International Journal of Physical Education, Fitness and Sports-IJPEFS, Vol.1. No.4.Dec 2012 ISSN 2277-5447

CONNECTING THEORY TO PRACTICE – EFFECTIVE WAYS OF TEACHING MOTOR LEARNING COURSE FOR UNDERGRADUATE PHYSICAL EDUCATION STUDENTS

Jin Wang, Ph.D*

Dept. of Health Promotion and Physical Education, Kennesaw State University, Kennesaw, GA-30144, USA

**Corresponding Author Ph: (770) 423-6233; Email: jwang@kennesaw.edu*

DOI: 10.26524/1241

ABSTRACT: Motor learning is an important subject and is a required course for undergraduate students who major in health and physical education according to NASPE standards two. The objective of motor learning courses at the undergraduate level is to prepare our students to be competent to teach motor skills in the future. However, teaching the motor learning course effectively at this level is truly challenging due to the abstractness of the motor learning theories which are largely based on laboratory experiments. Many times students‟ motivation of learning could be compromised due to a potential disconnect between theory and practice of motor learning course in general. Thus, the purpose of this paper is two-fold: (a) to illustrate the obstacles of teaching motor learning courses, and (b) to introduce the effective ways of connecting theory to practice for teaching motor learning at the undergraduate level.

Key words: Connecting theory to practice in teaching, motor learning and performance, teaching strategies, motor skills, sport, physical education, and coaching.

INTRODUCTION

Motor learning is an important subject and is a required course for undergraduate students who major in health and physical education according to NASPE national standard two. Rukavina & Jeansonne (2009) stated: "*one goal of physical education is to teach concepts that will help students learn and perform motor skills* [1]. "The career goals of our students are to become physical education teachers, coaches, and fitness or physical activity related professionals. Thus, the objective of motor learning courses at the undergraduate level is to prepare students to be competent to teach motor skills in the future. Truthfully, motor learning is one of the most vital courses of the undergraduate curriculum for physical education majors who will be responsible for teaching motor skills to school children. However, teaching a motor learning course effectively at this level is quite challenging due to the abstractness of the motor learning theories which are based on laboratory experiments such as Fitts‟ law (1954), Hick‟s law (1952), Stroop effect (1935) and many others [2-4]. As a result, students‟ motivation to learn is significantly hampered due to disconnection between theory and practice. Moreover, our text books on motor learning that are available mostly

focus on building the foundation of the subject instead of focusing on making connections between theory and practice. Commonly many students feel that the theory of motor learning has little impact on their future careers and as a result, their motivation for learning motor learning content is impeded. Rukavina & Jeansonne (2009) indicated:"*K-12* students enter physical education with many naïve conceptions or misconceptions of how motor skills are acquired [1]. Many practitioners don't know how to provide experiences that will teach students to apply their knowledge independently outside of the classroom when learning new skills. Thus, the purpose of this paper is two-fold: (a) to illustrate the obstacles of teaching motor learning courses at under graduate level, and (b) to introduce some teaching methods of connecting theory to practice for helping students better understand motor learning concepts. The objective of this paper is to promote discussion on how instructors can creatively teach motor learning courses at undergraduate level to benefit student learning.

THE CHALLENGES OF TEACHING MOTOR LEARNING COURSE AT UNDERGRADUATE LEVEL

The content of motor learning could be perceived by students as abstract, dry and theoretical

One of the challenges of teaching motor learning courses at the undergraduate level is that the content of the courses is abstract and theoretical, which makes it more difficult for students to learn. For example, performing motor skills is a result of the interaction of humans" neuro-muscular activities and all human movements are under the control of the brain"s commands. Consequently, to understand the nature of human movements, not only should students learn about the brain"s activities such as its information processing mechanism, dynamical systems, movement control systems (closed loop vs. open loop control systems), but also have to learn the concepts such as transfer of learning, manipulation component of movement, fading procedure feedback, elaboration hypothesis, kinematic and kinetic visual displays, double transfer design, inter-stimulus paradigms of faking, proprioceptive and exterioceptive sensory and more [5-8]. Since the human brain is like a black box which cannot be examined visually, scientists have to rely on experimental studies to reveal the various functions and control processes of its activities. For example, in order to understand how a person controls the intended movements, scientists have classified two control systems of the open loop and closed loop control systems. Traditionally, even the theories are taught, students might be still unclear the learned concepts for practical use. Furthermore, since only limited practical examples are available in the text books, if an instructor focuses on explaining the theoretical models of the concepts, it becomes a challenge for undergraduate students to make a connection between theory to practice with the learned concepts.

Instructors' overlook of making connections between theory and practice

In general, an instructor has received a great training in the area of his/her expertise and the instructor could easily overlook the importance of making extra efforts to connect

theory to practice for students‟ learning in the classroom. Instructors may introduce the theories and the relevant course material, and finally test students‟ understanding of the learned concepts. Thus, easily integrating the learned theories to practice becomes the second priority. In fact, such a premise of teaching is legitimate for those students who intend to move on to pursue graduate degrees in sport science areas, but in reality, a large majority of undergraduate students will enter the work force immediately after they graduate to teach at elementary, middle or high schools or coach sport teams. Therefore, such teaching could limit students‟ competence for their future careers. The following examples can illustrate and support the above argument. Traditionally, when an instructor teaches reaction-time (RT) theory, three models of RT will be introduced: (a) simple RT, (b) choice RT and (c) discrimination RT [9-10]. After the structures of RT are explained, some simple experiments might be conducted to demonstrate the nature of RT. Most likely, the requirements for teaching the RT unit are accomplished. However, from a practical perspective, with such teaching, students could still find themselves with a difficulty of applying the learned RT theory to their teaching or coaching practice; a few months later, they might have forgotten the RT concepts.

Likewise, a traditional way of teaching the classification of motor skills involves an introduction to the different categories of motor skills based on various perspectives such as task, cognitive or muscular, open or closed skill, and Gentile‟s two- dimensional classification system [11-12,8]. Once these theories were explained, the instructor might assume the students have already understood the reasons and practical implications of classifying motor skills into various categories. Unfortunately, sometimes such an assumption might not be an accurate premise because many undergraduate students find themselves with great challenges for making connections between theory to practice. If it is true, the students‟ learning outcome of motor skill classifications has limited value. In general, instructors could unconsciously assume that students have or would make a connection between theory and practice by themselves, but the reality could be very different.

Students' lack of study in the areas of research method and statistics

Since many motor learning theories are demonstrated through experimental studies, the literature on motor learning comprises many terminologies related to experimental findings. In general, the research method and statistics courses are offered at graduate level and many undergraduate programs may not offer these courses at some institutions. Thus, some students may have trouble to fully understand the course concepts that require research method and statistics backgrounds. In fact, research method and statistical concepts are relatively complex requiring an understanding of logic and a high level of cognitive thinking skills. The shortage of training in the subjects of research method and statistics could be an obstacle that hinders an instructor‟s teaching and students‟ learning at undergraduate

level. It is recommended that instructors be aware of students‟ knowledge base in the areas of these two subjects for effective teaching.

Some motor learning textbooks are too theoretical and lack practical examples

Although motor learning is a required course for undergraduate students according to the NASPE standards, the availability of textbooks on motor learning is limited compared to many other disciplines such as exercise physiology, biomechanics, exercise and sport psychology, sport management and administration, nutrition, physical fitness, physical therapy, etc. Although the authors of motor learning books have done the excellent jobs of introducing the concepts and theories logically and systemically, students in general find difficulty of making the connections between theory and practice by reading the textbooks. Effectively connecting motor learning concepts to practice largely depends to a great extent on either the instructors‟ conscious efforts or the students‟ own cognitive ability to do so. Instructors could often teach motor learning concepts at a higher level than students expect and instructors‟ application of theory to practice could be also compromised. Even though an instructor has the profound knowledge of motor learning, he/she may not automatically make a conscious effort of applying theory to practice in classroom. If a student reads theoretical textbook without an instructor‟s sufficient effort of connecting theory to practice, the student‟s learning could be significantly compromised. Since college students already have heavy course loads involving much homework and reading assignments, they may not have time, motivation and creative to apply the theory to practice. All the above factors could negatively affect student learning of motor learning course at the undergraduate level.

STRATEGIES OF CONNECTING THEORY TO PRACTICE FOR TEACHING MOTOR LEARNING COURSE ATUNDERGRADUATE LEVEL

Use practical examples to connect theory to practice in classroom

Once instructors have taught the theory of motor learning, they could use practical examples to illustrate how the theory can be utilized in real-world situations. Such an example is illustrated as follows: when teaching the structure of fractionated reaction time (FRT) that can be divided into two phases, namely pre-motor time and motor time. The pre-motor time is cognitive time that is divided into three stages, stimulus identification, response selection and response programming [13-14]. To help students understand the practical implications of RT and how a practitioner could use this concept to training regimen, the instructor could illustrate how the color contrast between stimulus and background can be manipulated in order to shorten or lengthen the RT at the stimulus identification stage. For example, if, at night, a martial arts master wears a black outfit, this will lengthen an opponent’s RT due to the low contrast between the black outfit (stimulus) and dark environment (background). Response selection could be depicted by using practical examples of how stimulus and response compatibility influencing response selection time. For example, a left-handed boxing athlete could create more challenge for a right handed

boxing athlete because the left-handed athlete‟s action is not compatible to the right- handed athlete‟s response in general so right handed athlete requires more RT to encounter the left-handed athlete. Thus more training is required for the right-handed athlete. Also, more offensive approaches for combat sports require a defender to learn more alternative defense skills so that it creates more challenges for the defender by lengthening RT in defensive process [15]. Many examples could be used to apply this concept to practical settings.

Also, when teaching the closed loop control system, the key element to emphasize is that the brain‟s decision as to what to do must rely on external feedback, so the nature of the closed loop control system correlates to open motor skills [16]. In other words, the performer‟s action must rely on the immediate external feedback which could be teammates‟ or opponents‟ actions, movement of the ball, opponent‟s attacks, or any unpredictable actions the performer must react to. If the instructor relates examples of external feedback, such as moving objects, moving parts of the body or the whole body to particular open motor skills, students can clearly conceptualize the nature of the closed loop control system. Thus, the speed and accuracy of reactions to external stimuli and how to sense intrinsic feedback become the focal points of training. To do this, manipulation of external feedback (speed of ball, pace of scrimmage, style of the opponent‟s fight, pressure of opponents‟ attack, etc.) should be strongly emphasized in training [15]. Clearly, these examples provide students with tangible information they can relate to after they have learned the concept of RT or the closed loop control system. Therefore, providing realistic and practical examples relating to the theory is an effective way of helping students connect theory to practice. More importantly, with such a teaching approach, the learning process becomes truly stimulating and interesting which can significantly enhance students‟ motivation of learning.

Use group projectsand homework to help students digest the theoretical concepts

After the concepts or theories of motor learning have been taught, students still may not understand the material covered because of the gap between the theory and practice. So it is truly beneficial to assign group projects that are hands-on and practical. Even though group project is a common assignment, the imperative emphasis of group project is to creatively design group project which could provide students with the opportunity to actually do something based on the theories they have learned. The group project approach stimulates students to brainstorm within the group, and learn from each other. Yet, this learning process also allows students to fully digest the theory and gives them a space to express themselves and creatively apply theory to practice. For example, when the concept of random & varied practice is taught [17], the instructor should first ask students to fully understand the nature of random and varied practice and then request students actually design and implement random and varied practice for different motor skills. Students can video-tape their innovative practice strategies and make presentations to the class. Obviously, the specific guidelines and grading criteria for the group project should be well established. Once

students completed their projects, the critiques from the instructor will be provided. Similarly, a group project could be assigned on applying the speed/accuracy trade-off theory to practical settings. To engage in open motor skills, a performer must accurately and quickly respond to external stimuli from other athletes (game related and ever-changing stimuli). According to the speed/accuracy trade-off theory [2, 18], when a performer increases speed, accuracy will decrease, or vice versa. This is a verified theory, but in reality, coaches would like to train elite athletes to perform with a fast speed while attempting to achieve the maximum accuracy, in games such as soccer, basketball, tennis, ice-hockey, or many other sport events. A group project based on the speed/accuracy trade- off theory could require the students to come up with creative ways to manipulate external stimuli in order to enhance either speed or accuracy; at a higher level, they could devise training methods that enhance both speed and accuracy for open motor skills. This type of group project allows students to think creatively, help each other and have fun while learning the course concepts effectively. Anecdotal evidence reveals that through the group project method students not only understand the theories well, but they are also able to apply the theories to practice with a high level of motivation.

Besides of group project assignments, homework should be also an imperative way to help students understand the course concepts. The situation oriented homework could stimulate students" creative thinking to answer the questions based on the theory and practice. Since each student has his/her unique background, some students may want to pursue in coaching career for the specific sport while others want to be a PE teacher at middle school. To design the individual based homework could enhance the student"s motivation for the topic he/she is interested in pursuing. Group project or homework is not a new teaching approach, but a well thought or well designed group project or homework could create great opportunities for students to effectively connect theory to practice.

Instructors make conscious effortsto connect theory topractice in classroom

Even though many motor learning theories could be abstract and boring, instructors should make a conscious effort for connecting theory to practice for effective teaching. If this is done, students will feel that the theories they learn are useful for their future professions and their motivation to learn will be consistently enhanced. However, such premise could be easily overlooked in teaching at undergraduate level. For example, when teaching how the exterior-sensory system contributes to the motor learning process, not only should the structural and physiological visual and auditory sensory systems be introduced, but how these two sensory systems are used to integrate the learning process should be explained as well. Theoretically speaking, the two visual components, focal and ambient vision [14], are described in teaching, but the importance of properly using focal and ambient visions contributes to the success of performing the open motor skills in sports such as basketball, soccer, ice-hockey and football is easily ignored. For example, advanced timing of visual focusing on proper stimuli such as movements of the opponents and teammates is

deemed a crucial element for speedy passing or attacking movements. In other words, before receiving a ball, the receiver should have already used his/her visual perception to find the best position to pass or attack so that as soon as the ball is received, the ball controller can immediately pass the ball to the proper teammate or execute a power attack. Such concept referred to "anticipation timing," means that vision is used to make the movements of the body and/or its parts coincide with those of an object or other persons [14]. Without the advanced timing of visual perception, the intended tactic cannot be executed effectively. From the auditory point of view, performers in competitive situations often have to use their audition to detect the direction and speed of an opponent who could becoming from behind or a lateral position. Also, soldiers or martial arts masters may fight with the enemy from behind at night-time. In all these situations, exterior-sensory systems play a vital role.

In addition, when learning the concept of "open motor skills", students often find themselves have the difficulty of understanding the true meaning of "open motor skills" in sports. A new term "reaction-time based motor skill" used to represent "open motor skills" helps students easily understand the nature of open motor skills, because the key element of executing open motor skills is the speed at which a performer can react to unpredictable external stimuli. Thus, the name changes for some dry terminologies could help students with a better understanding of the concepts. All the above teaching strategies could significantly help students understand the nature of the theoretical concepts and at the same time greatly attract students‟ attention to learning. Consequently, the students would feel that every concept they learn has a profound practical implication for their future practice in teaching motor skills.

Use illustrations or Diagrams to make easy for students to understand concepts

There is an old saying: "a picture is worth a thousand words." In order to simplify complex concepts and highlight the important key principles, the instructor could develop graphic illustrations or diagrams to provide students with easy-to-understand information about the theory or concept. For example, an instructor could make a correlation between the closed loop control system and the open motor skill because the brain relies on the closed loop control system to carry out the open motor skills (Figure I). Since both terms, closed loop control system and open motor skill, are very abstract, students have great trouble applying these concepts to practical settings, so when the instructor makes such a correlation between a control system and a particular motor skill, it really helps students retain these key concepts in their long-term memory. Likewise, the open loop control system correlates to closed motor skills as an inter-related model.

Another example is to teach the concept of the transfer of learning, which is an imperative theory for students to understand due to its broad uses and practical implications. The main purpose of transfer of learning is to manipulate different practice conditions to develop learners‟ motor skills, which can be effectively transferred to the target contexts. Secondly, a performer‟s learning of one motor skill could positively or negatively influence

the learning of another motor skill. An illustration of the concept of transfer of learning could help students understand the true meaning of the theory (FigureII). Basically, during practice, practitioners can intentionally manipulate the training regimens that are either easier or more difficult compared to competition settings. Since the performance in the *practice situation* is not important, but rather, the training design should focus on promoting learning. Based on the concept of Table I, students will easily understand that practice conditions can be designed either with a reduced difficult level of training (left side of Figure II) or enhanced difficult level of training (right side of the Figure II) to promote learning. Thus, the learned skills can be transferred to target contexts in the future. Likewise, a training related reaction time model could provide students with clear information about which factors affect RT and how to design the training for shortening or lengthening RT (Figure III& IV). These two diagrams clearly illustrate the three phases of cognitive stage (pre-motor time) and how each of these stages can be shortened through proper training. Thus, students could visually conceptualize what is RT and how proper practice can shorten RT for enhancing performance of training. In sum, the creative illustrations or diagrams of theories could simplify complex concepts and make learning process fun and entertaining.

Guest speakers help students make connections between theory and practice

In order to make students aware of the practical implications of the theories they are learning, instructors could invite successful coaches, athletes, PE teachers, or practitioners to the classroom to give talks about their experiences teaching motor skills. For this to be effective, the particular topic and the guest-speaker should be carefully selected. The topic should be relevant to the theoretical concepts, and the speaker should have vast knowledge and successful experiences. Speakers should provide firsthand information on how they have used the theories in practice to effectively teach motor skills, including experiences that might fall outside of the scope of the textbook. This could be a great opportunity for students to learn about situations in the real world because there is a lot to learn beyond the classroom. Guest lecturers could open the students‟ eyes, and motivate and inspire them to study motor learning. After the lecture is finished, students could be assigned to write reflection papers describing what they have learned from the lecturer and how the concepts could benefit their future teaching. Finally, there could also be group discussions for students to share their perspectives and learn from each other. A well-known guest lecturer could greatly inspire students to achieve their career goal and meantime enhance students‟ motivation of learning.

Conclusion

Generally speaking, teaching motor learning courses is not a difficult task, but teaching it effectively at the undergraduate level is a great challenge; it takes effort, dedication, and creativity to relate the abstract and boring theories to practice. In fact, many undergraduate students may not understand the importance of these courses and in addition they may lack the critical thinking skills required. With a theory dominated textbook, an instructor who should make a conscious effort to connect the theory to practice so that students‟ motivation of learning could be enhanced. By the time these students graduate from school, they can apply the learned concept sin the classroom to practical settings. As a result,

the students‟ competence of teaching or coaching in the future will be significantly enhanced as well. The above strategies for teaching motor leaning courses at the undergraduate level will provide readers with some awareness of the importance of applying theory to practice and help students become competent teachers or coaches in the future. Although an instructor has his/her own way of teaching, connecting theory to practice for teaching motor learning course is always helpful for students‟ learning and can also prepares students to become competent in their future teaching profession.

REFERENCES

[1] P.B. Rukavina, & J.J. Jeansonne, Integrating motor-learning concepts into physical education: Using guided discovery to address NASPE standard 2, *Journal of Physical Education, Recreation & Dance*, 80 (2009) 23-30.

[2] P.M. Fitts, The information capacity of the human motor system in controlling the amplitude of movement, *Journal of Experimental Psychology*, 47 (1954) 381-391.

[3] W.E. Hick, On the rate of gain of information, *Quarterly Journal of Experimental Psychology*, 4 (1952) 11-26.

[4] J.R. Stroop, Studies of interference in serial verbal reactions, *Journal of Experimental Psychology*, 18(1935) 643-662.

[5] P. Dunham, Distribution of practice as a factor learning and/or performance,*Journal of Motor Behavior,* 8 (1976) 305-307.

[6] R.A. Magill, (2007), Motor learning and control – Concepts and applications, Boston,MA: McGraw Hill.

[7] D.J. Rose, & R.W. Christina, (2006), *Multilevel approach to the study of motor control and learning*.San Francisco, Pearson, CA:Benjamin Cummings.

[8] R.A. Schmidt, & C.A. Wrisberg, (2008), *Motor learning and performance – A situation-based learning approach*, Champaign, IL: Human Kinetics.

[9] R.W. Christina, M.G. Fischman, M.G.P. Vercruyssen, & J.G. Anson, Simple reaction time as a function of response complexity: Memory drum theory revisited, *Journal of Motor Behavior*, 14 (1982) 301-321.

[10] S.T. Klapp, Feedback versus motor programming in the control of aimed movements, *Journal of Experimental Psychology: Human Perception and Performance*, 104 (1975) 147-153.

[11] A.M. Gentile, *A working model of skill acquisition with application to teaching*, Quest Monograph XVII (1972) 3-23.

[12] A. M. Gentile,. (1987) Skill acquisition: Action, movement, and neuromotor processes. In J. H. Carr, R. B. Shepherd, J. Gordon, A. M. Gentile, J. M. Held, (Eds.), Movement science foundations for physical therapy in rehabilitation. Rockville, MD: Aspen. Pp. 93–154.

[13] J.G. Anson, Memory drum theory, Alternative tests and explanations for the complexity effects on simple reaction time,*Journal of Motor Behavior*, 14 (1982) 228-246.

[14] R.W. Christina, & D.J. Rose, Premotor and motor reaction time as a function of response complexity, *Research Quarterly for Exercise and Sport*, 56 (1985) 306-315.

[15] J. Wang, Strategies of filling a performance gap between practice and competition, *Journal of Physical Education, Recreation and Dance*, 81 (2010) 26–32.

[16] J.A. Adams, A closed-loop theory of motor learning, *Journal of MotorBehavior*, 3 (1971) 111-149.

[17] R.A. Schmidt, A schema theory of discrete motor skill learning.*Psychological Review*, 82 (1975) 225-260.

[18] R.A. Schmidt, & D.L. Lee, (2005), *Motor control and learning – A behavioral emphasis*. Champaign, IL: Human Kinetics.

Figure I. The mechanisms of how closed-loop control system controls open motor skills

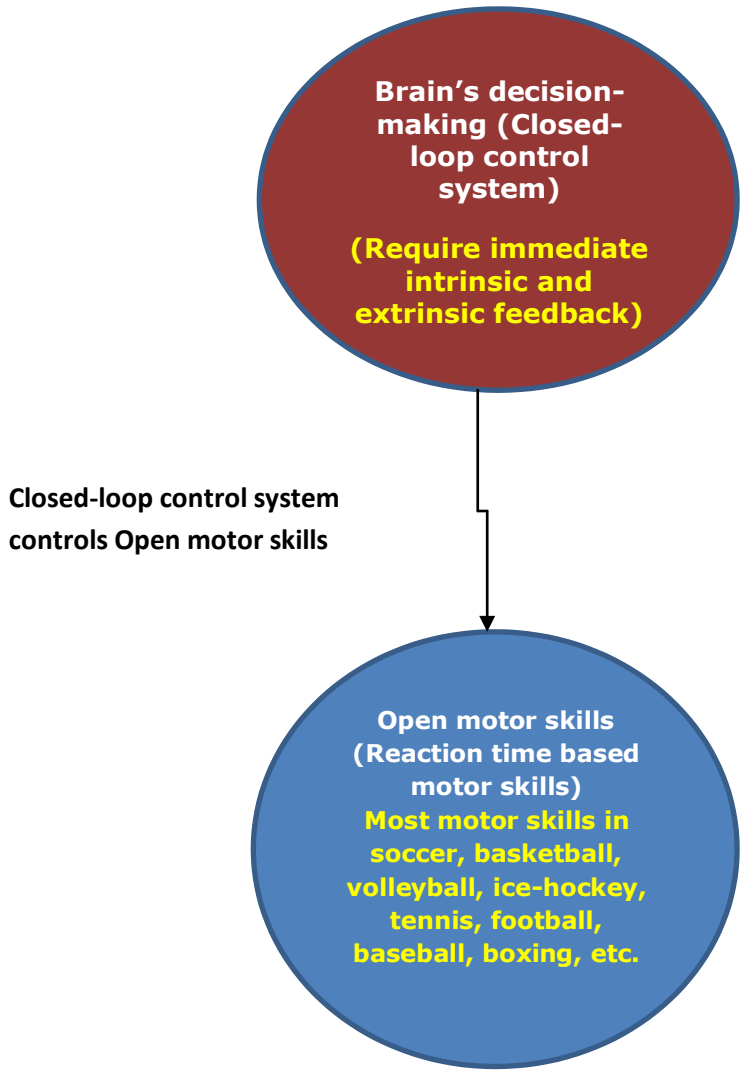

Figure II. The illustration of the concept of transfer of learning

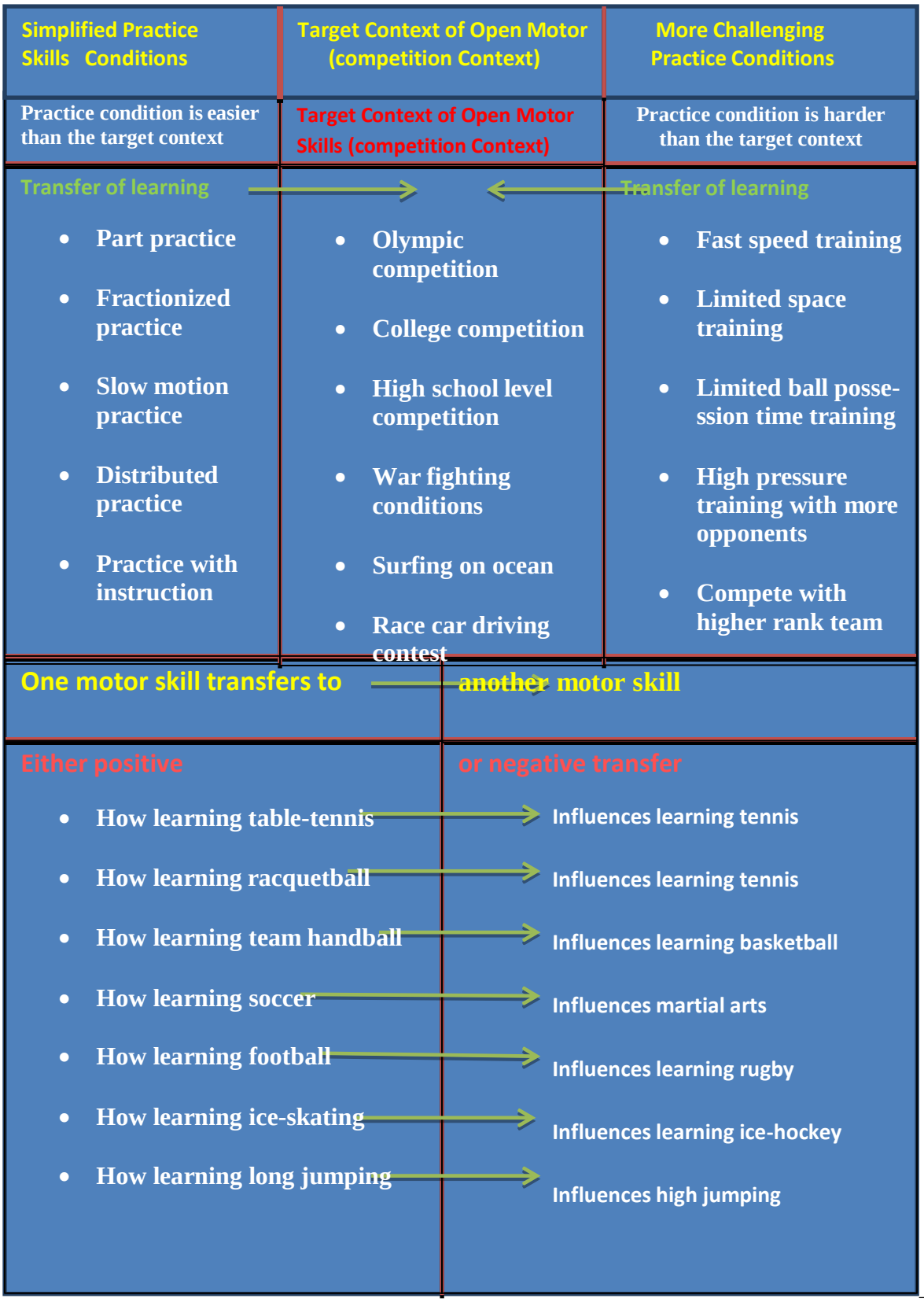

Figure III. Reaction-Time Model (Wang, 2010)

Pre-Motor Time (Cognitive Time)			**Motor Time**
Information Processing Stage			**Initiation of a Movement**
Detection of Game Situation Stage	**Decision-Making Stage**	**Command-Giving Stage**	**Time for Overcoming Inertia toInitiate a Movement**
Factors of Affecting This Stage of RT	**Factors of Affecting This Stage of RT**	**Factors of Affecting This Stage of RT**	**Determining Factors of Motor Time**
(1) Clarity (Sharpness) of the color of the stimulus.	*(1) Uncertainty or unpredictivity of game situations.*	*(1) Complexity of technique.*	*(1) Weight of the moving limbs or body parts.*
(2) Intensity (Brightness) of the color of the stimulus.	*(2) Potential ways of attacks and counter-attacks.*	*(2) Level of accuracy.*	*(2) Age of the athlete.*
(3) Contrast of background and stimulus.	*(3) Compatibility between attacks and responses.*		*(3) Genetic makeup of the nerve system.*
(4) Patterns of the movement	*(4) Skill level*		
(5) Loudness of sound.	*(5) Speed of competition.*		
(6) Feelings of touches.			

Figure IV. Information Processing Model of Pre-Motor Time of Reaction-Time (Wang, 2010)

Detection of Game Situation Stage	**Decision-Making Stage**	**Command-Giving Stage**
Life Examples *(1) My opponent is pushing the ball to my right side to beatme.*	**Life Examples** *(1) I have to use my right foot to tackle my opponent's ball.*	**Life Examples** *(1) Brain programs the tackle movement and sends the commands to the relevant muscles for an action.*
(2) My opponent is punching the left side of my face.	*(2) I must use left forearm to block the opponent's attack.*	*(2)Brain programs the tackle movement and sends the commands to the relevant muscles for an action.*
(3) My opponent is making a jump-shot to the basket.	*(3) I must quickly jump and block his shot.*	*(3)Brain programs the tackle movement and sends the commands to the relevant muscles for an action.*
Training Approaches *(1) Color manipulation training for sharpness and brightness of the colors*	**Training Approaches** *(1) Compatibility training between opponent's style of attack and defender's response.*	**Training Approaches** *(1) Use the simplest, fastest, easiest and most cost-effective skill to complete the actions*
(2) Contrast manipulation training between stimulus and background	*(2) Rapid speed training*	
(3) Sound manipulation training	*(3) Training for responding unpredictable stimuli*	
(4) Object-shape manipulation training	*(4) Anticipation training*	
	(5) Simulation training	
	(6) Pressure training	