Between-subject competition: A rat race

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Four blocks of four rats, matched on pretraining running speed, were randomly assigned in pairs to either a competition or non-competition condition following initial 100% reinforced double-runway training. Using a yoked design, "competition" Ss, reinforced selectively only for winning, improved significantly in running speed across testing days relative to "non-competition" Ss who were reinforced according to the reward schedule programmed by the yoked competition Ss performance.

Several early attempts to demonstrate competition effects in animals have been unsuccessful (Lepley, 1937; Winslow, 1940, 1944a, 1944b), but in each case methodological deficiencies such as lack of control of certain parameters of the reward variable were present.

Similar problems existed in a study by Bayroff (1940) which offered tentative evidence that the speed of performance of rats swimming in an underwater maze could be increased in a competitive situation. The first animal to swim to the goalbox was given immediate access to air while the "losing" animal was delayed air-access for an additional 20 sec. However, as Church (1961) points out, Bayroff employed no control condition to determine whether competition really was learned or if the results were simply due to, (1) the variation in number of trials, or (2) the delay of reinforcement. An additional consideration concerns whether rats swimming together swim faster than those swimming alone, another factor uncontrolled in the Bayroff experiment.

Church (1961) suggests a procedure for controlling for these contaminating effects by matching experimental and control subjects (Ss) on the crucial reward variables. This can be achieved by "yoking" Ss between groups on reward allocation, thus letting the trial-by-trial reward schedule of the experimental pairs in competition serve as the program of reward distribution for the control pairs without regard to the control's performance. Church (1961, 1962) has effectively used a modification of such a procedure in lever-box studies and has reported significant effects for competition. The present investigation utilizes the "yoked" design for exploring competition in the runway where motivational influences on a running response are more clearly observable, i.e., a rat race. "Competition" was presumed to be present if selectively reinforcing the faster of two animals improved the performance of both relative to yoked control pairs.

Method

The Ss were 16 male albino rats, approximately 180 days old, with previous shock experience but not in a runway. The animals were housed in individual cages with water continuously present and were maintained on an 80% of pre-deprivation body-weight schedule for 12

days before the experiment began. Training and feeding occurred at the same time each day to maintain 24-hr. deprivation.

A 54-in. double alley was divided into 36-in. runways and 9-in. start and goal chambers. A green plastic foodbox (3 in. x 2 in. x 1 in.) was equally divided between the two alleys by the middle Plexiglas wall and extended approximately 1-1/2 in. into the goal chambers. The raising of clear Plexiglas doors released the Ss into the runway and swinging Plexiglas goal-entry doors prevented retracing after the S entered the goal chamber. The middle wall dividing the alleys was of transparent Plexiglas and the plywood sides and floors were painted a flat black.

Randomly paired Ss were run simultaneously, 10 trials per day for three days on a 100% reinforcement schedule during initial training. Four homogeneous blocks of four Ss each were then established by rank-ordering the mean speed scores of the last five trials of the third day of training and placing the fastest four Ss together, etc., down to the slowest four Ss. Within each block, the Ss were randomly assigned to a "competition" pair and a yoked "non-competition" pair. The same pairs of Ss always ran together, but the side of the runway was alternated on each trial to avoid the development of alley preferences.

Reinforcement consisted of five .045 gm Noyes pellets and was given to the appropriate S of a given pair only after both Ss had arrived in the goal chamber. For competition pairs, the first S reaching the goal chamber received the reward. On the equivalent trial for the matched, non-competition pair, the S within the block randomly assigned to be yoked with the winning S of the competition pair was also reinforced regardless of his performance in the runway on that trial. The losing competition S and his yoked non-competition counterpart were unrewarded on that given trial.

The order of returning each S of a pair to the start-box was varied following each trial with about 30 sec. of the approximately 2-min. intertrial interval being spent in the goal chamber. All Ss were given 10 trials per day for five days, at which time testing was terminated because the reward distribution became too inequitable.

Results and Discussion

Response measures of interest were starting speed (reciprocal of latency to leave the starting chamber) and running speed (reciprocal of time between starting chamber exit and goal chamber entrance). The data were cast into a 4 by 2 by 5 factorial for repeated measurements on the last two factors with two Ss

Fig. 1. Comparison of competition versus non-competition mean running speed for the five days of testing.

in each competition and non-competition cell. Thus a total of 80 observations was involved in the analysis. The mean running speeds for the two groups are presented graphically in Fig. 1.

The factor of prime experimental interest, running speed in competition vs. non-competition groups, was significant ($F=8.94$, $df=1/4$, $p<.05$) and is interpreted as supporting a competition effect. The main effect for the repeated measures over days was nonsignificant, although the Competition by Days interaction was significant ($F=4.60$, $df=4/16$, $p<.05$). This interaction demonstrates that the competition animals increased their speed of running as a function of days to a greater extent than did non-competition Ss. The matching procedure was effective in producing near identical performance for the two groups on the first test day. While the competition group improved in performance over test days, the non-competition group showed no systematic change.

A comparable analysis of starting speeds, indicated a nonsignificant effect due to the competition variable ($F<1.00$). This was due at least in part to the vari-

ability in orientation at the start of the trials. Only the main effect for days was significant in this analysis ($F=11.99$, $df=4/16$, $p<.01$), indicating that both groups decreased their starting latencies as days of testing progressed.

As compared to the pre-planned 100% reinforcement for winning in the "competition" group, a post hoc inspection of the running speed data revealed that the "non-competition" group was also rewarded for "winning" on 60% of the trials (120/200). However, as noted, a competition effect was not present under the latter condition.

The present study and the lever-box studies of Church (1961, 1962) agree in that (1) competition can be demonstrated in rats when the appropriate controls are used, and (2) as the length of the contest increases extinction effects begin to emerge in the lesser rewarded animals, a situation which in the present study forced an earlier termination than planned. The present results are consistent with a position that competition is an acquired drive which combines with a primary drive to produce improved performance under conditions in which reward is contingent upon relative rate of responding.

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