JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR 1974, 22, 61-71 NUMBER 1 (JULY)

EFFECTS OF THE DIFFERENCE BETWEEN SELF AND COACTOR SCORES UPON THE AUDIT RESPONSES THAT ALLOW ACCESS TO THESE SCORES[1]

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An audit response allows access to an existing score from a subject's own performance (self audit) or from his coactor's performance (coactor audit). A previous study found that social stimuli (coactor present) increased audits relative to a non-social (no coactor) condition. The increase, designated a social-stimulus effect, was found to be due more to the coactor's score than to his mere presence. This finding suggested that the difference between self and coactor scores might affect the size of the social-stimulus effect. In the present study, six pairs of human subjects matched-to-sample for points that were exchangeable for money. During a session, matching-to-sample problems were distributed so that a subject's score was ahead, behind, or about even with his coactor's score. The even condition produced the largest social-stimulus effects, *i.e.*, the most audits that could not be attributed to non-social variables such as time or number of problems. The even condition may have produced the largest social-stimulus effects because it was the only condition where the major social reinforcer (being ahead) could be both present or absent and, consequently, the even condition was the only one where audits had a discriminative function with respect to the presence of the major social reinforcer.

Individuals frequently make responses that provide access to scores on their own performance or the performance of others. A student looking over a list of examination scores is a common example. Studies have attempted to determine the effects of knowledge of self and/or other's scores upon subsequent behaviors, particularly educational performance (*e.g.*, Krumboltz and Weisman, 1962) and self-reward behavior (*e.g.*, Bandura and Whalen, 1966; Masters, 1968; Mischel, Coates, and Raskoff, 1968). However, little is known about the rate of the responses that allow access to the scores or the variables that affect these responses. This is because the scores typically have been (1) provided by the experimenter's rather than the subject's responses, or (2) made available by responses that have consequences in addition to allowing access to a score (Hake, Vukelich, and Kaplan, 1973).

Making some aspect of a social stimulus dependent upon behavior has been an important method in social psychology for measuring the reinforcing aspects of social stimuli. Examples are imprinting stimuli (Peterson, 1960; Hoffman, Searle, Toffey, and Kozma, 1966), young offspring (Cross and Harlow, 1963), and sex stimuli (Sheffield, Wulff, and Backer, 1951). This same approach was followed by Hake *et al.* (1973) in their attempt to measure score-checking responses and the effects of another person upon them. Responses that allowed access to one's own or to another person's scores were designated as audit responses. They were measured by making illumination of the one-way mirrors that covered the scores dependent upon button-press responses. When a response was strengthened or maintained by allowing access to an existing score, the score was defined as a reinforcer, the response was designated as an audit response, and the entire process was designated as an audit (Hake *et al.*, 1973). Audit responses that allowed access to the subject's own score were designated as self-audit responses, and audit responses that allowed access to another person's score were designated as coactor-audit responses. The audit responses were independent of other responses and reinforcers, since they were not necessary (1) to produce points, (2) to complete the matching-to-sample task for which

[1]This research was conducted at the Behavior Research Laboratory, Anna State Hospital, supported by the Illinois Department of Mental Health and NIMH Grant 17981, and is based on a dissertation submitted by the first author to Southern Illinois University in June, 1972, in partial fulfillment of the Ph.D. degree. Reprints may be obtained from Ron Vukelich, Department of Psychology, Glassboro State College, Glassboro, New Jersey 08735, or Don Hake, Behavior Research Laboratory, Anna State Hospital, Anna, Illinois 62906.

points were given, or (3) to learn whether or not task responses were correct.

The major finding was that self as well as coactor audits increased when the situation was changed from a non-social one (no coactor) to a social one (coactor present). The subjects did make self audits when they were alone, but the increase in self audits when the coactor was added indicated that not all of the self audits during the social condition could be attributed to non-social variables, such as the frequency with which one's own score changed. The part of a behavioral change that can be attributed to the introduction of a social stimulus has been designated as a social-stimulus effect (Hake *et al.*, 1973); consequently, the increase in self audits that occurred upon the change from non-social to social conditions was designated as a social-stimulus effect.

Further analysis revealed that this social-stimulus effect was due more to the coactor's score than to his mere presence. The importance of the coactor's score, plus the finding that it was reinforcing to have access to both self and coactor scores within a brief time period (self and coactor audits within a 5-sec period were designated as interpersonal audits), indicated that the subjects may have been comparing scores and, as a result, that the difference between self and coactor scores might also affect the rate of audits. If so, that effect would also be a social-stimulus effect, since the difference between self and coactor scores is based upon the social stimulus, the coactor's score.

The present study investigated the effects of the difference between self and coactor scores upon the rate of self and coactor audits using the same procedure as in the previous study. The subjects earned points by working matching-to-sample problems. Sessions were arranged during which each subject's score was either ahead, behind, or even with his coactor's score by controlling the number of problems each of the two subject's received during the session.

It is clear, as was shown in the previous study, that non-social variables do produce audits. For example, both time and the number of score changes in a session are non-social variables that would be expected to affect the rate of audits. The present study posed a problem in separating social and non-social effects, since the non-social variable of number of problems (number of problems, points, and changes in point totals varied together) was not constant across the three conditions. The total number of problems in a session (self plus coactor problems) was constant across ahead, even, and behind conditions, but the number of problems a given subject or his coactor received in a particular session depended upon whether the subject or the coactor was scheduled to be ahead, even, or behind. It is difficult to conceive of a procedure in which changes in relative position can be arranged without some variations in either total or individual points or problems across conditions.

To demonstrate that the difference between self and coactor scores results in a social-stimulus effect requires that (1) one or more of the conditions (ahead, behind, or even) produce a social-stimulus effect; and (2) that one or more of the conditions produce a larger social-stimulus effect than the other conditions. Whether or not the difference between self and coactor scores resulted in a social-stimulus effect was evaluated in two ways. First, were there differences in the rates of the various types of audits under ahead, behind, and even conditions? If so, were these differences in the direction that would be expected from exclusive control by non-social variables, or were there consistent deviations from non-social control? For example, on the basis of the number of problems alone, the ahead condition, which had the most self problems, would be expected to produce the most self audits. Conversely, the behind condition, which had the most coactor problems, would be expected to produce the most coactor audits. Any consistent deviation from exclusive control by the non-social variable of number of problems would be indicative of control by social variables, and the condition with the largest deviation would be the condition with the largest social-stimulus effect. Second, the same number of problems that was scheduled for a given subject under each social condition (ahead, behind, and even) was also scheduled under non-social conditions. When compared to the appropriate non-social control for number of problems, did the ahead, behind, or even condition result in a change in the rates of audits from the non-social to the social conditions, *i.e.*, social-stimulus effects, and, if so, did any of the conditions (ahead, behind, or even) produce a larger social-stimulus effect than the others?

METHOD

Subjects

The six pairs of subjects consisted of 11- to 15-yr-old male volunteers from local junior and senior high schools. They participated in two sessions per day, four to five days per week. Sessions were conducted during free school periods and after school, with transportation provided to and from the laboratory.

Apparatus

The apparatus was the same as that used by Hake *et al.* (1973), which can be consulted for exact dimensions. Each member of a pair had a matching-to-sample apparatus that consisted of a panel for producing the sample stimuli (left side of Figure 1) and a panel for matching the sample stimuli (right side of Figure 1). Each subject's sample panel and matching panel were color-coded. The matching panel and sample panel of each subject were next to each other but the apparatuses of the two subjects were 4 m apart.

Each matching panel was on a table in front of the subject's chair. In the center of each matching panel, from top to bottom, were an opening where the point value of each problem was presented (magnitude-of-reinforcement stimulus), a light that flashed after a correct matching response on that panel (feedback stimulus), three pairs of buttons with a letter corresponding to each button (matching-response buttons), and a button that was to be depressed before talking (conference button). The two counters on the right side of the matching panel were labelled "me" (self-audit counter) and "other person" (coactor-audit counter). Pressing the button to the left of either illuminated the area behind the one-way glass covering that counter, thereby making the glass transparent and revealing the point score on that counter.

The sample panel was on a stand that put it at eye level of the seated subject. Illumination of a light (sample-operative stimulus) on the top of the sample panel indicated which of the subjects could work the next problem. The face of the sample panel contained three openings through which the sample stimuli were projected, and a button (sample-producing button), the depression of which resulted in a 1-sec presentation of one of two letters through each of the stimulus openings. The letter combinations were randomized on two, 33-pole steppers that alternated every 2 min so that letter combinations were presented in different orders.

The experimental room, approximately 6 by 7 by 2 m, contained a closed-circuit television camera, a microphone, and a voice-operated relay in full view of the subjects. Electromechanical scheduling and recording equipment, the video monitor, and the speaker were in an adjacent room.

Procedure

The procedure for the matching-to-sample task, audits, and conferences under all conditions. Each subject's sample panel and matching panel were next to each other (Figure 1), and, to ensure that each subject worked individually and could not see his coactor's score except by making audit responses,

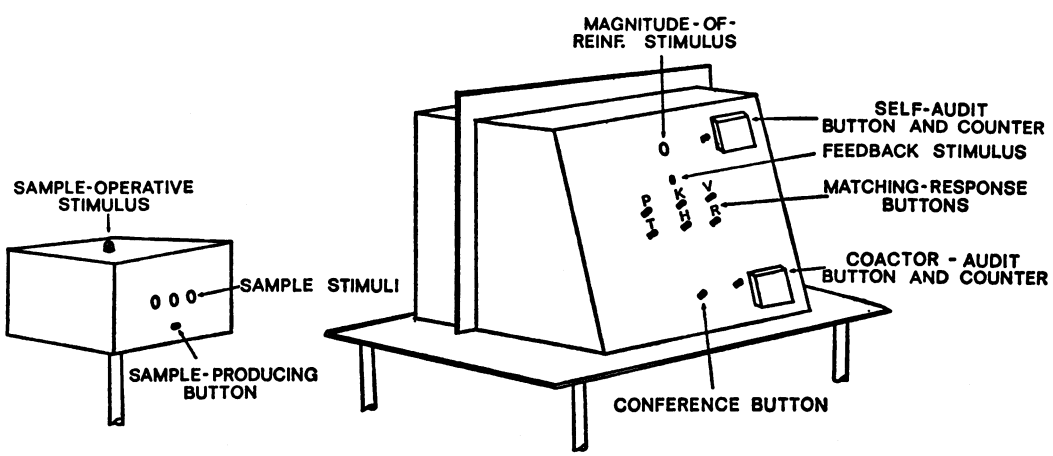

Fig. 1. Diagram of the sample panel (left) and the matching panel (right) of one subject.

the apparatuses of the two subjects were 4 m apart. The session, as well as every matching-to-sample problem, started with illumination of the magnitude-of-reinforcement stimulus that presented the 1-, 3-, or 6-cent point value of the problem on both matching panels. Three seconds later, the sample-operative stimulus on top of one of the sample panels was illuminated. The subject at the corresponding matching panel could then produce a 1-sec presentation of the sample stimuli on his sample panel by depressing his sample-producing button. A correct matching response, *i.e.*, depression of the buttons on the matching panel that corresponded to the sample stimuli, was followed by the feedback stimulus and by the recording of the appropriate number of points on the self-audit counter of that matching panel and on the coactor-audit counter of the other matching panel. A subject had 8 sec to produce the sample stimuli and make the matching response, as the sample-operative stimulus remained illuminated for 8 sec or until the matching response was completed, whichever occurred first. There were 7.5 sec between the end of one problem and the start of the next one: the magnitude-of-reinforcement stimulus for the next problem came on 7.5 sec after the previous matching response was completed, or 7.5 sec after the time allotted to work the problem had elapsed. The 1-, 3-, or 6-cent point value of each problem and which sample panel was operative on each problem both occurred in an irregular order, since they were both randomized on 33-pole steppers that were out of phase with each other.

There were differences between the procedures for Subjects 1 to 4 and Subjects 5 to 12 in terms of the operation of the audit counters and conferences. For Subjects 1 to 4, a single button press illuminated a given audit counter, which remained illuminated as long as the button was depressed. For Subjects 5 to 12, five button presses were required to illuminate a given counter for a constant period of 2 sec.

Subjects 1 to 4 were allowed to talk during sessions as long as they kept their conference button depressed. Talking without depressing the button resulted in a 20-cent fine for both subjects. For Subjects 5 to 12, the conference button was not effective and any talking resulted in a 20-cent fine for both subjects.

Acquisition session and instructions. An acquisition session, during which each subject worked alone, was provided before the first session of the experiment to ensure that the subject could work the matching-to-sample task. The session lasted until the subject correctly worked five consecutive problems. The instructions that preceded the acquisition session were basically the same as in Hake *et al.* (1973). They indicated (1) that the television camera and microphone allowed behavior to be monitored, (2) that each point was worth one cent and that the amount earned in the sessions would be paid weekly, (3) the function of the various stimuli and response buttons (magnitude-of-reinforcement stimulus, sample-operative stimulus, sample-producing button, sample stimuli, matching-response buttons) and how to work the problems, (4) how the subject could check his own or his coactor's score, and (5) that there would be a brief time between problems when all panel lights would be out and problems could not be worked.

Instructions for all subsequent sessions were shorter, indicating only what subjects had to do to check their own or their coactor's score and whether or not they could talk. At the end of the first session of each day, the subjects were asked to leave the room for about 5 min while the counters were cleared.

Ahead, behind, and even sessions. The 12 subjects were divided into pairs, and the members of each pair were always tested together under this condition. Ahead sessions were arranged by scheduling more matching-to-sample problems for one of the subjects than for his coactor, who was being tested simultaneously under the behind condition. Under these ahead and behind sessions, problems were distributed on a 60% to 40% basis in favor of the ahead subject for Subjects 1 to 4, and on a 67% to 33% basis in favor of the ahead subject for Subjects 5 to 12. Even sessions were arranged by distributing problems on a 50-50 basis. Regardless of the condition, the steppers that distributed the problems were scheduled to distribute problems in a mixed order, with no subject receiving more than three consecutive problems.

The basic experimental design for Subjects 5 to 12 involved the random ordering of one even, one ahead, and one behind session for each subject during each block of three sessions. Subjects 5 to 8 had four three-session blocks, each with one ahead, one even, and one behind session randomly assigned. Sessions

lasted 16 min. The procedure was the same for Subjects 9 to 12 except that there were only three blocks of sessions. Subjects 1 to 4 were randomly assigned to the different types of sessions, but each type did not occur once in each block of three sessions. Subject 1 had five ahead, three behind, and no even sessions, while the opposite conditions existed for Subject 2. Subject 3 had five ahead, five even, and four behind sessions, while Subject 4 had the opposite conditions. Sessions lasted 15 min for these four subjects.

Non-social control for number of problems. To evaluate the extent to which the audit responses under each social condition (ahead, behind, and even) could be attributed to a social-stimulus effect, it was necessary to determine the extent to which the audits under each condition could be attributed to non-social variables, such as time and number of problems. For this reason, Subjects 9 to 12 were also tested during 16-min non-social sessions in which the same number of each type of problem (self and coactor) was scheduled as under each of the social conditions (ahead, behind, even). Although the subjects were tested alone, coactor problems were scheduled as under the social conditions. There were three non-social control sessions for each type of social session. Two blocks of the three types of sessions occurred before the social sessions and one more block occurred after the social sessions.

Data Analysis

The independent variable of this study differed from most in that it did not exist from the start of the session. Several problems had to be worked before a subject was consistently ahead, behind, or even. For example, consider Subjects 1 to 4, for whom problems were distributed on a 60%-40% basis during ahead and behind sessions. Because the 1-, 3-, and 6-cent point values of problems were scheduled in a mixed order, and because subjects did not always work problems correctly, the point spread for some of the ahead and behind sessions did not become different from an even session until near the end of the session. For this reason, problems were distributed on a 67%-33% basis under ahead and behind conditions, respectively, for Subjects 5 to 12. A comparison of the scores of the odd-numbered subjects (*i.e.*, 5, 7, 9, 11) and the even-numbered subjects revealed that the average score for even sessions was about 110, with 17 points being the largest point spread for a single session. At the conclusion of the ahead and behind sessions, the average scores were about 150 and 75, respectively, with 42 points being the smallest point spread for a single session. However, relative position was not clear until halfway through the session. For example, at the end of the first 4 min, the average point spread was 25, but in eight of the 28 sessions the point spread was 17 or less, and in two sessions the subject scheduled to be behind was ahead. On the other hand, at the end of 8 min, or one-half of the session, the average point spread was 41 and never less than 20. Because of these considerations, the comparisons of audit responses during ahead, behind, and even sessions were based upon the last third (Subjects 1 to 4) or last half (Subjects 5 to 12) of the session.

Subjects occasionally illuminated the same audit counter several times in rapid succession. Such counter illuminations did not appear to be maintained by the score, since there was too little time between illuminations for the score to change. Hence, a counter illumination was designated as a burst and not counted if it occurred within 8 sec (slightly less than the minimum possible time between changes in scores) of a counter illumination of the same type that had already been counted as an audit.

RESULTS

The mean rates of the various types of audits for the last third (Subjects 1 to 4) or last half (Subjects 5 to 12) of ahead, even, and behind sessions are shown for each subject in Table 1. For most subjects, the rates of self and coactor audits were each about one to two per minute. These response rates work out to about 0.5 to one total audits (self plus coactor audits) per problem. The latter figure is obtained by first considering that there were about four problems per minute (self plus coactor problems), since each problem lasted about 14 sec (3 sec magnitude-of-reinforcement stimulus, 3 to 4 sec to work the problem, and 7.5 sec between problems). Second, by considering that rates of one to two per minute for both self and coactor audits make a total of two to four total audits per minute, it can be concluded that there were

Table 1

Mean rate of self, coactor, and interpersonal audits for the last third (Subjects 1 to 4) or last half (Subjects 5 to 12) of ahead, behind, and even sessions. Subjects 1 and 2 did not have any even sessions.

	Self Audits/min			*Coactor Audits/min*			*Interpersonal Audits/min*		
Subjects	*Ahead*	*Behind*	*Even*	*Ahead*	*Behind*	*Even*	*Ahead*	*Behind*	*Even*
1	2.28	1.33		2.28	1.53		2.12	1.26	
2	2.13	1.64		1.73	1.28		1.33	0.88	
3	1.95	1.08	1.92	1.55	0.80	1.48	1.50	0.56	1.44
4	2.88	1.75	2.48	2.08	1.75	2.32	2.00	1.40	2.24
5	2.66	1.07	1.82	1.41	0.97	1.66	0.88	0.50	1.41
6	1.60	1.50	1.50	1.03	1.38	1.35	0.71	1.29	1.22
7	1.63	1.00	1.66	1.13	1.22	1.85	0.50	0.44	1.04
8	1.38	0.72	1.16	0.82	0.88	1.07	0.53	0.66	0.81
9	2.50	1.50	2.13	1.71	1.34	2.38	1.46	1.00	1.63
10	0.92	0.71	1.17	0.71	0.88	1.54	0.46	0.71	1.00
11	0.96	0.88	1.34	0.84	1.38	1.25	0.44	0.46	1.21
12	0.88	0.54	0.80	0.71	0.63	0.88	0.42	0.42	0.71
Mean (10 Subjects with Even Sessions)	1.74	1.08	1.60	1.20	1.12	1.58	0.89	0.74	1.27
Mean (12 Subjects)	1.81	1.14	—	1.33	1.17	—	1.03	0.80	—

usually two to four total audits and four problems for each minute.

Table 1 shows that self audits occurred at a higher rate (10% or more) during ahead than during behind sessions for 10 of the 12 subjects. Subjects 6 and 11 had about equal rates during these conditions. The rates for self audits were also higher during even sessions than during behind sessions for nine of 10 subjects. Subject 6 had equal rates under these two conditions. There was no sizeable or consistent difference in self audits between ahead and even conditions.

Coactor audits occurred at a higher rate during even sessions than during behind sessions (eight of 10 subjects) and ahead sessions (nine of 10 subjects). There was no consistent difference between ahead and behind sessions.

Although there were at least 14 sec between completions of a self and a coactor matching-to-sample problem, and although subjects rarely averaged over one total audit per problem (self plus coactor audits), 82% of all coactor audits were within 5 sec of a self audit during the even sessions. Thus, when subjects made an audit during even sessions, they usually made both types instead of only one type. Hence, as in the previous study (Hake *et al.*, 1973) where there were only even sessions and 75% of all coactor audits were within 5 sec of a self audit, the temporal grouping of self and coactor audits indicates that it was reinforcing to have access to both types of scores within a brief time period. For this reason, an interpersonal audit was recorded whenever a self and a coactor audit occurred within 5 sec of each other. A given self or coactor audit was counted in only one interpersonal audit.

During the behind sessions, 72% of all coactor audits were within 5 sec of a self audit, but the percentage dropped to 54% during the ahead sessions.

Table 1 shows that interpersonal audits also occurred at a higher rate during even sessions than during ahead sessions (nine of 10 subjects) and behind sessions (nine of 10 subjects). There was no consistent difference between ahead and behind sessions.

To summarize, the three conditions did result in consistent differences for all three types of audits, and there were consistent deviations from exclusive control by the nonsocial variable, rate of problems. If audits had been entirely under the control of the rate of problems, the rate of self audits would have been highest under the ahead condition, and the rate of coactor audits would have been highest under the behind condition. Since interpersonal audits involve both types of

audits, and since the total number of problems (self plus coactor) was constant across conditions, interpersonal audits would have been about equal under all conditions. Instead, and indicative of a social-stimulus effect, the even condition produced consistent deviations from exclusive control by the non-social variable, rate of problems. The even condition resulted in about the same rate of self audits as the ahead condition, whereas both conditions resulted in more self audits than the behind condition. The even condition also produced more coactor and interpersonal audits than both the behind and ahead conditions. There was no consistent difference between ahead and behind conditions with respect to coactor audits or interpersonal audits.

Other consistent effects that would not be predicted from exclusive non-social control concern the response rate within sessions. Table 2 shows the percentage difference in the number of audits from the first third to the last third (Subjects 1 to 4) or from the first half to the last half (Subjects 5 to 12) of ahead, even, and behind sessions for each type of audit. Positive percentages indicate that the number of audits was highest during the last part of the session, while negative percentages indicate that the rate of audits was highest during the first part of the session. The rate of self audits increased within ahead (11 of 12 subjects) and even sessions (10 of 10 subjects) but decreased during behind sessions (10 of 12 subjects). The only consistent pattern for coactor audits was for the even sessions, where eight of the 10 subjects had positive percentages. The rate of interpersonal audits increased within even sessions for eight of 10 subjects and decreased within behind sessions for 10 of 12 subjects. No consistent trend was apparent for interpersonal audits during the ahead sessions. In summary, the even condition resulted in consistent within-session increases, albeit small in some cases, for all three types of audits; the ahead condition resulted in consistent increases for only self audits, and behind sessions resulted in consistent within-session decreases in self and interpersonal audits.

Table 3 shows the rates of self audits for Subjects 9 to 12, who were also tested under the non-social procedure during which sessions were scheduled with the same number of problems as under each of the social conditions (ahead, behind, even). Table 3 reveals a social-stimulus effect for each social condition, as the rates of self audits were higher under ahead, behind, and even conditions with the coactor present than under the appropriate non-social controls for number of problems. These results are consistent with the findings of the previous study (Hake *et al.*, 1973), which had only even sessions, and they extend them to indicate that the addition of a coactor increases self audits regardless of whether the subject is ahead, behind, or even. Table 3 also reveals that for each subject, the largest social-stimulus effect usually occurred under the even condition, with only one exception: the increase in self audits from non-social to social procedures

Table 2

Percentage difference in self, coactor, and interpersonal audits from first third to last third (Subjects 1 to 4) of sessions or from first half to last half (Subjects 5 to 12) of sessions.

	Self Audits			*Coactor Audits*			*Interpersonal Audits*		
Subjects	*Ahead*	*Even*	*Behind*	*Ahead*	*Even*	*Behind*	*Ahead*	*Even*	*Behind*
1	+3.8		−19.7	+10.7		−15.6	+7.3		−18.8
2	−5.0		−4.2	−6.0		−14.4	−3.0		−10.0
3	+14.3	+16.0	−15.0	+4.2	+8.8	−12.6	+14.0	+5.8	−24.8
4	+13.4	+14.6	−3.7	+5.2	+16.6	−3.5	+12.8	+17.0	+6.3
5	+10.0	+8.0	−0.3	−0.5	+15.3	0.0	−12.0	+11.5	−18.5
6	+12.5	+7.0	+12.0	−5.0	+4.0	+6.0	−13.4	+2.0	−2.0
7	+9.5	+24.5	−1.6	−2.5	+2.0	−6.0	−28.0	+4.5	−40.0
8	+25.0	+3.0	−7.0	+9.0	0.0	+10.0	−6.0	−8.0	−1.0
9	+10.0	+4.0	+4.2	−9.4	+5.4	−8.6	−6.0	0.0	−9.2
10	+14.6	+5.4	−22.6	0.0	+12.8	−18.0	+33.4	+1.3	−16.0
11	+2.6	+6.0	−6.0	−4.0	−6.0	+11.2	+17.0	+2.0	−8.6
12	+16.0	+8.0	−3.3	+6.6	+9.4	+11.4	+28.0	+8.6	+32.0
Mean	+10.6	+9.7	−5.6	+0.7	+6.8	−3.3	+3.7	+4.5	−9.2

Table 3

Self audits per minute under non-social and social conditions for last half of ahead, even, and behind sessions.

	Ahead			*Even*			*Behind*		
Subjects	*Non-Social*	*Social*	*Change*	*Non-Social*	*Social*	*Change*	*Non-Social*	*Social*	*Change*
9	2.43	2.50	+0.07	1.29	2.13	+0.84	1.09	1.50	+0.41
10	0.34	0.92	+0.58	0.31	1.17	+0.86	0.58	0.71	+0.13
11	0.54	0.96	+0.42	0.88	1.34	+0.46	0.58	0.88	+0.30
12	0.42	0.88	+0.46	0.42	0.80	+0.38	0.25	0.54	+0.29
Mean	0.93	1.32	+0.39	0.73	1.36	+0.63	0.63	0.91	+0.28

was slightly larger during even sessions than during either ahead sessions (three of four subjects) or behind sessions (four of four subjects). The larger social-stimulus effects under the even condition are consistent with the results in Table 1, which indicated that the audits under the even condition were not under exclusive control of the non-social variable, rate of problems. Table 3 indicates that all social conditions generated a social-stimulus effect, but that the deviations from exclusive non-social control under the even condition in Table 1 were the result of a larger social-stimulus effect under the even condition.

The higher rate of self audits during the social as opposed to non-social conditions could have been due in part to the fact that subjects had about four more matching-to-sample problems during the social sessions. Since subjects took only about 4 sec to complete a problem for which they were allotted 8 sec, and since problems were scheduled for the coactor without regard to the presence or absence of the coactor, approximately 4 sec of running time was lost per coactor problem under non-social conditions. However, it is not likely that this 10 to 20% difference in the number of problems accounted for the changes, since half of the comparisons showed about a 100% increase in self audits from non-social to social conditions and, with the exception of Subject 9 under the ahead condition and Subject 10 under the behind condition, the other comparisons showed about a 50% increase.

The score on the audit counters appeared to be maintaining audits, since the mean rates of coactor and interpersonal audits were only 0.10 and 0.04, respectively, during non-social sessions when coactor audit responses only illuminated that counter.

Illuminations of the self-audit counter that were designated as bursts ranged from 0 to 11% with a mean of 5%, while the percentage of total coactor audits designated as bursts ranged from 0 to 14% with a mean of 7%.

The first four subjects did use the conference button, as it was depressed 1.6 min per session on the average. The audio monitor revealed occasional instances in which the conferences were used to check scores, and it was for this reason that conferences were discontinued for Subjects 5 to 12.

Subjects typically averaged over 95% accuracy on the matching-to-sample task under all conditions, with the result that earnings per session reflected the type of session. For example, the eight subjects tested with a 2:1 ratio of problems between the ahead and behind conditions had average earnings of about $1.50 and $0.75 for ahead and behind sessions, respectively, and average earnings of about $1.10 for even sessions.

DISCUSSION

A change in an individual's behavior that can be attributed to the presence of some aspect of another person may be designated as a social-stimulus effect. The major finding of the present study was that when two individuals worked independently but in a social context, the difference between their scores affected how often they checked their own score and the other person's score. A difference between the scores of two individuals is a social stimulus, since it is necessarily based upon the score of another person. Hence, the effects of the difference between scores in the present study can be designated as a social-stimulus effect.

Since the difference stimulus required both self and coactor audits, and since it was rein-

forcing to have both scores within a brief time period, the interpersonal audit (defined as self and coactor audits occurring less than 5 sec apart) was the most likely source of the difference stimulus. The interpersonal audit may be an approximate measure of what psychologists (*e.g.,* Festinger, 1954) have referred to as a "social comparison" but have not measured (see review by Masters, 1971).

The major analyses in the present experiment, as in any study of social-stimulus effects, were aimed at separating the social-stimulus effects from the effects of non-social variables. The social stimulus of the present study posed special difficulties in this respect. Sessions during which a given subject's score was either ahead, behind, or even with his coactor's score were arranged by controlling the number of matching-to-sample problems each subject received during a session. Hence, the non-social variable of the number of problems was not constant across the three conditions. Demonstration that the difference between self and coactor scores resulted in a social-stimulus effect required (1) one or more of the conditions to result in a social-stimulus effect and (2) a difference in the sizes of the social-stimulus effects under the three conditions. These effects were demonstrated in two ways.

First, there were differences in the rates of the various types of audits under ahead, behind, and even conditions, and these differences were not in the direction that would be expected from exclusive control by the non-social variable, number of problems. For example, on the basis of the number of self and coactor problems alone, the ahead condition, which had the most self problems, would be expected to produce the most self audits, and the behind condition would be expected to produce the most coactor audits. Interpersonal audits would be expected to be about equal under all conditions, since they involve both types of audits and since total problems were constant across conditions. Instead, the even condition resulted in about the same rate of self audits as the ahead condition, and the even condition produced more coactor and interpersonal audits than both the behind and ahead conditions. These consistent deviations of the even condition from exclusive non-social control indicated that there was social control and that there were differences in the degree of social control.

Second, when the subjects were also tested under the non-social control procedure in which sessions were scheduled with the same number of problems as under each of the social conditions (ahead, behind, and even), the largest social-stimulus effects occurred under the even condition: the increase in self audits from the non-social to the social procedure was usually slightly larger during the even condition than under the others. The finding of a larger social-stimulus effect under the even condition is consistent with the overall-rate data, which indicated consistent deviations from exclusive non-social control for the even condition. However, the comparisons of ahead, even, and behind conditions with a non-social control indicated that all social conditions generated a social-stimulus effect; the even condition simply produced the largest social-stimulus effect.

Other effects that would not be predicted from exclusive non-social control, but which are consistent with the larger social-stimulus effects during the last part of the even sessions, concerned the within-session changes in response rate. These changes in response rate were particularly evident during even and behind sessions. The even condition resulted in consistent within-session increases for all three types of audits, while the behind sessions resulted in consistent within-session decreases in self and interpersonal audits. These results for the even sessions, which are consistent with Hake *et al.* (1973) where all sessions were even, suggest that the reinforcing value of an audit increases as the end of the even session is approached. On the other hand, as the end of a behind session is approached, and the individual's relative position has changed from nearly even at the start of the session to being progressively further behind, the reinforcing value of an audit appears to decrease. These within-session changes cannot be attributed to changes in the number of problems, since the rate of problems did not change from the first half to the second half of the session. Rather, the difference appears to be a social-stimulus dimension that can affect the rate of audit responses within sessions.

Once a social-stimulus effect has been demonstrated, it may be possible to isolate further the aspects of the social stimulus that are responsible. For example, in the previous study (Hake *et al.,* 1973), it was shown that the

coactor plus his score produced a bigger social-stimulus effect than the mere presence of the coactor. However, as in the present study, no condition evaluated the effects of the scores without any coactor being present, or what might be called the "simulation" of a social stimulus. Such research might be an important contribution to the analysis of the social nature of stimuli, but it should be pointed out that such stimuli would be social. With experienced human subjects, score changes, although mechanical stimuli, would be known to be produced by another individual and would thereby be designated as "quasi social stimuli" (Hake and Vukelich, 1972). The present experiment attempted only to determine whether or not the difference between scores could produce a social-stimulus effect.

The question remains as to why the even condition, the condition with smallest differences between scores, produced a larger social-stimulus effect than ahead or behind conditions. The most straightforward explanation may be in terms of the discriminative function of audit responses as observing responses (Wyckoff, 1952) that clarified either the presence (S+) or absence (S−) of the major social reinforcer of being ahead. It should be emphasized again that being ahead may be the social reinforcer, and it is the reinforcer that will be discussed here to explain the differences in the social-stimulus effects, but it is not the only reinforcer for auditing; the absolute number of points is also a reinforcer that maintains audits, but it is a non-social one. Under the ahead and behind conditions, there were changes in scores (non-social reinforcer) and changes in the magnitude of S+ or S− (the social reinforcer) that could have affected the rate of audits. But, by definition, there were no changes between the presence (S+) and absence (S−) of the major social reinforcer, being ahead, once the subject was consistently ahead or behind. Only during the even sessions was there a high probability of both S+ and S−. Hence, if audit responses are comparable to observing responses, the even condition produced the largest social-stimulus effects because it was the only condition during which either S+ or S− could be present and, consequently, the only condition where audits had a discriminative function with respect to the presence and absence of the major social reinforcer.

A similar analysis was shown to explain the "post-reset" observing responses of human subjects in a signal-detection experiment (Laties and Weiss, 1960). In that experiment, the signal, the deflection of a pointer, was scheduled according to a fixed-interval schedule of reinforcement. The subject's task was to detect a pointer deflection by making observing responses and then to make another response that reset the pointer. Fewer post-reset observing responses occurred when there were stimuli indicating that the reset response had been effective than when there were no such stimuli or when there were indications that the reset response might not have been effective. Laties and Weiss (1960) concluded that post-reset observing responses, or confirming responses as they were later called (Laties and Weiss, 1964), were controlled by the extent to which they had a discriminative function.

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Received 12 September 1973.
(Final Acceptance 15 January 1974.)