THE UNIVERSITY OF MANITOBA

PRESERVING A FREQUENTLY-USED PUBLIC SPORTS ENVIRONMENT THROUGH EDUCATIONAL SIGN PROMPTING AND A WEEKLY LOTTERY

by

Dickie Yu

A Thesis

Submitted to the Faculty of Graduate Studies

In Partial Fulfillment of the Requirements for the Degree

of Doctor of Philosophy

Department of Psychology

Winnipeg, Manitoba

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Abstract

This study examined, in a reversal design, the effects of an educational sign prompt and a weekly lottery in promoting golfers to repair ballmarks on greens on an 18-hole public golf course. The subjects included all golfers who played at the golf course during the study. A total of 29,551 rounds of golf were registered by the golf course, averaging 278.8 rounds per day, with only two days having fewer than 100 golfers during the study.

Throughout the study, the total number of unrepaired ballmarks on three specific greens were counted and then repaired each morning before golfers reached those greens. Unrepaired ballmarks were recorded as either "large" (obvious) or "small" (less obvious). Data were collected seven days a week for 106 consecutive days. The major dependent variable was expressed as the number of unrepaired ballmarks per 100 golfers per day.

During all baseline phases, data were collected under the normal conditions of the golf course. During educational sign prompting, a 0.9 m by 1.2 m sign was posted near the entrance inside the club house. The sign contained (1) an explanation of what a ballmark is, accompanied by photographs showing some unrepaired ballmarks; (2) a description of three simple steps of how a ballmark can be repaired, also accompanied by photographs depicting the steps; and (3) a request for golfers to help repair ballmarks on greens. During the weekly lottery, golfers had a chance to receive a raffle ticket and win a free round of golf at that golf course from a weekly draw if they were spotted repairing a ballmark by staff (who worked on the golf course).

The lottery system was described on a 0.9 m by 1.2 m sign posted at the same location as the educational sign prompt, which was absent during this condition.

The educational sign prompting had a large initial effect in decreasing the number of large ballmarks, but the initial baseline level was not recovered during the second baseline phase. The reinstatement of the sign prompt resulted in a decrease comparable to the terminal level of the previous sign prompting phase. However, the number of small unrepaired ballmarks were unaffected by the educational sign prompting. When the weekly lottery was introduced, the number of large ballmarks decreased to approximately the same level as in the sign prompting, but this was also accompanied by a decrease in small ballmarks. Following a reversal to baseline, the effects were replicated during the second weekly lottery condition. The last baseline phase showed a reversal to previous baseline levels. Overall, the mean percent reduction during each treatment from the previous baseline phase for large and total ballmarks, respectively, were: 36% and 7% for the first sign prompting phase; 38% and 16% for the second sign prompting phase; 40% and 34% for the first weekly lottery; and 21% and 24% for the second weekly lottery.

Questionnaires were given to 78 golfers and nine staff at the end of the study to evalute their preference for the procedures. The majority of the golfers preferred to have both strategies present. Only two golfers preferred neither of the two strategies. All staff felt that either one or both procedures were worthwhile for the golf course to adopt and all

but one staff member felt that both procedures were convenient to apply.

The results showed that the educational sign prompt was as effective as the weekly lottery in promoting golfers to repair large unrepaired ballmarks on greens, but not the total. In general staff found both procedures convenient and worthwhile to use and most golfers preferred either one or both strategies. The weekly lottery conceptualized as an antecedent strategy, situational variables which might have contributed to the impact of the procedures, and implications for helping behaviors were discussed with suggestions for future research.

Acknowledgement

Many individuals have contributed to the completion of this research. I would like to thank Mr. Rick Thain, Supervisor of Golf Courses, City of Winnipeg, Mr. Ron Dicken, Foreman of the Windsor Park Golf Course, and Mr. George Harper, Supervisor of the Windsor Park Golf Course, for providing the opportunity to conduct this research. Also, this research could not have been possible without the cooperation and assistance of all the staff at the Windsor Park Golf Course.

Dr. Garry Martin, my advisor, has provided invaluable assistance, supervision, and teaching throughout my graduate training and during all phases of this research. Dr. Joseph Pear, Dr. John Whiteley, and Dr. Dennis Hrycaiko, my committee members, have provided constructive and helpful comments and suggestions for the conduct of this research.

Michelle Hume, Craig Turner, Rosemarie Hrydowy, and Garry Martin sacrificed many hours of sleep and braced sometimes cold, wet, and stormy mornings to conduct reliability observations.

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Introduction

The last decade has witnessed tremendous growth in the application of behavior modification principles and procedures in areas traditionally thought to be outside the domain of behavior analysis. Pertinent to the present study are two areas of research: behavioral community psychology and behavior modification in sport. While behavior modification in sport is very much an emerging field (Martin & Hrycaiko, 1983), behavioral community psychology is well established (Geller, Winett, & Everett, 1982; Glenwick & Jason, 1980; Martin & Osborne, 1980; Nietzel, Winett, MacDonald, & Davidson, 1977).

Behavioral Community Psychology

Applied behavior analysis is a field with a set of well defined methodologies (Baer, Wolf, & Risley, 1968; Hersen & Barlow, 1976; Sidman, 1960), an empirical conceptual base (Skinner, 1938), and a coherent philosophy (Skinner, 1953, 1971, 1974, 1978). Despite minor discrepancies most writers agree that behavioral community psychology is an extension of applied behavior analysis. Although behavioral community psychology research encompasses a wide spectrum of target behaviors, the ensuing review will focus on research concerned with environmental preservation or ecological behaviors.

Litter Control. Studies in this area have taken place in a variety of settings ranging from a fast food restaurant and movie theatre to a grocery store and shopping mall (Burgess, Clark, & Hendee, 1971; Geller, Farrris, & Post, 1973; Geller, Witmer, & Tuso, 1977), from a football stadium to a city street and public highway (Baltes & Hayward, 1976; Finnie, 1973; Jason, Zolik, &

Matese, 1979; O'Neil, Blanck, & Joyner, 1980), and from picnic and campground areas to nature trials (Crump, Nunes, & Crossman, 1977; LaHart & Bailey, 1975; Powers, Osborne, & Anderson, 1973). Intervention strategies for litter control have either involved manipulating antecedent conditions or consequences or both.

Antecedent manipulations have generally taken the form of prompting through signs or handbills for proper litter disposal or pick up (e.g., Geller, 1975; Geller et al., 1973; Geller, Witmer, & Orebaugh, 1976; Geller et al., 1977; Jason et al., 1979). Other antecedent manipulations included trash can design (e.g., by making it more attractive and salient or by increasing its number in problem areas) and the examination of the effects of a clean versus a littered environment on littering behavior (Crump et al., 1977; Geller, Brasted, & Mann, 1980). While consequences were typically used in conjunction with antecedent strategies, the most commonly employed consequence was money given for trash deposits or litter bag usage (e.g., Chapman & Risley, 1974; Powers et al., 1973). Other consequences such as badges, drinks, and toys for children have also been studied (Clark, Burgess, & Hendee, 1972; Cope & Geller, 1981; LeHart & Bailey, 1975). Of the studies reviewed, only two examined a lottery (Baltes & Hayward, 1976; Powers et al., 1973) and none employed feedback (by providing information concerning present and past performance of the individual or the group) as a consequence for litter control.

Overall, the use of antecedent strategies produced modest increases, if any, in proper litter disposal or pick up. When consequences were used either alone or in conjunction with

antecedent prompts, results were generally more pronounced. Since the unit of measurement varied across studies (e.g., litter measured by weight or bags), comparisons across studies are not meaningful.

Waste Reduction and Resource Recovery. All but one of the studies reviewed were concerned with increasing paper recycling. Most studies were conducted with students in dormitory settings (Couch, Garber, & Karpus, 1979; Geller, Chaffee, & Ingram, 1975; Witmer & Geller, 1976) and in elementary schools (Hamad, Bettinger, Cooper, & Semb, 1979; Hamad, Cooper, & Semb, 1977). A few studies, however, were conducted on a community-wide basis such as community neighborhood programs and in apartment complexes (Arbuthnot, Tedeschi, Wayner, Turner, Kressel, & Rush, 1977; Jacobs, 1978; Jacobs & Bailey, 1979; Reid, Luyben, Rawers, & Bailey, 1979).

Similar to the litter control studies, prompts for waste paper collection and recycling were generally provided through flyers, signs, and the availability of collection bins in studies with dormitory students. Community-wide studies generally employed brochures and flyers on recycling, reminder letters, phone calls, and even prompts appearing in newspapers.

The most common consequence strategy examined was money given for paper turned in measured by weight (e.g., Geller et al., 1975; Luyben & Bailey, 1979; Witmer & Geller, 1976). Five of the 15 studies reviewed employed a lottery or raffle system and two studies employed public feedback as consequences (Couch et al., 1979; Geller et al., 1975, Ingram & Geller, 1975; Jacobs, 1978; and Witmer & Geller, 1976).

Once more, antecedents alone appeared to produce only small effects. But the introduction or addition of consequence strategies resulted in drastic positive changes, resulting in some cases up to 10 to 15 times more paper returned by weight than when antecedents were employed alone (Hamad et al., 1977; Witmer & Geller, 1976).

Residential Energy Conservation. Almost all studies which dealt with residential energy conservation focused on reducing electricity consumption (e.g., Hayes & Cone, 1977, 1981; Palmer, Lloyd, & Lloyd, 1978; Winett, Kagel, Battalio, & Winkler, 1978). Only three studies dealt with gas-use reduction (McClelland & Belsten, 1978; McClelland & Cook, 1980; Winett & Nietzel, 1975).

Antecedent strategies alone in the form of flyers, posters, letters, and pamphlets, which encouraged dwellers to conserve electricity and provided energy saving tips, were generally ineffective (Hayes & Cone, 1977; Heberlein, 1975; Kohlenberg, Phillips, & Proctor, 1976; Palmer et al., 1978; Winett et al., 1978; Winett & Neitzel, 1975). However, Winett (1978) found 60% reduction in unnecessary lighting in university classrooms as a result of prompting through large signs. Also, Winett, Hatcher, Leckliter, Fort, Fishback, & Riley (1981) were successful in reducing electricity consumption by 9% to 15% in townhouses and apartments by providing information and showing videotaped programs demonstrating energy saving techniques.

When consequences were introduced either by themselves or in combination with antecedents, reductions in the range of 10% to 30% were reported (Hayes & Cone, 1977; Kohlenberg et al., 1976; Palmer et al., 1978; Winett et al., 1978; Winett & Nietzel,

1975). Relative to the previous areas, a larger number of studies employed feedback as a consequence. Feedback was generally given in written form on a daily or monthly basis by researchers (Becker, 1978; Becker & Seligman, 1978; Hayes & Cone, 1981) or through a mechanical device which gave continuous cost or electricity consumption feedback (Blakely, Lloyd, & Alferink, 1977; Kohlenberg et al., 1976; McClelland & Cook, 1980). Although many studies combined feedback and monetary rebates for energy saved (e.g., Newsom & Makranczy, 1978; and Seaver & Patterson, 1976), the monetary rebate component produced only a slightly larger effect, if any, than the use of feedback alone when comparisons were made across studies (c.f., Hayes & Cone, 1981; Seligman & Darley, 1977; Winett, Neale, & Grier, 1979; Winett, Neale, Williams, Yokley, & Kauder, 1979). One study examined the use of a raffle system. The raffle was combined with feedback posters and a contest component and led to a 6% reduction of electricity use in master-metered dormitories (Newsom & Makranczy, 1978).

Transportation Energy Conservation. Target behaviors in this area included reducing vehicle miles travelled (Foxx & Hake, 1977; Hake & Foxx, 1978), increasing carpooling (Hirst, 1976; Jacobs, Fairbanks, Poche, & Bailey, 1982; Rose & Hinds, 1976), and increasing bus ridership (Deslauriers & Everett, 1977; Everett, Deslauriers, Newsom, & Anderson, 1978). Although antecedent strategies in the form of goal setting pamphlets, verbal and written instructions, flyers, and newspaper advertisements have been employed, all studies reviewed also employed consequence strategies in conjunction with antecedents.

Monetary rewards in the form of rebates for reduced mileage travel (e.g., Foxx & Hake, 1977) or reduced parking fee for carpooling (e.g., Letzkus & Scharfe, 1975) have been found to be effective. Other consequences such as providing a priority lane for carpooling and buses (e.g., Rose & Hinds, 1976) and preferential parking for carpooling (Hirst, 1976) have also been examined. Relative to studies in the previous area, various forms of feedback were more frequently examined in promoting transportation energy conservation. For example, Hake and Foxx (1978) combined monetary reward with self-monitoring to reduce vehicle miles travelled by college students. Public feedback in conjunction with group competition were also found to be effective in increasing transportation energy conservation (Runnion, Watson, & McWhorter, 1978). However, Hayward and Everett (1975) found cost feedback (daily commuting cost based on car mileage) alone to be ineffective in reducing travel mileage with university employees. Also, Lauridsen (1977) reported only minimal gain when feedback was used alone. Two studies that investigated a lottery component as a consequence in conjunction with feedback (Lauridsen, 1977; Runnion et al., 1978) reported only small gains in transportation energy conserved.

In general, the use of a priority lane or preferential parking were the most effective in increasing carpooling and bus riding (Rose & Hinds, 1976; Hirst, 1976). Also, small reductions (up to 22%) in vehicle mileage were reported as a result of monetary reward and/or feedback (Hake & Foxx, 1978). However, feedback alone or in conjunction with lottery systems seemed to produce, at best, small effects.

Transportation Safety. A more recent area of application has been concerned with target behaviors such as reducing vehicular speeding and promoting seat belt wearing. Van Houton, Nau, and Marini (1980) found public posted feedback to be effective in reducing speeding on an urban highway. Moreover, feedback was found to be more effective than increasing the amount of traditional police surveillance in reducing highway speeding (Van Houton & Nau, 1981).

A recent study by Geller, Peterson, and Talbott (1982) found "incentive flyers" given to drivers contingent on seat belt wearing was clearly more effective than when flyers were given out non-contingently. Although the flyers prompted seat belt wearing, they functioned more as conditioned reinforcers in that the accumulation of a specific number of flyers with the same symbol could be exchanged for a prize.

Summary of Research on Environmental Preservation. Intervention strategies for dealing with environmental problems or ecological behaviors have primarily involved the manipulation of antecedents or consequences. Antecedent strategies alone generally resulted in either small changes or no change at all. Interventions involving consequences alone or in conjunction with antecedents generally produced a much larger effect on the target behavior.

A certain type of consequence appeared to be a predominant strategy within a specific area. For example, almost all litter control studies reviewed employed monetary reward as a consequence. Only two studies employed a lottery condition and one investigated the use of feedback. A number of energy

conservation studies (both residential and transportation) employed feedback either alone or in combination with monetary reward. On the other hand, waste reduction and resource recovery studies presented a mixture of consequence strategies including monetary reward, lottery, and feedback. To some extent, the feasibility of certain consequences might have been precluded by natural constraints in the setting.

A current limitation of behavioral applications at the community level is that while researchers have demonstrated the overall effects of certain treatments in particular settings, it has been difficult and often impossible to demonstrate behavior change for individuals. This is especially true for studies conducted in public settings in which the subjects may be constantly changing (e.g., street and highway litter control studies). While it can be argued that the subject population is relatively stable in some settings (e.g., college dormitory and residential or apartment complexes), only one study (Geller et al., 1982) attempted to monitor the number of treatment exposures applied to specific individuals (actually, the car's license plate was monitored) and behavior change (seat belt wearing) of those individuals.

Behavior Modification in Sports

Despite some early attempts in extending behavior analysis to sport environments (Rushall & Pettinger, 1969; Rushall & Sidentop, 1972), it was only recently that behavioral applications in sport began to gain momentum. This trend is reflected by the proliferation of research reports and books during the past few years. In a review on behavior modification

in sport and physical education (Donahue, Gillis, & King, 1980), the authors cited a number of published and unpublished studies which dealt with athletic behaviors in areas such as swimming (Bell, 1977), baseball (Heward, 1978), jogging (Kau & Fischer, 1974), football (Komaki & Barnett, 1977), and basketball (Mertler, 1975). While the studies represented an impressive start, the authors concluded that research had focused on very few sports, that evaluation methodologies were limited, and that the effectiveness of many operant procedures remained unexamined in the sport environment.

In a three-year span since Donahue et al.'s review, considerable growth has already been documented (Martin & Hrycaiko, 1983). Hrycaiko and Martin (1983) pointed to recent advances in sport skill development, motivation for practice and endurance training, cognitive behavioral approaches to enhance competitive performance, decreasing problem behaviors of athletes, and behavioral assessment of coaches and athletes. The authors concluded that the future of the behavioral approach to sport is both promising and exciting.

Statement of the Problem

Despite the growth of behavioral applications in sport, most studies have been concerned with coaching behaviors and sports skill development of individuals or small groups of athletes. Little research has been conducted in community sport settings. Also, sports etiquette as a target behavior has been neglected. In certain individual sports (e.g., gymnastics), etiquette may not be as important as the skills required and it may not be a problem for coaches to instruct. While they are not always

effective due to competing variables, many natural and contrived contingencies such as rules and regulations exist to curb unsportsperson-like behaviors. Also, consequences (both reinforcing and aversive) supplied by referrees, opponents, and fellow athletes serve as another source of control. Where such consequences are powerful, immediate, and contingent upon behavior, sports etiquette is generally observed.

In public sport environments an agent to enforce such contingencies is often not available. Moreover, the natural consequences for not observing certain etiquette may be non-existent or too delayed to exert any control over the athletes. Failure to observe sports etiquette not only causes fellow athletes undue unpleasantness, it may also have detrimental effects on the sport environment in some settings. One example is failure to observe golf etiquette on a public golf course. While golf etiquette involves a number of behaviors (Watson & Hannigan, 1980), failure to repair ballmarks on greens and to replace divots on fairways are likely the most problematic to the environment.

Since the breaching of most etiquette behaviors (e.g., making unnecessary noise while another golfer is addressing the ball or making a stroke) have direct and immediate effects on other golfers, one is more likely to observe those etiquette behaviors to avoid possible aversive consequences that might be provided by the individual affected. On the other hand, repairing one's ballmarks on greens or replacing divots on fairways does not lead to immediate consequences. The maintenance of the natural environment as a consequence appears

to be too delayed to exert much control.

Purpose of the Study

The purpose of this study was to examine the use of two antecedent procedures, educational sign prompting and a weekly lottery, to improve ballmark repairing behaviors of golfers on a public golf course. While sign prompting has typically been considered as an antecedent strategy, and a lottery system as a consequence strategy, it is argued that both be viewed as predominantly antecedent strategies. Even though consequences are involved in a lottery system, the behavior in question for any given individual is more likely under the control of the announcement or presence of the lottery system. Because only a small number of individuals subsequently come into contact with the consequence, the resulting behavior change under study is largely rule-governed (Baldwin & Baldwin, 1981; Skinner, 1969).

Method

Setting and Subjects

The study was conducted at Windsor Park, an 18-hole municipal public golf course in Winnipeg. The subjects of the study included all golfers who played at the golf course during the study. Based on daily records kept by the golf course, a total of 29,551 rounds of golf were recorded for the duration of the study, averaging 278.8 rounds per day. Approximately 11% of the rounds were played by "seniors" (65 years or older), 6% by "juniors" (16 years or younger), 76% by "regulars" (between 16 and 65 years old), and 7% of the rounds were played by golfers after 7 p.m.. The last group was classified as "twilight golfers" and age categories for this group were not available

since there were no differential rates for different age groups among these golfers.

Research Design

A reversal-replication design (Hersen & Barlow, 1976; Martin & Pear, 1983) was used to examine the effects of the educational sign prompting and weekly lottery to promote ballmark repairing. Following an initial baseline phase, the educational sign prompt was introduced for a period of time after which it was withdrawn (reversal to baseline) and then reinstated. Following another reversal to baseline observation, the weekly lottery was introduced, withdrawn, and then reinstated in a fashion similar to the educational sign prompting. The study ended with a reversal to baseline condition. The duration of the phases in order are as follows.

Initial baseline	18 days
Educational sign prompting	15 days
Baseline	14 days
Educational sign prompting	12 days
Baseline	10 days
Weekly lottery	14 days
Baseline	7 days
Weekly lottery	14 days
Baseline	2 days

Data Collection Procedures and Dependent Variable

Throughout the study, the number of unrepaired ballmarks were counted and then repaired on three specific greens each morning before golfers reached those greens. The three greens were numbers 10 (a 98 m par three), 12 (a 286 m par four), and 16

(a 129 m par three). Unrepaired ballmarks were categorized as either "large" (obvious) or "small" (less obvious). This distinction was made after six days of data collection. A large ballmark was defined as a circular indentation approximately 2.4 cm in diameter (the size of a quarter) and typically, although not necessarily, accompanied by either a breakage of turf or turf protruding above the surface of the green as a result of the ball's impact. A small ballmark was defined as a circular indentation less than 2.4 cm in diameter, with no breakage of turf, but at least approximately 0.5 cm deep. An unrepaired ballmark was counted only if the entire indentation was on the green. Ballmarks which were partially or entirely located on the apron were excluded.

To record the number of unrepaired ballmarks, the observer started from one edge of the green and laid a thin string across the length of the green to mark off a strip, approximately 2 m wide. The observer then counted silently and with a wrist counter the number of large and small unrepaired ballmarks while walking slowly through that strip. The next and subsequent strips were marked by adding a second string and then subsequently moving one of the strings 2 m in front of the other until the entire green was covered. Ballmarks were repaired as they were counted except when interobserver reliability was being assessed (described later). Thus the number of unrepaired ballmarks found each morning were always left from the previous day. Prior to the study observers repaired all unrepaired ballmarks on the three greens to ensure that the first day of data collection included ballmarks left only from the previous

day. The number of large and small unrepaired ballmarks were recorded on a data sheet at the end of each strip. In addition to the daily ballmark count, the weather conditions and number of rounds played during the previous day were obtained from the records kept by the golf course.

Data were collected daily for 106 consecutive days except for two mornings (days 3 and 80) due to poor weather conditions. In each case data collected on the following day (which would be cumulated for two days) were averaged for those two days.

In order to adjust for the daily fluctuation in the number of golfers, the major dependent variable was expressed as the number of unrepaired ballmarks per 100 golfers per day. This was calculated by dividing the number of unrepaired ballmarks by the number of golfers (rounds played) from the previous day and then multiplying the dividend by 100.

Interobserver Reliability

During interobserver reliability checks, the primary and a secondary observer independently counted the number of unrepaired ballmarks on each strip. The secondary observer counted them prior to the primary observer. The same individual served as the primary observer throughout the study. Different secondary observers were used. One secondary observer, who had many years of golfing experience, was given verbal instructions on data collection procedures and the definitions of large and small ballmarks prior to reliability observations. Three other secondary observers received individual training from the primary observer and attained at least an 80% agreement with the primary observer on a green prior to reliability assessments. The same

individual served as the primary observer throughout the study. Reliability checks were conducted on 30% of all observation days, with at least 25% during each phase. A reliability coefficient was calculated for each green by dividing the smaller number by the larger number recorded by the primary and second observers. The reliability scores for the total, large, and small ballmarks on each green are presented in Appendix I.

Of the 267 reliability scores shown in Appendix I, 234 (87.6%) were at or above 0.70, 29 (10.8%) were between 0.5 and 0.69, and 4 (1.5%) were at or below 0.4. Low interobserver reliability (0.5 or lower) was primarily due to the fact that there were very few ballmarks on the greens on those days and if an observer missed one out of a total of only two ballmarks, it would result in a very low agreement score (0.5 in this case). For example, there was one instance of zero agreement (see Appendix I) and on that occasion, one observer recorded one small ballmark and the other zero.

Overall, the mean coefficient per green for the total number of unrepaired ballmarks (large and small combined) was 0.93, ranging from 0.70 to 1.00. The mean coefficient per green for the number of large and small unrepaired ballmarks, respectively, were 0.86, ranging from 0.38 to 1.00, and 0.79, ranging from 0.00 to 1.00.

Baseline

During all baseline phases, data were collected under the normal conditions of the golf course. There were no signs posted in the club house or on the golf course to prompt golfers to repair ballmarks on greens.

Educational Sign Prompting

During this condition, a 0.9 m by 1.2 m sign was posted near the entrance inside the club house. The sign contained: (1) an explanation of what a ballmark is, accompanied by photographs showing some unrepaired ballmarks; (2) a description of three simple steps of how to repair a ballmark, accompanied by photographs depicting the steps; and (3) a request for golfers to help repair ballmarks on greens (see Figure 1).

Insert Figure 1 about here

Weekly Lottery

During this condition, a golfer had a chance to receive a raffle ticket if he or she was spotted (by staff who worked on the golf course) repairing a ballmark and win a free round of golf at that golf course from a weekly draw. The lottery system was described on a 0.9 m by 1.2 m sign posted at the same location as the educational sign prompt, which was absent during this phase. Prior to the introduction of the lottery system, the staff who worked on the golf course were given a written definition of ballmark repairing behavior and some guidelines designed to "space out" ticket-giving such that it was unpredictable to the golfers (see Appendix II for written instructions given to staff). It was also predetermined that no more than 20 tickets would be given out each day. Golfers who received lottery tickets could deposit them in a small box located beside the sign inside the club house and the weekly draw was made by a staff member who worked in the club house. The

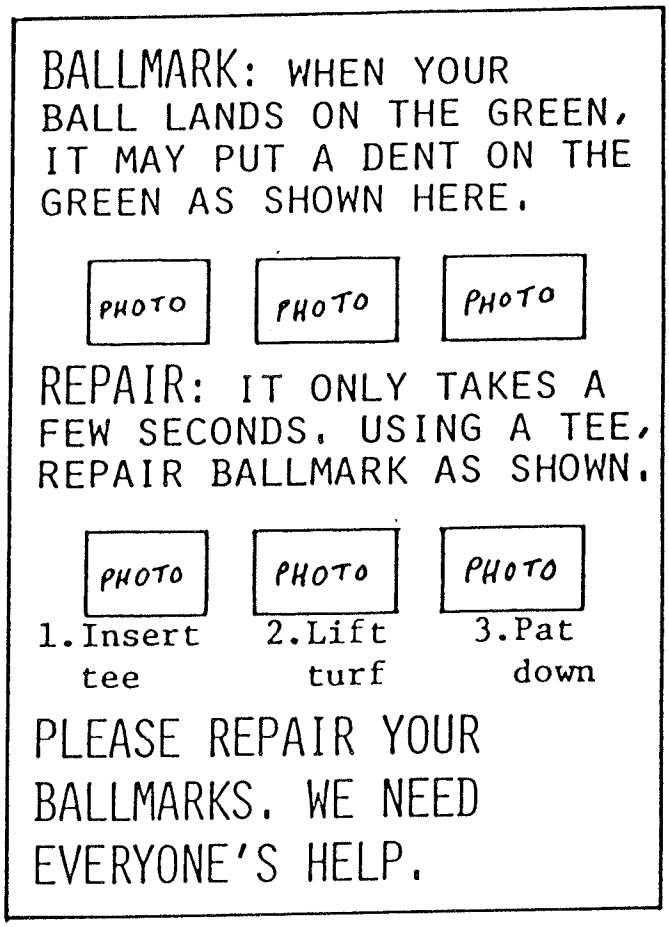

Figure 1. Sign posted during the educational sign prompting condition.

lottery sign is shown in Figure 2.

Insert Figure 2 about here

Social Validation

At the end of the study, questionnaires were given to golfers to evaluate the acceptability of and their preference for the procedures and their subjective reports on whether their behaviors were affected differently under the two experimental conditions. A total of 78 golfers participated during this phase with 21, 28, and 29 golfers sampled on a Saturday, Sunday, and a Tuesday morning, respectively. In addition a brief, one-page description of the study and the results obtained was prepared and was given along with a questionnaire to nine staff at the golf course to evaluate the convenience of applying the procedures and their preference concerning the procedures. Sample copies of the questionnaires are attached in Appendix III. It should be noted that golfers did not receive the one-page description of the study and results with their questionnaires.

Results

Figure 3 shows the number of golfers (rounds played) per day throughout the study. The mean number of golfers (rounds played)

Insert Figure 3 about here

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per day during each phase were 317 (initial baseline), 299 (first educational sign prompting), 301 (second baseline), 284 (second educational sign prompting), 304 (third baseline), 308

Figure 2. Sign posted during the weekly lottery condition.

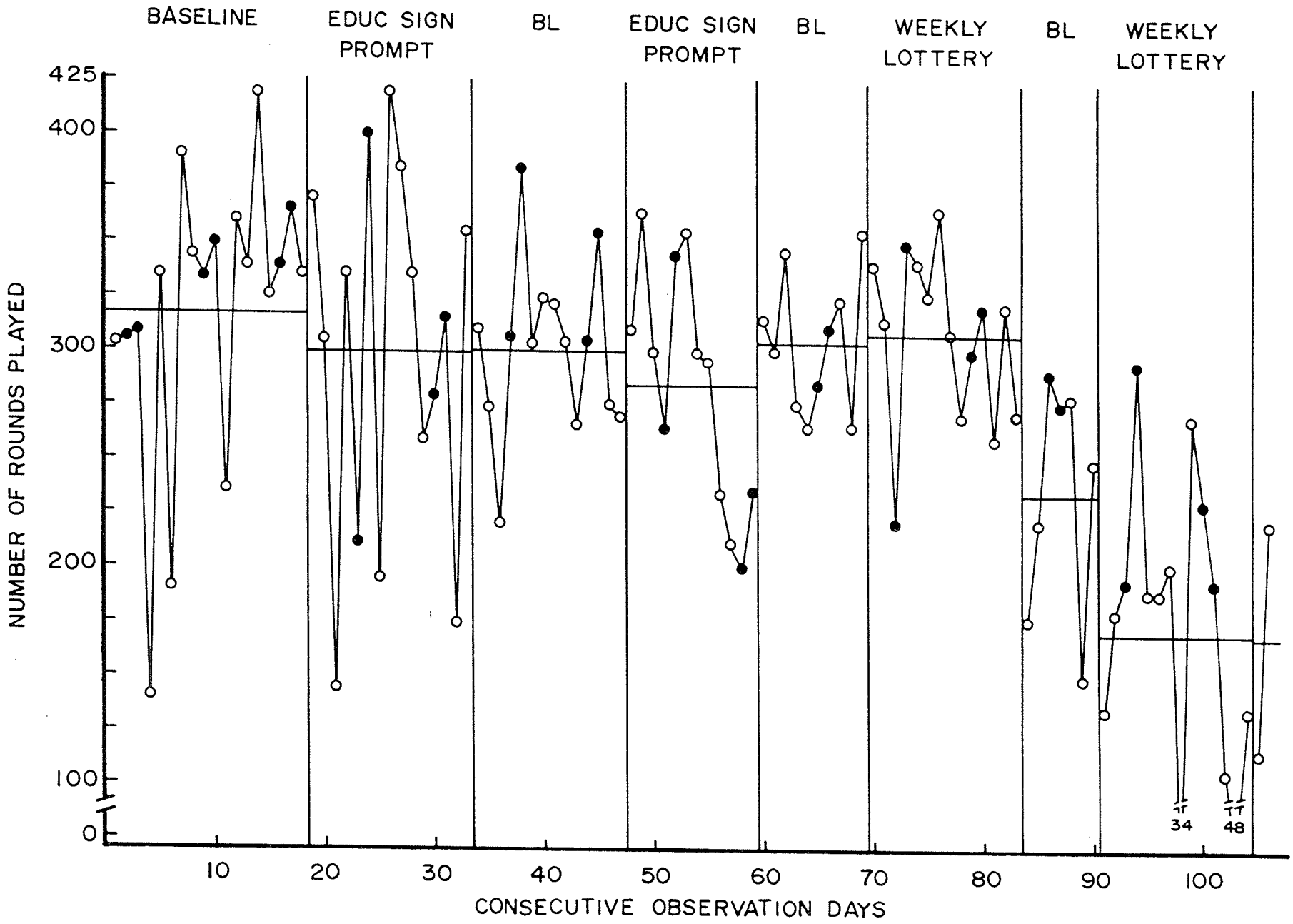

Figure 3. The number of golfers (rounds played) per day. Filled data points represent **Saturdays** and Sundays.

(first weekly lottery), 234 (fourth baseline), 171 (second weekly lottery), and 169 (final baseline). The mean number of golfers (rounds played) per day during the study was 278.8, ranging from 34 to 419, with only two days (days 98 and 103) having fewer than 100 rounds played.

Figure 4 shows the total number of unrepaired ballmarks (large and small combined) on the three greens per 100 golfers per day. It should be emphasized that the Figure shows the rate

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Insert Figure 4 about here

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of unrepaired ballmarks for every 100 golfers. Thus the actual number of unrepaired ballmarks recorded per day was always higher except for the two days which had fewer than 100 rounds played. While the educational sign prompting conditions resulted in small mean reductions from their respective preceding baseline phases, the daily number of unrepaired ballmarks were quite variable. When the first weekly lottery condition was introduced, however, it resulted in a substantial and immediate decrease from the preceding baseline condition, with similar results being obtained during the second lottery condition. The last reversal to baseline condition resulted in an increase comparable to previous baseline levels. The mean percentage in reduction of unrepaired ballmarks for each experimental condition from its preceding baseline phase were: 6.8% and 15.6% for the first and second educational sign prompting conditions, respectively; and 34.1% and 23.7% for the first and second weekly lottery conditions, respectively.

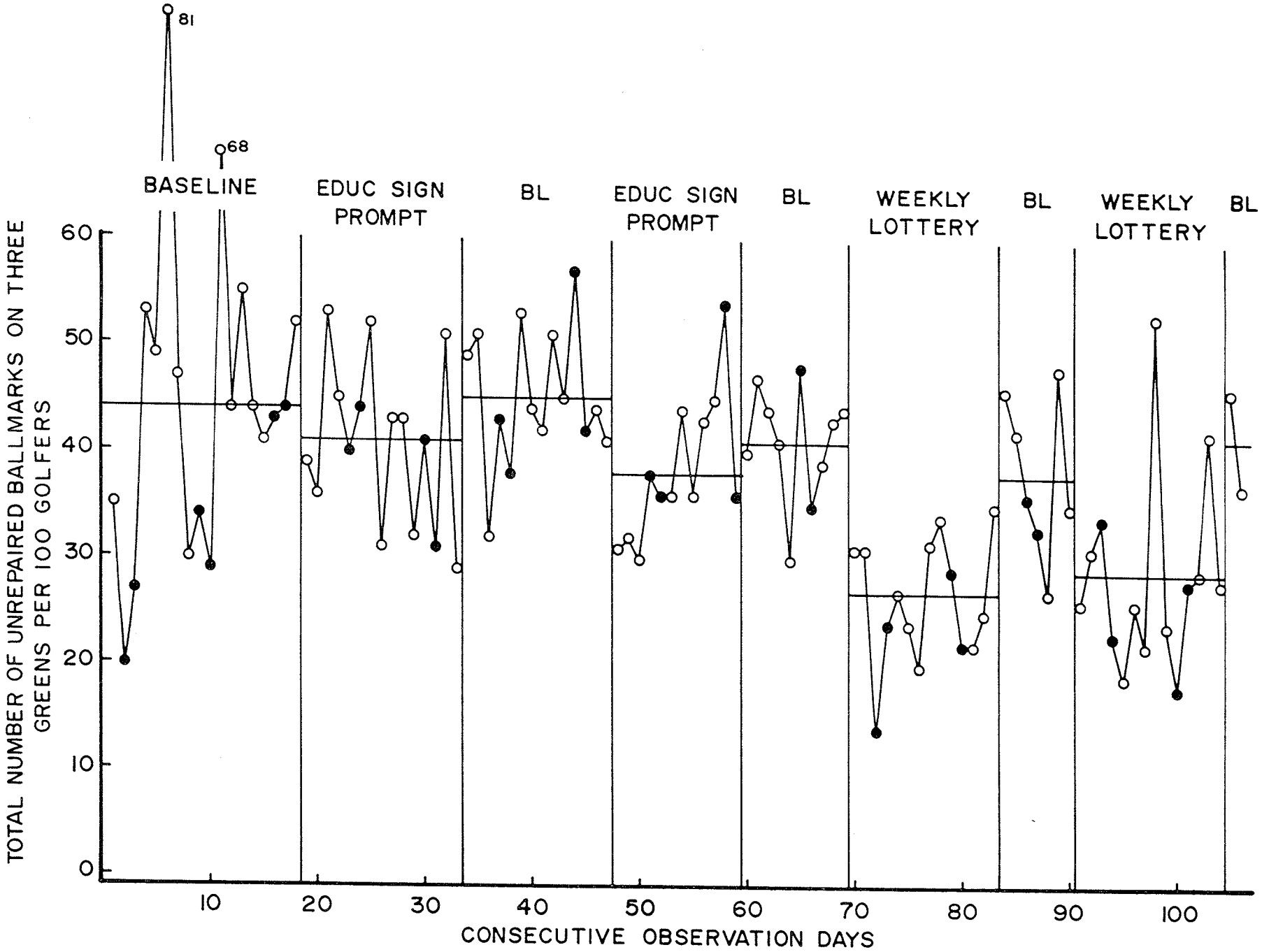

Figure 4. Total number of unrepaired ballmarks on three greens per 100 golfers per day. Filled data points represent Saturdays and Sundays.

Figure 5 shows the number of large unrepaired ballmarks on the three greens per 100 golfers per day. The introduction of

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Insert Figure 5 about here

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the first educational sign prompting resulted in a fairly immediate and substantial decrease (36% mean reduction for that phase) from the preceding initial baseline. However, the initial baseline level was not recovered during the second baseline. Although the overall level during the second baseline phase was somewhat higher compared to the terminal level of the first educational sign prompting, the phase means for the two conditions were identical. The reinstatement of the educational sign prompting resulted in a mean reduction of 38.1% from the second baseline phase and a subsequent reversal to baseline (third baseline phase) resulted in an increase comparable to the second baseline condition. The first and second weekly lottery conditions resulted in mean reductions of 40% and 21% from the preceding baseline phases, respectively. The final reversal to baseline showed an immediate increase in unrepaired ballmarks.

Figure 6 shows the number of small unrepaired ballmarks on the three greens per 100 golfers per day. The educational sign

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Insert Figure 6 about here

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prompting conditions appeared to have no effect on decreasing the number of small unrepaired ballmarks. The results showed an increasing trend, regardless of conditions, and maintained at a

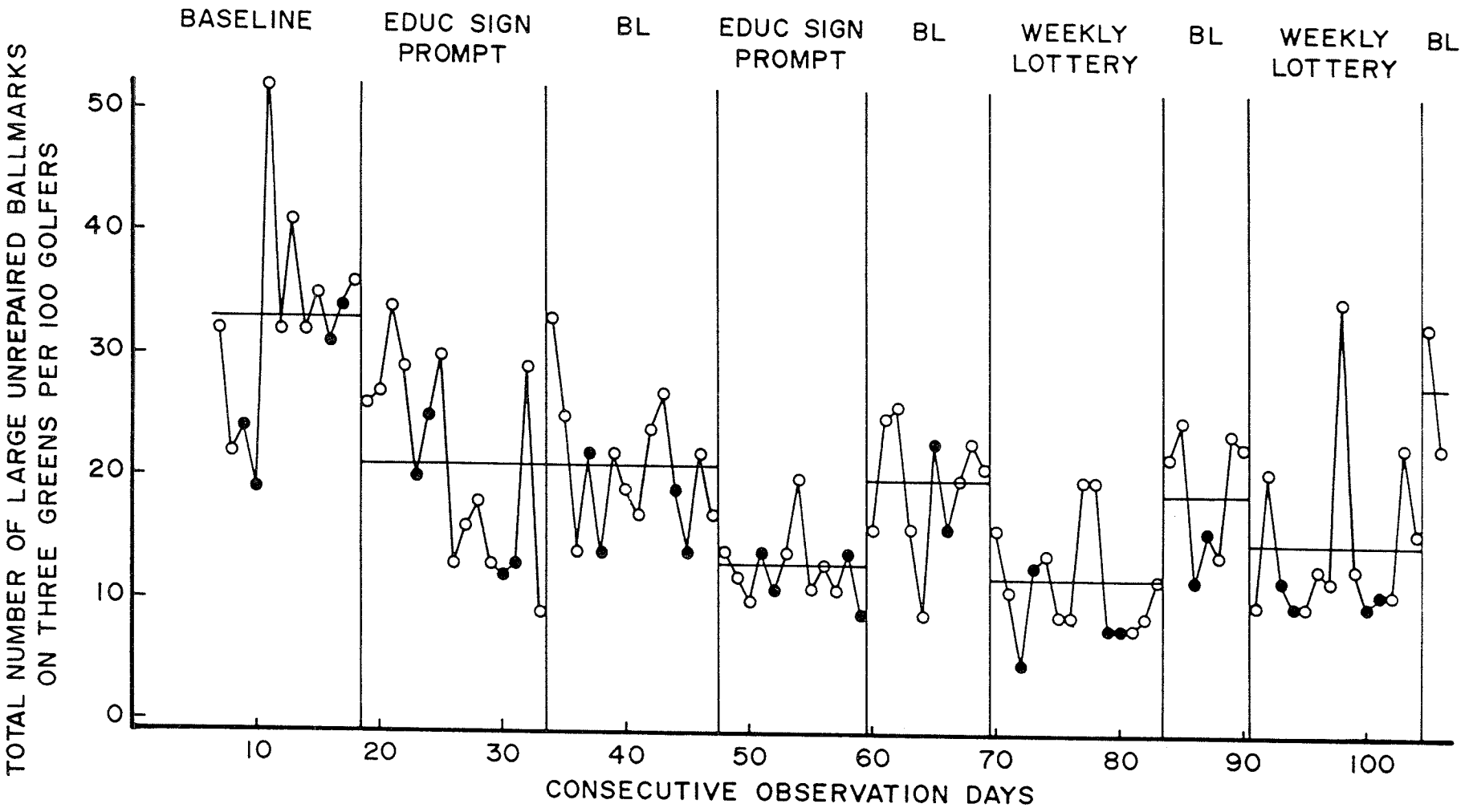

Figure 5. Total number of large unrepaired ballmarks on three greens per 100 golfers per day. Filled data points represent Saturdays and Sundays.

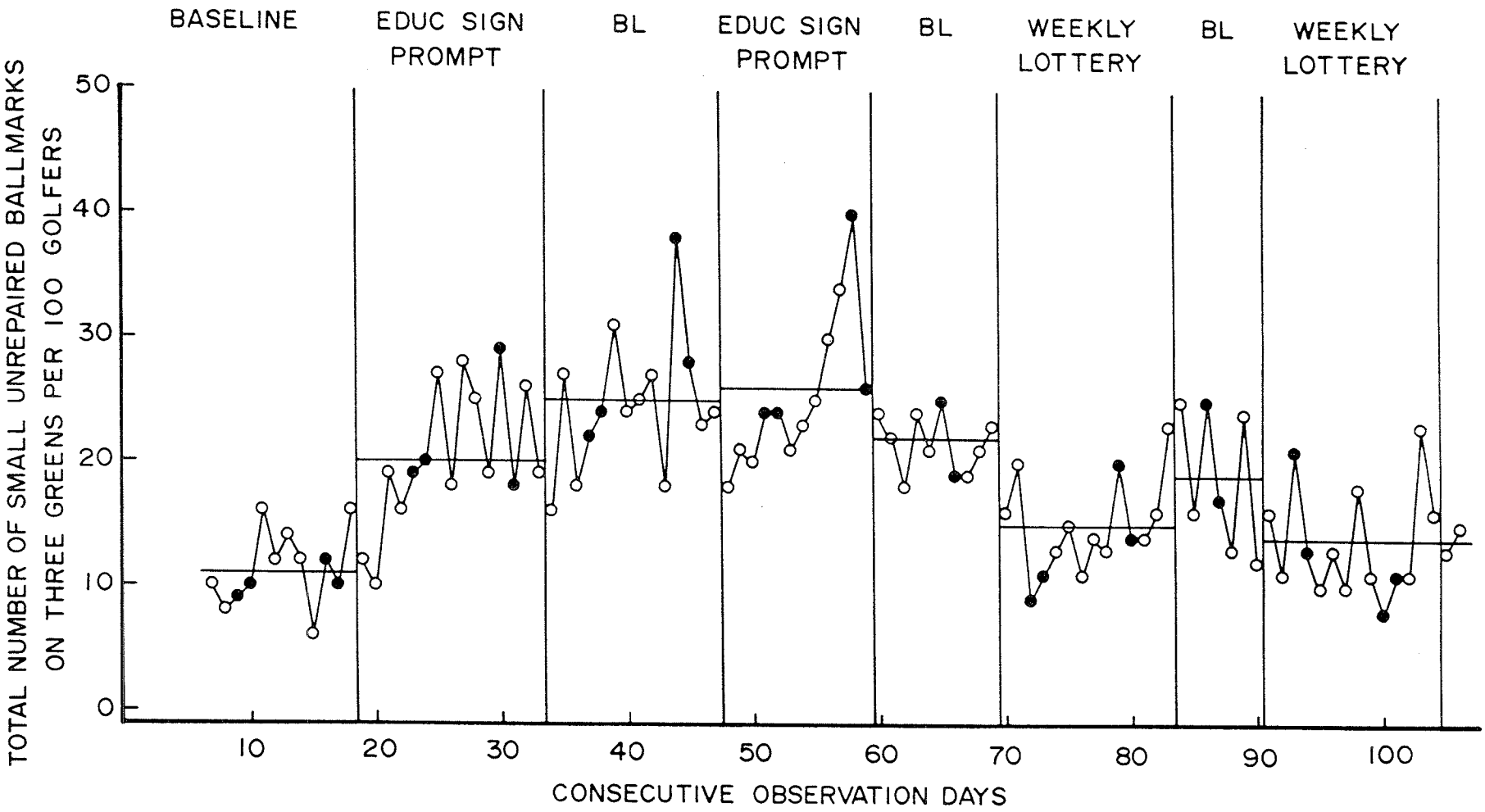

Figure 6. Total number of small unrepaired ballmarks on three greens per 100 golfers per day. Filled data points represent Saturdays and Sundays.

level of more than 20 unrepaired ballmarks per 100 golfers per day until the first weekly lottery condition. The introduction of the first weekly lottery condition resulted in a mean reduction of 31.8% from the preceding (third) baseline phase. Following a reversal to baseline level, the second weekly lottery resulted in a mean reduction of 26.3% from the fourth baseline. No reversal was observed, however, during the last baseline condition. The raw data for the number of golfers per day, the number of total, large, and small ballmarks per day, and the number of total, large, and small ballmarks per 100 golfers per day are presented in Appendix IV.

Of the 78 golfers who received the questionnaire, the results showed that 28% of the golfers played, on the average, two or more rounds per week, 53% played one round per week, and 19% played less than one round per week.

When questioned whether they remembered reading the sign posted in each condition, 59% remembered reading both signs, 4% remembered reading the weekly lottery sign, 24% remembered reading the educational prompt sign, and 13% remembered neither signs. In terms of preference for the two procedures, 49% preferred to have both strategies present (i.e., the weekly lottery as well as the educational sign prompt posted), 15% preferred the weekly lottery only, 31% preferred the educational sign prompting only, and 3% preferred neither procedure. Two golfers (3%) indicated that they could not respond to the question because they did not play very often. Finally, 18% of the golfers indicated that they "reminded" themselves or others to repair ballmarks more often during the educational sign prompt

than in the weekly lottery condition while a similar percentage of golfers indicated the reverse. On the other hand, 58% indicated that they reminded themselves or others to repair ballmarks on greens as often during both conditions and 6% of the golfers, by not responding to that question, indicated that they did not remind themselves or others to repair ballmarks more often during either experimental condition than during baseline condition.

The results of the questionnaires distributed to golf course staff are summarized in Table 1. A total of nine questionnaires

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Insert Table 1 about here

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were distributed with four being given to staff who worked in the club house and five to staff who worked on the golf course. None of the club house staff reported the posting of the signs in the club house to be a hindrance or cause any inconvenience to their duties or operations of the club house. Of the four club house staff, two reported that it was worthwhile for the golf course to use the educational sign prompt, one preferred the weekly lottery, and one preferred to have both present. For the five staff who worked on the golf course, three indicated that spotting golfers repairing ballmarks and giving out tickets were not at all disruptive to their regular duties while one individual indicated that it was quite disruptive. One staff member could not respond to the question since he did not participate in the giving out of tickets. Despite the one staff member who reported that the lottery procedure was disruptive,

Table 1

Summary of Results from Questionnaires to Staff (N=9)

	Number of Staff	
	Club House	Golf Course
Procedures being disruptive:		
Very much	0	0
Quite a bit	0	1
Somewhat	0	0
Slightly	0	0
Not at all	4	3
(Did not respond)	0	1*
Preference:		
Sign prompting only	2	0
Weekly lottery only	1	2
Both procedures	1	3
Neither procedure	0	0

* One staff could not respond because he did not participate in giving out lottery tickets.

all staff said that it was worthwhile for the golf course to use the weekly lottery or both procedures.

Discussion

While the educational sign prompting was as effective as the weekly lottery condition in reducing the number of large unrepaired ballmarks, it had little effect in influencing golfers to repair small ballmarks. On the other hand, the weekly lottery condition resulted in substantial decreases in both large and small ballmarks. In addition, most golfers preferred either or both procedures over baseline condition. While one staff who worked on the golf course found the lottery procedures disruptive to use, all felt that either or both procedures were worthwhile for the golf course to adopt.

Some observations from the staff questionnaire are noteworthy. While virtually no effort was required from the staff to implement and maintain the educational sign prompting procedure, the weekly lottery required some effort from the club house staff (making a draw once a week) and considerable effort from the golf course staff (observation and giving out tickets). If the staff's preference for the procedures was purely under the control of the results, all staff should have preferred the weekly lottery or at least both procedures. But considering the effort involved for staff who worked on the golf course to implement the lottery procedure, one might suspect that they would more likely prefer the sign prompting procedure. This, however, was not the case. Casual comments from the staff who worked in the club house revealed that even though the lottery procedure was more effective, golfers <u>should</u> be repairing

ballmarks and they should not have to be receiving something for doing what they should be doing. Similar comments were also encountered from some golfers who responded to the questionnaire and indicated that they preferred sign prompting over weekly lottery. Since the golfers had no knowledge of the results at the time, it is not clear whether their attitude would change given the results of the study. While those who revealed such comments were few, it points to the possibility that simple reinforcement procedures for certain behaviors may produce "psychological reactance" (Brehm, 1966, 1972) or "behavioral reactance" in which "individuals who feel controlled by external events (such as a demanding prompt) are expected to resist compliance when possible or emit contrary behaviors in order to assert their personal freedom" (Geller et al., 1982, p. 30). On the other hand, while the staff who worked on the golf course had to put out more effort for the weekly lottery procedure, they were also responsible for maintaining the condition of the greens. The larger improvements produced by the lottery procedure may have been sufficient to offset the required effort.

The above also suggest that the treatment procedures used in this study were cost-effective in that the staff considered the outcome to be significant enough to warrant the cost of the treatment. The implementation of the educational sign prompting procedure amounted to the cost of making the sign. On the other hand, the weekly lottery required staff input (giving out lottery tickets and making a weekly draw) in addition to the cost of the sign. The prize (a free round of golf) in this case did not amount to any actual cost to the golf course. A cost-benefit

analysis, in which the monetary cost for treatment is compared to the monetary savings as a result of the treatment, was not possible for this study because the monetary cost for maintaining the greens could not be isolated from the operating budget of the golf course.

A common limitation of community application is the lack of individual data. The nature of the setting and target behavior and other practical considerations often pose severe restrictions on direct observations of individual behaviors. The results of such studies often show changes for groups of individuals, the composition of which is often uncontrolled. On the basis of the questionnaires distributed to golfers, there is a strong indication that a large percentage of the golfers were "regulars" in that they played at least one or two rounds each week. This is confirmed by the fact that the golf course had weekly bookings by two "weekend" groups (Saturdays and Sundays), a "seniors" group (two days per week), and a "ladies" group (one day per week). According to the Staff at the club house, each group consisted of approximately 50 individuals, the composition of which was relatively stable. In addition, two club house staff indicated that, based on their past experience, approximately 75% of the golfers played at least one round each week. Although the above suggest that a large percentage of the golfers contacted the treatment procedures regularly, individual data are still lacking. Attempts were made initially in this study to conduct direct observation of specific individuals who had regular reserved bookings on Saturday and Sunday mornings. This was, however, discontinued due to a number of problems. First,

opportunities for the individuals observed to engage in ballmark repairing (i.e., the ball hitting the green on the fly) occurred at a very low rate. Second, the reliability of observing the same individual from one week to the next was, although not impossible, difficult to establish. Third, in order to compensate for the above problems, the direct observation period was extended to an inordinate amount of time (hoping to increase the number of observations and to establish reliability on specific individuals). Finally, even though the observer(s) was located approximately 35 m from the green being observed, there were indications that golfers were becoming sensitive to being "watched".

Another criticism that might be leveled against this study is that the number and size of ballmarks may be affected by weather conditions. "Wet" greens would yield more and larger ballmarks than "dry" ones. Thus, fluctuation in the number of ballmarks may be a result of the green's condition apart from the treatment procedures. While this factor can not be completely eliminated, the daily temperature (recorded by the club house at 2:30 p.m.) and the daily weather condition obtained from the club house records showed a fairly consistent pattern throughout the study. In general the weather was hot and dry with temperatures fluctuating between 20 and 30 degrees Celsius except during the last two phases. In addition, rain was recorded at the golf course on only seven days throughout the study (see Appendix V for information on temperature and precipitation during the study). Considering the stability of temperature and weather conditions, the effect of this factor was presumably minimal.

Another extraneous variable in this study is that the number of unrepaired ballmarks may fluctuate simply as a result of variability in the performance of the golfers. This is an important factor and also one that could not be controlled. Variability in golfers' performance probably accounted for much of the variability in the results in this study. However, in most cases and especially during the weekly lottery conditions, the effects observed were large enough to suggest that the treatments did contribute to the decrease.

In interpreting the results of this study, a few factors are worth noting. Even though the weekly lottery procedure was more effective than the educational sign prompting in general, the possibility of sequential treatment effects should not be overlooked. While the lottery conditions were able to decrease the number of unrepaired ballmarks from their respective preceding baseline phases, the fact that the initial baseline level for large ballmarks was not recovered during the second baseline phase (see Figure 5) suggested that some carry-over effects may have been operating. Also, in considering the effects of either procedure, it would be an oversimplification to conclude that either treatment procedure was solely responsible for the final outcome observed. A number of situational variables may have added to the impact of the manipulated antecedents. For example, it is possible that the treatment procedure only affected some golfers to increase their ballmark repairing. In turn, these golfers may have influenced other members in the group by either verbally reminding them or by simply functioning as a model. Another possibility is that

stimulus generalization may have occurred in that a golfer not only repaired his or her own ballmark, but additional ones near by.

Altruistic or helping behavior has been defined as "behavior that benefits another person rather than oneself" (Wrightsman, 1977, p. 278). While helping behavior can be exhibited in different forms such as performing a favor for a stranger or making a donation, it is often considered under the rubric of prosocial behavior--behavior that has positive social consequences (Wispe, 1972, 1977). From an operant orientation, such behavior may be viewed as under the control of a number of variables. First, it is rule-governed (Skinner, 1969) in that one behaves in a certain way as a result of a verbal instruction supplied either by oneself or others. Social norms and values on helping behavior are examples of such rules sanctioned by our culture. A problem, however, with helping behavior under the control of rules is that the behavior is typically weak due to a lack of immediate consequences and that the long term consequence of benefiting the culture exerts weak control. In addition, numerous situational variables may compete with helping behavior. Such variables might include the inconvenience of helping, the amount of effort required, and possibly competing verbal statements (belief) that it is not one's responsibility. The educational sign prompt in this study might be viewed as an attempt to strengthen the control of the rule by specifying the behavior and the conditions under which it should occur as well as the long term consequence of such helping behavior. While the results suggest that such a strategy was as effective as the

weekly lottery in decreasing the number of large ballmarks, it had no effect on the number of small ballmarks. It is argued that the weekly lottery should be viewed also as an antecedent strategy as opposed to a consequence strategy. This argument is based on the fact that only a small number of individuals actually contacted the back-up reinforcer (winning the prize). Thus the announcement or presence of the lottery system functioned as an antecedent to perhaps strengthen a golfer's verbal behavior concerning the reinforcer and in turn behaviors that increase the probability of being reinforced (i.e., repairing ballmarks). This is similar to buying lottery tickets in everyday life in that the ticket-buying behavior is primarily under antecedent control (e.g., self-generated verbal statements concerning potential reinforcers). Many people behave, few are reinforced.

In conclusion, the results of this study showed that the educational sign prompt was as effective as the weekly lottery system in decreasing the number of large unrepaired ballmarks, but not the total; that staff considered both strategies convenient and worthwhile to use; and either one or both strategies were generally preferred by golfers over baseline condition. A number of questions and concerns have been raised which future research may address. First, replication of this study is necessary to tease out any potential sequential treatment effects. Second, better assessment methodologies need to be developed for obtaining individual data in community settings such as the one exemplified in this study. Third, future research is needed to examine the component effects of the

nature of consequence implied in a weekly lottery and the immediacy of the consequence implied. Finally, more long term studies are needed to examine the durability of the effects observed in this research.

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Appendix I

Interobserver Reliability Scores

for Total, Large, and Small Ballmarks on each Green

Interobserver Reliability Scores
for Total, Large, and Small Ballmarks on each Green

	10th Green			12th Green			16th Green		
Day	Total	Large	Small	Total	Large	Small	Total	Large	Small
5	.93			.89			.93		
6	.98			.96			.91		
7	.88	.94	.63	.92	.98	.74	.99	.98	1.00
8	.84	.83	1.00	.97	1.00	.93	.86	.83	1.00
13	.94	.92	.65	.94	.98	.80	.97	.91	.65
20	.91	1.00	.73	.91	.95	.88	.97	.92	0.00
22	.79	.95	.45	.94	.72	.82	.96	.94	.68
26	-	-	-	-	-	-	1.00	.89	.94
29	.95	.56	.67	.95	.67	.83	.95	.72	.64
31	1.00	.74	.71	.94	.82	1.00	.87	.94	.67
34	.93	.98	.80	.98	.97	1.00	.98	.97	1.00
36	1.00	.87	.88	.93	.56	.90	.86	.57	.88
38	.94	.76	.88	.85	1.00	.80	.98	.91	.96
40	.98	1.00	.96	.93	.81	.82	.96	.92	.88
45	.93	.64	.80	.84	.88	.82	.98	.86	.93
53	.92	.78	.60	.93	.82	.97	.97	.77	.93
54	.98	.94	1.00	.94	.81	.73	.95	.74	.76
56	.91	.64	.91	.88	.79	.72	.72	.80	.68
62	.98	.90	.78	.95	1.00	.92	.88	.95	.78
64	.83	1.00	.73	.70	.75	.68	.76	.75	.76
69	-	-	-	.93	1.00	.88	.98	.93	.96
71	.94	.81	.75	.84	.88	.83	.91	.92	.81
73	.93	.92	.94	1.00	.93	.91	.87	.89	.83
77	.89	.95	.81	.92	.82	.89	.88	.93	.60
78	.87	.67	.14	.88	.83	.95	1.00	.96	.90
85	.86	.92	.75	.94	.85	.92	.83	.96	.50
90	.96	.85	.67	.98	.87	.69	1.00	.93	.88
96	.80	.38	.78	.91	.82	.86	.88	.80	.50
98	1.00	1.00	1.00	1.00	.86	.67	1.00	.80	.67
99	.94	.70	.56	.77	.93	.58	.96	.86	.73
103	1.00	.50	.50	1.00	1.00	1.00	1.00	.83	.50
106	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Appendix II

Written Instructions for Staff for Giving Out Lottery Tickets

GUIDELINES FOR GIVING OUT RAFFLE TICKETS FOR REPAIRING BALLMARKS

For the purpose of the project, please observe the following guidelines for giving out raffle tickets to golfers.

1. Simply give out the tickets when the opportunity arises. There is no minimum number that you have to give out on a particular day, but all staff together should give out no more than 20 tickets in one day.

2. Give one ticket to a golfer only after you observed that he or she has repaired a ballmark on a green (it doesn't matter which green). From an observer's (your) standpoint, ballmark repairing should at least include the golfer bending down, making prying motions towards the green, and patting down the areas either by foot or using the putter.

3. When giving out a ticket, simply thank the individual "for repairing a ballmark". Details of the weekly draw for the raffle are explained on the tickets and on the sign in the club house. Therefore, there is no need to give any explanation. If asked, simply ask them to read the ticket and the sign in the club house.

4. There are two restrictions on giving out tickets: (a) golfers who did not repair a ballmark or who began repairing ballmarks while you are giving a ticket to a member or members of that group do not get a ticket; and (b) please do not give out tickets to golfers from successive groups at the same green. That is, if a ticket has been given out to a golfer of a group on a particular green, the next group coming up on that same green do not receive any tickets whether they repair ballmarks or not. This serves to space out ticket giving as well as not to cue golfers off such that they only repair ballmarks when there's a staff around. Of course, you might observe them later at another green and give them tickets.

Your cooperation in this project is greatly appreciated.

Appendix III

Questionnaires Distributed to Golfers and Staff

A Questionnaire for Golfers at the Windsor Park Golf Course

As you may have noticed, we have tried out two methods during this season to promote golfers repairing ballmarks on greens. The purpose of this questionnaire is to gather some information as to how golfers feel about the methods. We would appreciate your help in taking a few minutes to complete this questionnaire. The information you provide will be valuable in helping to determine the best way for improving and maintaining the golf course's condition. Please check the appropriate response for each question below. Please return the questionnaire to me after it is completed. Thank you for your cooperation.

1. On the average, how often did you play at Windsor this season?

___more than twice a week
___twice a week
___once a week
___less than once a week

2. The first method used to promote ballmark repairing involved posting a sign in the club house explaining what a ballmark is, how it can be repaired, and asking golfers' help in repairing ballmarks on greens. Do you remember reading that sign?

___yes ___no

3. The second method involved a weekly lottery for a free round of golf. The lottery system was described on a sign inside the club house. Do you remember reading that sign?

___yes ___no

4. If one of the two methods were to be used in the future, which one would you like to see the golf course adopt?

___sign prompting (the first method)
___weekly lottery (the second method)
___have both sign prompting and weekly lottery present
___neither one should be used

5. How strong is your preference indicated in question 4 above?

___very strong ___quite strong ___mild ___very mild

6. When the sign prompt (the first method) was posted, did you remind yourself or others to repair ballmarks more often then when it was not posted?

___much more often ___more often ___about the same ___less often ___much less often

7. When the lottery system was posted, did you remind yourself or others to repair ballmarks more often than when it was not posted?

___much more often ___more often ___about the same ___less often ___much less often

8. If you reminded yourself and/or others while you're playing, did you do it more often when one method was used?

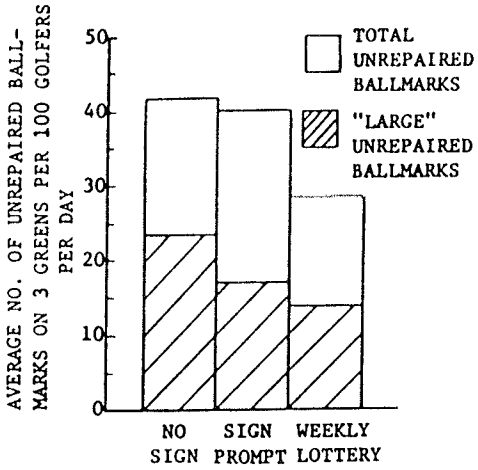
___more often in sign prompting (the first method)
___more often in weekly lottery (the second method)
___about the same

A Brief Description of the Results of the Ballmark Repairing Project and A Questionnaire for Staff at the Windsor Park Golf Course

As you know, we have been examining two methods during this season to promote golfers to repair ballmarks on greens. The first method (sign prompt) involved simply posting a large sign in the club house explaining what a ballmark is, how it can be repaired, and prompting golfers to repair ballmarks on greens. The second method involved posting a large sign in the club house anouncing a weekly lottery system in which golfers had a chance to receive a raffle ticket from staff if they were spotted repairing ballmarks on greens and winning a free round of golf from a weekly draw. This project has now been completed and the results are briefly described below.

Throughout the project, the total number of unrepaired ballmarks on three greens (number 10, 12, and 16) were counted and then repaired each day. Unrepaired ballmarks were divided into two types: "large" (obvious) ballmarks and "small" (less obvious) ones. Presumably, the large ballmarks are more damaging to greens if left unrepaired.

You might recall, the signs were not posted in the club house throughtout the entire project. Rather, it was displayed for short periods of time (one to two weeks) separated by periods of no sign. This allowed us to compare the number of unrepaired ballmarks found when the signs were posted versus when the signs were not posted. Because the number of golfers varied each day, the results are presented in terms of the number of unrepaired ballmarks per 100 golfers. The figure below shows the average number of unrepaired ballmarks per 100 golfers per day during each of the periods.



It should be emphasized that the number of ballmarks indicated in the figure has been combined for the three greens and has been adjusted for 100 golfers only. This means if there were 300 golfers a day, the actual number would be tripled for the three greens.

In summary, the results indicate that the sign prompt had a substantial influence on golfers in repairing large ballmarks, but with small or little impact on golfers in repairing smaller ballmarks. However, the weekly lottery showed a substantial effect in promoting golfers to repair both large and small ballmarks.

We would like to thank all the staff, especially those who helped giving out lottery tickets, for your cooperation throughout this project. Special thanks to Mr. Rick Thain, Ron Dicken, and George Harper for their permissions to carry out the project and for their continued cooperation during the project. A more detailed report for this project is being prepared and it will be made available upon completion.

As part of this project, we would like to request your cooperation in taking a few minutes to complete the attached questionnaire. The purpose of the questionnaire is to gather information on how you, as staff, feel about the procedures used and the results of the project from a practical standpoint. Please do not identify yourself. I will return to collect the completed questionnaire. Thank you again.

A Questionnaire for Staff

1. (For staff who work in the club house.) Did you find the posting of either one of the signs in the club house to be a hindrance or cause any inconvenience in your duties or operations of the club house?

___very much ___quite a bit ___somewhat ___slightly ___not at all

2. (For staff who work out on the golf course.) Did you find that spotting golfers for repairing ballmarks and giving out tickets to be disruptive to your regular tasks?

___very much ___quite a bit ___somewhat ___slightly ___not at all

3. Considering the results described earlier, and considering your own reactions to the methods used, do you feel that it is worthwhile for the golf course to use either or both of the procedures?

___sign prompting (the first method)
___weekly lottery (the second method)
___both should be used
___neither should be used

Appendix IV

Raw Data for the Number of Golfers Per Day, the Number of Total, Large, and Small Ballmarks Per Day, and the Number of Total, Large, and Small Ballmarks Per 100 Golfers Per Day

Day	No. of Golfers	No. of Ballmarks Total	Large	Small	Ballmarks/100 Golfers Total	Large	Small
1	303	110			36.3		
2	305	58			19.1		
3	308	82.5			26.8		
4	140	73.5			52.5		
5	334	163			48.8		
6	191	154			80.6		
7	390	185	145	40	47.4	37.2	10.2
8	343	103	75	28	30.0	21.9	8.1
9	333	112	81	31	33.6	24.3	9.3
10	349	100	66	34	28.7	18.9	9.8
11	236	160	123	37	67.8	52.1	15.7
12	361	160	117	43	44.3	32.4	11.9
13	338	186	140	46	55.0	41.4	13.6
14	418	182	133	49	43.5	31.8	11.7
15	326	135	114	21	41.4	35.0	6.4
16	338	145	105	40	42.9	31.1	11.8
17	366	162	126	36	44.3	34.4	9.8
18	335	175	122	53	52.2	36.4	15.8
19	370	143	97	46	38.6	26.2	12.4
20	306	111	82	29	36.3	26.8	9.5
21	144	76	49	27	52.8	34.0	18.8
22	337	152	99	53	45.1	29.4	15.7
23	212	84	43	41	39.6	20.3	19.3
24	400	177	99	78	44.3	24.8	19.5
25	194	111	58	53	57.2	29.9	27.3
26	419	130	56	74	31.0	13.4	17.6
27	384	166	60	106	43.2	15.6	27.6
28	336	144	60	84	42.9	17.9	25.0
29	258	83	34	49	32.2	13.2	19.0
30	279	114	32	82	40.9	11.5	29.4
31	316	98	42	56	31.0	13.3	17.7
32	174	97	51	46	55.7	29.3	26.4
33	355	101	33	68	28.5	9.3	19.2
34	310	150	101	49	48.4	32.6	15.8
35	273	140	67	73	51.3	24.5	26.7
36	220	71	31	40	32.3	14.1	18.2
37	307	133	66	67	43.3	21.5	21.8
38	384	145	54	91	37.8	14.1	23.7
39	303	161	67	94	53.1	22.1	31.0
40	324	142	63	79	43.8	19.4	24.4
41	322	134	55	79	41.6	17.1	24.5
42	304	155	72	83	51.0	23.7	10.3
43	267	119	72	47	44.6	27.0	17.6
44	306	174	58	116	56.9	19.0	37.9
45	354	149	50	99	42.1	14.1	27.9
46	276	122	60	62	44.2	21.7	22.5
47	269	109	45	64	40.5	16.7	23.8
48	310	96	42	54	31.0	13.5	17.4
49	363	117	42	75	32.2	11.6	20.7
50	300	89	29	60	29.7	9.7	20.0
51	263	101	37	64	38.4	14.1	24.3
52	343	122	39	83	35.6	11.4	24.2
53	355	127	51	76	35.8	14.4	21.4

Day	No. of Golfers	No. of Ballmarks			Ballmarks/100 Golfers		
		Total	Large	Small	Total	Large	Small
54	299	131	61	70	43.8	20.4	23.4
55	296	106	32	74	35.8	10.8	25.0
56	233	101	30	71	43.3	12.9	30.5
57	212	96	24	72	45.3	11.3	33.9
58	200	107	28	79	53.5	14.0	39.5
59	235	84	22	62	35.7	9.4	26.4
60	315	126	49	77	40.0	15.6	24.4
61	301	141	75	66	46.8	24.9	21.9
62	347	152	89	63	43.8	25.6	18.2
63	276	110	43	67	39.9	15.6	24.3
64	264	78	23	55	29.5	8.7	20.8
65	285	136	65	71	47.7	22.8	24.9
66	312	110	50	60	35.3	16.0	19.2
67	323	127	66	61	39.3	20.4	18.9
68	265	115	60	55	43.4	22.6	20.8
69	355	156	74	82	43.9	20.8	23.1
70	340	106	53	53	31.2	15.6	15.6
71	314	97	33	64	30.9	10.5	20.4
72	221	31	11	20	14.0	5.0	9.0
73	350	83	44	39	23.7	12.6	11.1
74	342	93	49	44	27.2	14.3	12.9
75	327	78	30	48	23.9	9.2	14.7
76	366	73	34	39	19.9	9.3	10.7
77	308	103	61	42	33.4	19.8	13.6
78	269	90	54	36	33.5	20.1	13.4
79	300	86	25	61	28.7	8.3	20.3
80	321	64	24.5	39.5	22.1	8.4	13.6
81	259	64	24.5	39.5	22.1	8.4	13.6
82	322	81	30	51	25.2	9.3	15.8
83	272	95	32	63	34.9	11.8	23.2
84	177	82	38	44	46.3	21.5	24.9
85	221	92	56	36	41.6	25.3	16.3
86	291	106	34	72	36.4	11.7	24.7
87	276	91	45	46	33.0	16.3	16.7
88	279	76	39	37	27.2	14.0	13.3
89	149	72	36	36	48.3	24.2	24.2
90	248	86	56	30	34.7	22.6	12.1
91	134	35	14	21	26.1	10.4	15.7
92	179	56	37	19	31.3	20.7	10.6
93	193	65	24	41	33.7	12.4	21.2
94	295	68	29	39	23.1	9.8	13.2
95	188	36	18	18	19.1	9.6	9.6
96	187	49	25	24	26.2	13.4	12.8
97	202	45	24	21	22.3	11.9	10.3
98	34	18	12	6	52.9	35.3	17.6
99	269	64	35	29	23.8	13.0	10.8
100	230	42	24	18	18.3	10.4	7.8
101	193	54	22	32	28.0	11.4	16.6
102	107	31	12	19	29.0	11.2	17.8
103	48	20	11	9	41.7	22.9	18.8
104	134	38	22	16	28.4	16.4	11.9
105	115	53	38	15	46.1	33.0	13.0
106	222	83	50	33	37.4	22.5	14.9

Appendix V

Information on Daily Temperature and Precipitation at the Golf Course Throughout the Study

Daily Temperature and Precipitation

at the Golf Course throughout the Study[1,2]

BASELINE 1		EDUC SIGN PROMPT 1		BL 2		EDUC SIGN PROMPT 2		BL 3		WEEKLY LOTTERY 1		BL 4		WEEKLY LOTTERY 2		BL 5	
Day	°C	Day	°C	Day	°C	Day	°C	Day	°C	Day	°C	Day	°C	Day	°C	Day	°C
1	31	19	21	34	29	48	32	60	25	70	35	84	33	91*	15	105	8
2	32	20	20	35	31	49	28	61	26	71	23	85	33	92	20	106	17
3	26	21*	14	36	31	50	28	62	26	72*	19	86	26	93	14		
4	16	22	19	37	24	51	26	63	29	73	27	87	25	94	17		
5	17	23*	17	38	25	52	23	64	32	74	25	88*	19	95	18		
6	15	24	20	39	25	53	29	65	31	75	25	89*	16	96	15		
7	14	25	15	40	29	54	23	66	30	76	29	90	24	97	17		
8	23	26	18	41	30	55	33	67	27	77	31			98*	14		
9	27	27	27	42	32	56	36	68	18	78	28			99	17		
10	24	28	31	43	29	57	33	69	30	79	31			100	17		
11	24	29	34	44	23	58	30			80	30			101	12		
12	29	30	27	45	27	59	29			81	30			102	10		
13	22	31	29	46	31					82	29			103	6		
14	27	32	20	47	30					83	33			104	8		
15	25	33	30														
16	28																
17	24																
18	20																
Phase Mean:	24		23		28		29		27		28		25		14		13

[1] Phase Means have been rounded off to whole numbers.
[2] An asterisk denotes rain for that day.