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IMPROVED CURVEBALL HITTING THROUGH THE ENHANCEMENT OF VISUAL CUES

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This study investigated the effectiveness of using visual cues to highlight the seams of baseballs to improve the hitting of curveballs. Five undergraduate varsity baseball team candidates served as subjects. Behavior change was assessed through an alternating treatments design involving unmarked balls and two treatment conditions that included baseballs with ¼-in. and ⅛-in. orange stripes marking the seams of the baseballs. Results indicated that subjects hit a greater percentage of marked than unmarked balls. These results suggest that the addition of visual cues may be a significant and beneficial technique to enhance hitting performance. Further research is suggested regarding the training procedures, effect of feedback, rate of fading cues, generalization to live pitching, and generalization to other types of pitches.

DESCRIPTORS: discrimination training, curveball hitting, fading visual cues, enhancement of visual cues, baseball

The ability to discriminate the type of pitched baseball is essential to consistent hitting. Identifying the type of pitch allows the batter to adjust the speed and location of the swing of the bat. One element of this discrimination is the identification of the spin (rate of rotation) of a baseball. Different types of pitches have differing rates and directions of spin. A curveball spins in a downward direction, a fastball spins in a backward direction, and a knuckleball does not spin. The downward spin and speed of the baseball affect the lateral deflection (curve) of the baseball (Allman, 1982; Briggs, 1959). The faster the spin on the ball, the more deflection occurs in the flight path. By effectively identifying the rate of spin of an approaching curveball, hitters can gauge their swing with respect to the anticipated location of the pitch.

Identifying the spin of a fast-pitched baseball is a difficult discrimination; a batter must decide whether or not to swing within 0.13 s after the delivery of the pitch (Brancazio, 1984). Errorless learning, the addition of prompts, and fading have been used to teach difficult discrimination tasks (Terrace, 1963; Touchette, 1968). This study investigated whether the addition of visual cues, highlighting the seams of a baseball, would assist batters to identify rate of ball rotation and improve the hitting of curve balls.

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METHOD

Subjects

Five candidates for the St. Cloud State University men's baseball team consented to participate. Subjects were randomly selected from the total roster of candidates ($N = 55$) by using a random number selection process. Subjects were informed of the purpose of the study. All subjects had played baseball in high school and summer leagues. During the spring baseball season following the study, Subjects 1, 4, and 5 competed at the varsity level, and Subjects 2 and 3 participated at the junior varsity level. Subjects 1 and 4 played outfield, and Subject 5 pitched. Subjects 1, 2, and 3 were unable to complete the entire study due to various injuries that occurred during the preseason baseball practice.

Apparatus

The experiment was conducted inside a standard indoor batting cage (75 ft by 10 ft by 15 ft). There was a dark green backdrop at the end of the batting cage (behind the pitching machine) to provide a consistent hitting background. All pitches were thrown by a Curvemaster pitching machine (Model

CEM 2200). The settings on the Curvemaster to indicate the angle and speed of the pitches were marked and held constant throughout the study. All pitches were thrown at approximately 65 mph as measured by the Eagle Pitcher: Jugs Supergun II (Model Sn-58). The height of the pitches was adjusted to accommodate each subject's strike zone. To begin each session of 20 pitches, one ball was thrown to ensure the location of the pitch within the person's strike zone.

All baseballs were either Wilson A1010C or A1010. At no time were the two types mixed. After Session 36, the change from A1010C to A1010 was made due to availability. All baseballs were put into the Curvemaster with the label facing the experimenter, right side up. Subjects 1, 2, and 3 were right-handed hitters and received curveballs simulating those from a right-handed pitcher. Subjects 4 and 5 were left-handed hitters and received curveballs simulating those thrown from a left-handed pitcher. Any scuffed, cut, or smudged balls were discarded.

The baseball bats were the size and model chosen by each subject. All bats complied with the National Collegiate Athletic Association specifications and were made of metal. None of the subjects was allowed to change the style, weight, or model of his bat once the experiment had begun.

During the training conditions, baseballs with either ¼-in. or ⅛-in. orange highlighting stripes around and including the seams were used. The highlighting enhanced the visibility of the seams. All highlighted baseballs were colored with Sharpie (30006) orange permanent markers manufactured by Sanford Corporation (Bellwood, Ill.).

Experimental Procedures

Each batting session consisted of 20 pitches; each subject received two batting sessions per day. Between each batting session, subjects stood around the batting cage waiting for their second turn. The wait varied between 5 and 20 min, depending upon the number of subjects receiving batting practice. Neither coaching nor instruction was provided by the experimenters during any part of the study.

Unmarked balls. The subjects were asked to hit as many unmarked curve balls as they could during 20-pitch sessions.

¼-in. and ⅛-in. training. During the ¼-in. and ⅛-in. stripe training sessions, 10 marked balls were presented with 10 unmarked baseballs. The presentation was random, with the stipulation that the middle 10 pitches included five marked and five unmarked balls.

Design

An alternating treatments design was used. The alternating treatment conditions consisted of hitting unmarked and marked balls. The dependent variable was the number of well-hit balls. A *well-hit ball* was defined as follows:

1. Any ball hit into the side of the batting cage more than 15 ft from home plate and below a diagonal line from shoulder height at 15 ft to the top of the batting cage.
2. Any ball hit into the top of the cage more than 40 ft from home plate.
3. Any ball hit into the side of the batting cage below a diagonal line from the top front corner of the batting cage to the bottom rear corner of the batting cage.
4. Any ball hit on a straight line back to the rear wall of the batting cage.
5. Any ball hitting the protective pitching screen or reaching the rear wall of the batting cage in one bounce or less.
6. Only balls that were hit with a full swing were recorded as well hit; partial swings were scored as *not well hit.*
7. Balls swung at and missed were recorded as not well hit.

To assist in the identification of well-hit and not well-hit balls, the batting cage was partitioned according to the abovementioned criteria by ½-in. red plastic ribbon. A diagram of well-hit balls is available to interested readers by contacting the first author.

Reliability

An independent observer collected data on well-hit balls on four occasions, twice in the unmarked condition and once each in the ¼-in. and ⅛-in.

treatment conditions. During each reliability check, data were collected on all subjects. The independent observer stood outside the batter's cage, one half the distance from the pitching machine. Interobserver agreement on well-hit balls was assessed by dividing the number of agreements by the number of disagreements plus agreements and multiplying the result by 100. Interobserver agreement ranged from 85% to 100%, with an overall mean of 91.6%.

RESULTS

The data were analyzed by all 20 pitches and by the middle 10 pitches to determine the effects of warm up (first five pitches) and fatigue (last five pitches) on hitting performance. The data showed no consistent effect across subjects when analyzed by middle 10 or by all 20 pitches. Subjects 1 and 5 hit a higher percentage of marked balls within the middle 10 pitches, and Subjects 2, 3, and 5 hit a higher percentage of marked balls across all 20 pitches. In the ⅛-in. condition, Subjects 1, 3, 4, and 5 hit a higher percentage of marked balls within the middle 10 pitches.

Unmarked Balls

Individual hitting performance for Subjects 1, 2, 4, and 5, within the 10 middle pitches, is shown in Figures 1 and 2. Subjects 1, 4, and 5 participated in 15 unmarked sessions, and Subject 2 participated in 17 sessions. As shown in Figures 1 and 2, hitting performance was variable for each subject. The mean percentage of well-hit balls was 42.4% and 41.8% for the middle 10 pitches and all 20 pitches, respectively.

Marked Balls: ¼ and ⅛ In.

Subjects 1, 2, and 3 had fewer sessions in the ⅛-in. condition due to injuries received during regular preseason baseball practice.

Within treatment sessions. The mean percentage difference between hitting marked and unmarked balls within each condition was computed by comparing the average percentage of well-hit marked balls with the average percentage of well-hit unmarked balls (see Table 1). The mean overall increase in hitting marked balls as compared to unmarked balls for all subjects in the ¼-in. treatment condition, middle 10 pitches, was 10.2% (range, 2.0% to 19.0%). The mean overall increase for all 20 pitches was 10.0% (range, 7.0% to 12.9%).

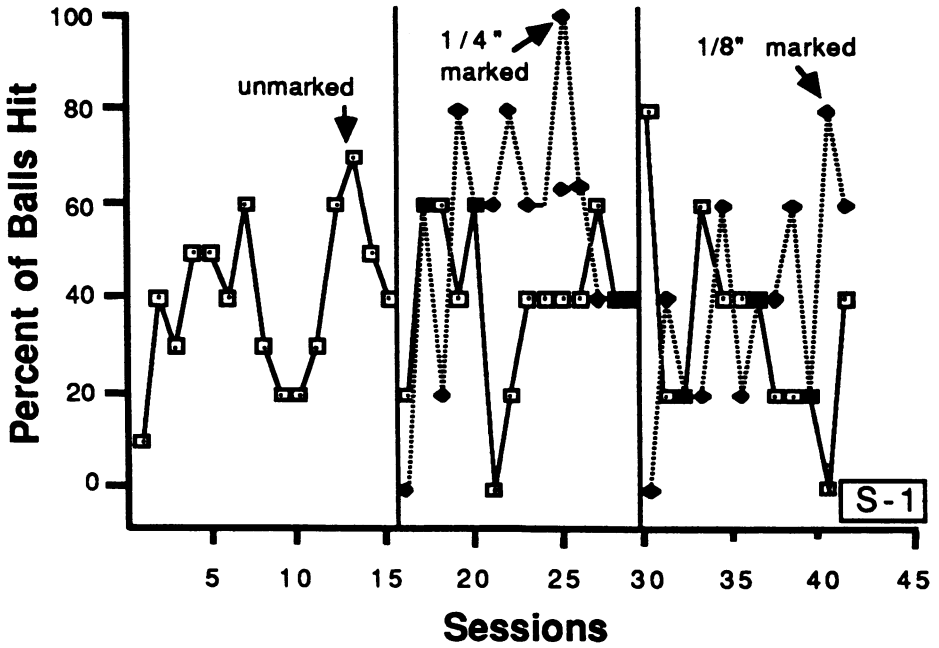
The mean increase in hitting marked balls as compared to unmarked balls in the ⅛-in. treatment condition was 8.4% (range, 2.5% to 17.1%) for the middle 10 pitches, and 5.0% (range, −5.0% to 14.8%) for all 20 pitches per session.

Marked balls compared to unmarked balls. The mean increase in hitting ¼-in. marked balls compared to the unmarked ball condition (for the middle 10 pitches) was 6.7% (range, 0.0% to 14.3%). For all 20 pitches, the mean increase in hitting marked balls was 4.2% (range, −0.6% to 10.8%).

The mean increase in hitting ⅛-in. marked balls compared to the unmarked ball condition (for the middle 10 pitches) was 2.6% (range, −1.7% to 7.3%). The mean increase in hitting marked balls for all 20 pitches was 1.5% (range, −3.8% to 4.8%).

DISCUSSION

The addition of visual cues to baseballs appeared to enhance batters' performance in hitting marked curveballs compared to unmarked balls, both within treatment conditions and when compared to the unmarked condition. Two additional observations regarding the marked balls should be made. First, the percentage of well-hit unmarked balls during treatment conditions was lower than the percentage of well-hit unmarked balls during the unmarked ball condition. Thus, the increase in hitting marked and unmarked balls within conditions may have been due to a negative contrast effect (i.e., reduced proficiency at hitting unmarked balls when presented in the context of 50% marked balls) or to enhanced visibility of the ball (rather than spin detection). Second, the mean increase in hitting marked balls was higher for the ¼-in. condition compared to the ⅛-in. condition. This suggests that either the cues were faded too rapidly or the method



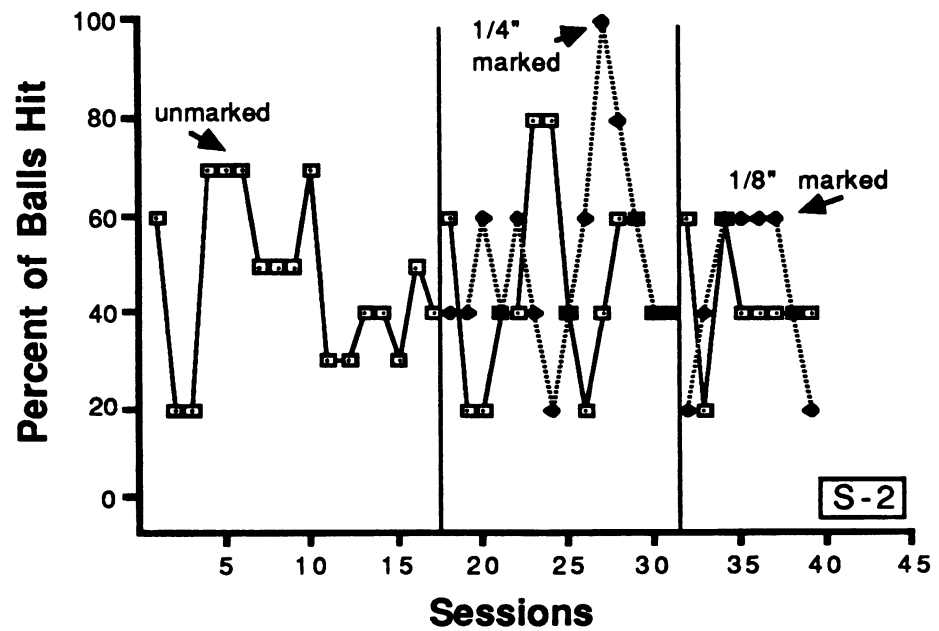
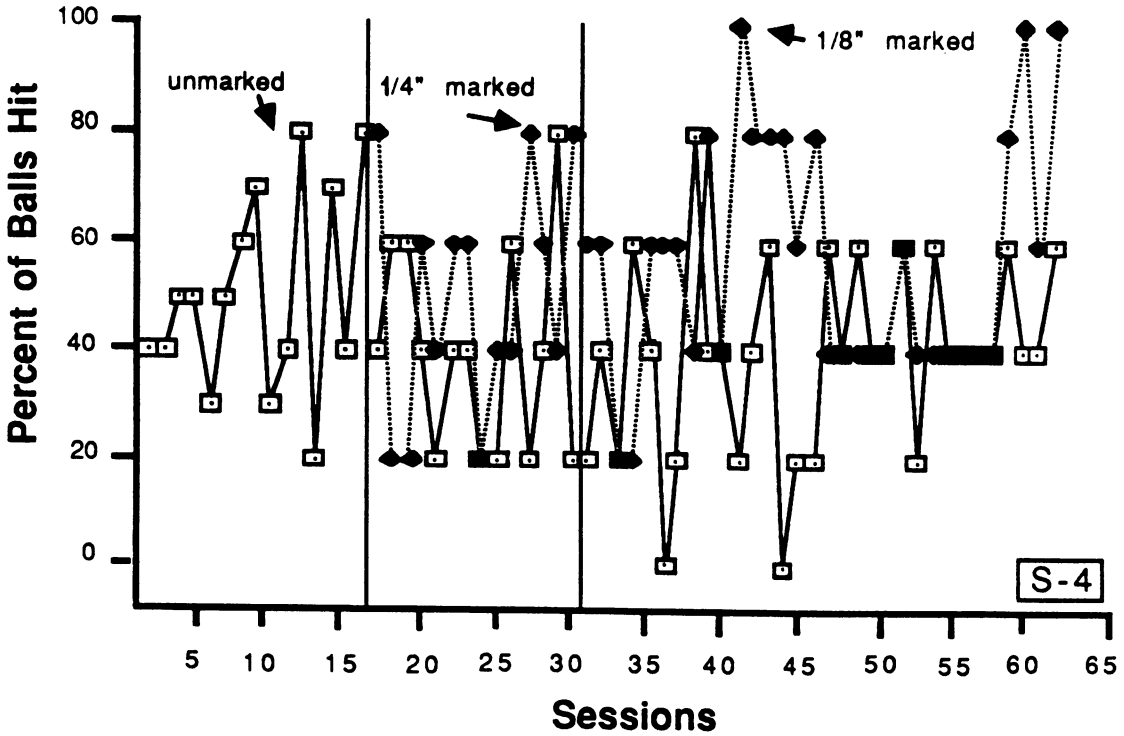


Figure 1. The percentage of the middle 10 pitches hit by 2 right-handed batters.



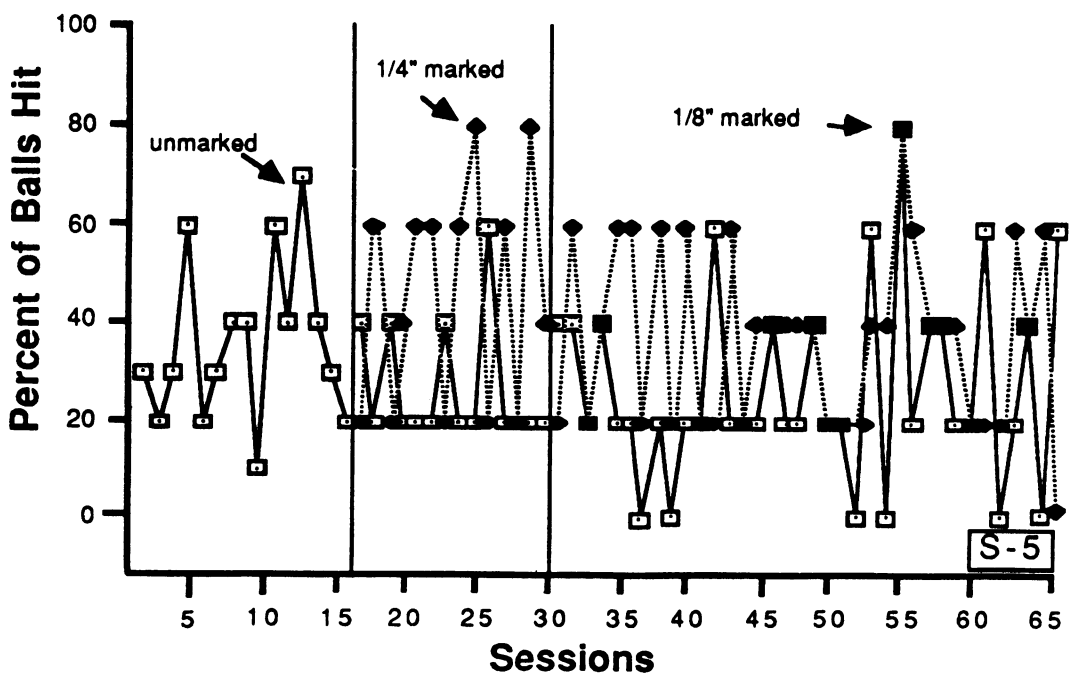


Figure 2. The percentage of the middle 10 pitches hit by 2 left-handed batters.

Table 1
Individual and Mean Percentage of Well-Hit Curveballs

Subject	Condition	No. of Trials	Middle 10 pitches			Overall 20 pitches		
			Unmarked	Marked	Increase	Unmarked	Marked	Increase
1	Unmarked	15	40.0			38.3		
	¼ in.	14	40.0	54.3	14.3	35.7	46.4	10.7
	⅛ in.	12	33.3	38.3	5.0	34.2	38.3	4.2
2	Unmarked	17	46.5			48.8		
	¼ in.	14	45.7	51.4	5.7	41.4	50.0	8.6
	⅛ in.	8	42.5	45.0	2.5	42.5	45.0	2.5
3	Unmarked	17	39.4			39.4		
	¼ in.	10	42.0	44.0	2.0	34.0	41.0	7.0
	⅛ in.	6	40.0	46.7	6.7	45.0	40.0	−5.0
4	Unmarked	15	50.0			51.3		
	¼ in.	14	40.0	50.0	10.0	37.9	50.7	12.9
	⅛ in.	32	39.8	56.9	17.1	36.9	51.3	14.4
5	Unmarked	15	36.0			31.3		
	¼ in.	14	26.7	45.7	19.0	31.4	42.1	10.7
	⅛ in.	36	27.2	37.8	10.6	26.9	36.1	9.2
M	Unmarked		42.4			41.8		
	¼ in.		38.9	49.0	10.2	36.1	46.1	10.0
	⅛ in.		36.6	44.9	8.4	37.1	42.1	5.0

of ball presentation may not have been the most efficient for promoting discrimination. Possibly, presentation of the various levels of marked balls in blocks of trials would facilitate the discrimination by removing the uncertainty of ball type being thrown. These observations suggest the need for further research to identify efficient methodologies for teaching this discrimination.

Another potential area of research is the effect of verbal feedback and/or positive reinforcement techniques. Verbal feedback and/or praise were not used, so as not to confound effects of the discrimination training program. However, during one batting session, Subjects 1 and 3 asked to see how they did and were shown the data regarding their individual performance for that one session. No further feedback was provided until the end of the study, when subjects saw graphs of their performance. It is not known whether additional interventions (verbal praise, tangible rewards, public posting, etc.) would have enhanced the subjects' performance.

Additional research is needed to determine whether the discrimination will be maintained when the cue is faded entirely. The original intent of the study was to fade systematically the visual cues from high-level prompts to naturally occurring levels (i.e., to unmarked balls). Due to time constraints (baseball season began), this final fading condition was not accomplished. Further, it is not known whether the discrimination of the spin of the seams for curveballs will assist in the ability to discriminate the various types of pitches thrown and allow batters to adjust their swings accordingly. One limitation is the procedure used to throw a variety of pitches. The Curvemaster machine requires adjustments for each type of pitch thrown and a trial throw to determine whether the ball is within the strike zone. Thus, the batters not only anticipate a change in type of ball thrown but are also provided with a sample. Using a live pitcher was an option considered. However, for 5 subjects to receive 20 pitches, a minimum of 100 pitches would be required, assuming all are strikes. The type of pitch thrown (screwballs, sliders, and curveballs in particular) creates undue stress on the arm. It would be difficult to throw that many balls consistently (many major league pitchers are relieved after 70 to 120 pitches).

In summary, the addition of visual cues to base-

balls resulted in an increase in hitting marked curveballs compared to unmarked curveballs. Further, all subjects reported that they perceived improvement in picking up the flight of the ball as a result of the training.

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