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MODELING IN LEARNING TWO VOLLEYBALL SKILLS [1]

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Summary.—The present study was designed to investigate the influence of two different types of modeling and knowledge of performance on acquisition and retention of two volleyball skills (set and serve). Participants were 63 boys and 53 girls in elementary school, whose mean age was 11.7 yr. ($SD = .5$). The children were randomly assigned into two groups given the same practice method for 16 practice sessions (8 for the set and 8 for the serve) but different types of modeling. Some participants observed a videotape of an expert model performing the skills, and the second group observed a videotaped replay of their own performance. Verbal cues were provided simultaneously with the videotaped demonstration. The first group improved set and serve skills more on acquisition and on the retention test than the second group. This improvement was present when scores and form were evaluated. Modeling plus instructional cues seemed to improve children's learning of two volleyball skills (set and serve), and this procedure is suggested for use by practitioners.

Social learning theorists suggested that learning through observation of a model is powerful (Carroll & Bandura, 1982, 1985, 1990). Use of modeling or visual demonstrations is an important tool in physical education to teach new motor skills, particularly to beginners (Burwitz, 1975; Feltz, 1982). It is very useful to teachers and coaches to know how they can use modeling. When a participant observes a model, the pattern of the motor skill is learned by focusing attention on the spatial and temporal characteristics of the skill. This cognitive representation is used in producing a response and provides a pattern for comparing with performance feedback for corrective adjustments (Bandura, 1986). Pollock and Lee (1992) explained that modeling is an effective teaching method because actions which are difficult to describe verbally often can be demonstrated visually. Recently, Richardson and Lee (1999) defined modeling as a procedure that provides information about the nature of a skill or a task to be performed, usually as conceptual information about "what to do," and is provided prior to attempting performance. On the contrary, augmented feedback refers to information about the nature of a specific performance, usually as information about "what was done," and is provided during or after performance. Effectiveness of modeling is related to (a) the characteristics of the observer, (b) the characteristics

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of the model, (c) the type of task, and (d) the strategies for demonstration (Rose, 1997).

A number of studies in which videotape feedback was used (Rothstein & Arnold, 1976) found that skilled performers tended to benefit more than did novice performers. They also found that novice learners tended to benefit more when videotape was combined with specific skill-related verbal cues.

A crucial factor for the effectiveness of modeling is the characteristics of the model. Martens, Burwitz, and Zuckerman (1976) tested the idea that participants would learn more by watching someone learn a skill than by observing either a correct or incorrect model. Lirgg and Feltz (1991) questioned the generalizability of these findings, suggesting that "using familiar models may have created idiosyncratic results." Viewing a skilled model led to better performance than did viewing an unskilled model, regardless of whether the model was a teacher or a peer. Adams (1986) and McCullagh and Caird (1990) noted that it may seem better to use a skilled model than an unskilled one. Landers and Landers (1973) and Martens, *et al.* (1976) argued that all the models were really skilled at the task but feigned low skill in particular experimental conditions. In examining the model's skill, Weir and Leavitt (1990) made some interesting arguments about different information conveyed by skilled and unskilled models. In a recent study Zetou, Fragouli, and Tzetzis (1999) examined the influence of two types of modeling, indicating that performance was better after watching an expert model than for those who watched their own movements on videotape.

The nature of the task being demonstrated determines what information it presents to the observer for observation. Poulton (1975) asserted that, if the skill to be learned requires constant adjustment to external conditions, as tracking an object, or timing (open skill), the observer will attend to different information than if the task is fixed choreography of movements (closed skill). So, if skills have a very complex spatial path, demonstration is the best learning support because it provides the dynamic spatial transformations that are not possible with verbal representations (Carroll & Bandura, 1982). Rikli and Smith (1980) found that modeling enhanced learning of the tennis serve that is a closed environment skill.

Another important factor related to the effectiveness of modeling is the strategies for demonstration. Many researchers have recommended the use of verbal cues should accompany the demonstration, especially when the observers are children. In examining the role of directive verbal cues, Roach and Burwitz (1986) assessed both the form and accuracy of cricket batting and found that verbal cues in conjunction with modeling led to better performance than either modeling alone or a control condition. Weiss and Klint (1987) found that modeling plus verbal rehearsal strategies aided children to attend selectively to relevant task components and to remember the specific order of skills. McCullagh, Stiehl, and Weiss (1990) reported similar findings. Doody, Bird, and Ross (1985) concluded that the combination of auditory and visual demonstrations produced better performance than either visual demonstrations or control conditions without demonstrations. In examining the effects of modeling in combination with verbal feedback Tzetzis, Mantis, Zachopoulou, and Kioumourtzoglou (1999) indicated that the combination of videotaped and model presentation with knowledge of performance was important in assisting learners to become proficient at skiing skills both in speed and in technique.

Another important issue for the effectiveness of modeling on learning a skill is how long learners view the demonstrations. Rose (1997) and Magill (1993) suggested that learners need time to familiarize themselves with the videotaped demonstration and learn to extract the most useful information. They recommended that demonstrations should be presented for at least five weeks to be effective.

There are numerous studies which have assessed the effects of modeling on learning motor skills measuring the result of the movement (Weiss, 1983; Miller & Gabbard, 1988; Starek & McCullagh, 1999). A few studies have attempted to assess components of movement form (McCullagh, 1987; Little & McCullagh, 1989; Carroll & Bandura, 1990). Poulton (1975) and Gentile (1972) asserted that, when the skill is closed, improvement in form is the most critical to skill development. Feltz (1982) indicated that form was a better indication of modeling effects than movement result. McCullagh (1987) and Martens, *et al.* (1976) supported this notion. These studies point to the importance of assessing both movement result and movement form, since modeling may have differential effects on these performance components.

The aim of this study was to identify the effect of viewing a videotape of an expert model combined with verbal cues designed to focus attention on critical parts of the skill or videotaped replay of learners' own performance combined with error-correction cues on the acquisition and retention of the result and form of the set and serve volleyball skills.

METHOD

Subjects

The participants were 116 elementary school children (63 boys and 53 girls) 12 yr. old ($M = 11.7$, $SD = .5$). At the beginning of the first lesson they were randomly assigned into two groups and received the same verbal instructions on how to perform the skill.

Procedure

Participants in the Expert Modeling group (EM, $n = 51$) stood in front of a color video monitor (SONY, 22 in.) at a distance of 2 m, and they watched a demonstration by an expert model for 2 min. at the beginning and 2 min. in the middle of a 40-min. practice period (Landers, 1975). The perception of the model's identity was varied. The models were an elite male and a female gold medallist volleyball player in the Olympic games of 1996. They demonstrated the skill four times from a side angle and four times from a front angle.

The teacher simultaneously provided participants verbal instructional cues about the seven important factors of the skill (the position of feet, of body, of hands, the point at which to touch the ball, etc.) on which the participants were to focus their attention. After the demonstration, participants performed four kinds of drills and practiced 10 acquisition trials of the skill. Researchers have suggested the use of videotaped modeling combined with practice (Carroll & Bandura, 1982). They then received the same videotaped demonstration for 2 min. with the same verbal instructional cues. Every skill was taught for eight (8 × 40 min.) practice sessions.

Participants in the Self-modeling group (SM, $n = 64$) watched a videotape of their own movements for 2 min. twice during a 40-min. practice and performed four kinds of drills in 10 acquisition trials. All participants were videotaped with two professional Panasonic cameras from a 6-m distance and a 45° angle. Then they watched their own movements on two color video monitors for 2 min. and received standard verbal instructional cues from two instructors who were trained to watch and correct important errors. The most important point for correct execution of the technique was noted first and the less important ones later (Fishman & Tobey, 1978). After the demonstration participants performed the same drills for 15 min. and were videotaped again. Then they watched their own movements again and received verbal cues from the instructor.

Measures

In this experiment, the result and the form (technique) of the skill were measured (Little & McCullagh, 1989; Kernodle & Carlton, 1992). There were three measurement periods. A pretest for the volleyball set took place in the first measurement period (Bartlett, Smith, Davis, & Peel, 1991) and the AAHPERD's volleyball test for the serve (1984). The reliability of the tests were in acceptable ranges (.88 and .80, respectively). After the 8 wk. of practice there was the second measurement (posttest) and a week later a third measurement (retention test).

Evaluation of Data

Evaluation of the volleyball set.—The purpose was to measure the participants' ability to set the volleyball toward the net. The equipment used were a volleyball net and standards, 4-ft. by 6-ft. mats or marked areas on the floor, a 30-ft. long rope and two poles 10 ft. high for boys and 9 ft. high for girls. The participant stood in middle court position within the 6-ft. by 5-ft. area. He received a high throw from a teacher and executed a set so that the ball went over the rope and onto the target area. Throws from the teacher, which did not fall into the 6-ft. by 5-ft. area, were repeated. Each participant had 10 trials. The trial was counted as valid, but no points were recorded if the ball touched the rope or net or did not fall in the target area. Ratings of one to five points were awarded for each set that went over the rope and landed on or hit any part of the target area, including lines. The maximum possible result score for the 10 trials was 50 points (Fig. 1).

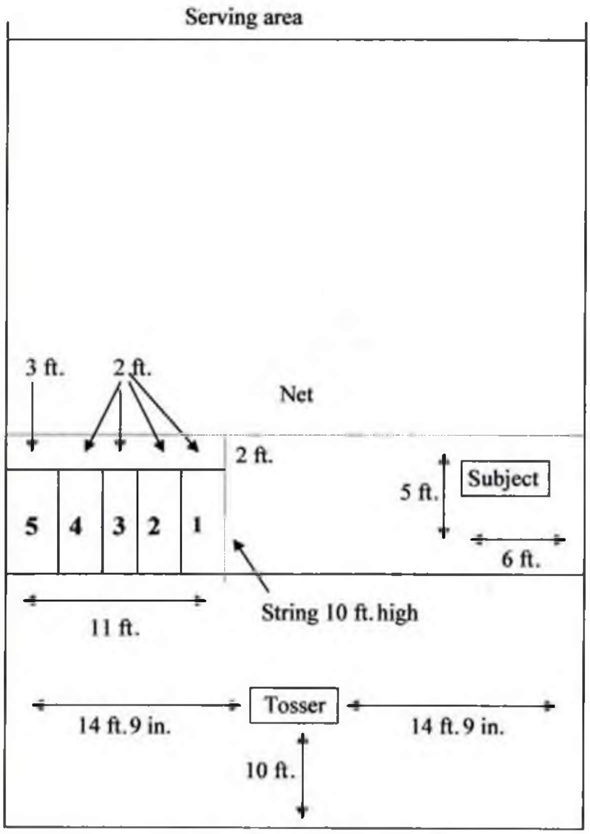

Fig. 1. The test of set skill

Evaluation of the volleyball serve.—The purpose was to measure the participant's skill in serving. Equipment included volleyball net and poles and a marked court. The server stood opposite the marked court in the proper serving position. He used a legal serve in hitting the ball over the net into the opposite court. For children below the age of 12, the serving line was located 20 ft. from the net. The server was given 10 trials. When the ball hit the net and did or did not go over, it counted as a trial but no points were given. The total number of points made was determined by where the ball landed in the opposite court. For all balls that struck on a line, the higher score of the areas concerned was awarded the maximum of 40 points (Fig. 2).

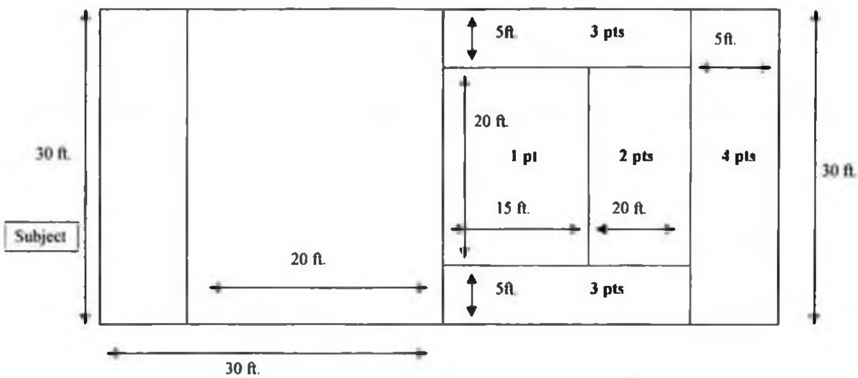

FIG. 2. The test of serve skill

Evaluation of Form

To evaluate the form (technique) of both skills, the participants in the two groups were videotaped (professional Panasonic camera) from a 6-m distance and a 45° angle. The form was evaluated by two observers who watched the video (intrajudge reliability = .87, interjudge reliability = .84) on the seven critical points of the form of each skill (ASEP, 1993; Kluka & Dunn, 1996; Asher, 1997). The evaluation rating was one point for every element correctly executed. A perfect execution was graded seven (no mistakes) for each trial, and the worst execution was graded zero (7 mistakes, 7 × 10 trials = 70 possible points).

Training of Instructors

Prior to introducing the training programs, specific directions were given and training was conducted for the teachers on how to implement the instructional methods. Specific written directions were given for identification of errors, when to give information, how many times, what to say and how (in what order). A pilot test with another group for four days assured the understanding and the correct implementation of the procedures by the instructors.

Results

Overall Analysis

A 2 (Groups) × 3 (Measurement Periods) multivariate analysis of variance with repeated measures on the last factor was used to analyze the two treatment conditions and the three measurement periods on acquisition and retention of the result and the form for the two volleyball skills. The pretest was used as a baseline for participants' volleyball skill.

Set Skill

For the result on volleyball set skill there was a significant interaction between the measurement period and the group ($F_{2,228} = 14.08$, $p < .01$). There was also a significant main effect for measurement period ($F_{2,228} = 212.21$, $p < .01$) and a significant main effect for group ($F_{1,114} = 14.21$, $p < .01$). To identify the differences, separate *t* tests between groups were performed on each measure. Analysis showed no significant difference between the groups on the first measurement ($t_{1,114} = 501$, $p > .05$); however, the differences were significant on the second ($t_{1,114} = 4.65$, $p < .001$) and third measurements ($t_{1,114} = 3.83$, $p > .05$). As shown in Table 1, at the end of the practice session the Expert Modeling group performed significantly better ($M = 27.8$ out of 50) than the Self-modeling group ($M = 18.4$ out of 50). Similarly, this difference was also present during the retention test ($M = 30.12$, vs $M = 22.18$ out of 50, respectively).

TABLE 1
MEANS AND STANDARD DEVIATIONS FOR SET AND SERVE SKILLS ON RESULT AND FORM FOR THREE MEASUREMENT PERIODS AND TWO MODELING GROUPS

Skill	Group	Pretest		Posttest		Retention Test	
		M	*SD*	*M*	*SD*	*M*	*SD*
Set result score	Expert Modeling	9.69	8.68	27.76	11.71	30.12	12.19
	Self-modeling	8.92	7.70	18.37	10.06	22.18	10.14
Set form score	Expert Modeling	26.84	7.62	57.24	10.19	58.65	7.59
	Self-modeling	27.58	7.35	43.46	11.65	48.35	14.93
Serve result score	Expert Modeling	5.31	4.23	12.22	5.33	13.76	6.41
	Self-modeling	4.95	4.18	13.86	9.59	9.34	6.95
Serve form score	Expert Modeling	18.63	8.27	59.82	6.80	61.59	6.80
	Self-modeling	18.88	7.25	50.45	8.16	43.63	10.87

For the form of the volleyball set skill there was a significant interaction between the measurement period and the group ($F_{2,228} = 19.68$, $p < .01$). There was also a significant main effect for measurement period ($F_{2,228} = 282.44$, $p < .01$), and a significant main effect for group ($F_{1,114} = 32.14$, $p < .01$). A further comparison of the means indicated no significant difference between the groups in the first measurement ($t_{1,114} = -530$, $p > .05$); however, the differences were significant on the second ($t_{1,114} = 6.67$, $p < .001$) and the third measurements ($t_{1,114}=4.49$, $p>.05$). As shown in Table 1, at the end of the practice session the Expert Modeling group performed significantly better ($M=57.24$ out of 70) than the Self-modeling group ($M=43.5$ out of 70). Similarly, this difference was also present during the retention test ($M=58.65$ out of 70 vs $M=48.35$ out of 70).

The results indicated that the Expert Modeling group improved more on the set skill than the Self-modeling group, when outcome and form were evaluated. Table 1 shows the performance of the two groups on result and on form for the set skill.

Serve Skill

For the result of the volleyball serve skill there was a significant interaction between the measurement period and groups ($F_{2,228}=9.45$, $p<.01$) and also significant main effects for measurement period ($F_{2,228}=69.67$, $p<.01$) and for group ($F_{1,114}=1.36$, $p<.01$). Comparison of the means indicated no significant difference between the two groups on the first measurement ($t_{1,114}=.46$, $p>.05$) or at the end of the practice session ($t_{1,114}=-1.10$, $p>.05$). However, for the performance of the two groups there was a significant difference on the third measurement ($t_{1,114}=3.52$, $p<.01$). As shown in Table 1, the two groups performed equally the volleyball serve skill during the first ($M=5.31$ out of 40 vs $M=4.95$ out of 40) and last blocks ($M=12.22$ vs $M=13.86$) of the practice session. On the retention test the Expert Modeling group outperformed ($M=13.76$) the Self-modeling group ($M=9.34$).

Also, for the form on the volleyball serve skill there was a significant interaction between the measurement period and groups ($F_{2,228}=40.02$, $p<.01$) and significant main effects for measurement period ($F_{2,228}=796.32$, $p<.01$) and for group ($F_{1,114}=81.88$, $p<.01$). Analysis indicated no significant difference between the two groups at the first measurement ($t_{1,114}=-173$, $p>.05$); however, the differences were significant on the second ($t_{1,114}=6.601$, $p<.001$) and third measurements ($t_{1,114}=10.31$, $p>.05$). As shown in Table 1, at the end of the practice session the Expert Modeling group performed significantly better ($M=59.82$ out of 70) than the Self-modeling group ($M=50.45$ out of 70). Similarly, this difference was present during the retention test ($M=61.59$ vs $M=43.63$).

Discussion

The two groups (Expert Modeling and Self-modeling) performed equally well the serve skill, when means were evaluated, but it seemed that only the Expert Modeling group learned the serve skill. On the contrary, when form was evaluated this difference was not noted. The Expert Modeling group performed better on acquisition and retention tests than the Self-modeling group.

The present study was conducted in a real world environment (school setting) and attempted to examine differences in learning a motor skill under different observational and instructional conditions (Bandura, 1971; McCullagh, 1986, 1987). There was research to identify whether expert modeling produces better performance than self-modeling for learning two volleyball skills. Both groups improved on result and on form. The participants who watched the expert model and received attention and instructional cues performed better on the volleyball set and serve than did the participants who watched their own movements and received instructional error correction cues. Perhaps the Expert Modeling group's performance standard was higher because subjects wanted to perform like the model. In the Self-modeling group there was no such goal to motivate the subjects.

Possibly the participants who observed the expert model improved their self-efficacy and performed better than the Self-modeling group. Feltz, Landers, and Raeder (1979) and Gould and Weiss (1981) reported that viewing live and filmed models increased perceived efficacy in motor tasks. Lirgg and Feltz (1991) found that subjects viewing either a skilled teacher or skilled peer performed better and had higher efficacy beliefs than subjects who viewed an unskilled teacher or an unskilled peer. Likewise, McCullagh (1986) reported that subjects who viewed a high-status model outperformed subjects who viewed a low-status model.

In this study the children who observed the expert model performing a perfect execution of a skill seemed to be assisted more than those who observed themselves (a less perfect execution of the skill). It is possible that the perfect execution influenced novices to learn a new skill because this gave more accurate information or that the elite athletes concentrated children's attention more and motivated them to imitate and to strive more towards a better performance.

Important factors that possibly affected the learning of two volleyball skills in combination with the model were the cues. Possibly instructional cues assisted children to focus more attention on their execution of the skill than the children who received cues for correction of errors. Possibly children could not concentrate attention on both correcting their errors and improving their performance at the same time they had to keep the good elements of their execution, or they do not remember them when returning to the practice. Concentration of attention could decrease a perfect execution, if there is more than one source of information. Magill and Schoenfelder-Zohdi (1996) suggested that observing a model and receiving knowledge of performance provided novices with information useful for producing and correcting attempts to perform the skill. Thus, both sources of information aid in developing the memory representation of the skill being learned.

Both groups observing the model improved in both the result and form of new skills. In the modeling literature, when the task to be learned requires a new skill, such as rotary pursuit (Burwitz, 1975) or rolling a ball to a target (Gould, 1980), observing a model is an effective procedure.

Both skills were new for the participants, demanding coordination of limbs and of body. Newell (1985), Scully and Newell (1985), and Whiting (1988) suggested that observing an expert model may provide information that facilitates the development of appropriate coordination patterns of limb and body movements for performing the skill (Landers, 1975). That information could facilitate the development of coordination, and this is possibly the key to visual demonstration (Magill, 1993; Magill & Schoenfelder-Zohdi, 1996). Possibly the use of self-modeling is more effective for pubescent participants or skilled athletes because they would be more motivated and more intent on performing better and could recognize and correct their errors.

These results may provide useful information and instructional guidelines for different instructional settings. It is proposed that practitioners include video modeling for their classes because it is an effective procedure, especially for children. It is easier and requires less time but conveys more information when a model is provided participants than just giving a verbal description alone. The children could more easily create the form of movement (Schmidt's schema theory) and then reproduce and perform the skill. It was confirmed that through modeling one acquires the cognitive components of the task but skilled execution requires practice and feedback.

It is suggested that much research must be done in different practice settings with both sexes at different levels of expertise and with skills of different complexity. Then the application of this theory could be more useful for physical education instructors and coaches.

REFERENCES

ADAMS, J. A. (1986) Use of the model's knowledge of results to increase the observer's performance. *Journal of Human Movement Studies*, 12, 89-98.

AMERICAN ALLIANCE FOR HEALTH, PHYSICAL EDUCATION, RECREATION AND DANCE. (1984) *Skills Test manual*. Reston, VA: Association.

AMERICAN SPORT EDUCATION PROGRAM. (1993) *Coaching youth volleyball*. (2nd ed.) Champaign, IL: Human Kinetics.

ASHER, K. S. (1997) *Coaching volleyball*. Indianapolis, IN: Masters Press.

BANDURA, A. (1971) Analysis of modeling processes. In A. Bandura (Ed.), *Psychological modelling conflicting theories*. New York: Adline-Atherton. Pp. 105-124.

BANDURA, A. (1986) *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

BARTLETT, J., SMITH, L., DAVIS, K., & PEEL, J. (1991) Development of a valid volleyball skills test battery. *Journal of Physical Education, Recreation and Dance*, 62, 19-21.

BURWITZ, L. (1975) *Observational learning and motor performance*. Edinburg, Scotland: Féderation Européenne de Psychologie des Sports et des Activités Corporelles. [Conference Proceedings]

CARROLL, W. R., & BANDURA, A. (1982) The role of visual monitoring in observational learning of action patterns: making the unobservable observable. *Journal of Motor Behavior*, 14, 153-167.

CARROLL, W. R., & BANDURA, A. (1985) A role of timing of visual monitoring and motor rehearsal in observational learning of action patterns. *Journal of Motor Behavior*, 17, 269-281.

Carroll, W. R., & Bandura, A. (1990) Representation guidance of action production in observational learning: a casual analysis. *Journal of Motor Behavior*, 22, 85-97.

Doody, S. G., Bird, A. M., & Ross, D. (1985) The effect of auditory and visual models on acquisition of a timing task. *Human Movement Science*, 4, 271-281.

Feltz, D. L. (1982) The effects of age and number of demonstrations on modeling of form and performance. *Research Quarterly for Exercise and Sport*, 53, 291-296.

Feltz, D. L., Landers, D. M., & Raeder, V. (1979) Enhancing self efficacy in high avoidance motor tasks: a comparison of modeling techniques. *Journal of Sport Psychology*, 1, 112-122.

Fishman, S., & Tobey, C. (1978) Augmented feedback. In W. G. Anderson & G. T. Barrette (Eds.), What's going on in gym: descriptive studies of physical education classes. *Motor Skills: Theory into Practice* (Monograph), 1, 51-62.

Gentile, A. M. (1972) A working model of skill acquisition with application to teaching. *Quest*, 17, 3-23.

Gould, D. R. (1980) The influence of motor task types on model effectiveness. Unpublished Ph.D. dissertation, Univer. of Illinois, Urbana-Champaign.

Gould, D. R., & Weiss, M. R. (1981) The effects of model similarity and model talk on self-efficacy and muscular endurance. *Journal of Sport Psychology*, 3, 17-29.

Kernodle, W. M., & Carlton, G. L. (1992) Information feedback and the learning of multiple degree of freedom activities. *Journal of Motor Behaviour*, 24, 187-196.

Kluka, D. A., & Dunn, P. J. (1996) *Volleyball*. (3rd ed.) Boston, MA: Brown & Benchmark.

Landers, D. M. (1975) Observational learning of a motor skill: temporal spacing of demonstrations and audience presence. *Journal of Motor Behavior*, 7, 281-287.

Landers, D. M., & Landers, D. M. (1973) Teacher versus peer models: effects of model's presence and performance level on motor behavior. *Journal of Motor Behavior*, 5, 129-139.

Lirgg, C. D., & Feltz, D. L. (1991) Teacher versus peer models revisited: effects on motor performance and self-efficacy. *Research Quarterly for Exercise and Sport*, 62, 217-224.

Little, W. S., & McCullagh, P. (1989) Motivational orientation and modeled instructional strategies: the effects on form and accuracy. *Journal of Sport and Exercise Psychology*, 11, 41-53.

Magill, R. A. (1993) *Motor learning: concepts and applications*. (4th ed.) Dubuque, IA: Brown.

Magill, R. A., & Schoenfelder-Zohdi, B. (1996) A visual model and knowledge of performance as sources of information for learning a rhythmic gymnastic skill. *International Journal of Sport Psychology*, 27, 7-22.

Martens, R., Burwitz, L., & Zuckerman, J. (1976) Modeling effects on motor performance. *Research Quarterly*, 47, 277-291.

McCullagh, P. (1986) Model status as a determinant of attention in observational learning and performance. *Journal of Sport Psychology*, 8, 319-331.

McCullagh, P. (1987) Model similarity effects on motor performance. *Journal of Sport Psychology*, 9, 249-260.

McCullagh, P., & Caird, J. (1990) Correct and learning models and the use of model knowledge of results in the acquisition and retention of a motor skill. *Journal of Human Movement Studies*, 18, 107-116.

McCullagh, P., Stiehl, J., & Weiss, M. R. (1990) Developmental modeling effects on the quantitative and qualitative aspects of motor performance acquisition. *Research Quarterly for Exercise and Sport*, 61, 344-350.

Miller, G., & Gabbard, C. (1988) Effects of visual aids on acquisition of selected tennis skills. *Perceptual and Motor Skills*, 67, 603-606.

Newell, K. M. (1985) Coordination, control and skill. In D. Goodman, R. B. Wilberg, & I. M. Franks (Eds.), *Differing perspectives in motor learning, memory and control*. Amsterdam: North-Holland. Pp. 295-317.

Pollock, B. J., & Lee, T. D. (1992) Effects of the model's skill level on observational motor learning. *Research Quarterly for Exercise and Sport*, 63, 25-29.

Poulton, E. C. (1975) On prediction in skilled movements. *Psychological Bulletin*, 54, 467-473.

Richardson, J. R., & Lee, T. D. (1999) The effects of proactive and retroactive demonstrations on learning signed letters. *Acta Psychologica*, 101, 79-90.

Rikli, R., & Smith, G. (1980) Videotape feedback effects on tennis serving form. *Perceptual and Motor Skills*, 50, 895-901.

Roach, N. K., & Burwitz, L. (1986) Observational learning in motor skill acquisition: the effect of verbal directing cues. In J. Watkins, T. Reilly, & L. Burwitz (Eds.), *Sports science: Proceedings of the VIII Commonwealth and International conference on sport, physical education, dance, recreation and health*. London: E. & F. N. Spon. Pp. 349-354.

ROSE, J. D. (1997) *A multilevel approach to the study of motor control and learning.* Needham Heights, MA: Allyn & Bacon.

ROTHSTEIN, A. L., & ARNOLD, R. K. (1976) Bridging the gap: application of research on video tape feedback and bowling. *Motor Skills: Theory into Practice*, 1, 35-62.

SCULLY, D. M., & NEWELL, K. M. (1985) Observational learning and the acquisition of motor skills: toward a visual perception perspective. *Journal of Human Movement Studies*, 11, 169-186.

STAREK, J., & MCCULLAGH, P. (1999) The effect of self-modeling on the performance of beginning swimmers. *The Sport Psychologist*, 13, 269-287.

TZETZIS, G., MANTIS, K., ZACHOPOULOU, E., & KIOUMOURTZOGLOU, E. (1999) The effect of modeling and verbal feedback on skill learning. *Journal of Human Movement Studies*, 36, 137-151.

WEIR, P. L., & LEAVITT, J. L. (1990) Effects of model's skill level and model's knowledge of results on the performance of a dart throwing task. *Human Movement Science*, 9, 369-383.

WEISS, M. R. (1983) Modeling and motor performance: a developmental perspective. *Research Quarterly for Exercise and Sport*, 54, 190-197.

WEISS, M. R., & KLINT, K. A. (1987) "Show and tell" in the gymnasium: an investigation of developmental differences in modeling and verbal rehearsal of motor skills. *Research Quarterly for Exercise and Sport*, 58, 234-241.

WHITING, H. T. A. (1988) Imitation and the learning of complex cyclic actions. In O. G. Meiejere & K. Roth (Eds.), *Complex movement behavior: "the" motor action controversy.* Amsterdam: North Holland. Pp. 381-401.

ZETOU, E., FRAGOULI, M., & TZETZIS, G. (1999) The influence of star and self modeling on volleyball skill acquisition. *Journal of Human Movement Studies*, 37, 127.

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