A Chaining-Mastery, Discrimination Training Program to Teach Little Leaguers to Hit a Baseball

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One of two little league baseball teams, consisting of boys between the ages of 8 and 12, was taught to hit a baseball using a chaining-mastery program extrapolated from the "Total Golf" (Simek & O'Brien, 1981) program. Following two baseline games and a baseline measurement session, 10 of the 12 boys on the experimental team participated in a chaining-mastery batting program, beginning with slow pitches from close to the batter and progressing to normal speed pitches from the regulation distance. Both game performance and a repeat of the baseline measures following Game 6 showed large increases in the number of hits. The control team showed no such increases. Following Game 6, a program of discrimination training for hitable balls (strikes) was instituted with the experimental team using a mastery approach to produce earlier discriminations of strikes from balls. Number of bases on balls increased for Games 7 through 10 after remaining stable for the first 6 games. For the control team, bases on balls increased during Games 3 through 6, but remained stable for Games 7 through 10. Batting averages revealed similar improvement for the experimental team from a baseline of .250 to .342 for Games 3 through 6, and .369 for Games 7 through 10, and no improvement for the control team (baseline = .281, Games 3 through 6 = .230, Games 7 through 10 = .230). Two members of the experimental team rejected the chaining-discrimination training program in favor of practice in "guided positive fantasy" for batting skills, which was provided by the father of one of the boys. These two boys showed little improvement on the dependent measures. The results suggest that a program of chaining-mastery instruction for batting and discrimination training for pitch selection can be effective in teaching little leaguers to hit.

The success of operant approaches to teaching motor behavior has led a number of writers (Komaki & Barnett, 1977, Martin & Hrycaiko, 1983; Rushall & Pet-
tinger. 1969; Rushall & Siedentop. 1972; Siedentop. 1980) to suggest a role for behavior analysis in improving athletic performance. Within the past 10 years, a variety of sports have been subjected to operant analysis with feedback (Buzas & Ayllon. 1981; McKenzie & Rushall. 1974) and reinforcement of specific response segments of complex athletic behavior (Komaki & Barnett. 1977) as the most common interventions. Feedback has been a part of successful interventions in golf (Simek & O'Brien. 1978), soccer (Luyben. Hansen. Hardy. Leonard. & Romero. 1980), bowling (Kirschenbaum. Ordman. Tomarken. & Holtzbauer. 1982), gymnastics (Allison & Ayllon. 1980). football (Komaki & Barnett. 1977), and tennis (Buzas & Ayllon. 1981). Response specification procedures have been reported in football (Allison & Ayllon. 1980; Komaki & Barnett. 1977) and golf (Simek & O'Brien. 1981). In addition, contingency management has been employed to improve more global aspects of performance in baseball (Heward. 1978) and golf (O'Brien & Simek. 1981), and professional baseball has been analyzed from a reinforcement perspective (Howard. Figlerski. & O'Brien. 1982).

Some of the operant interventions in sports have focused on teaching responses that were not previously in the organism's repertoire (Komaki & Barnett. 1977. Simek & O'Brien, 1981). For the baseball beginner. the art of hitting a ball thrown at high speed with a relatively narrow bat is not in the subject's repertoire. Making contact with the ball may be viewed as a complex discriminated response that is controlled by the direction and height of the incoming pitch. The reinforcement for this chain of responses would seem to be the sight of the ball being hit sharply into the outfield. It has often been demonstrated (Kazdin. 1980; Millenson & Leslie. 1979) that response chains are most effectively taught by beginning with the response that is closest to reinforcement. Teaching from a mastery-based approach (Johnson & Ruskin. 1977. Keller. 1968). Simek and O'Brien (1981) developed a chaining program for teaching golf skills beginning with the very short putt and extending backward to the tee shot. On their first round following instruction, novices averaged 17.33 strokes better than a traditionally trained group of beginners (Simek & O'Brien. 1981). The present program extends the chaining-mastery approach for golf to learning how to hit a baseball. To generalize the golf program to hitting both the length of the swing and the direction of the required perceptual tracking were decreased or simplified. As mastery of hitting was achieved at each step. the length of the swing and distance of the stimulus pitch were extended until full swings at pitches from regulation distance were mastered.

Simek and O'Brien (1981) taught golf backward—from the green to the tee—requiring that each shot be learned to a mastery criterion of successful performance. From the perspective of Schmidt's (1975) schema model. this approach should develop schema that allow for both the recall of appropriate responses and the recognition of those responses by producing repetition of the correct movement at the most elementary level where that movement is likely to be easily pro-
duced. The mastery training also allows for the greater variety of experience, which Schmidt hypothesized would be most effective in developing schema.

METHOD

Subjects

Twelve members of one little league baseball team in northern central Pennsylvania were volunteered by their coaches for a program in hitting skills. The boys ranged in age from 8 years and 7 months to 11 years and 4 months, and varied widely in their baseline skills. Although some of the boys were capable of making solid contact most times at bat, others were unable to hit a pitched ball. A second team from the same league served as a standard treatment, control group. Their data were collected from box scores in the local newspaper at the end of the season. Given the team assignment system in little league, this represents a matched control group. The age range was identical to the experimental team.

Procedure

Following initial contact with the 1st-year head coach of the experimental team, the authors developed a program to shape baseball batting skills based on backward chaining and mastery instruction. This program was extrapolated from earlier research in golf (Simek & O'Brien, 1981).

Baseline data (times at bat, hits and walks) were collected for the first 2 games of a 10-game season. Following the second game, measurements were taken during a practice session for each player on the experimental team. The number of balls hit in fair territory before six strikes were accumulated by either swinging and missing, hitting a "foul" ball, or allowing a called strike to pass without swinging at it, was recorded. As is always the case in baseball, foul balls did not count for the final strike. Similar measurement sessions were carried out after the sixth and tenth games. The assistant coaches served as umpires for these sessions.

Preceding the collection of baseline data, the program was presented to the parents of the children at a team meeting. At this time, the parents of 10 children consented to the program to improve hitting skills. One parent, a dynamically oriented social worker, reacted negatively to behavior modification and decided to pursue his own program of "guided positive fantasy" to improve the hitting skills of his child. A second child, who was a close friend of the social worker's boy, also decided to participate in this cognitive approach rather than the behavioral program.

The actual chaining-mastery program was implemented before Game 3. By this time, the team had won one game and lost one game and had completed 12
practices. The chaining-mastery program, for hitters is presented in Table 1. In actual practice, each boy began at Step 2, but those who did not attain mastery at this step were dropped back to Step 1 as a remedial intervention. Mastery of each step in the chain required that the subject make contact a specified number of times out of a specified number of swings (as indicated in Table 1). With the exception of the first step, which was limited to pitches that would have been called strikes, this strategy eliminated the need for an umpire to monitor strikes and balls during the training sessions. The training program stressed hitting balls in play—foul balls were counted as swings, but not as hits.

Throughout the chaining-mastery program, the team coaches continued to give hitting instruction to all players. While the rest of the team was engaged in practice with the coach, pairs of subjects would spend 20 to 30 min on the chain with the first author and one of the assistant coaches. Over approximately 2½ weeks or 7 trials, all subjects completed the hitting chain. Progress through the chain seemed to reflect age, experience, and practice time at home. The experimenters continued to collect game by game data for the four games played during this period, as well as taking hitting measurements similar to those at baseline between the sixth and seventh game (Posttreatment 1 measure).

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Prestep)</td>
<td>Oversize wiffle ball and bat is held over home plate, player adjusts bat up and down to hit pitches from 8 ft away. No Swing</td>
<td>Contact on 5 consecutive pitches (pitches must be in strike zone)</td>
</tr>
<tr>
<td>2</td>
<td>Oversize wiffle ball and bat held halfway from plate (miniswing) pitches from 10 ft</td>
<td>Contact on 5 of 8 swings</td>
</tr>
<tr>
<td>3</td>
<td>Oversize softball and regulation little league bat, miniswing at pitches from 10 ft</td>
<td>Contact on 5 of 8 swings</td>
</tr>
<tr>
<td>4</td>
<td>Same ball and bat at 15 ft</td>
<td>Contact on 5 of 12 swings</td>
</tr>
<tr>
<td>5</td>
<td>Same ball and bat at 22 ft</td>
<td>Contact on 5 of 12 swings</td>
</tr>
<tr>
<td>6</td>
<td>Same ball and bat at 30 ft</td>
<td>Contact on 5 of 12 swings</td>
</tr>
<tr>
<td>7</td>
<td>Same ball and bat at regulation little league pitching distance (40 ft 6 in.)</td>
<td>Contact on 5 of 15 swings</td>
</tr>
<tr>
<td>8</td>
<td>Regular little league baseball and bat at 15 ft</td>
<td>Contact on 5 of 12 swings</td>
</tr>
<tr>
<td>9</td>
<td>Same ball and bat as in Step 8 at 22 ft</td>
<td>Contact on 5 of 15 swings</td>
</tr>
<tr>
<td>10</td>
<td>Same ball and bat as in Step 8 at 30 ft</td>
<td>Contact on 5 of 15 swings</td>
</tr>
<tr>
<td>11</td>
<td>Same ball and bat as in Step 8 at regulation distance (40 ft 6 in.)</td>
<td>Contact on 5 of 15 swings</td>
</tr>
</tbody>
</table>
TABLE 2

Discrimination Training Program and Mastery Criteria

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Player at plate without bat. Calls pitch (strike or ball) after pitch is in catcher’s mitt and before umpire calls pitch.</td>
<td>7 out of 10 pitches called correctly.</td>
</tr>
<tr>
<td>2.</td>
<td>Player at plate with bat (but no swing). Calls pitch (strike or ball) as or just before the pitch impacts the catcher’s mitt</td>
<td>7 out of 10 pitches called correctly.</td>
</tr>
<tr>
<td>3.</td>
<td>Player at plate with bat (no swing). Pitch must be called (strike or ball) as the ball passes over the plate.</td>
<td>7 out of 10 pitches called correctly.</td>
</tr>
<tr>
<td>4.</td>
<td>Player at plate with bat (no swing). Pitch must be called (strike or ball) as the ball passes over a white marker set 9 ft in front of the plate.</td>
<td>7 out of 10 pitches called correctly.</td>
</tr>
</tbody>
</table>

Note. In all cases, the umpire had the final decision as to whether a pitch was a strike or a ball.

At this time, it was noted that hitting skills for the 10 experimental subjects had improved dramatically, but that they continued to have difficulty discriminating strikes from balls. In fact, in game situations they routinely swung at pitches that were so far from the strike zone as to be unhitable. The game data showed that they had actually decreased the number of walks received per game from baseline through treatment (see Figure 1).

In order to correct this problem a new mastery program was developed to discriminate strikes from balls. This program is presented in Table 2. Each step of the intervention began by having the coaches model the desired behavior. The program was based on decreasing the time before a discrimination was made. The subject began by correctly identifying strikes, hitable balls, or nonstrikes after they hit the catcher’s glove, and ended when the subject was able to call out “strike” or “ball” when the pitch passed over a marker 9 feet in front of the plate. This intervention was aimed at teaching the subject to make the strike-ball discrimination early enough to initiate a swing when the pitch was within his strike zone (over the plate, between the batter’s shoulders and knees). The program was carried out in a similar manner to the hitting chain program. Coaches attempted to maintain a normal little league baseball pace on the pitches as they had at the latter stages of the hitting chain. Completion of this discrimination training required five practice sessions over a 2-week period, although most players completed it in three sessions. This intervention began prior to Game 7. Game data continued to be kept for all players and at the end of this intervention (i.e., following Game 10), Posttreatment 2 measure was collected in a similar manner to the baseline and Posttreatment 1 assessments.

Throughout the study, the two boys whose parents objected to the behavioral approach continued to take part in all regular practices and game play as determined by the coaches. The “guided positive fantasy” techniques employed by the father of one of these boys included relaxation and success images such as,
imagine you're floating on a cloud, imagine yourself successfully hitting the ball, and so on. The voice intonation observed in these settings was rather soft and melodic, similar to relaxation training or a permissive hypnotic induction. These procedures were continued throughout the study. Included in the program were eight pregame sessions in addition to other trials at practices.

For a variety of reasons, it is impossible to consider these two subjects as a true control group because they were neither randomly assigned nor equated for age (they were younger than all but one of the experimental group), ability, trainer, or time spent in training. Nonetheless, they were engaged in efforts to learn the same tasks as the experimental group over the same period of time, with the same coaches and regimen of team practices. They received treatment specifically directed toward improving their batting skills through cognitive or imagery training and, within the limitations of assignment, trainer, and organismic variables, provide at least an attention control group. Because identical data were collected on these subjects (as was the case for the experimental group), they provide a useful opportunity to measure on-going performance as it occurred without the behavioral program but with increased attention.

The timing of the intervention phase for the behavioral group represents a partial, multiple baseline design with hits and walks as the two behaviors treated sequentially. The hitting intervention (Treatment 1) began after two baseline games, but discrimination between balls and strikes remained under baseline conditions until Game 7 (Treatment 2). This design controls for the effects of maturity, age, and experience unless one assumes that these factors would effect each dependent measure at exactly the same time as the intervention did. The inclusion of a control team provides further information on the effects of maturity and practice without the behavioral program.

RESULTS

Figure 1 shows the number of hits and walks collected by the experimental team and control team, baseline through Treatment 2. In Treatment 1, the chaining-mastery approach was applied to hitting, but walks remained under baseline conditions. The data show a substantial increase in hits but little change in walks. For the control team, walks increased but hits remained constant during this period. When the discrimination training program was installed as Treatment 2, the number of walks to the experimental team increased, although hits continued to increase as well. The knowledgeable baseball fan will recognize that awareness of the strike zone benefits hitting as well as leading to more walks; therefore, the increase in hits in Treatment 2 is expected. Furthermore, Treatment 2 does not represent a return to baseline conditions on hitting because the effect of the intervention could not be subtracted. The performance of the control team remained constant for both hits and walks through Game 10. Statistical analysis
of number of hits over the final eight games revealed a significant difference in favor of the experimental team ($M = 10.75$) over the control team ($M = 7.25$), $t(14) = 2.57$, $p < .05$. A similar analysis of mean number of walks over the final four games was not significant, $t(6) = .77$, $p > .05$.

Unfortunately, the results depicted in Figure 1 are not as clear-cut as they appear. The average number of batting opportunities during Games 7 through 10 was 4.1 compared to 3.1 for Games 3 through 6. This means that there were more opportunities to get a hit or a walk during Treatment 2. Team batting averages for those periods suggest that this increase in opportunities is a result of treatment rather than the treatment results being an artifact of the increased opportunities. As the study progressed, the subjects simply made fewer outs, allowing
more boys to come to bat in each inning. The team batting average progressed from .250 at baseline to .342 during Treatment 1 and .369 during Treatment 2. Treatment 2 was marked by games with lopsided scores as the team went undefeated over these four games. The team finished in first place with eight victories and two losses. The standard control team finished in second place with a record of seven wins and three losses. Unlike the experimental team, however, their batting average did not improve. They batted .281 in the Games 1 and 2, .230 for Games 3 through 6, and .230 again for Games 7 through 10.

Figure 2 presents the experimental group's mean number of hits before collecting six strikes for measurement sessions held at baseline, between Games 2 and 3, after the chaining-mastery hitting program between Games 6 and 7, and after the discrimination training program for pitch identification after Game 10. The number of hits collected by the two control subjects and the two worst baseline experimental subjects are also presented in this figure. These data were unavailable on the standard treatment control team because the experimenters had no contact with it. These data are presented individually for each member of the experimental team in Table 3. Repeated measures ANOVA on the means of the experimental subjects at each occasion revealed significant differences. $F(2, 18) = 29.14, p < 0.01$. Newman-Keuls comparisons showed that all differences were significant beyond the 0.05 level.

![Figure 2](image-url)
TABLE 3
Number of Fair Balls Hit by Each Subject Before Collecting Six Strikes at Each Measurement Session

<table>
<thead>
<tr>
<th>Subject</th>
<th>Baseline</th>
<th>Postgame 5</th>
<th>Postgame 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>3</td>
<td>3</td>
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<tr>
<td>6</td>
<td>4</td>
<td>9</td>
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<tr>
<td>8</td>
<td>6</td>
<td>6</td>
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</tr>
<tr>
<td>9</td>
<td>14</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>66</td>
<td>106</td>
</tr>
</tbody>
</table>

Control 1 3 4 3
Control 2 2 2 3
Control Total 5 6 6

Although the two subjects in the guided positive fantasy group show little improvement across time, it is also obvious from figure 2 that they started out with less skills than the experimental group. The most meaningful comparison is probably between these two players and the two experimental group subjects with the worst baseline performance. Neither of the latter two boys hit even one ball in play before being counted out on six strikes at baseline. Yet, by the end of treatment their accomplishments had far out-distanced the two subjects who received the guided positive fantasy treatment. The lack of effectiveness in the attention-control treatment is further substantiated by the batting averages of the two guided positive fantasy subjects for each treatment phase: .000 for baseline, .143 for Games 3 through 6 and .111 for Games 7 through 10.

The experimental group means in Figure 2 are representative of individual performance. Eight of the 10 subjects showed an increase in the number of hits from Pretreatment to Posttreatment 1, and all 10 increased form Pretreatment to Posttreatment 2. No subject decreased from Posttreatment 1 to Posttreatment 2, although two subjects hit the same number of balls in play at each of these measurement sessions.

DISCUSSION

The present results indicate the efficacy of teaching novice baseball players to judge the strike zone and hit the ball through a combination of discrimination training and mastery-based instruction within a chaining model. The differential
response of the two accomplishments (hits and walks) over time as the two interventions, mastery-based instruction and discrimination training, were sequentially introduced is not easily explained through attention, goal setting, maturity or practice effects.

A second team that received neither intervention did not demonstrate the sequential improvement seen in the experimental team over the same number of games. In fact, the standard-practice control team showed little improvement over the 10-game season. Similarly, two players who chose not to participate in the chaining-mastery program, but received extra attention to batting in an imagery program, also showed little improvement.

It might be argued that the superiority of the experimental team over the control team simply reflected superior coaching. To support this position one would have to assume that the experimental team coach shifted his attention to walks at the same time that the behavioral program for walks was instituted, and that the experimental team coach was significantly better than the control team coach. The available data would support neither of those assumptions. Because the experimenters observed every practice, the first concern is easily dismissed. The experimental team coach devoted little time to teaching the strike zone throughout the season and certainly showed no increase in attention to that end during the discrimination training program to teach that skill. Because he did not intervene on this skill, his coaching could not be responsible for the improvement in bases on balls. As to the second assumption, the experimental team coach was a novice who agreed to the experiment because he felt that he did not know how to teach hitting. The control team coach, on the other hand, was a veteran of little league and was generally recognized as the league’s best coach. His team had won the league championship for the previous 2 years.

It should also be noted that the first three games of the season occurred before the behavioral program had been completed but after each team had held four practice and two traditional pregame batting practices. If the experimental team had a better coach of hitting than the control team, these first three games show little evidence of it. In fact, the control team out-hit the experimental team in all three games. The superiority of the experimental team in hitting does not occur until that skill is taught behaviorally, and the superiority of the experimental team in walks does not occur until that skill is taught behaviorally.

It could be argued that the presence of the experimenters provided general extra attention that produced a Hawthorne effect for the experimental team. The poor performance of the two attention-placebo control subjects who also received extra attention argues against this possibility. The case for a general attention affect is even harder to defend when the serial effects of training are reviewed in Figure 1. The experimenters were present, providing attention to all aspects of the subjects hitting for the last eight games, but bases on balls increased only when a specific training program for that response was instituted during Games 6 through 10.
Locke (1980) suggested instructions rather than learning as an explanation for the effects of many operant studies in applied settings due to the large increases in performance that are often seen in the first observation after treatment is initiated. As can be seen in Figure 1, neither intervention produced an immediate performance improvement. This argues for change produced through learning new responses rather than simply manipulating antecedent conditions (i.e., instructions).

The present results suggest that a program that combines discrimination training for pitch selection, and a mastery-chaining approach to batting skills can effectively improve the performance of little league baseball players. These techniques seem particularly effective in helping novices to develop this complex skill. When combined with the success of chaining-mastery techniques in teaching golf (Simek & O'Brien, 1981), the present results seem to justify further investigation of operant approaches to teaching complex athletic skills.

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Thomas C. Simek (the first author) is now at the Community Mental Health Center at Howard Community Hospital, Kokomo, IN.

REFERENCES


Martin, G. L., & Hrycaiko, D. (1983) Effective behavioral coaching What's it all about? In G. L. Martin & D. Hrycaiko (Eds.), *Behavior modification and coaching principles, procedures and research* (pp. 5-20) Springfield, IL: Thomas


O'Brien, R. M., & Simek, T. C. (1981, May) Contracting and chaining to improve the performance of a college golf team. Improvement and deterioration Symposium conducted at the Association for Behavior Analysis, Milwaukee


