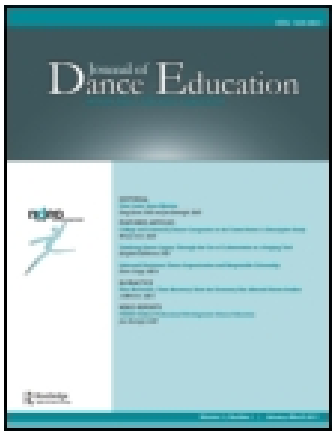

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Motor Learning and the Dance Technique Class: Science, Tradition, and Pedagogy

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Motor Learning and the Dance Technique Class

Science, Tradition, and Pedagogy

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Abstract

Learning the complex skills involved in dance presents many challenges. It is of vital importance that dance teachers are cognizant of motor learning principles that maximize and expedite learning, yet many traditional practices in the dance classroom may not draw on this research. In addition, more empirical research in the domain of dance learning is needed. Some information can be gained from the research performed using athletes, however, not all research involving sports skills translates to dance. The following discussion surveys selected motor learning research findings and their potential applications to the dance technique class with the aim of re-examining and even transforming traditional teaching practices.

Motor learning, which involves a set of processes consisting of presentation and subsequent replication of movement material,[1] has been a topic of increasing interest and research. Schmidt and Lee define motor learning as, "a set of internal processes associated with practice or experience leading to relatively permanent changes in the capability for motor skill."[2] Teaching any motor skill presents major challenges, yet it may be particularly difficult for teachers, most likely expert practitioners, to relate to the trials of the beginner. In dance, instructors execute traditional, time-honored teaching practices with the intention of producing efficient learning at all levels. Yet, some commonly practiced methods may actually inhibit learning. Margaret Skrinar reports that a teacher's lack of information about how students learn could actually detract from their learning and performance abilities, potentially turning future dancers away from the field.[3] Furthermore, the dance class, like any subculture, is embedded with traditions and widely held and implicitly accepted practices that are rarely questioned. These traditions come to represent the accepted practices, standards, and overall identity of dance learning and teaching. But, because of this focus on dance tradition, "much of the exciting psychomotor research, with its implications for dance skill acquisition, never reaches the novice [or even experienced] teacher."[4]

Researchers in the fields of cognitive psychology and motor learning have developed many powerful principles that are now being filtered into various pedagogical contexts. Sports science and physical education, for example, incorporate research that guides coaches and physical education teachers in the most efficient methods of teaching sport-related motor skills. Focusing on the dance technique class, this discussion takes a close look at traditional pedagogical practices, juxtaposing them with selected applicable motor learning research findings. It is important to note here that, although scant research in motor learning and dance exists, and some additional research findings can be transferred from sport to dance, many

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such inferences simply cannot be made without more studies specific to the dance classroom. The following sections discuss limited attention capacity, focus of attention, bilateral transfer, practice scheduling, feedback, errors, and learning styles. Similarities between research findings and typical occurrences in the dance technique class will be highlighted in hopes of both crystallizing pedagogical practices and inspiring new empirical research in dance.

Attention Capacity and Overload

Cognitive psychologists work from the widely-held premise that the learner has a limited capacity for attention.[5] This means that an individual can attend only to a limited number of incoming stimuli at any given moment due to the fact that numerous stimuli cannot be processed simultaneously and that these stimuli fade quickly if not encoded (imprinted through processing into long-term or permanent memory). The working memory system, a set of activities within which attention functions, serves as the active workplace for mental operations. The central executive serves as the "headquarters" of the working memory system, overseeing this dynamic state, whose information changes depending on where one's attention shifts.

Since attention is limited, simultaneously focusing on more than one task can pose potential problems. Furthermore, tasks compete with each other for attention. Within the working memory, a mechanism known as the "response selector" selects and initiates responses to incoming stimuli, but can only do so one stimuli at a time. Pashler[6] provided evidence that one cannot equally select and execute responses to two simultaneous stimuli without delaying the processing of one, which is referred to as a "bottleneck in the flow of mental events."[7] When learning to drive, for example, focusing on speed, keeping the car inside the lane, preparing to turn, and monitoring other cars can feel overwhelming, and can actually be dangerous. However, since "practice decreases the resource-demand of a task,"[8] once an individual has, through the practice of driving, mastered the tasks involved, each task actually takes up less of the limited attention resources, and the skill of driving (and all its sub-skills) gets easier.

In addition, if a learner can associate an aspect of a new skill to something she already knows, then this new information takes up less of the available attention capacity, leaving room for additional new information. To beginners, or novice learners, however, all the items presented are relatively new, having fewer preset constructs on which these items can hang. Therefore, the beginner's attention capacity is reached sooner than it would be with advanced or accomplished learner.

Many teaching and learning issues in the dance classroom arise out of the fact that attention is limited. Hence, many teaching applications based on this principle can be put to use to improve dance learning. It becomes very important to consider how much and what kind of information a teacher dispenses to a beginner-level class at any given time. A teacher whose intentions are to be helpful and thorough may, instead, be bombarding the student with too much information. Once the student is overloaded, her potential for successful learning is very low. There are several ways for a teacher to help avoid this overload. A common adjustment that most teachers make is to create shorter combinations with simpler movements for beginners. It is important to keep initial instructions short and to the point, rather than explaining all the aspects, pitfalls, and nuances of the movement as it is introduced. A few (two to three) vital points to remember are appropriate. It is also important that the teacher allow multiple practices between instructions and feedback in order to allow for processing time, since practice diminishes the attentional resources of a given task.

Cueing

In addition, it is important to note that students can be overloaded while mid-stream in an exercise or combination, as well as before they begin. Learners "self-instruct" (i.e., they talk to themselves mentally) and this self-instruction pulls from their working memory's attentional capacity. Consequently, if an instructor is constantly giving out information before and during practice, processing could be delayed or students could become overwhelmed with information. One of the most common interruptions during a beginner's performance is "cueing." Cueing can take several forms: clapping or snapping fingers rhythmically, singing movement cues to the students on the beat, or even shouting out reminders such as, "Keep your focus up!" or, "Close 5th!" or, "Six and seven and eight." This practice, common for teachers of students at all levels, may be less distracting for intermediate and advanced dance students (those who have much more pre-learned information on which to hang the new information). To the teacher, these appear to be helpful cues that, in the moment, improve performance, especially for the struggling novice.

Based on what cognitive psychologists now believe about how learning takes place, however, these cues could distract the learner from the task, and

thus impede the learning process. Beginners have gleaned a tremendous amount of information from the teacher's introductory description and demonstration of a new movement. When the combination begins, they are quite busy talking to themselves, putting those strategies and directions into action. Their working memories are near capacity at this stage. Therefore, efforts to apply the incoming instructions from the teacher (to whom they would instinctively want to listen), as well as correctly execute the movements in space and time, has the potential to overload a student's attention capacity. A more effective strategy would be to introduce the movement, giving the two or three most important points about this movement that will help get them started, and then let the students practice it more than once without commentary. With careful observation of the students, the teacher can then note what they are repeatedly having trouble with, addressing one or two of those points before practicing again several times. Most likely, after several practices on their own, students themselves will solve some of the movement problems with no help from the teacher. In the traditional dance class culture, teachers who refrain from constant commentary may be perceived as passive, unhelpful, or even apathetic. Furthermore, cueing practices may be a deep-rooted habit for some teachers, which makes change a particularly difficult task. Overall, the ultimate goal is to acknowledge and practice the most efficient teaching methods that promote learning.

In addition to re-evaluating teaching practices, teachers could encourage students to incorporate helpful learning strategies. A first and obvious strategy for students is practice. With repeated practice, a movement or sequence improves. Yet, it also becomes more automatic, or integrated, which uses considerably less working memory, leaving more room for new incoming information and processing. Secondly, students learn well when they can relate new information to what they already know. Cognitive scientists believe that much of a successful learning process entails drawing on prior knowledge and beliefs to construct new knowledge.[9] In order to explain a new concept or movement, a dance teacher may want to incorporate an analogy from sports, or other daily activities common to all students. Of course, many teachers may recognize this concept or instinctively employ these strategies with students, yet they may not realize the sound foundation behind their effectiveness.

External and Internal Focus of Attention

What do students need to be thinking about when they learn new movements? More specifically, on what should they be focusing? Are there some strategies that enhance learning and others that hinder it?

Both internal and external references, or cues, are made for a variety of reasons in the dance class. Teachers give externally focused directional or frame of reference cues in many ways to help clarify movement, such as telling a student to raise his or her leg parallel to the floor. Even more common is the teacher's practice of referencing the body (an internal focus) when giving instructions and feedback, such as acknowledging the relationship of the shoulder to the opposite knee or the knees over the toes. Similarly, it is not an unusual experience for a student, whether a beginner or even an intermediate student, to complain of feeling overloaded with strategies and references. For example, teachers will often break down a movement or series of movements, making the students aware of the many mechanical details that are involved in a successful execution. Many of these cues direct the focus internally, referring to parts of the body relative to other parts, or simply requiring conscious attention to what the body is doing. Students often claim that they executed the movement more easily *before* they became so aware of the micro-executions and relationships they were making in order to make the movement as a whole successful. With other concepts, such as the dynamic lines of energy extending through and beyond the body, teachers refer to the floor, the walls, or the ceiling. Or, referencing a direction, teachers call students' attention to a window or door, another dancer, or, for qualitative enhancement, refer to the sky beyond the ceiling, or even the negative space created by the body. Teachers most likely do not consciously consider whether they are making external or internal references, or which may be more effective in learning movement.

The field of motor learning has investigated issues of external versus internal focus of attention with some interesting results in the context of sport skills. It is even more interesting to ponder the implications that this body of research may have if applied to the dance class. In formative studies, Wulf and various colleagues,[10-12] investigated whether instructions that focused the learner externally (away from the body or on an implement or apparatus) were more effective than internally focused instructions. Researchers predicted that the effects of instructions that focus externally (specifically on an apparatus or the effects of one's movements) would more effectively enhance learning than those that focus the learner

internally (on her body's movements). Overall, the studies successfully demonstrated that instructions emphasizing an external focus of attention enhanced learning more than instructions that emphasized an internal focus.

Furthermore, in a very recent study, Wulf and colleagues[13] looked at feedback in relation to external and internal focuses of attention, using complex sport skills rather than motor tasks. The results showed that the externally focused feedback condition demonstrated a more effective performance than that of internally focused feedback. This was true for both advanced and novice learners, with a generally permanent effect. Although the sports skills analyzed (a volleyball serve and a soccer pass) are obviously not the same as dance, they are considered complex motor skills, as are most dance skills. A study that compares the effect of external focus of attention with and without an apparatus may be needed in order to help determine whether this motor learning principle has true implications for dance, and, even more importantly, whether the importance lies simply in focusing away from the body (something done less often in dance), or whether obtaining a benefit from external focus is dependent upon the use of an implement.

More similarity can be seen between manipulating a ball and dancing with a prop. A second poignant element of this research lies not only in the reasons why external focus is more effective, but also in the reasons why internal focus of attention is less effective. Studies addressing this question[12,14] found that too much internal focus can interfere with one's automatic motor control processes (the regulations in controlling movement that require no conscious attention). The external focus effect seems less apt to interfere with that automatic process. Thus, a learner who is focused on many internal instructions or feedback could more easily be overloaded with information. Comparatively, in dance, it is interesting to note that students constantly maintain a plethora of internal references (from both themselves and the teacher) while practicing and learning movements. The body is used pervasively as a reference to itself (i.e., arms in relation to each other, head to "tail" or tailbone, homolateral and contralateral references). These pedagogical practices have not yet been empirically researched from this perspective. In fact, these internal references are central to understanding developmental movement patterns, from which there have arisen many interesting and beneficial applications to dance, somatic therapies, and dance/movement therapy. This new perspective on external versus internal focus and learning could provide a very rich area for new comparative research.

Overall, although the above findings on focus of attention in sport activities such as volleyball and soccer cannot necessarily be directly applied to dance instruction without more specific studies, they may pose important questions worth investigating in terms of the amount of internal focus that dance teachers require students to use. For example, these findings raise questions about how realistic our demands on the dance learner are in the learning moment. How often is an unknown overload taking place, and how often is this misinterpreted for slow learning, or even an inattentive learner? Do dance teachers consciously impart more internally focused instructions to the dance student? If so, is this practice out of habit, tradition, or from evidence of student success? Are there other unexplored methods of conveying information that would lead to more efficient learning? Moreover, dance uses props, rather than sports implements such as rackets, baseball bats, and the like. Yet props are seldom used for dance instruction. What could such an emphasis on external focus of attention mean for a dance class? Could the strategic use of props for instruction more rapidly increase learning in that dancers focus attention beyond the body? (I am reminded of former long time José Limon company member, Carlos Orta, who often utilizes bamboo sticks in his teaching as well as in his repertory, with an emphasis on carving the body through space). The findings related to external versus internal focus of attention are cause for examining anew our time-honored yet perhaps excessive practice of drawing students' attention to their bodies during the learning process. More studies need to be conducted in the dance learning arena in order to determine the extent to which the use of external cues translates to the dance classroom, as well as how these cues might affect novice learners in particular.

Bilateral Transfer

Teachers are probably familiar with the collective sigh that occurs when they ask students to transfer a new combination to the opposite side. The dance lore that implies that learning on the second (usually left) side is more difficult than the first probably got its reputation because, as the majority of individuals are right-handed, teachers more frequently start with the right or preferred side when teaching material. Thus, the second, or left side is seen as more difficult. Bilateral transfer, defined as the transferring of motor pat-

terns to the other side of the body through practice on one side,[15] is one of the most distinguishing practices of the dance technique class. Yet, in a motor learning study done in a dance classroom with both inexperienced dancers and those with some dance training, Puretz reported that bilateral transfer was better from the non-preferred side to the preferred side.[16] This finding suggests that teachers should begin teaching from non-preferred side, knowing that the student will have a more successful transfer of learning to the preferred side. One important issue to recognize here is that movement combinations can be quite complex beyond the beginner level, and may not feature one side or the other. For example, in a typical ballet barre combination, the barre provides additional spatial orientation for the more uniform, unilateral movements. However, in an advanced ballet or modern technique class, where a combination in center floor travels and turns less uniformly in three-dimensional space, often repeatedly changing the leading side, this discrete difference between a "right" and a "left" side is not so obvious, and transfer may take more time. In addition, there is no guarantee that the right side is the preferred side for every student. Yet, starting from what students' perceive to be the non-preferred side could be encouraging if they are confident that the reversal may not be quite as difficult.

Furthermore, when students are learning a combination in class, time is allotted for them to work out the combination on the second side, either individually or as a group. However, students often undertake this challenge on a regular basis with no applicable strategies to help them. In this situation, universalizing verbal cues can be of help. For example, in referencing the body, teachers usually refer to "left" or "right." Therefore, while rehearsing the second side, a student must go through the material and place new labels on each movement, recalling the opposite cue from the first side. Conversely, using universal cues allows a teacher to standardize her language, rather than assigning new words to the translated movements. For example, on the first side, if the right leg is used to initiate the sequence, the teacher can refer to it, instead, as the *downstage* leg. When the movement is repeated on the second side (and the left leg is actually used), the teacher can still refer to the *downstage* leg, which is a more efficient and a seemingly more easily comprehended adjustment to this transfer.

This strategy, congruent with findings on attention capacity and focus of attention, is useful for several reasons. To begin with, a student can mentally rehearse one set of instructions, rather than two. Second, universalizing cues propels a student's attention externally to her orientation in the room (external focus of attention) rather than focusing on her body, whose reference to the space is dynamic. Lastly, it may deflect a student's association with perceiving one side as being the "left" side, which has developed a reputation in dance class culture for being more difficult. This author currently knows of no study conducted to examine if this universalizing of language has increased learning. However, from personal experiences teaching dance technique classes, this tool has proved helpful to students on several occasions. Again, this is an area that could be greatly enhanced by empirical research.

Practice, Practice, Practice

Whether it be teaching dance or any other motor skill, it is important for the teacher to enumerate the goals that she wishes to achieve. Most often, a main goal will include that of instilling a permanent capability for a skill, rather than a temporary one. There are a myriad of ways to practice a new skill to ensure that relatively permanent learning takes place. Within the typical one to two-hour time frame of a dance class, a full lesson is planned and executed with the expectation that the students will have learned something tangible. No teacher wants to leave the students feeling that they have not quite accomplished anything at the end of a class. Rather, accomplishment should be palpable to the student.

Blocked and Random Practice

There are many ways to schedule, or order the practicing of individual skills, and different kinds of practice can lead to different levels of retention of these skills over the long term. Two of these methods are blocked practice and random practice. In blocked practice, identical practice trials are executed one after the other (i.e., A-A-A-B-B-B-C-C-C). In random practice, the different tasks are practiced in a random order (i.e., A-B-B-A-C-A-C-B-C). Research in motor skills has shown that blocked practice leads to a stronger performance initially, but weaker learning effects on retention tests than does randomly ordered practice.[17] If a student practices on a schedule of several randomly ordered skills, rather than just one repeated skill, it will take the student longer to initially perform the skill well, but the skill will more likely be retained for the long term. One possible reason for this advantage is the comparative and contras-

tive analyses that must take place with random practice.[17] Another hypothesis proposed by Lee and Magill[18] is that the pre-performance action planning that takes place must be constantly reconstructed in random practice, but are already available in working memory during blocked practice. In other words, the learner must prepare to execute a different skill more often throughout the practice session, rather than repeat the planning and execution of the same skill several times in a row. Easily remembering what to do from the previous identical trial promotes good performance in the initial learning stages, but is detrimental to the long-term retention of a motor skill.

This information on learning and retention has some challenging implications as it bumps up against traditional dance teaching practices. Evidence of student retention, motivation, and progress are very important components to a teacher's success. Students who do not see immediate visible progress and who are not motivated to persevere in order to gain long-term benefits may become frustrated and even drop out. For a studio or community dance class, this could prove particularly detrimental to a teacher's income or reputation. Additionally, in a college dance class on a ten-week quarter system, demonstrating to administrators that visible progress is being made may be quite challenging. In light of these issues, it becomes evident that teachers must build awareness of the nature of the dance-learning environment and serve as pro-active advocates for their own professional needs.

Once again, it is worth reiterating that it is not appropriate to link all findings on sport skills or motor tasks to the context of dance skills. Although the differences between the two are sometimes obvious and at others more subtle, motor skills specific to dance must be further analyzed. First, many motor learning studies use simple skills, yet few dance skills would qualify as simple. Second, the issue of just what an isolated dance skill is must be determined. In the ballet class, however, this may not be as difficult, as ballet is made up of many discrete movements (movements with distinct beginnings and endings, such as a tennis serve or a frappé), each named, and often rehearsed with a blocked practice-type repetition in class exercises, as in repetitions of frappés, tendus, or degages. In a modern dance class, such discrete, and repeated movements may be harder to isolate.

Although it may be frustrating to be introduced to the plausible information above only to discover that there are no easy, ready-made applications, the research can at least open up the vistas of dance instruction for new investigations that have the potential to better define teaching and learning practices. For example, traditional dance culture has prescribed a logical order of exercises at the ballet barre for hundreds of years. But, in light of the findings on blocked and random practice, would a frappé combination be more effective, say, if combined with ronde de jambes and degagés in a bit of a more random order, rather than isolated and repeated in the traditional blocked format? Of course, there are many factors to consider, such as making sure the warm-up progresses appropriately, avoiding overly complex combinations, and aligning the warm up with the rest of class. If found to be more efficient, though, what would this strategy imply for the structure of the traditional ballet class?

Feedback: Too Much of a Good Thing?

A fifth principle that enhances efficient learning is feedback. Students obviously obtain a plethora of information in regard to their success simply by experiencing a movement. However, a teacher or observer can provide additional critical information about the movement in addition to this self-monitoring. In motor learning, *augmented feedback* is generally categorized according to information given to the learner from an outside source, and is in addition to what is called *inherent feedback,* or the information she receives simply by executing the movement.[19] Augmented feedback can be either related to the nature of the movement produced called *knowledge of performance* (KP) or related to the result or goal that the movement produces called *knowledge of result* (KR). In relating this concept to dance, it is probably most appropriate to refer to knowledge of performance, which the dance field relates to as "crits" or corrections in the dance class. However, I will also generalize the more massive findings on knowledge of results to verbal critiques (or feedback) in dance since, as Schmidt and Lee assert:

> We will assume that the mechanisms of all types of augmented feedback are essentially the same . . . for example, the principles that have been discovered for KR would be applicable to situations when KP would be given.[20]

Experiments with the frequency of external feedback show that giving feedback less than 100% of the time is more effective in promoting retention than giving feedback 100% of the time.[21]

How might we try to look at this finding through the lens of dance learning? In dance, augmented

feedback is primarily conveyed through corrections, or "crits." Movement sequences, even in the beginning classes, are longer than the typical discrete motor skill that most studies employ. Nevertheless, it may be possible to consider that feedback after a longer series of discrete skills might still benefit from a rate less than 100% KR. One of the important reasons for the success of less frequent KR is that the learner relies less on hearing from an outsider for corrections, which may prove very important to how a learner attends to the learning and refinement of a skill. On the other hand, high frequency of KR in the initial stages of learning can temporarily enhance performance (if not overwhelming the learner), as it provides motivational factors, informational help, and increases the stimulus-response (SR) bond.[22] However, this strategy fails to lead to sustained effects on a more permanent basis.[23]

Currently, there is no rule that prevails in dance teaching methodology as to the ideal frequency of feedback. In fact, most teachers probably feel that, depending on the individual situation, more is better. Many times, teachers want to accelerate the learning process, giving out an abundance of information both between and during practice attempts. Contrary to what might seem logical, less teacher feedback may allow the student to process the feedback that she does receive throughout repeated trials, without being over-stimulated by corrections. Again, the learner's limited capacity for attention is a contributing factor. Therefore, beginners would most likely gain the most advantage from restricted feedback.

Modeling and the Benefits of Errors

Instructions alone are insufficient for successful motor learning. Therefore, teachers routinely practice modeling, or demonstrating, both to introduce a movement combination and to elucidate a problem that needs correcting. Research has shown that modeling techniques are essential for acquiring skills, providing clues on strategies and spatial information.[24] It is not the purpose of this discussion to provide a comprehensive review of motor learning research on modeling, of which there is an overwhelming amount. Rather, this section will focus on a specific study related to modeling, framed by the larger context of performance errors.

Common modeling practice in a dance class consists of emulating an expert practitioner. The students typically spend a portion of every class observing the teacher (or a model student) who executes the movement the way it is meant to be. But, what is a beginner gleaning from the expert's demonstration? Adams[25] suggests that learning from observing a novice's mistakes is sometimes more effective than watching a perfectly correct demonstration by an expert. When students observe a fellow student incorrectly executing a movement and then fixing that movement, more information can be gleaned than from simply observing the teacher's correct demonstration of the movement again and again. In this experience, students are observing the processing operations involved in correcting and improving one's performance. In regard to observing experts, Adams found that novice athletes are not likely to gain much more than general information. The core issue here may be whether errors are included in the demonstration or not.[26] Implications for these results in the dance class may convey valuable information about how beginners learn. Uncovering the processes behind skill execution reveals variations between incorrect and correct versions of a movement, which could be valuable information for a learner. Teachers may instinctively draw attention to a student who is having trouble and then attempt to help the student fix the problem as the rest of the class observes. Many times, however, beginner dancers are more self-conscious when attention is drawn to them, such as when in-class crits, or corrections, are given directly. They are also more self-conscious about (and distracted by) making errors, yet it is these beginners who obtain the most benefit from this principle. It is a teacher's responsibility to help students to understand the value of the process and to facilitate a culture that understands the balance between the necessity of error and the importance of holding high standards, as this results in the best possible performance from students.

Dance is a performing art; therefore, dance training, at all levels, should include preparing dancers for the unpredictability and technical demands that lie beyond class and onto the stage. This training includes how to recover from mistakes on stage when they do occur, how to develop focus and concentration, and how to alleviate or avoid fatigue during a performance. It is commonly held in the dance profession that a noticeable mistake during performance is glaring and deemed unacceptable (and virtually unforgivable) at the professional level. Yet, beginners may very likely make mistakes in performance. A student at the cognitive stage of motor learning needs to be able to execute and move through inaccuracies while learning movement. In class, multiple attempts, which will include mistakes, are important in

translating the movement from idea to reality. Creating a class culture in which errorless performance is expected can build a looming fear of making a mistake. This will most likely cause undo stress, create performance anxiety, and ultimately impede or slow learning (and increase errors).

If the beginner's dance learning environment must be differentiated from the kinds of pedagogical and performance standards and expectations in the advanced or professional level, how can the instruction of novices still mirror the expectations of dance as a performing art? Teachers might incorporate a wider variety of instructional methods, especially at the beginning level, that capitalizes on the way beginners learn best. If the beginners are entering a performance situation, then careful considerations (such as increased time, more practice, less challenging movement, fewer critiques close to performance, a supportive audience) must be made to prepare them. As learners move to advanced levels, their capacity for attention will increase (as their ability to make more movements automatic increases); therefore, they will more easily be able to manage the kinds of performance skills required.

Learning is a process that does not manifest in neat and tidy ways, and mistakes can be a vital part of this process. Learning strategies can provide a positive balance to the errors that are sometimes inevitable. Primary examples of such strategies include meta-cognitive devices in which the student becomes aware of his or her learning process through self-monitoring, predicting outcomes, activating background knowledge, or planning ahead.[27] Beginners in particular could benefit from exploring these learning strategies. The messy job of processing and coping with the inaccuracies that come along with learning motor skills is an essential component of the culture of dance learning. Therefore, every resource should be culled to help the learner progress with the utmost efficiency.

Learning Styles: Casting a Wide Net

The final principle of motor learning that should be addressed are the differences in individual learning styles. Although it is common knowledge among teachers that students learn in different ways, teaching methods do not always accommodate these differences. In the dance classroom, some students learn best by watching the demonstration of the movement. Others prefer to "mark" the movement along with the teacher, and still others need to hear the counts, perceiving the rhythmical structure of the movement. Research has shown that combining these types of learning styles with multi-layered cues is more effective than appealing to only one mode.[28] However, Borelli and Skrinar,[29] in studying visual, verbal, and kinesthetic cues in dance instruction, found that verbal instruction was more common that all of the other types of cueing.

One method of accommodating all theses learning styles can be found in how the teacher demonstrates the new movement. Teachers often resort to excessively, yet unconsciously counting over one's demonstration, or during the students' rehearsal trials. Yet counts only convey one kind of information. Instead, while demonstrating, a teacher can "rap" in a descriptive way, (such as, "cir-ir-cle, down, up, up" for an exercise in waltz time), giving information to the students in more than one modality. Learners are hearing both the rhythms and the verbal description as they mark the movement. Many times, multiple demonstrations are needed, providing further opportunities for varied forms of modeling. This "rhythmic rapping" may not be new to teachers who incorporate this idea naturally or who are aware of the importance of attending to learning styles. Nevertheless, it is important for all teachers to be cognizant of the sound basis behind these practices.

Conclusion

Overall, there are numerous issues to consider when teaching dance – many more than can be enumerated in one article. Not included in this discussion are such issues as the many aspects of memory, motivation issues, visual proprioception, warm-up decrement, and how stress can affect learning. Furthermore, many issues raised here require individuals with both knowledge in the fields of motor learning and cognitive science, as well as the domains of dance and dance learning, in order to conduct research in the dance class itself. Yet, there is also a need to continue to make direct applications from the small body of specific psychomotor research that exists in dance to both teaching methods and teacher training programs.

Preparing future dancers from the ground up involves instilling learning practices and habits that will follow a dance student through a career of experiences and achievements. The professional field of dance is competitive and dancers need to be diversely talented, equipped with an armful of strategies to compete for a seemingly shrinking number of desirable positions. Although both present and future teachers can benefit from new, solidly based teacher practices in the classroom, the field may be missing opportunities to recruit interest in the science of dance teaching and learn-

ing. How can we encourage more of the retiring professionals who enter academia to pursue scientific paths of study related to dance? Many feel they lack the qualifications, yet I have seen many colleagues hurdle that obstacle by entering graduate programs in various scientific fields with much success. Most dancers want to study more creative or innovative fields such as choreography or dance technology. Yet, the science of dance learning can be a rewarding choice of study at a time when the sciences are benefiting from a recent plethora of new findings about the way people learn.

This discussion is intended to be one of the many needed discourses related to the bounty of cognitive science and psychomotor research findings available to dance learning. In any situation, improvement often demands change. Historically, dance teaching has held tightly to tradition and the apprenticeship of observation. Yet, it is teachers who are ultimately responsible for transforming their field by reflecting the best practices and methods. Perhaps this article will precipitate further discussion and investigations of traditions and practices within the dance class, and impel new, illuminating research in these areas.

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References

1. Puretz S: Psychomotor research and the dance teacher. *In:* Clarkson PM, Skrinar M (eds): *Science of Dance Training.* Champaign, IL: Human Kinetics Publishers, Inc., 1988, p. 282.
2. Schmidt RA, Lee TD: *Motor Control and Learning*. Champaign, IL: Human Kinetics Publishers, Inc., 1999, p. 264.
3. Skrinar M: Selected motor learning applications to the technique class. *In:* Clarkson PM, Skrinar M (eds): *Science of Dance Training.* Champaign, IL: Human Kinetics Publishers, Inc., 1988, p. 269.
4. Puretz S, 1988, p. 279.
5. Bruning RH, Schraw GJ, Ronning RR: *Cognitive Psychology and Instruction*. Upper Saddle River, NJ: Prentice-Hall, Inc., 1999.
6. Pashler H: Attentional limitations in doing two tasks at the same time. Current Direction in Psychological Science 1:44-47, 1992.
7. Reisberg D: *Cognition: Exploring the Science of the Mind*. New York: W.W. Norton & Company, Inc., 1997, p. 109.
8. Reisberg D, 1997, p. 111.
9. Bransford JD, Brown AL, Cocking RR: *How People Learn: Brain, Mind, Experience and School.* Washington, DC: National Academy Press, 2000, p. 10.
10. Wulf G, Hoss WP: Instructions for motor learning: Differential effects of internal versus external focus of attention. Journal of Motor Behavior 30(2):169-179, 1998.
11. Wulf G, Lauterbach B, Toole T: Learning advantages of an external focus of attention in golf. Research Quarterly for Exercise and Sport 70:120-126, 1999.
12. Wulf G, McNevin NH, Shea CH: The automaticity of complex motor skill learning as a function of attentional focus. Quarterly Journal of Experimental Psychology 54(A):1143-1154, 2001.
13. Wulf G, McConnel N, Gartner M, Schwarz A: Enhancing the learning of sport skills through external-focus feedback. Journal of Motor Behavior 34(2):171-182, 2002.
14. Wulf G, Shea CH, Park JH: Attention in motor learning: Preferences for and advantages of an external focus. Research Quarterly for Exercise and Sport 72(4):335-344, 2001.
15. Underwood BJ: *Experimental Psychology*, (2nd ed). Englewood Cliffs, NJ: Prentice-Hall, 1966.
16. Puretz S: Bilateral transfer: The effects of practice on the transfer of complex dance movement patterns. Research Quarterly 54(1):48-54, 1983.
17. Shea JB, Morgan RL: Contextual interference effects on the acquisition, retention, and transfer of a motor skill. Journal of Experimental Psychology: Human Learning and Memory 5:179-187, 1979.
18. Lee TD, Magill RA: Influence of practice schedule on testing schema theory predictions in adults. Journal of Motor Behavior 17:283-299, 1985.
19. Schmidt RA, Lee TD, 1999, pp. 324-325.
20. Schmidt RA, Lee TD, 1999, p. 330.
21. Winstein CJ, Schmidt RA: Reduced frequency of knowledge of results enhances motor skill learning. Journal of Experimental Psychology: Learning, Memory and Cognition 16:677-691, 1990.
22. Schmidt RA, Lee TD, 1999, pp. 326-352.
23. Salmoni AW, Schmidt RA, Walter CB: Knowledge of results and motor learning: A review and critical reappraisal. Psychological Bulletin 95:355-386, 1984.
24. Schmidt RA, Lee TD, 1999, pp. 290-291.
25. Adams JA: Use of the model's knowledge of results to increase the observer's performance. Journal of Human Movement Studies 12:89-98, 1986.
26. Schmidt RA, Lee TD, 1999, p. 292.
27. Bransford JD, Brown AL, Cocking RR, 2000, p. 18.
28. Cratty B: *Teaching Motor Skills*. Englewood Cliffs, NJ: Prentice-Hall, 1973.
29. Borrelli G, Skrinar M: Instructional cue use in two dance idioms. Kinesiology for Dance 5(1):6, 1982.