Dancers' Learning Styles: Novices Versus Experts

Novices and expert dancers use different mechanisms in learning new movement sequences. Anderson's (1996) Adaptive Character of Thought (ACT-R) theory can shed light on the possible cognitive differences between novices and expert dancers. In his theory, long term memory is divided into declarative memory and procedural memory. Declarative memory is explicit and conscious, comprised of schema-like chunks of information that contain facts about the world. Procedural memory, on the other hand, is largely implicit and contains information on how we execute certain actions, such as driving a car or simply walking. Representation of procedural memory is in the form of productions, which consists of two parts: the IF component specifying the condition and the THEN component determining and implementing the action. These productions are goal-driven and hierarchical in structure, sometimes creating sub-goals in order to attain an overarching goal.

Cognition occurs with the interaction of procedural and declarative memory, with productions frequently retrieving chunks of information in order to achieve its particular goal (Anderson, 1996). It is the efficiency of this conversation between procedural and declarative memory that separates the novice dancers from the experts. Experts, when cued to perform, would do so more quickly and more accurately than novices. Novices need to translate the unknown movement from bits and pieces of what was previously present in their knowledge. There would be an active conversation between procedural memory and declarative memory until the movement is figured out. Experts perform automatically without the need for the constant back and forth between the two memories.

By definition itself, expert knowledge of dance movement must be rooted in procedural memory. Novices, however, cannot activate productions of movements because of lack of experience in its execution. This holds even if the movement was previously demonstrated and a mental representation of it had been created. Knowledge of a specific movement can exist in declarative memory since novices can identify and recognize movement without being able to perform it. In expert performance of sport, Hodges et al. acknowledged just this; that the development of both perceptual-cognitive and perceptual-motor skill is important. These different skills may develop at different rates and may lead to an athlete knowing "*what* to do, but not *how* to do it" (p.474). Anderson (1996) said that the creation of chunks of information in declarative memory originates from perceptions from the environment as well as the actions performed that have resulted from the production rules. Knowledge does not necessarily equal ability to perform. With little or no training in dance, novices would be able to identify and characterize a pirouette turn but may not be able to accurately perform the movement. Procedural memory and declarative memory are seen as two distinct systems and it is reasonable to expect that experts and novices rely on different strategies in memory retention depending on which memory system they are more apt to use.

Novice and expert minds are organized in ways distinct from each other, leading each to approach tasks and problems in divergent ways. In general motor skill abilities, novices and experts were shown to differ in problem solving ability of complex situations (French et al., 1996). Young children between the ages of 7 and 10, divided into three groups of baseball skill (high, average and low), were found to provide more accurate solutions to complex baseball game situations when the children in question were at a higher skill level. Specifically in dance, novices and experts use different strategies in learning a new dance routine matched to provide adequate and appropriate difficulty to each skill level. (Poon & Rodgers, 2000). The authors found that although both groups of dancers used counting as a strategy in remembering the routine, expert dancers did not limit themselves to a fixed and definite counting system and associated specific musical cues to specific movements. The study also pointed to the different ways novices and experts segment the choreography. Expert dancers chunked the movement information into longer phrases of movement but in the process had significantly less chunks to remember than novices. These chunks were also systematic, with more agreement between individual expert dancers. Novices tended to remember specific individual movements with relatively little agreement among themselves. With this in mind, it is obvious that the ways in which the brain operates are dependent on prior experience and the skill level attained.

Evidence for the brain's dependency on prior experience can be seen in experts' abilities to chunk information for expediting recall of dance movement when compared to novices. Poon and Rodgers (2000) argue that novices use more mental space to verbally express the smaller movements that make up a dance movement. A novice may code a "chasse" movement as "right foot to the right, left foot to meet right foot, right foot to the right." Experts chunk the long verbal description that novices use into a shorter form that is simpler to remember: the dance term "chasse." Chunking results from the ability to reorganize the information attained in past situations. Expert dancers recognize patterns from their past experiences that allow them a more efficient way to categorize movements. Prior experience that eventually leads to chunking is important; without it there would be no difference in performance of recall between experts and novices.

In all the previous examples and explanations of chunking, it is important to mention that chunking is defined in terms of words. Experts rely on verbal chunking in memory; this argument is valid in Poon and Rodgers study only because jazz, the form used in the study, is a structured dance form. If, in the past experiences of a dancer, dance classes are filled with verbal terms corresponding to specific movement, the mind will organize all movement information in a verbal manner. Starkes, Deakin, Lindley and Crisp (1987) conducted a study in which ballet dancers were tested on their verbal and motor recall of structured dance segments and motor recall of unstructured dance segments. The structured dance segments comprised of professionally choreographed movements and unstructured segments involved the same movements placed in a random sequence. They found that expert ballet dancers performed significantly better in both motor and verbal recall of the structured movements than in motor recall of the unstructured dance segments. In a later study by Starkes, Caicco, Boutilier & Sevsek (1990), modern dancers were subjected to the same experimental task. Modern dance is significantly less structured than ballet and relies less on rigid movement vocabulary and specific terminology. Although the modern dance experts expectedly performed much better than the novices in all conditions, the advantage in motor recall for structured dance segments previously seen in ballet dancers was not produced. Helga Noice and Tony Noice (2006) suggests that these findings point to modern dancers abilities to recall a wider range of movements than ballet dancers because of less use of verbal labels in modern dance (p. 498). Each dance student is taught in a different way and this influences the structure of their knowledge later in their dance career, explaining any results favoring verbal account of memory.

Thinking of the movement vocabulary in terms of words and verbal chunking can explain some of the experts' quick abilities to access the information needed; however, we see that this is not a sufficient explanation. Problems occur when considering that many dance forms have no verbal labels or when considering that some forms have only recently evolved terms when they were originally historically absent. Middle Eastern dance, or bellydance, is one such example of this. Movement terminology evolved for this ancient dance only in the mid-20th century as an attempt to add structure to the dance form. Regardless, before the structuralization of bellydance, many dancers were able to become skilled practitioners of the art form. Because of the lack of terminology prior to this period, dancers could not have depended on verbal chunking. As chunking contributes greatly in the acquisition of expertise, it is likely chunking does occur but in a different form than what Poon & Rodgers (2000) hypothesized.

Another dance that fails to validate the effectiveness of verbal chunking is flamenco. Flamenco dance does make use of dance terminology to characterize and group different movements together but no terms exist for specific movements. "Floreos" and "plantas" correspond to hand movements and are also localized to a body part. The specific terms themselves do not include descriptions of the other parts of the body resulting in various combinations of "plantas" and "floreos" to create multiple movements. Thus it is possible to use the same hand "floreo" with different arm positions and arm movements to make two very distinct movement patterns, neither with its own term assigned to it. There is not enough dance terminology in flamenco to include all aspects of specific dance patterns to allow an adequate verbal chunking of all relevant information.

There are a few dance terms in use in flamenco dance. "Plantas" are strikes to the floor with the ball of the foot. "Golpes" are stomps to the floor involving the whole foot. "Tacon" indicates a strike to the floor with the heel. Dancing flamenco involves repeating these foot movements to create a percussion accompaniment to the music. There are no terms that involve special groupings of the different footwork previously mentioned but there are patterns that emerge in which certain footwork expectedly follows specific footwork. Experts are somehow still able to chunk together the different combinations of "planta", "golpe" and "tacon" leading to better memory and performance of the movement. If memory were driven by verbal chunking, taking the terms of flamenco footwork into consideration, it would seem that experts learn movements similar to novices. In a typical pattern that occurs repeatedly throughout flamenco dancing, the experts would remember "planta, tacon, golpe, golpe." This is definitely not the case as the expert flamenco dancers are able to remember these four foot movements as one movement despite lacking verbal terminology.

In the bellydance and flamenco dance styles, verbal chunking has limited usefulness. Its benefits are specific to structured dance forms such as ballet. Chunking is a necessary component to movement learning; however, verbal chunking is not necessary in the acquisition of skill in dance movement. There must be some other mechanism within expert dancers' minds that can account for learning movement patterns of non-structured forms of dance. Chunking based on nonverbal aspects of memory must be at work.

Prior experience shapes the way representations are structured (Poon & Rodgers, 2000). Verbal chunking occurs within structured dance forms such as ballet and jazz because the students have been taught in a structured verbal way. However, even these verbally structured dance forms have a kinesthetic component in the dancer's mental representations as well.

Schmidt (1975) identifies four important elements that are present when storing a movement to be learned into memory. First, the initial conditions are evaluated, noting the state and postures of the body as well as the surrounding environment. Using the dancer as an example, the temperature of the dance studio and tensions in the body due to stress are examples of conditions that are stored. Second, response specifications consider the different characteristics of a basic pattern of movement that can be altered, such as speed and force. An arabesque, both legs straight, balancing on one leg with the other raised behind the body, can be produced in a fast lively manner and can also be produced in a slow serious intention. Third, information regarding the sensory consequences of the movement performed are stored, including visual, auditory and proprioceptive information. This includes all the information that the dancer's senses are taking in during a specific movement. Fourth, the response outcome is stored. Although, there is a goal, it is the actual movement that is stored. In attempting a pirouette, it is the turn that the student ends up executing, no matter how off balance or incorrect, that is stored instead of the memory of the idealized perfect pirouette that was seen performed. All this information is stored to form a schema of a movement after it is performed. Verbal labels in very structured dance forms such as ballet do aid retrieval to trigger fast behavioral responses but, as Schmidt shows us, it is not possible to separate out the kinesthetic qualities of dancers' representations.

An important element to obtaining expertise is deliberate practice (Ericsson & Charness, 1994; Ericsson, Krampe, & Tesch-Romer,1993). Deliberate practice can be defined as any activity in which the goal is to improve the skill level of a performer (Ericsson et al., 1993). In particular, dancers can engage in deliberate practice through repetition of movement in dance classes and practicing movements in their own time. Deliberate practice is not limited to physical activities and can also be undertaken through the use of mental imagery, though mental imagery should be accompanied by physical practice to be effective (Taktek, Zinsser, & St-John, 2008).

There are several kinds of imagery that can be used to promote retention of skills, however, the most applicable to dance are kinesthetic and visual imagery. Brain imaging studies were undertaken to compare EEG readings of subjects engaged in motor execution, observation, kinesthetic imaging and visual imaging of clenching a ball with a hand (Neuper, Scherer, Reiner, & Pfurtscheller, 2005). The results show an overlap of activation of cortical regions with movement execution and kinesthetic motor imagery and that visual and kinesthetic imaging produced different patterns of activation in the brain. Another study involving tapping movements to a metronome showed similar overlap (Stinear, Byblow, Steyvers, Levin, & Swinnen, 2006). Neuper et al. suggests that the two kinds of imaging techniques are functionally different and each can be appropriated to specific activities. Since motor execution and kinesthetic imagery are closely tied to each other with respect to brain activation, it is only logical to assume that novices cannot use kinesthetic imaging strategies in learning dance until proper execution of movement is possible.

Mental imagery has been shown to be an effective retention strategy for physical performance (Taktek, Zinsser, & St-John, 2008). Taktek et al. conducted an experiment that tested the ability of imagery to improve performance. In a pretest, children were asked to attempt underarm throws of a tennis ball at a target 5 times. Depending on which group they were assigned to, the children were asked to engage in a practice session differing in retention strategies. In the Specific Physical Practice Group (SPPG) the children physically executed 20 additional throws at the target. In the Visual Imagery Group (VIG), they imagined the tennis ball moving toward the target 20 times. In the Kinesthetic Imagery Group (KIG), the children were asked only to imagine what they felt as if they were performing 20 additional throws. In the Visual Imagery and Physical Practice Group (VIPPG), the children visually imagined and executed 10 throws each. The Kinesthetic Imagery and Physical Practice Group (KIPPG) had the same task as the VIPPG group except substituted visual imagery with kinesthetic imagery. After the practice sessions, the children were subjected to a posttest, executing five throws in the same conditions as the pretest. The children then went through a transfer phase of the study to see if the skills learned would transfer over to a similar activity. The same procedure was used for the transfer task except this time a heavier tennis ball was used to throw at the target. With the exception of VIG and the control group, all groups increased performance from the pretest to the posttest. Mental imagery, regardless of type, when coupled with physical practice, led to significantly higher performance levels than the physical practice alone; however, contrary to their hypothesis, the authors did not find a significant difference between kinesthetic and visual imagery.

Although Taktek et al. gave many reasons why their hypothesis, a significant effect in favor of kinesthetic imagery, was rejected in their experimental design, they failed to point out one important factor that could have confounded the results. One reason that they did not consider touches on the subject of expertise. They failed to consider the prior experience their subjects may have had with underhand ball throws. Most children have previous experience throwing balls through play. The participants were between the ages of 8 and 10, ages in which throwing balls was well within their movement vocabulary. Most children are far from being expert ball throwers; nevertheless, one can still make the assumption that children are quite skilled in the practice of ball throwing.

Differences between kinesthetic and visual imagery may be highlighted when considering level of expertise. In the previously mentioned study, an effect may arise if children were further separated into groups based on familiarity of playing with balls. Children would exhibit a more pronounced difference between kinesthetic imagery and visual imagery if they had very little or no prior experience with throwing balls. The more experience with ball-throwing a child has, the less of a difference between kinds of imagery. Familiarity with the task would enable the children to be adept at both visual and kinesthetic imagery. Of course, finding children that are not familiar with playing with any type of balls would be difficult in today's society in which physical education of children in school is a requirement. Further research is needed in a less common experimental task. I expect that when differing the amount of expertise between groups, results would show a main effect.

Fleishman & Rich (1963) found that different abilities are dominant at different stages of perceptual-motor learning. The authors tested the subjects on kinesthetic sensitivity and spatial visual abilities. The kinesthetic sensitivity measure involved comparing seven weights varying in 2 gram increments with both hands. They lifted one weight in each hand using only the wrist, leaving the arm on a table. They then indicated whether the second weight was heavier, lighter or the same weight as the first. The spatial ability measure was adapted from the United States Air Force Aerial Orientation Test. In this test, the subjects had to match the land, sea and sky horizons from the cockpit with the orientation of one of five planes. The experimental task had subjects keep a target-follower on a small, randomly moving disc. The target-follower was controlled by two handles, each handle controlling either a left-right motion or to-from motion. Results showed that performance correlations increased with spatial-visual abilities early in the task and later increased with kinesthetic sensitivity. In the early stages of learning the task, spatial-visual abilities proved to be more important; in the later stages with continued practice, kinesthetic abilities would take over. Although this study did not use complex movements and only measured hand movements in turning handles, a parallel result is expected in dance learning styles of novice and expert dancers. Early in the learning stage, novices are expected to depend on visual abilities, but as they gain more experience in becoming a more skilled performer, kinesthetic abilities would define their learning styles, and these abilities would transfer into the kinds of imagery they would use in deliberate practice techniques.

A study found that dancers and nondancers generally do not differ in the general ability to engage in visual or kinesthetic imagery , however, nondancers expressed more difficulty than dancers when imagining themselves performing or visualizing an image of themselves performing a dance movement (Foley, Bouffard, Raag & Disanto-Rose, 1991). The motivating factor promoting the ease of engaging in either visual or kinesthetic imagery is prior experience. Obviously, one can not engage in kinesthetic imagery if one can not replicate the sensations of the target movement in one's mind. In the same study by Foley et al. (1991), nondancers had better recall of movements when they performed the movements themselves than when they observed the movement being performed by another person. This is as expected since in order to engage in kinesthetic imagery, the action must be executed. This study serves as evidence that even in nondancers, once kinesthetic information is available, it is a better tool for memory than that of visual imagery.

From all the evidence regarding dancers' learning styles previously mentioned, it is safe to conclude that novices depend on explicit or declarative memory to remember the movements then depend on visual imagery in memory maintenance and deliberative practice. Experts, on the other hand, due to their prior experience and skill, make use of the procedural memory system in learning. Because expert memory is structured in an implicit procedural manner, the strategies used to practice and retain what is learned must be in kinesthetic form. They are not limited to visual imagery and depend more on kinesthetic imagery in memorizing and in mental practice. Even if what is stored in experts memory is in verbal form, kinesthetic information can not be separated from the verbal chunks of information. Once novice dancers gain more experience with their dance form, more kinesthetic information is available for them to help retain learned movements. As novice dancers gain experience and knowledge, progressing in skill, these dancers will slowly begin to rely more on kinesthetic imagery to guide their memory.

It is important to study expertise in motor areas such as dance because of the reliance of movement learning on kinesthetic information. Fueling this argument is the phenomenon of *knowing how but being unable to do*. In chess, experts knowing the movements needed to win the game will be physically able to move the pieces to achieve this goal, assuming that the expert in question has control of all basic motor functions. In motor areas such as dance, knowing does not equal performing. A novice belly dancer may understand from countless observations that to perform a shimmy, both hips must drop and rise in opposition of each other, but lack of physical practice limits performance. In order to study expertise in areas involving motor skill, research must be done in the context of those areas. Studies done on expertise outside this domain, such as about chess, math, or physics, may help our understanding of expertise acquisition but it is important to consider that it can also be severely limiting.

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