*COMMENTS ON SHIMP'S (1983) DOUBLE DISSOCIATION
BETWEEN KNOWLEDGE AND TACIT KNOWLEDGE*

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Shimp (1983) found in five pigeons "double dissociation" between the distribution of pairs of long and short reinforced interresponse times and "self-reports," obtained by symbolic matching to sample, concerning these interresponse times. This result can be explained by assuming that the birds used a fixed temporal interval as matching criterion, independently of which pattern of interresponse times was reinforced.

Shimp (1983) makes an explicit distinction between "knowledge" and "tacit knowledge," or, to use another terminology, between "knowing that" and "knowing how." That an organism "knows how" is deduced from its conforming to the requirements of a reinforcement contingency, whereas ascertaining "knowing that" requires some report — not necessarily linguistic — about its own behavior. Furthermore, Shimp (1983, p. 62) states, as an hypothesis supported by his earlier work, that "tacit knowledge about the contingency develops only when knowledge is also displayed," implying that "knowing that" is a necessary condition for "knowing how." (The linguistic hazards connected with the use of the word "knowing" from a behavior-analytic point of view are pointed out and dealt with by Hineline, 1983.)

Shimp's thesis emerged from a study (Shimp, 1981) of whether nonverbal organisms could remember and "report" the temporal organization of their recent behavior. By receiving reinforcement for their short and long, but not intermediate, interresponse times, five pigeons were trained to discriminate two classes of interresponse times. Bimodal distributions of their interresponse times demonstrated "tacit knowledge." In order to test "knowledge," a symbolic matching-to-sample probe was added as a further requirement for reinforcement:

The bird had to peck a green key when the most recently emitted interresponse time belonged to the class identified as short, and a red key when it belonged to the class identified as long. The experiment comprised six patterns (pairs of reinforced interresponse times), for two of which discrimination proved too difficult. The other four patterns showed .8 to .9 probability of correct responding. Figure 1 shows these patterns as the uppermost four lines, denoted A through D. Thin lines denote the reinforced ranges (in seconds), and thick lines denote the unreinforced intermediate time intervals, which also indicate the demarcation between the two classes.

To confirm his thesis of "knowledge" being a prerequisite for "tacit knowledge," Shimp (1983) carried out an experiment that was essentially a repetition of his 1981 study, but with an extension of the ranges of the pairs of reinforced interresponse times. Surprisingly, he found double dissociation between temporal properties of behavior that were subject to reinforcement and the accuracy of the birds' reports of their own behavior, those reports also being explicitly reinforced. That is, both tacit knowledge without knowledge and knowledge without tacit knowledge were found. Based on a closer analysis of Shimp's experiments, I shall propose another interpretation of his data, more in line with his own earlier (1981) thesis.

Ten different pairs of reinforced interresponse times covered a range from 0.6 s (lowest lower bound) to 27 s (highest upper bound). See Conditions (or patterns) 1

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Fig. 1. Experimental Conditions A through D (Shimp, 1981) and 1 through 10 (Shimp, 1983). Thin lines denote reinforced time intervals, and thick lines indicate the unreinforced intervals. The vertical line at 4.5 s denotes the pigeons' assumed criterion.

through 10 in Figure 1. The shortest pattern(s) (Condition 10 and, possibly, Condition 9) resulted in bimodal interresponse-time distributions, and thus "tacit knowledge," but in low frequencies of correct matching implying no or little "knowledge." It was the other way around with patterns of intermediate length, Conditions 1 to 4 or 5. For these, the interresponse-time distribution showed only a single peak (no "tacit knowledge"), but a high frequency of correct matching responses, not only for the class of short interresponse times, which is to be expected, but also for long ones—"knowledge." For the longest pairs of patterns, again a single peak was found, and the frequency of correct matching responses was low.

To explain this double dissociation, let us start with Conditions 1 through 4 (see Figure 1), all of them intermediate patterns. What can we deduce more in detail regarding tacit knowledge from the pertinent interresponse-time distribution given in Figure 1 of Shimp's paper? The bird is sensitive to the availability of reinforcers for interresponse times longer than the lower bound

of the shorter interresponse time of the pair, and places most of its interresponse times near that bound. (The location of the peak towards still shorter interresponse times is probably an example of the time-order error, which is often encountered in psychophysical research.) Furthermore, the bird is affected by occasional reinforcers following much longer interresponse times, although it seems insensitive to the specific limits of the longer reinforced class (no corresponding peak). (For example, in Condition A, of all probes about 40% were reinforced, only about one quarter of which belonged to the "long" class.) The contingency set up for the probe (the "self-report") required the bird to choose between the two categories—short and long interresponse times of a pair—but evidently without detailed "tacit knowledge" regarding the class of long interresponse times.

Yet the frequency of correct matching responses was high. Therefore, we have to ask: Is there any other (discriminative) behavior than the one intended that is reinforced by the contingency set up? If, in per-

forming on the matching-to-sample procedure, the bird categorizes the duration between its next-to-last peck and the lighting of the colored keys not as shorter or longer but as falling below or above about 4.5 s, its behavior for all four intermediate patterns would agree with what Shimp found experimentally. The assumed criterion of 4.5 s is indicated in Figure 1. One can see that for Conditions 1 through 4 the criterion works perfectly. If there was a reinforceable inter-response time, it must have been below 4.5 s if it belonged to the class of shorter and above 4.5 s if it belonged to the class of longer ones. For the remaining more extreme conditions this criterion becomes less and less applicable. For Condition 5, the one in which reinforcement starts at 3.5 s, inter-response times falling between 4.5 and 5 s are incorrectly classified as "long." This is not serious, however, because most of the short inter-response times crowded around 3.5 s—the lower bound for reinforcement. The frequency of correct matching responses was only a little lower than for the previous four conditions. For still more extreme conditions, for which the 4.5-s criterion is of no use, the birds displayed superstitious behavior (what psychophysicists call "response bias") in the sense that their behavior was not strongly determined by the contingency. This can be concluded from the observation that the individual birds behaved differently. For example, Birds 1 and 4 tended to respond "long," and Birds 2 and 5 tended to respond "short" for Conditions 6 through 8. (Remember that responding on the same colored key throughout would give 100% correct responses for one class and 0% for the other.)

Birds 2 and 4 deserve an extra comment. Bird 2 seems to have conformed rather well to the matching contingency for all conditions, perhaps with the exception of the shortest pattern (Condition 10). One might conclude that it responded in accordance with a varying criterion. Bird 4 does not seem to have exhibited superstitious behavior for Conditions 9 and 10. As assessed in accordance with the 4.5-s criterion, it

emitted more than 80% correct responses for short and less than 30% for long inter-response times in Condition 10. In Condition 9 correct responses exceeded 90% for the short inter-response times and fell below 65% for long ones. As Figure 1 shows, reinforceable long inter-response times falling in the interval 4.5 to 6 s were classified as correct according to the programmed criteria, and only those falling between 3 and 4.5 s were classified as incorrect.

In the experiment reported in 1981 by Shimp, however, the pigeons responded correctly about 80% of the time for all conditions except the two that required very difficult discriminations. One possible explanation for the apparently better performance in this experiment is that the birds' criterion for discrimination was 2.5 s, which would work perfectly in all four conditions. This, however, would make the transition to 4.5 s in Shimp's 1983 experiment difficult to understand, inasmuch as the birds were the same in the two experiments and the first condition of the 1983 experiment was the same as the last condition of the 1981 study. Another possibility builds on the fact that the shorter reinforced inter-response times were the same for all four conditions, thereby facilitating the acquisition of a new criterion from one condition to the next. In the second experiment both reinforced inter-response times were changed between conditions.

Behaving in a way other than that intended by the experimenter ("misunderstanding," or "simply not following instructions") is not rare, either in humans (e.g., Eisler, 1982) or in animals (e.g., Eisler, *in press*).

The analysis given here implies that Shimp's 1983 experiment is inconclusive as to the question asked. Whether the birds "knew" which of the shorter or longer inter-response times they had responded to cannot be inferred from their behavior, because their basis for discrimination appears to have been other than that intended. Accordingly, Shimp's thesis that "knowledge" is a necessary condition for "tacit knowledge" cannot be rejected on the basis of the apparent double dissociation he found.

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