

when attempting to learn the overhand throw with the nondominant arm. One of the questions that remained was whether or not error-correcting instructions by themselves would be as effective as error-correcting instructions augmented by videotape replay. The purpose of this study was to examine the influence of two methods of providing information to novices attempting to learn the overhand throw. Participants for this study consisted of 27 women from 19 to 22 years of age randomly assigned to one of two experimental groups. One group ( $n = 12$ ) received verbal, error-correcting instructions and a second group ( $n = 15$ ) received verbal, error-correcting instructions plus videotape replay of a just completed attempt at throwing. Participants were asked to throw a ball as far as possible along a straight line. At ball release they were asked to close their eyes, complete the throw and step behind a partition to minimize intrinsic visual feedback. All participants completed three practice sessions per week for two weeks for a total of six sessions and 400 practice trials. Performance was assessed with respect to distance thrown and throwing form by using a group  $\times$  trials analysis of variance model to analyze each dependent variable. The  $t$  tests, with Bonferroni adjustment, were used to test differences between pairs of means. Although both treatments resulted in increases in performance and learning, no significant difference between groups was found with regards to distance thrown or a biomechanically derived throwing score for either performance scores or learning scores. A subjective rating score also indicated increases in performance and learning for both groups and did find a significant result with respect to a retention test in favor of those receiving only verbal transitional information. These results suggest that the information provided by videotape replay may be redundant for those in the cognitive stage of learning when it is provided in addition to appropriate and effective verbal error-correcting instructions.

### **The Effects of Visual Aiming Cues on Golf Putting**

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Putting a golf ball is a perceptual motor skill that has been broken down into three major components. The ability to read the breaks in the green, the ability to aim, and the ability to stroke the putt, all play a significant role in the success of the stroke. Of these three skills, the ability to aim has received considerable attention. It has been noted that aiming at an intermediate target located between the ball and the hole (spot putting) increases performance (Knight, 1988). Additionally, golfers and manufacturers have recognized the technique of using the inscription on a golf ball as an alignment aid. However, to date, no research examining the usefulness of such an aid could be found. The purpose of this study was to determine if using an alignment aid located on the ball would improve performance. The participants were 64 novice golfers divided into four groups of 16. All groups putted at a hole located 9 ft away. An indoor putting surface was used. No measurable break was present between the start point and the hole. Group one putted an unmarked ball at a hole. Group two putted an unmarked ball at the hole, while using a mark on the green as an alignment aid (spot putting). This mark was located 1.5 ft away from the starting point and on line with the hole. Group three used a straight line embossed on the ball as

an alignment aid prior to putting at the hole. Group four used the alignment aid as well as the mark on the green. All participants completed 5 putts. The number of holed putts was used as the measure of performance. A one-way analysis of variance was used to analyze the data. Results indicated significant differences, with the combination of spot putting while using the alignment aid on the ball producing significantly more holed putts than any other group. The spot putting technique produced significantly more holed putts than the control group and the alignment group. There was no difference between the alignment group and the control group. These results are of interest to golfers, manufacturers and teachers. The results supported the use of spot putting as a successful technique. However, the use of an alignment aid combined with the spot putting technique produced significantly more holed putts.

### **Motor Timing Performance and Learning: A Developmental Effect**

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Recent studies suggested that motor timing learning in a sequential task could be separated to relative timing and absolute timing (e.g., Lai and Shea, 1998; Wulf, Schmidt, and Deubel, 1993). In schema theory, relative timing is an index of the generalized motor program while absolute timing characterizes parameter specification. It is unknown if physical growth and maturation enhances the learning of relative timing, absolute timing, or both. The primary purpose of the present experiment was to determine the developmental effect on relative timing and absolute timing performance and learning. Participants ( $n = 30$ ) from three age groups (preadolescence, adolescence, and young adulthood) were asked to alternately press two keys on a computer keyboard in an attempt to match the goal intervals presented on the computer monitor. All participants performed 96 practice trials in acquisition. Retention and transfer tests were administered approximately 24 hr after the completion of the acquisition. Analyses on results indicated that adolescence group and young adulthood group, who were not different from each other, performed significantly better than preadolescence group in the acquisition and retention of both relative timing and absolute timing. It suggests that adolescence is a significant period to develop motor timing learning. The transfer test, which the order of the finger on the right and left hand in the execution of sequential task was reversed, was to determine if practice promotes effector independence. The results revealed no difference between retention and transfer. This suggests participants as early as preadolescence can develop the control of the timing sequence independent of the order of the special effectors.

### **Effects of Three Practice Schedules on the Learning of Field Hockey Skills in Fourth and Fifth Graders**

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The limited number of studies on practice variability that have used children as participants seem to indicate that children do not benefit from contextual interference as much as adults