

*POSITIVE REINFORCEMENT OF LITTER REMOVAL  
IN THE NATURAL ENVIRONMENT<sup>1,2</sup>*

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Litter is an especially large and costly problem in unsupervised high-use recreational areas. This study investigated procedures to induce visitors to remove litter from an unsupervised U.S. Forest Service area in which signs attached to two litter stations instructed people to pick up and deposit litter. A small sum of money or chances on a larger sum given for participation usually resulted in more bags of litter being picked up per week. Although only a small proportion of the area's users participated in the project, ground surveys indicated the areas sampled were somewhat freer of litter during the payment condition. The results suggest that small monetary rewards may be a promising approach to litter control in unsupervised as well as supervised areas.

The problem of litter is large and costly. A recent national survey found that litter accumulates on the nation's primary and interstate highways at an average rate of one cubic yard per mile per month with an estimated cost of cleanup at \$28 million (Keep America Beautiful, Inc., 1968).

Until quite recently, few systematic attempts have been made to understand people's littering behavior, and most have relied upon local or national surveys (Keep America Beautiful, Inc., 1968, 1969; McCool and Merriam, 1970). A conclusion reached by one survey was that

“ . . . publicity efforts led by Keep America Beautiful, Inc., and the state highway departments continue to offer the most practical approach to the problem of reducing litter” (Keep America Beautiful, Inc., 1969, p. 2). Yet, no evidence was offered in this study to suggest that “publicity” was effective at all, let alone the best method of reducing the litter problem.

In several recent field experiments, Finnie (*unpublished*) manipulated a number of antecedent conditions and found that they reduced the amount of litter that accumulated during a given time. In one experiment, litter stations were established on one highway and compared to two other highways that did not have litter stations. Litter stations were rotated among the three highways every three months and each highway was cleaned before a change of conditions. Litter was counted in a sample area 30 ft wide by 1000 ft (9 by 300 m) long on both sides of the highway at distances of one and five miles from the litter station. The litter stations reduced roadside litter in the sample areas by 29%.

In a similar experiment, Finnie found that the presence of litter cans in a city area reduced litter by 7% when there was one can per four city blocks and by 17% when there was one can per block. He also found that attractively deco-

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rated cans with lids were more effective in reducing litter than plain 55-gallon cans without lids. In a fourth experiment, he observed patrons at hot-dog stands in a large city and recorded the number of persons who littered (threw a hot-dog wrapper on the ground) when the area around the stand was either clean or littered and when trash cans were available or not. Finnie found that more than three times as many customers littered when the environment was already littered and was without litter cans than when the environment was clean and cans were present.

Merely providing additional litter cans does not always ensure reduction of litter on the ground. Clark and Hendee (*unpublished*) compared one ranger district that had been selected for an extensive anti-litter campaign to a control district where no special emphasis was placed on keeping camps and roads clean. Hunters in the experimental area were provided with extra litter cans, given litter bags, and personally appealed to by forest service personnel as they entered the district to hunt. All these manipulations had no effect on the amount of litter that accumulated on the ground and roads. Both the experimental and control districts had about a 170% increase in ground litter over the hunting season.

These authors make an important distinction between picking up litter and using litter cans. They report that most of the hunters would deposit their own refuse in the litter cans but would not pick up the litter of others. Since some hunters littered, a gradual build up of ground litter occurred in both districts. Future studies will need to demonstrate a reduction in ground litter as well as an increment in the amount of litter collected from litter cans in order to demonstrate the effectiveness of any anti-litter program.

Burgess, Clark, and Hendee (1971) compared certain traditional remedies for the litter problem to a program that used positive reinforcement. Children in two theatres were placed in a variety of conditions designed to induce

them to pick up litter. At different times, children were provided with litterbags, given instructions, shown an anti-litter film, and provided with extra trash cans. The largest effect of any of these manipulations was produced by instructions accompanied by litterbags. This produced about a 38% increase in the amount of litter removed over the baseline condition. However, when the children were given litterbags and paid 10¢ or given a movie ticket for picking up litter, 95% of the litter was removed.

In a subsequent study conducted in a forest campground (Clark, Burgess, and Hendee, 1972), 26 children were asked to pick up litter by a forest ranger and told that they would be offered one of several prizes, such as Smokey Bear patches or gum, for participating. The children picked up 26 bags of litter weighing between 150 and 200 pounds in one day. This resulted in a 72% reduction in the normal amount of litter left in the campground. The usual cost of cleaning the campground was \$50 to \$60 and took 16 to 20 man-hours. The reinforcement program cost \$3 in prizes and required only 2 man-hours to put into effect.

So far, experiments using a positive reinforcement program to induce people to pick up litter have been relatively short-term. It is one thing to demonstrate that positive reinforcement contingencies are effective on a "one-time" basis and another to establish contingencies that will keep an area relatively free of litter over a summer or a year. Finnie has shown that altering some antecedent conditions can result in long-term gains, but the size of the reduction in litter was not large (29%). Burgess *et al.* (1971) and Clark *et al.* (1972) have shown that manipulating consequent conditions may result in a large reduction (95%) of litter, but their studies were conducted over a short span of time (several weekends) and were restricted to one target population, *i.e.*, children. Another characteristic of these latter two studies was that the design relied upon personal contact and authority figures (forest rangers) to initiate the programs. Considerable savings to public agencies could

be realized if anti-litter programs were established that did not require personal contact between the public and management personnel.

The purpose of the present experiment was to examine the effectiveness of a long-term program that rewarded participants with money for picking up litter. This study was conducted in part of an undeveloped canyon without the presence of management personnel and sought to involve anyone (adult or child) who frequented the canyon. The conditions that existed in the experimental areas closely resembled conditions where littering might be a serious problem, *i.e.*, a high-use area without supervision. Since it has been shown that individuals who do not come in contact with supervisory personnel litter more than those who do (McCool and Merriam, 1970), the results of this study might be more applicable to areas with low supervisory surveillance than the results of previous research.

## METHOD

### *Experimental Design*

An ABA design was used with two-week baseline periods alternating with three-week

experimental conditions for a period of 21 weeks. During experimental conditions, the participants received a letter thanking them for their participation and a payment of 25¢ or a chance to win \$20.00 in a weekly lottery for each bag of litter turned in. During baseline, no letters or payments were dispensed.

### *The Study Site*

Green Canyon is an undeveloped U.S. Forest Service area that lies in the foothills north of Logan, Utah. The canyon is used for recreational activities such as hiking, trail riding, camping, picknicking, and target shooting and was considered to have a litter problem both by the U.S. Forest Service and by residents of nearby areas.

The study site began at the Cache National Forest boundary and extended five-tenths of a mile up the canyon road (Figure 1). The locations with the greatest concentration of litter were target-shooting areas (Points 1, 2, and 3 in Figure 1). The fact that target shooting went on in the general area was a prime consideration in its choice as a project site; the target shooters contributed the bulk of the debris to the area as targets. These materials, an assortment of cans,

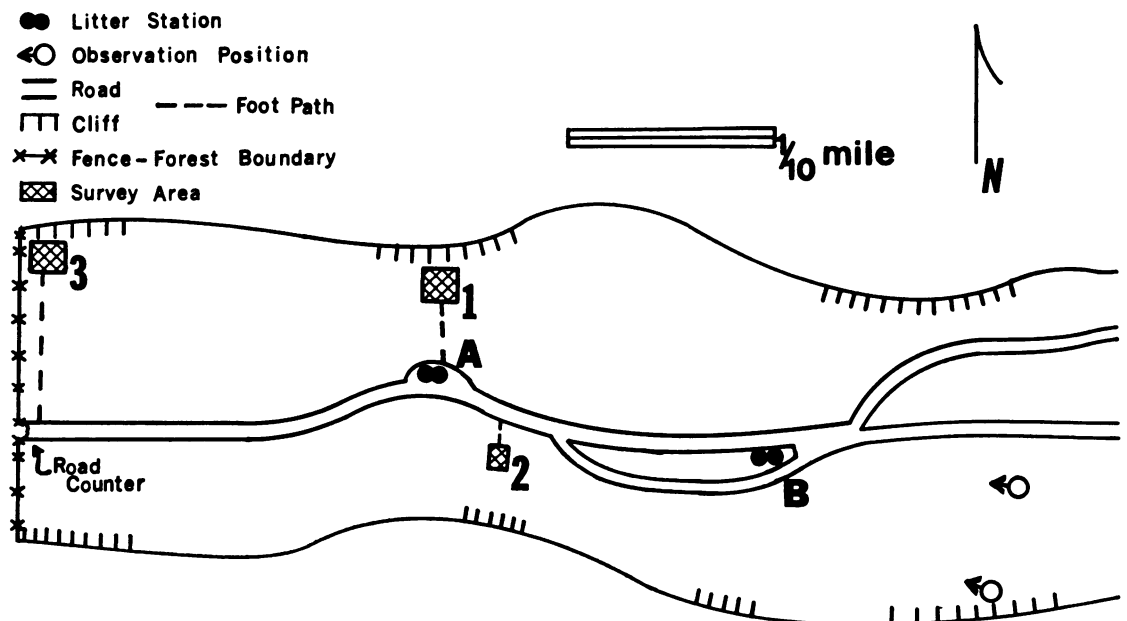


Fig. 1. A schematic drawing of the first half mile of Green Canyon, north of Logan, Utah. Points of interest to the study are identified in text.

bottles, cardboard boxes, *etc.*, were generally propped up, repeatedly shot at, and then left. One of the experimental stations was placed close to this main target shooting area, while the other was situated farther up the canyon on the opposite side of the road (Points A and B, Figure 1).

### Apparatus

*Litter stations.* Each station consisted of two 55-gallon oil cans chained to a 2-in. (5 cm) pipe cemented in the ground. Attached to the top of the pipe was a card container designed to provide a writing surface and to keep out rain and snow. Cards placed in the card slot could not be removed until the container was unlocked. A compartment attached to the bottom of the card container held five litter bags. A sign containing instructions on participation was attached to the drums. On this sign, precise instructions detailed a participant's responses and the payments possible. Figure 2 shows the (baseline) instructions that were common to each condition of the study. During experimental conditions, further information was placed below the words U.S.U. LITTER PROJECT, and above the first sentence of the instructions. This information detailed the payment possible, *viz.*:

PER BAG/EARN 25¢ or  
CHANCE TO WIN  
\$20.00/PER WEEK.

This statement was covered by a metal plate during baseline conditions.

*Litter bags.* Plastic bags, 19.5 by 14.5 by 38.5 in. (49.5 by 37 by 99 cm), were marked with an identification number and a horizontal line about 13 in. (33 cm) from the bottom.<sup>3</sup> Each bag was rolled to form a cylinder about 8 in. long and 1 in. in diameter (20 by 2.54 cm). A data card with a number identical to the one on the bag was wrapped around the cylinder and the roll was held by a wire tie.

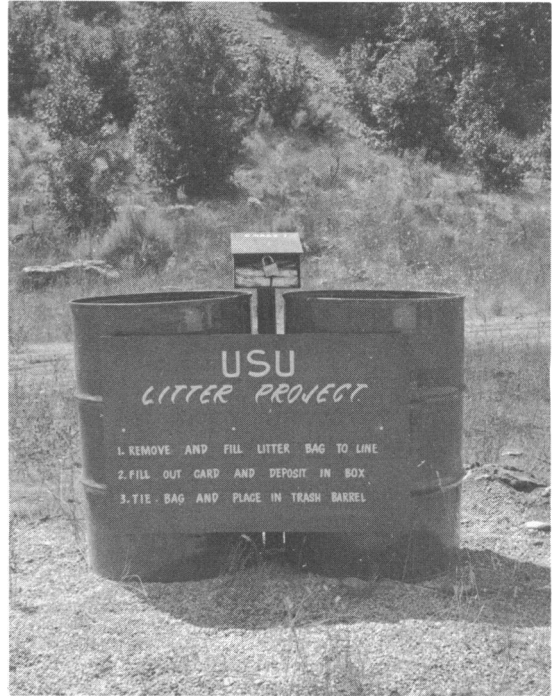


Fig. 2. An example of one of the litter stations *in situ*, Green Canyon, Utah. The small box between the two barrels held litter bags and contained a slot in the top for inserting information cards.

The data card requested the participant's name, address, phone, age, sex, reason for coming to the canyon, and, during the experimental conditions, whether the participants desired 25¢ or a chance for the \$20.00.

### Procedure

To ascertain the size of the litter problem, the canyon was cleaned of litter by nine boy scouts and three adults on two weekends in May 1971. A total of 1676 lb of litter was removed, which required 78 man-hours.

A road counter was placed at the only entrance to the canyon and the two litter stations were placed beside the road (Figure 1). Daily observations from 1 to 5 hr in length were made from concealed positions one to four times a day. The observer stationed himself on a hill elevated 75 to 100 ft (22.5 to 30 m) above the canyon behind brush and large boulders. Observations were made using binoculars and a

<sup>3</sup>Kindly supplied by the U. S. Forest Service.

telescope. The observer classified persons in the canyon as target shooters or non-target shooters and counted the number of individuals in each vehicle. An attempt was made to sample all daylight hours at least once a week. During each observation, the road-counter readings were taken, filled bags were removed, weighed, volume estimated, and general contents recorded.

Participants in the project were instructed to remove and fill the litter bag to a horizontal line (about one-third of the bag), fill out the data card, place it in the card container, and then tie and deposit the litter bag in the litter bin. A bag of litter filled to the line counted as a single instance of participation in the study, that is, constituted a response.

During the experimental conditions, a form letter was filled out and mailed to each participant the following morning. For those selecting the 25¢ for each bag, the money was enclosed with the form letter. Those choosing a chance for each bag received the form letter indicating the number of chances entered in their name. The chance cards were collected for the week which ended at midnight on Tuesdays. Wednesday morning the winner was selected by use of a table of random numbers. The check for \$20.00 was mailed on Friday mornings. Only the winning participant was informed. All letters had a return address so that any participant could obtain the name of the winner upon request. At no time in any of the instructions or letters were the boundaries of the project given. Therefore, the number of areas in which the project was being conducted was never known to anyone turning in litter.

Procedures were in effect for 15 weeks beginning mid-July 1971 and ending in November with the advent of winter weather. The procedures were replicated when the ground cleared the following spring during six weeks, from mid-April through all of May 1972.

*Ground survey technique.* Three separate areas of the canyon were surveyed for ground litter on two occasions during the final six weeks of the study. The first survey took place immediately

before the sixteenth week. At this time, the project had been in recess 4 to 5 months because of winter weather. The second survey was conducted three weeks after the first on the final day of experimental conditions in the eighteenth week.

These surveys were accomplished by sinking spikes in the ground and running string from spike to spike, thus defining an area. Any litter overlapping the strings or entirely inside these areas was tallied. The first two authors ( $O_1$  and  $O_2$ ), counted litter on wrist counters within an area. The survey count was made on a single area and a single type of litter at a time. Bias that might have entered from a knowledge of the results of the first survey was precluded: (1) by having  $O_1$  and  $O_2$  report their counts independently to the third author, and (2) by waiting until the completion of the second survey to examine and compute the results of both surveys.

*Definition of litter.* Litter was divided into two categories: metal and paper. Metal or paper objects estimated at 1 in. by 1 in. (2.5 by 2.5 cm) or larger were counted. Metal objects included cans of all shapes and sizes, automobile parts, and the like. Paper materials included labels, cardboard boxes, and ammunition boxes.

## RESULTS

A total of 88 people filled out information cards, 56 of these during an experimental condition and 32 during a baseline condition. The age range of participants was 4 to 41 yr and the bulk of these (58) was between the ages of 11 and 25. The ratio of males to females was approximately 7:2. Most of the people (70%) participating listed their occupation as students. A variety of reasons was given for coming into the canyon, with the most frequent being to hike (10); to target practice (9); to take a drive (9); to pick up litter (9); and to accompany a target shooter (7).

Over the 21 weeks of the study, 187 bags of litter totalling 1658 lb were removed. The

majority of these bags (*viz.*, 139) was picked up during experimental conditions (Figure 3, top panel). During the first experimental condition, the average number of bags turned in per week increased roughly ten-fold over the number of bags turned in during the first baseline. When baseline conditions were reinstated, the initial baseline rate was fully recovered. The second return to experimental conditions produced an average number of bags per week essentially equal to that of the second baseline period, and the data through the fifteenth week cannot be differentiated from the second baseline condition.

Work was halted after 15 weeks due to the advent of winter. When the ground cleared in

spring (week 16 of the study) experimental conditions were reinstated, and a number of bags comparable to the first experimental condition was turned in. Subsequent return to baseline conditions was followed by fewer bags being filled each succeeding week.

The bottom panel of Figure 3 depicts the estimated number of people in the canyon by week through the 21 weeks of the study. This estimate was obtained by counting the number of people in a sample of 1118 vehicles over the 21 weeks; this averaged 2.2 people per vehicle. Weekly vehicle counts (*i.e.*, road-counter totals) were then multiplied by this average to provide the estimated number of people using the canyon each week. Estimates of the number of target shooters per week were calculated by multiplying the proportion of target shooters to non-target shooters *actually seen* by the estimated number of people per week.

There was an increase in the number of individuals using the canyon during weeks 9 to 14. Along with this increase, there was also an increase in the proportion of the population that engaged in target shooting. The decrease in the number of target shooters during weeks 18 to 21 corresponded to a U.S. Forest Service order prohibiting shooting in the area.

The ground survey indicated decreased amounts of litter during the experimental part of the replication (Figure 4). Each of the three areas surveyed showed a decrease from the first to the second observation. Area 1 showed the largest average decrease (55% and 28% for metal and paper respectively). Area 2 decreased an average of 55% in metal objects and 19% in paper products, while Area 3 decreased 23% in metal and 9% in paper. A comparison between O<sub>1</sub> and O<sub>2</sub> revealed close agreement in the estimate of overall reduction of litter. For the three areas, O<sub>1</sub> found a decrease of 241 pieces of litter (-40%) and O<sub>2</sub> found a decrease of 225 pieces (-42%).

Ten lottery checks totalling \$200 were awarded during the 12 weeks of experimental conditions. An additional \$8.50 was paid to

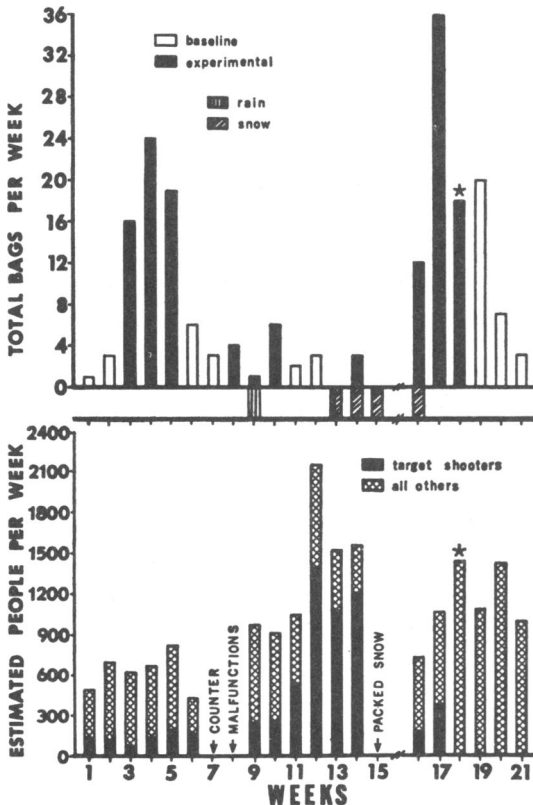


Fig. 3. Upper panel: The number of litter bags filled each week. The asterisk indicates publication of U. S. Forest Service orders prohibiting shooting in the area. Lower panel: the estimated number of weekly users of the canyon and the proportion of those who were target shooting. Data points for weeks 7, 8, and 15 were not included due to non-functioning equipment.

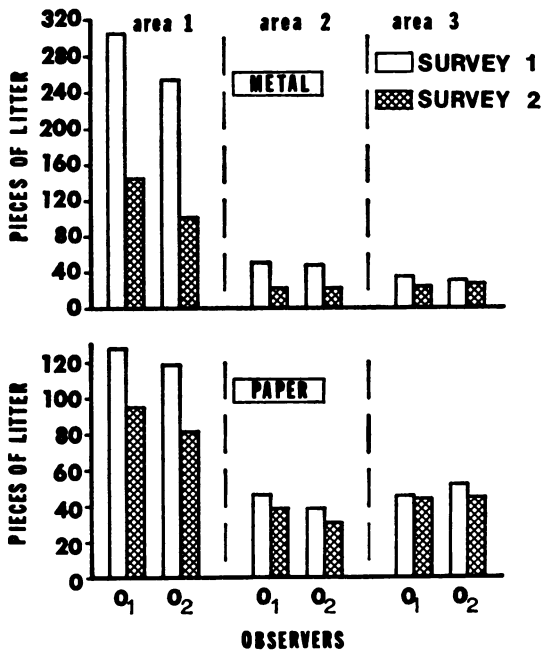


Fig. 4. The amount of metal (upper panel) and paper (lower panel) litter recorded by independent observers during two surveys of three areas in Green Canyon, Utah.

individuals desiring the 25¢ payment. Of the 139 bags received during experimental conditions, 101 (73%) were turned in for a chance in the lottery; 34 (24%) were turned in for payment of 25¢; and four (3%) were turned in by individuals who indicated on the card they desired no payment. Some persons contributed loose litter to the litter cans, or contributed filled bags but did not fill out the information card. All of this litter constituted an additional 219 lb. Twelve persons filled out cards, but turned in bags that were not filled to the line.

Reasons for participating in the project ranged from "need the money" (college students mostly) to statements about the importance of cleaner environments.

## DISCUSSION

The present results are important both to litter prevention and litter pickup. That is, the procedures produced increased amounts of litter at collection points and concurrently decreased

the amount of litter on the ground in the same area. These findings extend the generality of the procedures employed to date in litter control and indicate the size of the effect possible by providing reinforcement contingencies.

The present study also extends the literature in litter control in a number of other ways. First, it demonstrates that adults will pick up litter in areas without supervision (32% of the participants were 21 or over). Finnie (*unpublished*) showed that adults would use litter cans (prevention) but not that they would pick up litter. Burgess *et al.* (1971) demonstrated that children would pick up litter for incentives, but members of the same research team found that adults may not do so when there were no consequences for picking up litter (Clark and Hendee, *unpublished*).

Secondly, the study shows that incentive procedures can be effective across long periods of time. Both published experiments that have employed incentives have been one-time applications (Burgess *et al.*, 1971; Clark *et al.*, 1972).

Third, the percentage of people who opted for a chance on \$20 rather than the sure payment of 25¢ suggests that the lottery is an effective device for manipulating the behavior of individuals in a natural setting. One advantage of a lottery is that its administration may be simple. Personal delivery of a reinforcer necessitates contact with many individuals, while in the lottery, contact with only the winners is necessary. Further, for the same outlay of funds, it may be possible to produce greater participation with a lottery because the amount specified as a prize can be quite large, and therefore more likely to function as a reinforcer for more individuals coming in contact with a project.

Finally, previous research has not separated the reinforcing effects of adult attention on children's behavior (Baer and Wolf, 1970) from non-personal reinforcers employed concurrently. The present study demonstrates that the presence of an individual is not a necessary component of a positive reinforcement system

for litter control in the natural environment. Conceivably, administrative costs of programs that do not require personal contact should be considerably less than programs requiring such contact.

At least two possible reasons for the failure to recover experimental effects during weeks 8 to 10 and 13 to 15 can be made in terms of target shooters and weather conditions. Clearly, the presence of a large number of people target shooting would be sufficient to dissuade all but the very foolish from engaging in litter removal while shooting was going on. This area was known as a location for "sighting-in" weapons and these weeks of the study corresponded roughly to the beginning of hunting seasons in Utah and a number of surrounding states. Further, target shooting in this area was largely unsupervised. The cans used in the litter stations were occasionally shot through. Angles of trajectory indicated that the individuals were shooting up and down the road that traversed this area as opposed to shooting into the hillside. Also, inclement weather prevailed for four of the eight weeks between weeks 8 and 15 (Figure 3). Limited participation was probably related to either or both of these postulated reasons.

Comparing the estimated number of people using the canyon during these 21 weeks and the number of people participating in the project, we obtained the disappointingly low proportion of 0.004. In other words, while we were able to induce some individuals in the overall population of users to pick up litter, the proportion affected by the procedures was low indeed. This can be contrasted with the U.S. Forest Service

group who report a high proportion of child-participants given personal solicitation by a uniformed forest ranger (Clark, 1972). The next research step should be a systematic examination of the conditions that increase participation in unsupervised areas.

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