, DeWitt R, Jew P, Kelleher P, Burnham T, Busch J, D'Anna K, Mowbray R, Imamura IT. Electromyographic analysis of traditional and non-traditional abdominal exercises; implications for rehabilitation and training. *Phys Ther.* 2006;86(5):656-71.

Dancers frequently engage in abdominal strengthening regimens. This research project investigates which abdominal muscles or surrounding trunk muscles are activated during traditional and non-traditional exercises. The authors define traditional exercises as those which flex the trunk by lifting the head and shoulders off the floor toward the pelvis, known as "crunches". Non-traditional exercises include reverse crunches or exercises that activate the abdominal muscles but do not involve trunk flexion or use various commonly seen exercise devices. These non-traditional exercises engage the abdominal muscles differently and may activate other

muscles such as the small spinal muscles and the latissimus dorsi. The authors investigated which muscles were active during the six exercises tested. They discuss the muscular contribution of each exercise in detail, and provide pictures and clear, easy to read tables. The results of this study, and studies like it, can help danc-

ers strengthen effectively by knowing which exercises to include in a training protocol. For example, if a dancer is looking for a specific exercise for the lower abdominals or one that will engage the latissimus dorsi and the obliques at the same time, then this paper is a good resource.