ACQUISITION OF MOTOR SKILL AFTER BILATERAL MEDIAL TEMPORAL-LOBE EXCISION

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Abstract—The acquisition of selected motor skills was studied in a 40-year-old man with a severe amnestic syndrome resulting from a bilateral medial temporal-lobe resection carried out 13 years before. On Rotary Pursuit, Bimanual Tracking, and Tapping, his scores improved from session to session, and on the one task where it was feasible to retest several days after the end of training (Rotary Pursuit), he showed complete retention. These results imply that motor learning can be mediated by brain structures still intact in this patient. The additional finding that he was inferior to normal men of his age on two tasks, in both initial and final levels of performance, is attributed to his relatively long reaction time rather than to the memory deficit.

OBSERVATIONS in normal man suggest that the development of motor skill is qualitatively different from most kinds of learning. In contrast, for example, to rote learning of cognitive material, quite complex motor skills (such as skating, swimming, pronouncing a foreign language, dancing, and piano playing) are usually acquired most efficiently in childhood, are extremely difficult to eradicate through disuse, and show little relationship to the level of general intellectual function. In view of such distinctions it is reasonable to postulate that motor learning may be mediated, at least in part, by different neural structures than those implicated in other forms of learning. A clue that this may be the case stems from an analysis of the performance of SCOVILLE's [16] patient, H.M., in a wide variety of learning situations.

This man was operated upon in 1953 for the relief of incapacitating non-focal seizures, the anterior hippocampus, the hippocampal gyrus, uncus, and amygdala being removed bilaterally by means of a frontal approach permitting the temporal neocortex to be spared. Consequent to this procedure, H.M. showed a profound anterograde amnesia which has persisted essentially unchanged. The retrograde amnesia is now restricted mainly to the year before his operation, and there is no general intellectual loss or deficit in attention span.

On a wide variety of tasks, which included free recall of short prose passages and complex patterns, face recognition, continuous recognition of visual patterns and of verbal material, paired-associate learning, and maze learning, H.M. failed to show any significant retention of the material presented to him. Nevertheless, in 1959, H.M. performed 39 trials on a mirror-drawing task and showed steady improvement (indicated by reduced time and error scores for both hands) over a three-day period [9], although on the second and third days he was not aware of having done the task before. Similarly in 1962, while unable to learn the correct sequence of turns in a 10-choice tactual maze, H.M. gradually reduced

his time scores over 80 trials [4]. On the basis of these two findings, it was hypothesized that other motor skills could also be acquired by patients with bilateral lesions of the medial temporal structures [10].

To explore this possibility further, it was decided to train H. M.on a few other motor-learning tasks, including two on which trials could be distributed over several days, thus permitting one to look for day-to-day improvement and to compare his rate of learning with that of a group of normal right-handed male subjects of about the same age as H.M. This study, the results of which are reported below, was carried out in June, 1966, at which time H.M. was 40 years old.

METHOD

The tests chosen consisted of three motor-learning tasks (Rotary Pursuit, Bimanual Tracking, and Tapping) and two control tasks (Reaction Time and Serial Ordering of Digits). On Rotary Pursuit and Bimanual Tracking, training of H.M. took place over two consecutive weeks, one week being devoted to each task. Because the normal control subjects were tested at work, their training on each of these tasks was limited to five days. All subjects were given the Tapping test twice, on one day only.

In one of the control procedures, a test thought to be sensitive to personal tempo, the subject was asked to arrange lists of digits in serial order. One year after completion of other testing described in this report, measurement of H.M.'s reaction times was made, the purpose being to achieve a better understanding of his reduced efficiency, as compared to that of normal control subjects, on Rotary Pursuit and Bimanual Tracking.

The subject was not told his actual scores on any test, either from trial to trial or from day to day, but it was possible for him to derive information about his performance from the clicking of the automatic timers and counters, which recorded his time and contact scores.

Motor-learning tasks

1. *Rotary Pursuit.* The apparatus is shown in Fig. 1. The subject was instructed to hold the stylus between the thumb and index finger of his preferred hand and to rest the tip of the stylus on the metal target. He then was told that in a few seconds the disc would begin turning and that he should keep the stylus in contact with the target until it stopped. During each trial the disc rotated at 45 rev/min for 20 sec. After one trial with the preferred hand, the subject switched to his non-preferred hand, continuing to alternate hands in this way until he had completed four trials with each hand. The intertrial interval was 20 sec. It should be noted that the task was not the same for left and right hands because the disc always rotated in a clockwise direction. For each trial, the time on target and the number of contacts with the target were recorded. Testing was carried out twice a day on the first two days and once a day thereafter.

2. *Bimanual Tracking.* After all training sessions on the Rotary-Pursuit apparatus had been completed, subjects began the tracking task, the apparatus being a memory drum adapted for this purpose (Fig. 2). The aluminum drum was painted flat black except for two asymmetric tracks approximately $\frac{1}{4}$ in. wide, which the subject saw through a horizontal slit $\frac{3}{8}$ in. high. Holding a stylus in each hand, he was required to place the left-hand stylus on the left-hand track and the right-hand one on the right-hand track, and to maintain these contacts while the drum rotated in discrete steps every 2 sec, 1 sec, or $\frac{1}{2}$ sec.

Each session consisted of six 20-sec, trials, two trials being given at the 2-sec speed, two at the 1-sec speed, and two at the $\frac{1}{2}$-sec speed. There were two testing sessions per day, and both time and contact scores were obtained for each hand on all trials.

3. *Tapping.* The apparatus for this task is shown in Fig. 3, the procedure being that described by THURSTONE [19] (pp. 49–51). Holding a metal stylus in his right hand, the subject tapped each sector of the divided circle on the right as quickly as possible, in the sequence 1, 2, 3, 4, for 30 sec. He then did the same thing with his left hand, this time tapping the divided circle on the left. In the third stage of the task, he was required to work with both hands simultaneously, again for 30 sec, always tapping in the order 1, 2, 3, 4. It will be noted that these numbers are arranged differently on the left and right sides of the tapping board; yet in the bimanual condition, the counter recording the contacts registered only when the sectors with corresponding numbers were hit simultaneously. All subjects performed this task twice in the same day, the intervening 40-min period being spent in various activities outside the testing room.

Control tasks

1. *Reaction Time.* The subject was seated at a table with one hand supported by a book, his index finger resting lightly on a key which operated a microswitch. At the beginning of each trial the experimenter gave the signal, "Ready," and after 0–4 sec delay, she pushed a silent switch to activate a Standard electric timer and one of three stimuli, one visual and two auditory. The visual stimulus (V_1) was provided by a Chicago miniature lamp with 0.52 mean spherical candelpower, the auditory ones (A_1 and A_2) by a Line medium-tone AC-DC buzzer and by a Lafayette burglar alarm module connected to a 6-volt battery and a speaker, respectively. By depressing the key as quickly as possible, the subject stopped the timer and turned off the stimulus. Forty consecutive trials were given with each stimulus, in the order V_1, A_1, A_2, V_1. Within each group of forty trials, the subject alternated right (R) and left (L) hands as follows: R-L-L-R-L-R-R-L, each letter representing five trials with the corresponding hand.

2. *Serial Ordering of Digits.* In doing this pencil and paper task, the subject utilized test forms similar to that shown in Fig. 4. He was instructed to rank each group of seven digits starting with the lowest digit in that group. Thus, in the first set of blanks provided, the subject would write 1 2 5 5 6 6 8. During the 15 min that he was required to work on this task, a light would flash every 60 sec, whereupon the subject was supposed to draw a vertical line after the digit he had just written, and then resume the task. These time markers made it possible to calculate the number of lines completed in each of the three 5-min periods. Because of H.M.'s memory impairment, each time the light flashed the examiner told him to draw a line.

RESULTS

The results of the present study give additional support to the notion that the medial temporal-lobe structures are not necessary for the acquisition of motor skill. On the two tasks which involved learning over several days (Rotary Pursuit and Bimanual Tracking), H.M.'s performance improved from session to session and from day to day. Similarly, his tapping scores after a 40-min rest interval were superior to those recorded before it.

8 2 6 5 1 6 5 _ _ _ _ _ _ _   1 4 7 8 0 1 3 _ _ _ _ _ _ _

2 8 0 4 9 8 9 _ _ _ _ _ _ _   1 2 6 5 9 9 2 _ _ _ _ _ _ _

4 0 0 2 7 3 2 _ _ _ _ _ _ _   9 6 0 8 7 4 7 _ _ _ _ _ _ _

2 5 9 4 0 3 9 _ _ _ _ _ _ _   6 6 1 3 4 7 5 _ _ _ _ _ _ _

3 5 1 2 6 7 4 _ _ _ _ _ _ _   6 4 5 6 8 9 1 _ _ _ _ _ _ _

2 7 3 5 4 2 6 _ _ _ _ _ _ _   4 2 6 0 7 4 3 _ _ _ _ _ _ _

4 8 7 0 8 1 9 _ _ _ _ _ _ _   9 3 1 6 1 7 6 _ _ _ _ _ _ _

1 8 3 1 7 2 8 _ _ _ _ _ _ _   5 9 2 9 0 2 8 _ _ _ _ _ _ _

8 6 5 8 3 2 9 _ _ _ _ _ _ _   6 9 7 7 4 3 6 _ _ _ _ _ _ _

5 9 3 9 1 0 6 _ _ _ _ _ _ _   4 8 4 1 3 2 5 _ _ _ _ _ _ _

5 1 0 3 8 2 0 _ _ _ _ _ _ _   4 9 5 1 8 9 8 _ _ _ _ _ _ _

8 2 8 3 4 0 9 _ _ _ _ _ _ _   9 4 8 8 4 1 9 _ _ _ _ _ _ _

4 7 3 5 8 5 6 _ _ _ _ _ _ _   8 2 8 6 7 4 7 _ _ _ _ _ _ _

9 2 4 7 7 6 9 _ _ _ _ _ _ _   9 6 1 8 9 4 2 _ _ _ _ _ _ _

1 7 0 3 2 8 7 _ _ _ _ _ _ _   1 4 3 6 1 3 7 _ _ _ _ _ _ _

5 3 4 1 6 9 4 _ _ _ _ _ _ _   8 9 2 8 6 3 5 _ _ _ _ _ _ _

8 2 9 4 1 8 1 _ _ _ _ _ _ _   6 9 3 5 2 4 8 _ _ _ _ _ _ _

2 5 7 7 4 2 9 _ _ _ _ _ _ _   1 7 2 4 7 2 8 _ _ _ _ _ _ _

3 8 6 5 7 5 4 _ _ _ _ _ _ _   3 1 2 3 8 5 9 _ _ _ _ _ _ _

2 4 1 3 4 5 9 _ _ _ _ _ _ _   0 6 4 9 6 3 5 _ _ _ _ _ _ _

3 4 0 7 2 6 4 _ _ _ _ _ _ _   2 0 2 8 6 5 3 _ _ _ _ _ _ _

2 1 4 3 8 8 3 _ _ _ _ _ _ _   4 5 3 9 3 8 1 _ _ _ _ _ _ _

1 3 0 9 2 9 7 _ _ _ _ _ _ _   6 8 3 0 4 2 9 _ _ _ _ _ _ _

7 1 0 6 0 8 2 _ _ _ _ _ _ _   7 3 8 1 7 3 2 _ _ _ _ _ _ _

5 5 7 9 9 2 7 _ _ _ _ _ _ _   1 2 6 1 4 3 3 _ _ _ _ _ _ _

5 2 3 9 0 1 6 _ _ _ _ _ _ _   3 4 8 0 6 0 8 _ _ _ _ _ _ _

2 1 6 4 2 9 3 _ _ _ _ _ _ _   8 0 4 2 8 2 5 _ _ _ _ _ _ _

6 4 4 8 6 7 5 _ _ _ _ _ _ _   3 4 6 9 3 9 0 _ _ _ _ _ _ _

0 2 5 8 4 3 7 _ _ _ _ _ _ _   0 7 8 4 4 6 9 _ _ _ _ _ _ _

8 1 5 3 6 8 6 _ _ _ _ _ _ _   6 2 0 3 8 7 6 _ _ _ _ _ _ _

FIG. 4. Test form for Serial Ordering of Digits.

In contrast, H.M. was inferior to normal subjects on the two control tasks (Reaction Time and Serial Ordering of Digits), suggesting a slowness of tempo which presumably is independent of the memory deficit observed in learning situations which are not primarily motor.

Motor-learning tasks

In the presentation of results for Rotary Pursuit and Bimanual Tracking the scores for right and left hands have been combined for visual simplicity, since the focus of this report is on changes in over-all level of performance rather than on hand differences. In analyzing these data, the Mann-Whitney U test [18] was used to compare the scores of the normal control subjects on the first session with their scores on the last.

1. *Rotary Pursuit.* Figure 5 shows the Rotary-Pursuit time scores for H.M. as compared with the mean scores for seven normal control subjects, all right-handed males who ranged in age from 34 to 43 years. There is a significant increase in H.M.'s time-on-target from Session 1 to Session 9 ($U=5$, $p=0.001$) and for the normal control subjects from Session 1 to Session 7 ($T=0$, $p=0.02$). Nevertheless, the two curves differ in that the control subjects' initial level of performance was superior to that of H.M., and their scores continued to rise over the five days of testing, whereas H.M. reached asymptote on Session 4.
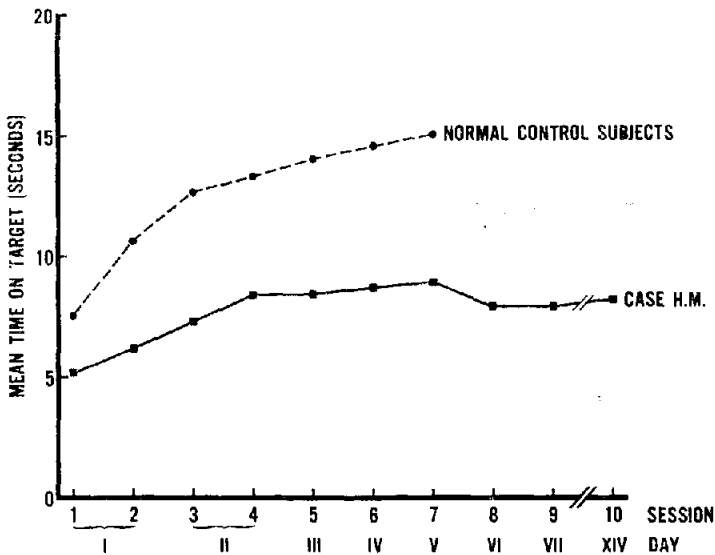

FIG. 5. Rotary Pursuit: time scores.

The Rotary-Pursuit contact scores (Fig. 6) are more meaningful if one first considers the requirements of the task. In the initial phase, the subject learns to get back on target quickly once he has lost it, but as he becomes more proficient, he stays on target for longer periods of time, the problem then being less one of recovering quickly as of not losing contact. A comparison of the Rotary-Pursuit contact scores for H.M. and for the normal control subjects (Fig. 6) shows an opposite trend in the two sets of data; that is, H.M. increased his number of contacts with the target from Session 1 to Session 9 ($U=0.5$, $p<0.001$), but the control subjects learned to make significantly fewer contacts from Session 1 to Session 7 ($T=0$, $p=0.02$). It, therefore, seems as if H.M.'s performance reflects an increasing efficiency in getting back to the target when he has lost it, whereas the performance of the normal control subjects shows a steady decrease in the number of departures from the target.
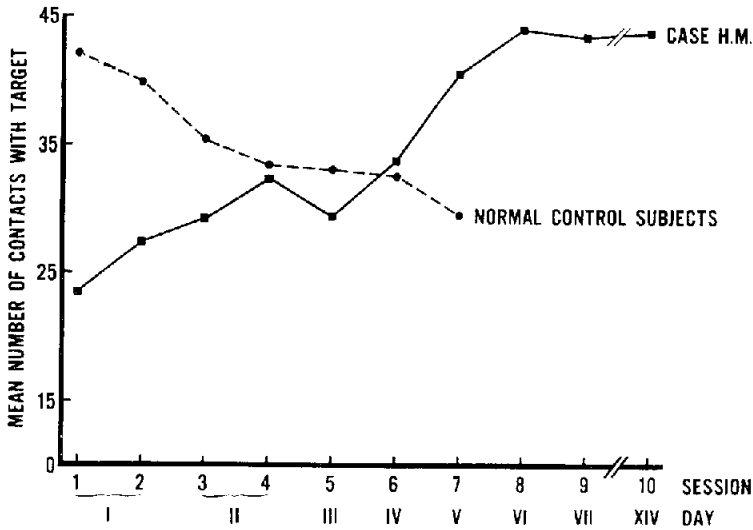
FIG. 6. Rotary Pursuit: contact scores.

Figures 5 and 6 also show H.M.'s retention scores (Session 10) obtained one week after the final training session. It is clear that his performance on Day XIV was as efficient as on Day VII, no opportunity for practice on this task having been given in the interval.

2. *Bimanual Tracking.* Figure 7 shows the time scores for the same normal control subjects who performed the Rotary-Pursuit task, and for H.M. The scores obtained at the $\frac{1}{2}$-sec speed were found to be the most informative because at the lower speeds the normal control subjects consistently achieved near-maximum time scores after only a few sessions.
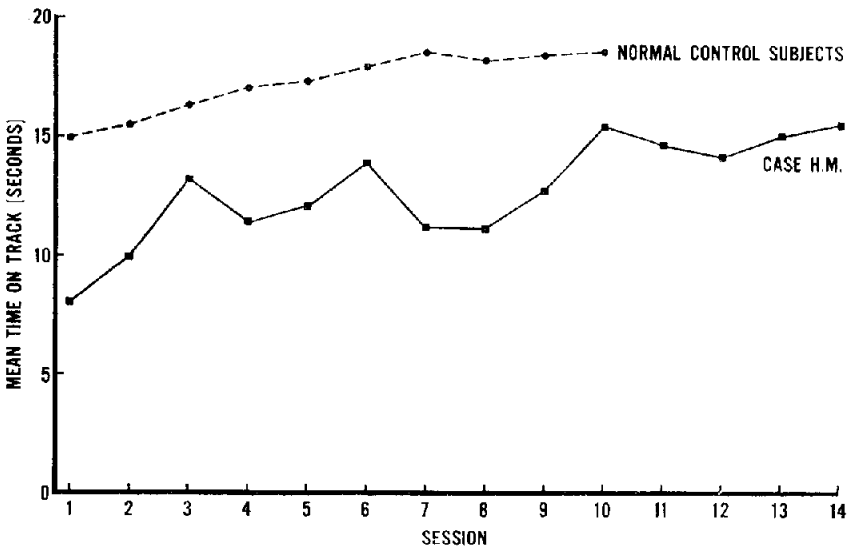

FIG. 7. Bimanual Tracking: time scores.

The score indicated on the graph for each session, therefore, is the mean time on track during two 20-sec trials in which the drum moved every half sec. There was a significant improvement in H.M.'s time scores from Session 1 to Session 14 ($U = 5$, $p = 0.001$), and although the curve for the normal control subjects is flatter, they also showed a significant increment in level of performance ($T = 0$, $p = 0.02$). As in the Rotary-Pursuit task, H.M.'s performance was inferior to that of the normal control subjects throughout training, and his scores were more variable.

The contact scores for the same trials are plotted in Fig. 8. The two curves are clearly distinct but, unlike those for Rotary Pursuit, show similar trends. The decrease in mean number of contacts with the tracks, from initial to final levels, is significant in both cases (H.M.: $U = 5$, $p = 0.001$; Controls: $T = 0$, $p = 0.02$). Nevertheless, H.M.'s contact scores were within the range of scores for the normal control subjects on Sessions 1 and 2 only, and as training progressed, his scores fell farther away from the normal range. It was not
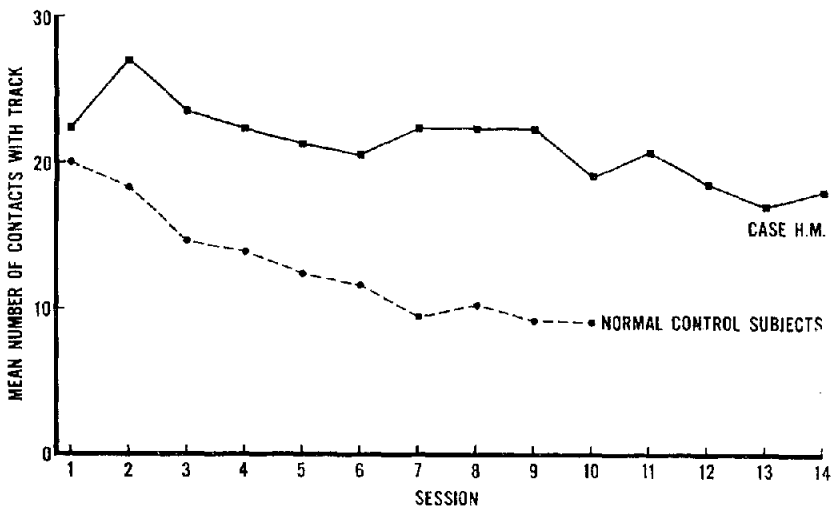

FIG. 8. Bimanual Tracking: contact scores.

possible to test for retention of Bimanual Tracking because the patient was discharged soon after the completion of training.

3. *Tapping*. Table 1 shows the test-retest scores for unimanual and bimanual conditions. H.M.'s initial test scores were well within the range of scores for normal control subjects of the same age. His retest scores, obtained 40 minutes later, showed improvement, this being especially marked in the unimanual conditions.

Table 1. Tapping scores for right-handed male subjects (age range: 35–45 years)

Subjects	Test	Right hand		Left hand		Both hands	
		Mean	Range	Mean	Range	Mean	Range
Case H.M.	1st	90.0	–	90.0	–	20.0	–
	2nd	103.0	–	103.0	–	22.0	–
Normal control	1st	102.2	74–131	97.5	63–136	20.2	12–30
(N = 10)	2nd	109.2	76–144	107.5	75–144	25.0	21–34

Control tasks

1. *Reaction Time.* The data for the four blocks of 40 trials are given in Table 2. The mean age of this normal control group, all right-handed men, was 40.7 years (range: 37–44 years), H.M.'s age being 41 years at the time of this testing. Not only are H.M.'s mean reaction times well above those of the normal control group, but his mean scores fall outside the range of mean scores achieved by the control subjects, the single exception occurring in the first block of V_1 data where one normal subject was slower than H.M. Like the normal control group, H.M. required less time to respond to the auditory stimuli than to the visual. The slight increase in his mean visual reaction times for Trials 121–160, as compared with that for Trials 1–40, was consistent with the change seen in four of the six normal control subjects, and is probably attributable in all five cases to fatigue.

Table 2. Reaction Time in msec averaged over 40 consecutive trials

Subjects	Stimuli							
	V_1		A_1		A_2		V_1	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Case H.M.	270.8	—	244.8	—	236.8	—	286.3	—
Normal control (N=6)	220.5	189.3 276.8	182.2	159.0– 215.3	182.4	154.8– 198.0	217.2	206.5– 241.3

2. *Serial Ordering of Digits.* These data are shown in Table 3; H.M.'s scores are inferior to those of male control subjects whose ages ranged from 38 to 43 years. Most remarkable, however, is the drop in H.M.'s performance for the third 5-min period. This reduction in efficiency may have been due to the cumulative effect of periodic interruptions of his work with reminders to draw a line in response to the blinking light. During the last 5-min period he appeared unusually restless at these times and complained of being "mixed up."

Table 3. Serial Ordering of Digits: Number of lines completed per five-minute period

Subjects	1–5 Min		6–10 Min		11–15 Min	
	Mean	Range	Mean	Range	Mean	Range
Case H.M.	25.0	—	25.0	—	18.0	—
Normal control (N=6)	37.8	28–48	40.0	30–49	40.3	28–48

DISCUSSION

The primary finding of this study is the clear evidence of H.M.'s ability to acquire certain motor skills despite a severe impairment in learning other kinds of material. On Rotary Pursuit, Bimanual Tracking, and Tapping, his scores improved from session to session, and on the one task where it was feasible to retest several days after the end of training (Rotary Pursuit), he showed complete retention. These results imply that motor learning involving visually- and proprioceptively-guided movements can be mediated to some extent by brain structures which are still intact in H.M.

A dissociation between visual and kinesthetic memory systems, consistent with the findings obtained in the present study, has been proposed recently by POSNER [12, 13] and POSNER and KONICK [14]. They found no increase in the extent to which subjects forgot the location of a visually-presented position in space over a 20-sec rest interval, whereas reproduction of the distance of a hand movement without visual guidance became increasingly inaccurate over a 20-sec rest interval. Nevertheless, in POSNER'S experiments the unequal difficulty of the visual and kinesthetic memory tasks and the greater similarity of the various interpolated activities to the visual than to the kinesthetic task makes his results less than definitive.

The contrast between storage of motor and other input can be extended by considering differences in long-term retention of the respective responses. In general, retention of a variety of motor skills is very high, even for no-practice intervals of up to two years, and relearning is rapid (for reviews see [1], Chap. 8, and [8]). On the other hand, verbal material is typically forgotten much more quickly [7, 20]. The few instances in which motor learning dissipates rapidly ([1], pp. 236–237; [8]) are those in which the task has a large verbal or other non-motor component.

The present study suggests that H.M. is somewhat inferior to normal subjects of his age on some of the motor tasks, in both initial and final levels of performance. This impairment, which is probably unrelated to the memory deficit, seems to be confined to tasks where his rate of movement is controlled by the apparatus (as in Rotary Pursuit and Bimanual Tracking), for on tasks where H.M. can set his own rate of performance (such as Mirror Drawing and Tapping) his scores approach more closely those of normal control subjects.

A possible explanation of this interesting discrepancy between the two types of tasks is that in Rotary Pursuit and Bimanual Tracking, unlike Tapping, reaction time is relevant [15]. Proficiency in these tasks is partially dependant upon being able to return quickly to the target or track whenever contact is broken. H.M.'s reduced time-on-target is, therefore, understandable in view of his relatively long reaction times, which were measured independently with standard reaction-time procedures. Patients with cerebral lesions have previously been reported to have longer reaction times than control subjects [3, 5], and extending this finding ARRIGONI and DE RENZI [2] have suggested that reaction time is positively correlated with lesion size.

Not only is H.M. slow in responding to a particular stimulus, his rate of spontaneous activity is also low, and this may have contributed to his poor performance on Rotary Pursuit and Bimanual Tracking. Moreover, on the serial ordering task, in which he had to arrange strings of seven digits in rank order, he completed far fewer items than did the normal control subjects. Although it is possible that the memory deficit forced him to refer back to the original string of digits more often than did the control subjects, it is more likely that his natural slowness of tempo was the major determinant of his low score. This trait was also characteristic of SCOVILLE and MILNER's [17] patient D.C., who underwent a bilateral medial temporal-lobe removal combined with orbital undercutting, and of PENFIELD and MILNER's [11] cases P.B. and F.C., who had both undergone left temporal lobectomies, and in addition manifested electrographic abnormality in the right temporal lobe. These inter-patient similarities suggest that the low activity rate may be attributable to the medial temporal-lobe lesion rather than to a pre-morbid characteristic.

It seems unlikely that H.M.'s reduced efficiency on certain motor tasks is directly attributable to his severe amnestic syndrome, but it is possible that the two deficits are

cumulative. Thus, although the patient recognized the apparatus from day to day, it is unlikely that he retained any impression of how well he had done on the task the day before. He was not always trying to improve upon yesterday's performance (as were the normal control subjects) because he could not remember what yesterday's performance was. In addition, he might have been less efficient in predicting the irregular shifts in the two tracks encountered in the bimanual task, although the extent to which this strategy was employed by either the normal subjects or H.M. was not determined.

Anecdotal evidence obtained in addition to the quantitative measures described in this report suggests that "testing-habits" [6] were also retained from one day to the next by H.M. At the beginning of each Rotary-Pursuit and Bimanual-Tracking test session he was allowed to look at the apparatus and then asked to describe the task. His memory for the Rotary-Pursuit task, though somewhat inaccurate, was consistent in specifying that he had to touch the stylus to the target in order to stop the disc from turning. On one occasion he further stated that he was not supposed to "touch that spring part" on the stylus, something that he had in fact been reminded about several times before. H.M.'s description of the Bimanual-Tracking task was consistently accurate from Session III on. It is interesting that a similar sparing of testing-habits was observed by GLICKSTEIN and SPERRY [6] under very different conditions. They found that split-brain monkeys, though failing to show intermanual transfer of somesthetic discriminations, did show consistent transfer of the general testing procedure, which involved reaching out and feeling the two discriminanda before selecting one or the other.

The dissociation of different levels of memory, seen in H.M., is relevant to the study of normal memory function. H.M. performs normally on short-term memory tasks ([10]; see also SIDMAN et al. and WICKELGREN this issue), but he shows little evidence of being able to establish new long-term memory traces; this impairment, in turn, contrasts with his ability to acquire motor skill and to remember certain testing-habits from day to day. The pattern of breakdown suggests that there is more than one set of neural structures concerned with memory, and one wonders to what extent the corresponding physiological processes also differ. Electrophysiology has given very few clues as to what the processes may be, and the data that are available have little relevance to the analysis of complex behavior. In the meantime, it would be helpful to know if there is a motor analogue of H.M.'s memory deficit, the subject showing no impairment in initial level of performance but an inability to improve his skill beyond this point. I do not know of any such cases being reported, which may mean that the very specific and severe deficit in motor learning hypothesized does not exist, or that no one has bothered to look for it. What we do know is that the medial parts of the temporal lobes are not necessary for the acquisition of motor skill, but which neural structures are critical for such behavior remains to be answered.

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Résumé—L'acquisition de certaines habiletés motrices fut étudiée chez un sujet de 40 ans présentant un grave syndrome mnésique résultant d'une résection bilatérale de la partie interne des lobes temporaux, résection pratiquée 13 années auparavant. Sur des tests de poursuite rotatoire, de poursuite bimanuelle et de "tapping," ses scores s'amélioraient de séance en séance et dans la seule tache où il était possible de le retester plusieurs jours après la fin de l'entraînement (poursuite rotatoire), il montrait une rétention complète. Ces résultats impliquent que l'apprentissage moteur peut dépendre des structures cérébrales encore intactes chez ce malade. En outre, le fait qu'il était inférieur aux normaux de son âge aux deux épreuves, à la fois dans les niveaux, initial et final, de performances, est attribué au relatif allongement du temps de réaction plutôt qu'au déficit mnésique.

Zusammenfassung—Der Neuerwerb einiger ausgewählter motorischer Handfertigkeiten wurde bei einem 40-jährigen Mann mit einem schweren amnestischen Syndrom untersucht, das aus einer bilateralen medialen Temporallappenresektion resultierte, die 13 Jahre vor dem Versuch ausgeführt worden war. Bei drei Aufgaben, kreisförmiger Handnachführbewegung (Rotary Pursuit), beidhändigem Nachfolgen, und Klopfen, verbesserten sich seine Leistungen von einem Mal zum anderen. An der einen Aufgabe, der kreisförmigen Handnachführbewegung (Rotary Pursuit), an der man ihn nach einigen Tagen wieder prüfen konnte, zeigte er, dass er die Aufgabe vollkommen behalten hatte.

Die Ergebnisse lassen darauf schliessen, dass motorisches Lernen durch Hirnstrukturen vermittelt werden kann, die bei diesem Patienten noch intakt sind. Die zusätzliche Beobachtung, dass er schlechter als ein normaler Mann seines Alters an zwei der Aufgaben abschnitt, nicht nur im Anfangsstadium, sondern auch im Endstadium seiner Leistungen, wird eher seiner relativ langen Reaktionszeit als seinem Gedächtnisausfall zugeschrieben.