STATISTICAL IDENTIFICATION OF STRUCTURES INVOLVED IN THE BEHAVIORAL EFFECTS OF SEPTAL FOREBRAIN LESIONS

by

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Abstract

Discriminant analysis is applied to the anatomical and behavioral data obtained on 18 unoperated control rats and 99 rats with lesions in and about the septal forebrain area. The analysis indicates that specific and, to some extent, disparate sub-areas of the septal region are involved in mediating the facilitated two-way avoidance performance and increased emotionality accompanying large spetal lesions.

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Introduction

The present experiment was concerned with the identification of the areas of the septal region whose destruction is responsible for the behavioral symptons frequently reported to accompany massive septal lesions. One of the earliest and most consistent findings has been the production of the rage syndrome (Brady and Nauta, 1953; 1955). Another consistent behavioral change has been that of facilitated two-way avoidance performance (King, 1958; Schwartzbaum, Green, Beatty, and Thompson, 1967). The one effect, however, does not necessarily involve the other. Unilateral lesions have been shown to produce facilitated avoidance performance that is equivalent to that produced by bilateral lesions but to reduce emotionality (Green and Schwartzbaum, 1968).

Most studies of the septal region have focused on the behavioral analyses, and have treated the anatomical bases of such results in an incidental way. However, one systematic behavioral-anatomical study does exist. Harrison and Lyon (1957) attempted to identify the structures involved in the rage syndrome. They found no consistent relation between behavioral changes and either small or larger and more inclusive lesions, and suggested that the rage syndrome was, in fact, attributable to incidental damage of nonseptal structures. Their conclusions, however, were based on an analysis of

individual, exceptional cases, rather than on a statistical analysis of the data. The fault to be found with this analytical technique is that it involves the assumption that, within the experimental group, all the behavioral variability should be explained by lesion size and placement. In view of the behavioral variability frequently encountered within groups of normal rats, such an assumption seems implausible. It appears that the technique of discriminant analysis (Cooley and Lohnes, 1962) is a suitable alternative to the analytical methods employed by others concerned with the septal forebrain nuclei in the rat. The particular application of discriminant analysis made in the present experiment is sufficiently novel as to require some comment and justification.

First, the usual neuropsychometric practice was reversed, in that behavioral measures were used to define the groups into which the subjects were to be classified, while the weighted sums of brain damage assessments entered into variance calculations. This reflected the current study's concern with the identification of structures responsible for particular behavioral changes, rather than with the development of behavioral tests, which are diagnostic of specific brain damage.

Second, in the stistical assessments of the discriminant analyses, the discrimination achieved

was compared to the level of discrimination obtained using lesion size as the discriminator. The mass of data implicating, at least indirectly, the septal nuclei in the production of the rage syndrome and in the facilitation of avoidance performance made a random reference level inappropriate.

Third, the incorporation into the discriminant analyses of subjects with damage peripheral to the septum and of subjects with no brain damage avoided the error of overexplaining the behavioral variance within the septally lesioned group.

Fourth, the assessment of brain damage within topographically, rather than anatomically, defined regions technically facilitated the analyses. This procedure, of course, failed to utilize morphological data that must eventually be incorporated into any neuropsychological analysis of the septal region.

Finally, the development of behavioral categories posed a serious problem. Behavior theory provided no firm basis for the partitioning of the subjects into discrete groups. For this reason, the categories that were used in the final analyses were those that yielded coefficients that were relatively insensitive to the random incorporation or deletion of subjects, and stable in the sense that slight shifts in the behavioral categories did not seriously disturb the

relative weights assigned to various regions of the brain.

Technical and substantive questions concerning the procedures may be raised. However, the present experiment was undertaken with the assumption that the techniques employed would yield the best available evidence bearing on the question of the anatomical specificity of the behavioral effects attributed to large septal lesions. The author's hypothesis was that the evidence would clearly implicate the septal nuclei in such behavioral disturbances.

Method

Subjects. The subjects were 117 male, Long Evans rats approximately 90 days old at the beginning of the experiment. Ninety-nine were experimental subjects and 18 acted as unoperated controls.

Surgical procedures. The experimental subjects received lesions varying in locus and extent. An attempt was made to produce lesions which were anteriorally, centrally, and posteriorly placed as well as lesions that involved massive damage, cortical damage, and electrode insertion only. Surgery was performed under deep ether anesthesia. The lesions were produced electrolytically by passing an anodal current through a 0.01-inch stainless steel electrode insulated except for 0.5 mm. of its tip.

Ratings and resistance to handling. Eight to 10 days after surgery all experimental subjects were rated for resistance to handling. Each unoperated contol was rated just prior to avoidance training. The method used was similar to that described by Thomas, Moore, and Hunt (1959). The subject was assigned a score of zero if he showed a normal response (little or no avoidance or struggling) and a score of four if he showed a very extreme response (biting, squealing, and struggling). Intermediate numbers were given for less extreme reactions. The ratings were made by two independent observers.

Avoidance apparatus. The two shuttle-boxes used were similar to those employed by Vanderwolf (1964). Each had two compartments, six (width) by 12 x 12 inches separated by a guilotine door. One compartment was white and the other black. The floor consisted of a shock grid. The shock level was .4 ma. of 60 cycle alternating current delivered to the grid bars. Mirrors placed below the shock grid allowed observation of the subjects.

Avoidance procedure. All subjects were run in the shuttle avoidance task on the same day that they were rated for emotionality. The avoidance task was similar to that employed by Krieckhaus, Simmons, Thomas and Kenyon (1964). The door separating the compartments was opened simultaneously with switching off a light (CS) in the compartment containing the subject and switching on a light in the opposite compartment. Continuous footshock (US) was administered 5 seconds after CS onset until the subject crossed to the opposite side of the apparatus. After an intertrial interval of one minute, the lights were reversed, the door raised and the subject had to cross back to the original side. Each subject received 50 trials in a single session.

Anatomical procedures. Following the experiment, the subjects were sacrificed under deep ether anesthesia by percardial perfusion with physiological saline followed by perfusion with 10% formalin in physiological saline. The brains were sectioned at 30 micra and every third section stained with cresyl violet acetate. The sections were projected onto standard drawings of the brain. These drawings were photographs of 30 micra sections of an undamaged brain upon which a grid had been imposed (see Figure 1 and 2)[1]. The grid was aligned such that on each standard section, vertical zero (0) was in line with the dorsal surface of the cortex and lateral four (4) with the midline. In transferring the brain sections of the subjects onto the standard drawings, the subject's section showing the genu of the corpus callosum was projected onto standard section 82, while the subject's section showing the middle of the crossing of the anterior commissure was projected onto standard section 136. Brain damage was encoded such that if any tissue within a square was damaged, the square was assigned a value of one; otherwise, a value of zero was assigned. Damage was summed across the squares within the 16 areas (A1-D4) as shown in Table 1.

Data analysis. The measures used for each subject include:

Emotionality: Rating on resistance to handling averaged over two observers.

Avoidance: Number of conditioned avoidance responses (CARs) in 50 trials.

Total Lesion size: Brain damage scores summed over 16 brain areas (see Anatomical procedures).

The reliabilities cited in the results are rank-order correlation coefficients computed for emotionality between the ratings assigned by each observer; and for avoidance, between the number of CARs on odd and on even trials.

Discriminant analyses between high and low performance groups were completed for the behavioral classifications indicated in Table I-C. The reliabilities cited in the results are rank-order correlation coefficients between the discriminant coefficients computed for two randomly selected subgroups of the 117 subjects.[2] The stabilities cited are rank-order correlation coefficients between the discriminant coefficients of the analyses for adjacent criteria. The standard for the acceptance and subsequent interpretation of any discriminant analysis was that it achieved significant ($p < .05$) relative to randomness reliability and stability.

Finally, to assess the statistical adequacy of the discriminant functions, rank-order correlations between

the discriminant scores of individual subjects and the subject's performance on the corresponding behavioral scale were compared to the rank-order correlations between total brain damage and the behavioral measures. Since the discriminant functions were computed to be classification devicies, this procedure involved the imposition of a stricter and more conservative standard than would one involving point-biserial correlation coefficients.

While the significance level used throughout the analyses was 0.05, the cited p-values are the minimum values achieved using the procedures and tabulations of Bruning and Kintz (1968) and of Siegel (1956).

Results

The individual data are listed in Table II. Each subjects's avoidance score, emotionality score, damage per area of the brain, and total brain damage are shown. Frequency distributions of the avoidance scores, of the emotionality scores, and of the total brain damage scores are shown in Figure 3.

The reliability of the avoidance scores was 0.69 ($p < .01$).

The reliability of the emotionality scores was 0.96 ($p \approx 0$). There was also high absolute agreement between the observers on their ratings of the subjects' resistance to handling; i.e., there was complete agreement on the ratings of 100 of the 117 subjects, disagreement by one scale point on the ratings of 15 subjects and by two points on two subjects.

The reliabilities and stabilities of the discriminant functions are shown in Table III. Considering these figures for avoidance performance, there was no compelling reason for choosing among the various criteria. On the basis of the reliabilities, 22 and 31 were the only acceptable criteria explored. Since 31 accomplished the most equal split of the population, the discriminant function using this criterion was chosen for further analysis. However, a later review of the computations indicated that the choice of 31 over 22 made no substantial difference in the outcome of the subsequent analysis. In

the case of emotionality ratings, 3 was the only acceptable criterion.

Table IV shows pertinent discriminant functions for avoidance performance and emotionality.

Attending only to the gross and consistent results of the discriminant analyses, a simplified version of the results obtained here is shown in Figure 4. Those areas whose destruction increased the probability that a subject would be classified in the high performance group are designated as facilitatory, while those areas whose destruction decreases this probability are designated as inhibitory. Areas contributing in no consistent way to the discrimination are designated as neutral.

The facilitating areas involved in the avoidance conditioning effect were C1, A2, D2, B3, and D4 (cortex, hippocampal rudiment, the accumbens nucleus, bed nucleus of the anterior commissure, the lateral and medial septal nuclei, and the nucleus of the diagonal band of Broca). The inhibitory areas included D1, B2, C2, A3, and B4 (cortex, the lateral septal nucleus and the accumbens nucleus).

The facilitatory areas for emotionality included B1, D2, B3, C3, and C4 (cortex, the accumbens nucleus, the hippocampal rudiment, the bed nucleus of the anterior commissure, the lateral septal nucleus, the medial septal

nucleus, and the nucleus of the diagonal band of Broca. The only consistently inhibiting area was C2 (mainly cortex and a small dorsal portion of the lateral septal nucleus).

The results of the discriminant analyses using only the brain damage scores for the facilitatory and inhibitory areas shown in Figure 4, yielded the functions shown in Table V.

Since the computations of the discriminant functions involved the manipulation of the brain damage scores to obtain an optimal classification procedure, it should not be suprising that such a result was achieved.

Table VI shows the results of a more stringent test. The discriminant scores and the total brain damage scores were compared by computing their rank-order correlations with the individual subjects' performance on the behavioral test; i.e., the test scores were treated as ranking, rather than classification devices. For avoidance performance, the discriminant scores' correlation was significantly higher than that of the total brain damage. For emotionality, there was no significant difference between the correlations obtained using total brain damage and those obtained using the discriminant scores.

Discussion

The discriminant analyses provide a statistical basis for ascribing the facilitated avoidance performance and emotionality to septal damage.

The most elementary explanation focuses upon lesion size within the septal area and ignores the findings concerning specific facilitatory and inhibitory areas. Considering first the avoidance conditioning data, one can conclude that: the probability that a subject will be included in the high performance group is an inverted U-shaped function of the amount of septal damage; i.e., this probability increases with increasing lesion size up to a point, and then declines with further increases in lesion size. Considering the emotionality data, the results indicate that: the probability that the subject will be included in the high performance group is a monotonic non-decreasing function of the amount of septal damage; i.e., the probability increases with increasing lesion size up to a point, bur further increases in size neither increase nor decrease this probability.

Conclusions beyond these, if based only on the data of this experiment, could not be regarded as sound, since the analyses reflect not only the nature of septal-behavior relationships but also the distribution of the brain damage used to assess such relationships. However,

the results of other experiments, together with the results obtained here, permit an interpretation in terms of the specific loci of the inhibitory and facilitatory areas.

First, the results obtained here are in close agreement with those reported by Kaada, Rasmussen, and Kveim (1962), in their study of passive avoidance behavior following lesions of the septum and other areas. The lesions that these investigators found to be effective in disrupting passive avoidance behavior generally involved those areas that were found to be facilitatory in the present study. Van Hoeson, MacDougall, and Mitchell (1969) also found facilitatory areas for improved two-way avoidance performance which are consistent with those found here. Many of the anterior lesions that Kaada et al. (1962) found to be ineffective in disrupting passive avoidance behavior intruded primarily upon areas designated here as either neutral or inhibitory. Thus, the results obtained here provide additional evidence for the existence of a functionally important neural system arising in the frontomesial cortex and continuing ventromedially into the hypothalamus and brain stem (Kaada et al., 1962).

Considering the anatomical specificity of the hyperemotionality associated with large septal lesions, one finds two sources of additional evidence. First, Kelly (1969) used essentially the same procedure as was

employed here, but worked with a different set of topographically defined subareas in and around the septal region. Second, the author reanalized the published data of Harrison and Lyon (1954), completing a discriminant analysis of their estimates of damage to anatomically defined areas in and near the septal region. The three sets of results agree in implicating a central core of septal structures in the production of hyperemotionality. They disagree in their findings concerning the existence of inhibitory areas. In the present study, only one inhibitory area was found; this infringed upon midline cortex, the corpus callosum, and the dorsal portion of the lateral septal nucleus. Kelly's and Harrison and Lyon's data yielded inhibitory areas generally ringing the septum in much the same manner as was observed here in the analysis of the avoidance conditioning data. At the present time, the consistencies and inconsistencies of the evidence suggest that the hyperemotionality may result from massive destruction of the central core of the septal region and may be only tangentially related to disturbance of avoidance conditioning accompanying septal lesions.

Since only 18 subjects in the present study sustained unilateral damage, no firm conclusions can be made regarding the necessity for bilateral destruction in producing the behavioral effects of septal damage.

However, the available evidence provides no reason to disagree with Green and Schwartzbaum (1963) who found that unilateral lesions facilitated avoidance performance but reduced emotionality.

The results of the present experiment do not allow for extended conjectures concerning the functional organization of the areas found to be involved in the production of hyperemotionality and facilitated avoidance performance. Such speculations must wait upon a more thorough understanding of the behavioral nature of the symptoms of septal damage.

However, reasonable questions do arise in connection with the conclusions offered here. The most important of these relate to the problem of moving from probabilistic to neurological statements. It has been found that destruction to various areas sum to yield statements concerning the probability of observing a symptom of septal damage. It is a matter for further experimentation to determine whether the intensity of the symptoms will also show such an additive effect. A similar, but more specific quesion can be raised concerning the inhibitory areas: Will the destruction of such areas yield decrements in performance independent of the destruction of facilitatory areas, or is their effect only reactive with destruction of the facilitatory areas?

The answers to these questions and the validation of the statistical procedures adopted here depends upon

further anatomical studies of the septal region employing a diverse set of lesions, more restricted in size and unrestricted as to continuity. The present sutdy has made its most substantial contribution to an understanding of septal function by:

1. Clearly implicating the destruction of septal structures in production of the facilitated avoidance performance and hyperemotionality accompanying massive lesions in the general area of the septum.

2. Providing an initial topographic definition of areas involved in these behavioral effects.

3. Advancing a technique that may be of general utility in the study of brain-behavior relationsips.

Footnotes

1. The brain diagrams in Figures 1, 2, and 4 were taken from De Groot (1959) and from Moore (1958).

2. For purposes of internal reliability of criterion scores, the subjects were randomly divided into two groups. U test run on these groups yielded z values of 0.314 and 0.598 ($p > .05$) for avoidance and emotionality respectively.

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Table I-A

Summing to yield values of 16 variables:

Variable	Vertical limits, grid line numbers	Lateral limits grid line numbers	Anterior-posterior limits, section numbers
A1	0-2)		
A2	2-4)		
A3	4-6)	2-6	46-73
A4	6-8)		(10 sections)
B1	0-2)		
B2	2-4)		
B3	4-6)	2-6	76-103
B4	6-8)		(10 sections)
C1	0-2)		
C2	2-4)		
C3	4-6)	2-6	106-133
C4	6-8)		(10 sections)
D1	0-2)		
D2	2-4)		
D3	4-6)	2-6	136-163
D4	6-8)		(10 sections)

Table I-B

Structures included in brain areas A1 to D4

Brain Area	Acc	BAC	BHC	BSM	BST	LS	MS	NDB	NSF	Hip	NTS	Cor
A1												X
B1												X
C1												X
D1												X
A2												
B2												
C2						X	X					
D2						X						
A3	X											
B3	X											
C3	X	X				X	X	X		X		
D3					X	X			X		X	
A4										X		
B4	X											
C4	X							X				
D4		X						X				

Table I-C. Discriminant analysis procedure. For emotionality and avoidance measure, the criteria for defining the high performance group in successive discriminant analyses appear as column headings. The populations on which the analyses were performed appear as row headings. The entries of the table are the number of subjects in the high performance group. For example, using an emotionality rating of 3.0 as a criterion, of the 117 subjects in the study, 44 achieved scores ≥ 3.0; of the 58 subjects in Random Subgroup I, 20 achieved scores ≥ 3.0; and of the 59 subjects in Random Subgroup II, 24 achieved scores ≥ 3.0.

Table I-C

Discriminant Analysis Procedure

	High Performance Group Defined As									
	Emotionality				Avoidance					
Populations	1.0	2.0	3.0	4.0	20	22	25	31	34	37
All Subjects N = 117	82	66	44	34	88	83	74	58	41	26
Random Subgroup I N = 58	40	33	20	16	41	41	37	29	18	12
Random Subgroup II N = 59	42	33	24	18	42	42	37	29	23	14

TABLE II

INDIVIDUAL DATA

RAT NUM	AVOID SCORE	HANDL SCORE	BRAIN AREAS																TOTAL
			A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3	A4	B4	C4	D4	
1	30	4.0	0	18	15	0	0	15	27	8	3	69	44	0	0	22	5	0	226
2	32	3.0	0	0	13	0	0	5	36	10	0	3	32	11	0	0	8	0	118
3	41	4.0	0	2	35	10	0	1	37	9	0	21	44	13	0	2	3	0	177
4	23	0.0	2	20	0	0	29	33	0	0	20	44	0	0	0	2	0	0	150
5	38	2.5	0	6	15	0	0	20	24	0	0	33	27	2	0	2	0	0	129
6	27	4.0	0	15	0	0	1	26	3	0	4	57	6	0	0	1	0	0	113
7	36	2.5	2	53	5	0	0	25	4	0	2	51	12	0	0	0	0	0	154
8	31	3.0	0	23	6	0	0	9	51	55	0	28	75	88	0	1	0	2	338
9	41	0.0	0	18	0	0	2	32	1	0	0	74	16	0	0	5	0	0	148
10	32	1.5	0	26	0	0	1	19	0	0	9	66	13	0	0	13	4	0	151
11	39	3.0	0	0	0	13	0	0	16	41	0	0	11	33	0	0	0	0	114
12	32	4.0	8	21	0	0	2	36	35	3	2	63	82	4	0	9	13	0	278
13	39	2.5	17	8	0	0	27	10	0	0	13	44	0	0	0	0	0	0	119
14	27	0.0	28	7	0	0	16	9	0	0	7	39	0	0	0	0	0	0	106
15	5	0.5	0	4	14	0	0	13	23	3	0	17	21	8	0	0	1	0	104
16	34	4.0	5	35	2	0	7	30	20	6	12	63	38	12	1	20	30	0	281
17	32	4.0	24	6	0	0	9	10	0	0	10	65	4	0	0	4	0	0	132
18	35	4.0	0	27	15	0	0	7	17	0	0	27	32	0	0	1	0	0	126
20	37	4.0	0	16	10	0	0	6	25	20	0	35	36	25	0	19	22	2	216
21	39	1.0	0	24	0	0	1	21	14	0	3	53	10	0	0	1	0	0	127
22	37	1.5	0	20	23	0	0	1	25	1	0	0	33	8	0	0	4	1	116
23	31	1.0	0	30	2	0	0	13	12	1	0	24	41	3	0	2	0	0	128
24	36	4.0	8	61	10	0	5	22	29	6	27	70	41	4	1	6	0	0	290
25	21	2.0	34	8	0	0	17	0	0	0	51	19	0	0	0	2	0	0	131
26	38	1.0	0	0	22	1	0	0	15	12	0	1	17	14	0	0	0	0	82
27	47	4.0	0	9	66	11	0	4	65	34	2	64	72	58	0	12	18	12	427
28	26	0.0	0	34	2	0	0	31	0	0	7	58	0	0	0	2	0	0	134
29	33	3.0	0	6	33	1	0	0	12	1	0	8	30	7	0	0	4	0	102
30	41	0.0	0	10	55	6	0	0	42	19	0	2	31	22	0	0	6	5	198
31	39	2.0	9	8	0	0	21	27	1	0	18	69	2	0	2	0	0	0	157
32	41	2.5	0	0	21	0	0	0	25	8	0	4	30	17	0	0	1	0	106
33	34	1.0	6	21	0	0	1	22	0	0	12	47	12	0	1	11	2	0	135
34	41	0.0	0	15	0	0	3	14	0	0	11	62	5	0	0	3	0	0	113
35	30	1.5	0	11	45	0	0	1	8	0	0	14	13	0	0	0	0	0	92
36	44	4.0	14	51	29	0	0	20	15	0	0	28	34	0	0	7	6	0	204
37	9	4.0	17	42	3	0	3	25	0	0	5	50	4	0	0	0	0	0	149
38	33	4.0	0	0	20	0	0	3	26	7	0	12	37	9	0	0	9	0	123
39	35	4.0	12	15	0	0	12	32	15	0	10	76	38	0	0	14	0	0	224
40	41	1.0	28	15	0	0	5	8	0	0	2	32	0	0	0	0	0	0	90

TABLE II (CONTINUED)

INDIVIDUAL DATA

RAT NUM	AVOID SCORE	HANDL SCORE	BRAIN AREAS																TOTAL
			A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3	A4	B4	C4	D4	
41	12	1.5	0	34	2	0	0	14	21	0	0	19	17	0	0	0	0	0	107
42	16	4.0	3	43	4	0	8	37	13	0	25	71	45	0	0	3	4	0	256
43	47	0.0	16	1	0	0	6	3	0	0	6	50	0	0	0	0	0	0	82
44	34	4.0	0	0	25	0	0	0	31	8	0	12	36	2	0	0	2	0	116
45	28	0.0	6	28	0	0	6	16	18	8	32	80	23	4	0	2	0	0	223
46	43	4.0	11	36	0	0	6	28	0	0	3	47	2	0	0	0	0	0	133
47	20	2.0	0	8	6	0	0	21	18	0	0	9	24	0	0	0	0	0	86
48	35	3.5	0	42	10	0	0	28	30	6	0	19	48	13	0	0	2	2	200
49	38	2.5	10	0	0	0	6	7	0	0	5	27	0	0	0	0	0	0	55
50	23	2.0	0	0	15	0	0	0	27	11	0	4	31	19	0	0	0	0	107
51	14	4.0	0	22	0	0	2	26	18	5	8	51	29	1	0	3	1	0	166
52	30	0.0	1	35	0	0	4	13	0	0	4	40	0	0	0	1	0	0	98
53	4	0.0	0	0	0	15	0	0	8	16	0	0	9	15	0	0	0	0	63
55	34	4.0	23	0	0	0	26	2	0	0	10	13	0	0	0	0	0	0	74
56	21	2.5	0	9	18	0	0	29	28	0	0	14	8	0	0	0	0	0	106
57	43	4.0	11	42	12	0	10	49	30	10	9	54	29	5	0	0	0	0	261
58	37	4.0	2	28	0	0	5	25	0	0	3	36	0	0	0	0	0	0	99
59	43	2.0	0	8	21	0	0	1	23	20	0	8	28	4	0	1	0	0	114
60	42	3.0	10	57	2	0	4	55	6	0	1	72	33	0	0	0	1	0	241
61	24	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	15	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	14	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	9	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	36	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	37	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	34	1.0	4	2	0	0	11	4	0	0	15	15	0	0	0	0	0	0	51
68	11	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	33	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	27	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	32	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	9	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	24	2.0	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49
81	36	1.5	7	0	0	0	32	16	0	0	2	0	0	0	0	0	0	0	57
82	16	0.0	9	11	0	0	3	1	0	0	3	18	0	0	0	0	0	0	45
83	27	0.0	59	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
84	15	4.0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	7
85	10	4.0	28	0	0	0	1	0	0	0	12	0	0	0	0	0	0	0	41
86	33	0.0	3	16	0	0	1	3	24	2	1	48	20	0	0	0	0	0	118
87	29	2.0	23	6	0	0	0	4	0	0	0	28	0	0	0	0	0	0	61

TABLE II (CONTINUED)

INDIVIDUAL DATA

RAT NUM	AVOID SCORE	HANDL SCORE	BRAIN AREAS A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3	A4	B4	C4	D4	TOTAL
88	3	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	30	0.5	27	12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	40
90	29	0.0	72	6	0	0	13	2	0	0	0	0	0	0	0	0	0	0	93
91	29	0.0	20	14	0	0	5	31	2	0	4	54	4	0	0	7	0	0	141
92	24	1.0	62	0	0	0	28	4	0	0	37	16	0	0	0	0	0	0	147
93	20	1.0	51	25	0	0	8	4	0	0	0	0	0	0	0	0	0	0	88
94	9	4.0	53	25	0	0	17	10	0	0	0	0	0	0	0	0	0	0	105
95	33	0.0	18	12	0	0	5	23	0	0	2	27	0	0	0	0	0	0	87
96	22	4.0	19	12	0	0	13	0	0	0	2	0	0	0	0	0	0	0	46
97	6	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	17	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	9	2.5	57	63	3	0	0	0	0	0	0	0	0	0	0	0	0	0	123
100	21	3.0	22	0	0	0	48	0	0	0	46	6	0	0	0	0	0	0	122
101	22	0.0	26	18	0	0	15	9	2	0	37	51	15	0	2	5	0	0	180
102	30	2.0	0	3	22	0	0	2	23	13	0	11	27	14	0	0	0	0	115
103	24	0.0	4	56	23	1	1	20	13	0	0	0	0	0	0	0	0	0	118
104	10	4.0	20	1	0	0	10	2	0	0	37	23	0	0	0	0	0	0	93
105	36	3.0	0	0	0	0	0	0	19	31	0	46	32	48	0	0	0	0	176
106	10	4.0	0	9	0	0	7	2	18	0	13	61	45	2	0	2	4	0	163
107	17	4.0	0	8	48	23	0	4	45	61	0	4	38	47	0	0	0	0	278
108	19	4.0	6	65	25	0	0	0	0	0	0	0	0	0	0	0	0	0	96
109	33	4.0	12	24	0	0	0	16	31	6	0	47	52	14	0	8	4	0	214
110	31	4.0	0	20	23	30	0	0	23	49	2	49	42	64	0	0	0	0	302
111	35	0.0	0	22	32	0	0	10	43	20	0	19	37	10	0	0	0	0	193
112	24	4.0	34	14	0	0	9	11	0	0	13	38	3	0	0	0	0	0	122
113	19	2.5	25	56	7	0	0	0	0	0	0	0	0	0	0	0	0	0	88
114	8	1.5	0	18	36	7	0	17	56	33	0	19	49	27	0	0	0	0	262
115	12	4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	10	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	3	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	25	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	32	2.0	25	7	0	0	20	9	15	20	60	66	18	0	11	18	6	0	275
121	38	0.5	0	0	21	0	0	0	16	25	0	0	15	16	0	0	0	0	93
122	34	4.0	0	27	0	0	0	13	4	0	0	60	15	0	0	0	0	0	119
123	28	3.0	0	0	1	5	0	0	9	31	0	0	11	44	0	0	0	0	101
124	33	3.0	0	5	10	0	0	0	25	1	0	3	49	17	0	0	5	0	115
125	16	2.0	0	0	13	1	0	0	24	6	0	0	30	6	0	0	0	0	80
126	32	0.0	0	39	12	0	0	24	21	2	0	21	30	6	0	0	0	0	155
127	39	1.0	0	0	9	8	0	0	11	17	0	0	14	21	0	0	0	0	80

Table III. Reliabilities and stabilities of the discriminant functions for avoidance and emotionality. Reliability = rank-order correlation between the discriminant coefficients computed for two random subgroups of the total population of subjects. Upper stability = rank-order correlation between the discriminant coefficients using criterion specified above the column and those computed using the next higher criterion. Lower stability = correlation computed using the specified criterion and the next lower criterion. NS = correlation did not differ signficantly from zero ($p > .05$) * = computations could not be completed because of inadequate sample sizes.

Table III-A

Avoidance

	Criteria					
	≥20	22	25	31	34	37
Reliability						
Rank-order correlation	*	.66	.31	.66	.19	*
p		.01	NS	.01	NS	
Stability						
Upper Rank-order correlation	.90	.88	.87	.66	.91	*
p	.01	.01	.01	.01	.01	
Lower Rank-order correlation	*	.90	.61	.87	.64	.91
p		.01	.01	.01	.01	.01

Table III-B

Emotionality

	≥1	2	3	4
Reliability				
Rank-order correlation	.22	-.07	.65	.52
p	NS	NS	.01	.05
Stability				
Upper Rank-order correlation	.07	.54	.88	*
p	.01	.05	.01	
Lower Rank-order correlation	*	.70	.54	.88
p		.01	.05	.01

Table IV-A

Normalized discriminant coefficients for avoidance behavior

	Criteria					
	≥ 25	≥ 31			≥ 34	
Area		Gp I	Gp II	Combined		Assigned Value
A1	0.14	-3.81	-0.70	-1.99	-2.85	
B1	-1.71	3.17	-0.92	-0.21	0.19	
C1	4.29	0.96	1.06	1.43	3.98	+
D1	-11.08	-3.19	-5.59	-4.90	-11.93	-
A2	3.43	9.24	5.01	6.65	9.31	+
B2	-1.33	-1.37	-1.92	-1.59	-0.35	-
C2	-3.84	-3.71	-0.89	-2.75	-2.95	-
D2	2.37	3.70	0.96	1.61	10.66	+
A3	-8.30	-4.17	-7.44	-7.28	-7.67	-
B3	4.66	2.86	2.35	3.00	3.57	+
C3	1.56	1.96	1.86	3.53	0.04	+
D3	1.82	-0.02	0.35	0.15	-5.95	
A4	32.01	29.21	55.93	44.64	1.49	
B4	-2.80	-13.17	-2.37	-8.71	-7.21	-
C4	4.06	16.45	0.82	8.06	7.91	-
D4	-16.60	-3.02	11.85	-3.51	23.92	

Table IV-B

Normalized discriminant coefficients for emotionality ratings

	Criteria				
	≥2.0	≥3.0		≥4.0	
Area		Gp I	Gp II	Combined	Assigned Value
A1	1.67	0.66	-0.03	0.24	1.06	
B1	1.25	1.49	0.24	1.64	1.48	+
C1	0.69	-1.57	1.68	-0.08	0.83	
D1	-2.40	-0.82	-0.88	2.57	11.55	
A2	2.80	-0.51	5.09	4.43	2.30	
B2	-0.61	1.02	-0.45	-0.30	-2.32	
C2	-5.16	-4.58	-3.29	-7.30	-3.18	-
D2	2.57	3.46	1.51	4.77	4.10	+
A3	1.27	1.74	-2.72	0.47	-0.64	
B3	0.44	0.65	0.69	0.67	2.12	+
C3	8.20	4.16	2.50	7.86	4.36	+
D3	1.50	-0.35	1.39	-0.18	-6.33	
A4	14.96	-25.63	-31.68	-36.11	-40.85	
B4	-11.55	-8.11	-3.35	6.13	1.74	
C4	15.67	27.61	6.59	14.87	11.86	+
D4	-29.25	-17.64	-37.92	-12.36	-5.26	

Table V

Normalized discriminant coefficients for avoidance and emotionality employing selected areas of brain damage

Avoidance		Emotionality	
Area	≥31 Combined Gps.	Area	≥3.0 Combined Gps.
A2	11.18	B1	4.85
A3	-12.44	B3	0.71
B2	-3.46	C2	-26.31
B3	7.01	C3	25.68
B4	-11.59	C4	27.84
C1	3.10	D2	14.61
C2	-5.16		
C3	7.62		
C4	16.61		
D1	-14.95		
D2	6.87		

Table VI

Significance tests of discriminant functions for avoidance and emotionality. Rank-order correlations are shown for z values and total brain damage scores compared with the criteria of 31 or greater avoidances and 3.0 or greater emotionality rating. The correlations associated with all variables as well as the selected variables (see Figure 4.1 and 4.2) are also shown.

Avoidances: 31 or greater

	All variables			Selected variables		
	Combined	Gp I	Gp II	Combined	Gp I	Gp II
z values	.54	.59	.57	.52	.58	.55
brain damage	.34	.44	.26	.34	.44	.26
probability (1-tailed)	.005	.01	.0005	.005	.01	.0005

Handling: 3.0 or greater

	All variables			Selected variables		
	Combined	Gp I	Gp II	Combined	Gp I	Gp II
z values	.52	.54	.56	.46	.48	.48
brain damage	.40	.38	.45	.40	.38	.45
probability (1-tailed)	.025	.025	.05	.05	.05	.05

Figure 1. The grid for encoding brain damage is illustrated on selected coronal sections through the septal region of the standard rat brain. The vertical grid is shown on the left margin; the lateral grid is shown along the bottom of each section. The resulting 80 square grid was imposed on 40 sections (every third section from Section number 46 to 163). Five sections (Section numbers 46, 76, 106, 136, and 163) are shown. Abbreviations used: Ac, anterior commissure or its anterior extension; Acc, nucleus accumbens; BAC, bed nucleus of anterior commissure; BHC, bed nucleus of hippocampal commissure; BSM, bed nucleus of stria medullaris; BST, bed nucleus of stria terminalis; CC, corpus callosum; FX, fornix; HC, hippocampal commissure; Hip, hippocampus or nucleus septohippocampalis; IG, induseum griseum; LOT, lateral olfactory tract; LS, lateral septal nucleus, MS, medial septal nucleus; NDG, nucleus of the diagonal band of Broca; NFS, nucleus septofimbrialis; NTS, nucleus triangularis septi; OC, optic chiasma; OT, olfactory tubercule; PO, preoptic area; Pyr, pyriform cortex; RhF, fhinal fissure; SM, stria terminalis; TH, thalamus; V, ventricle.

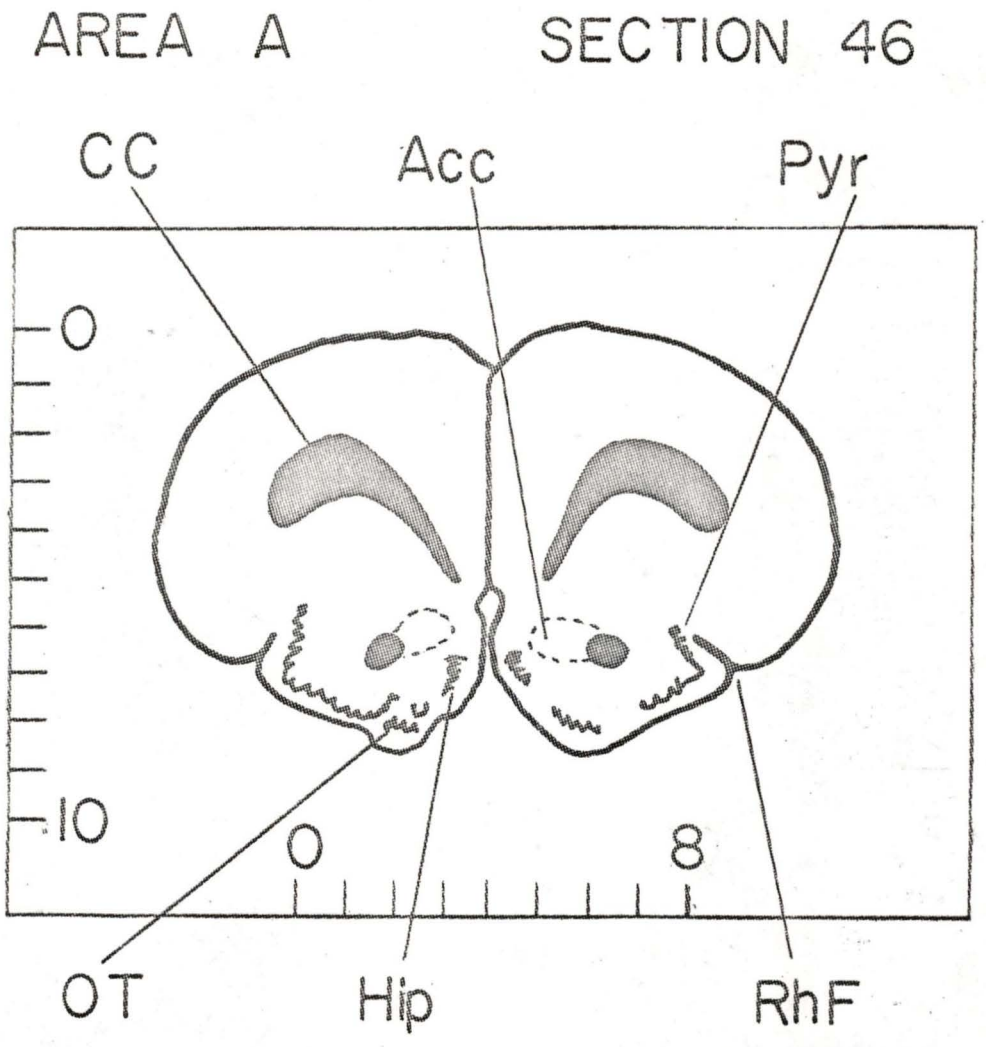

Figure 1.1

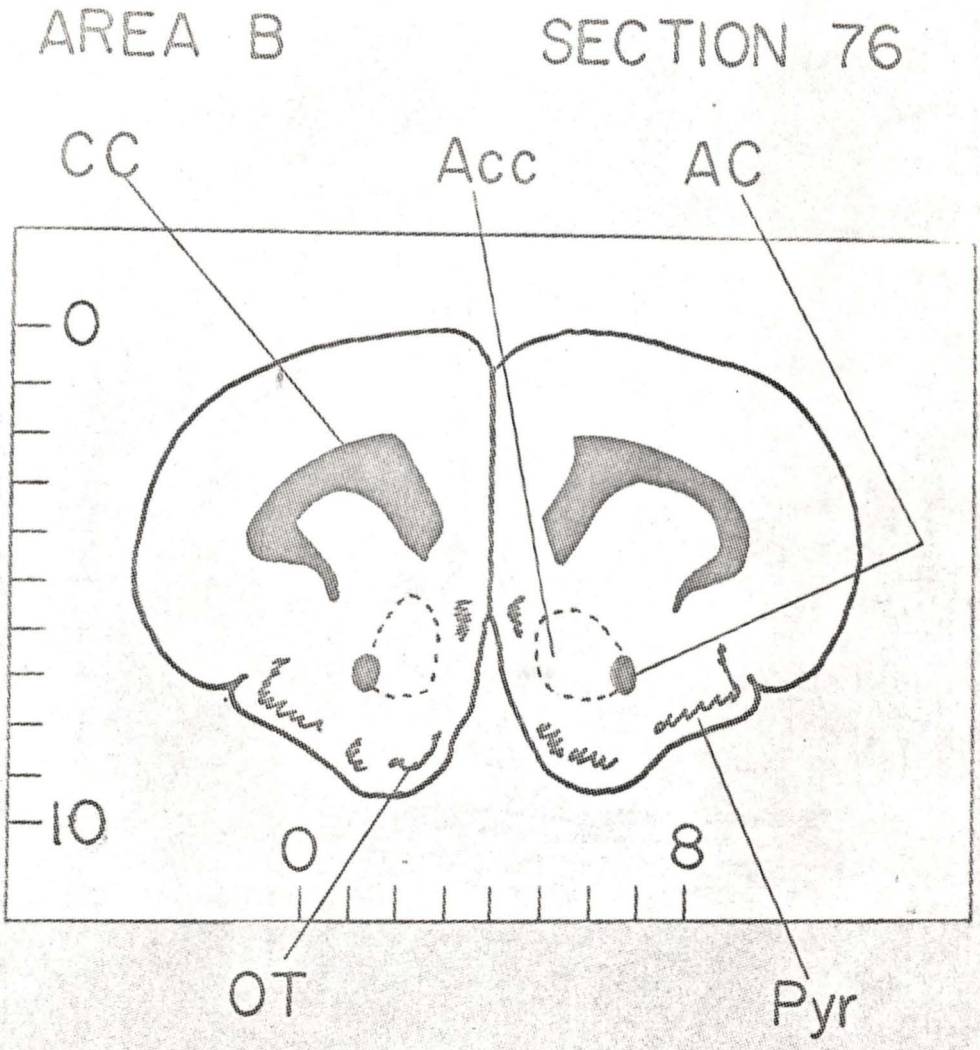

Figure 1.2

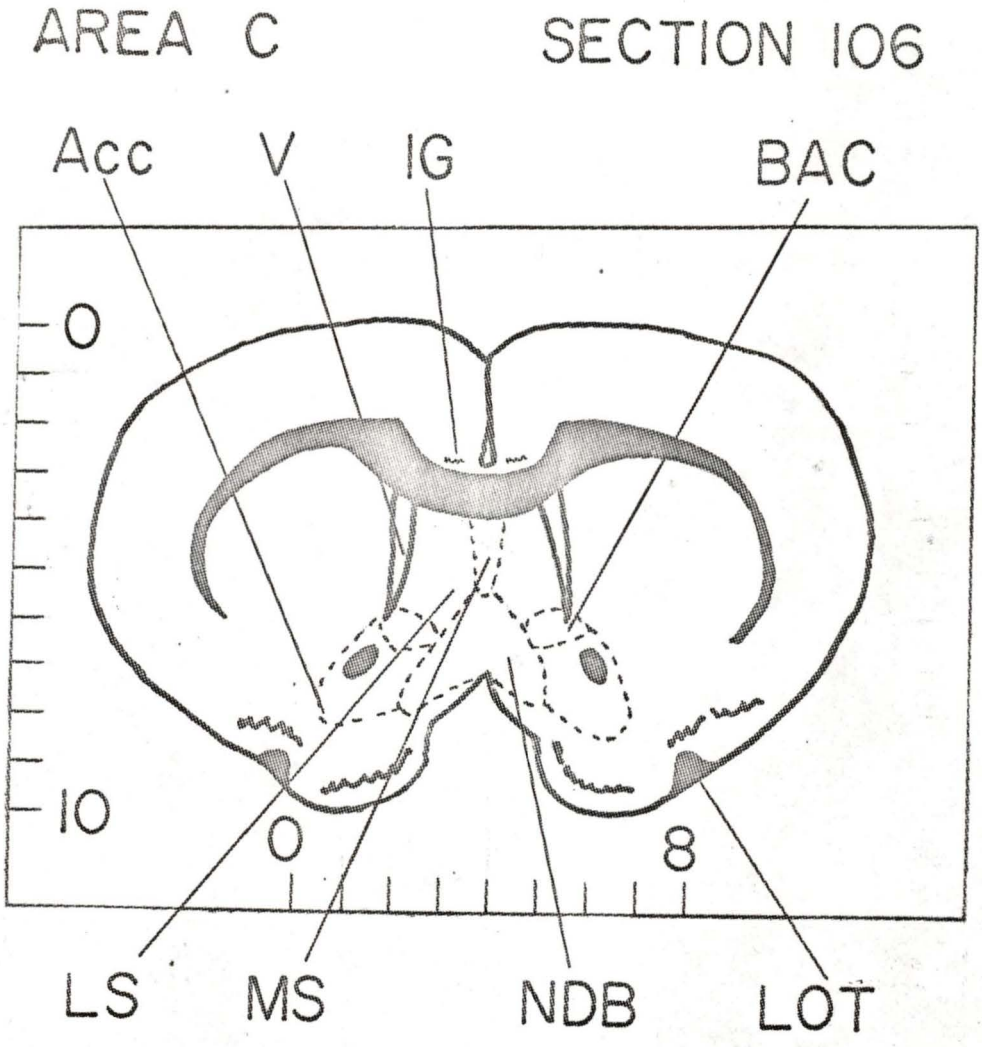

Figure 1.3

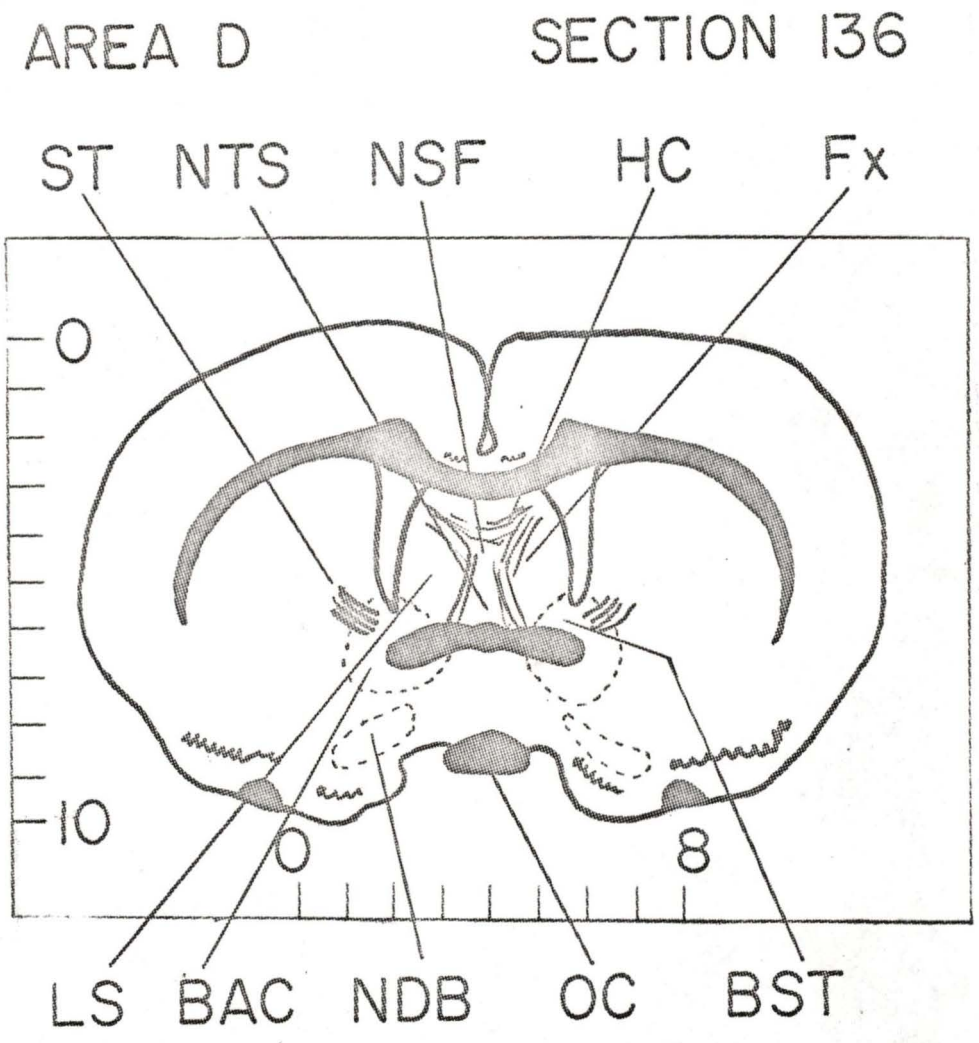

Figure 1.4

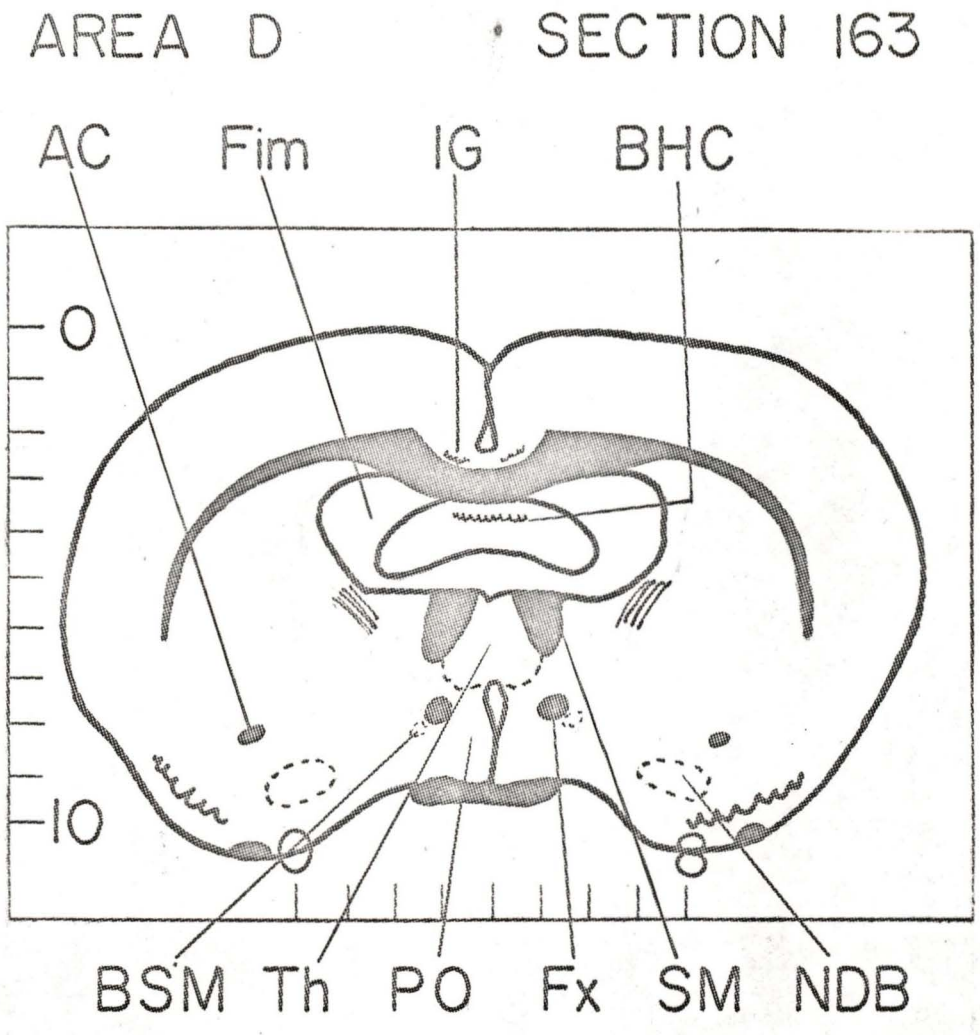

Figure 1.5

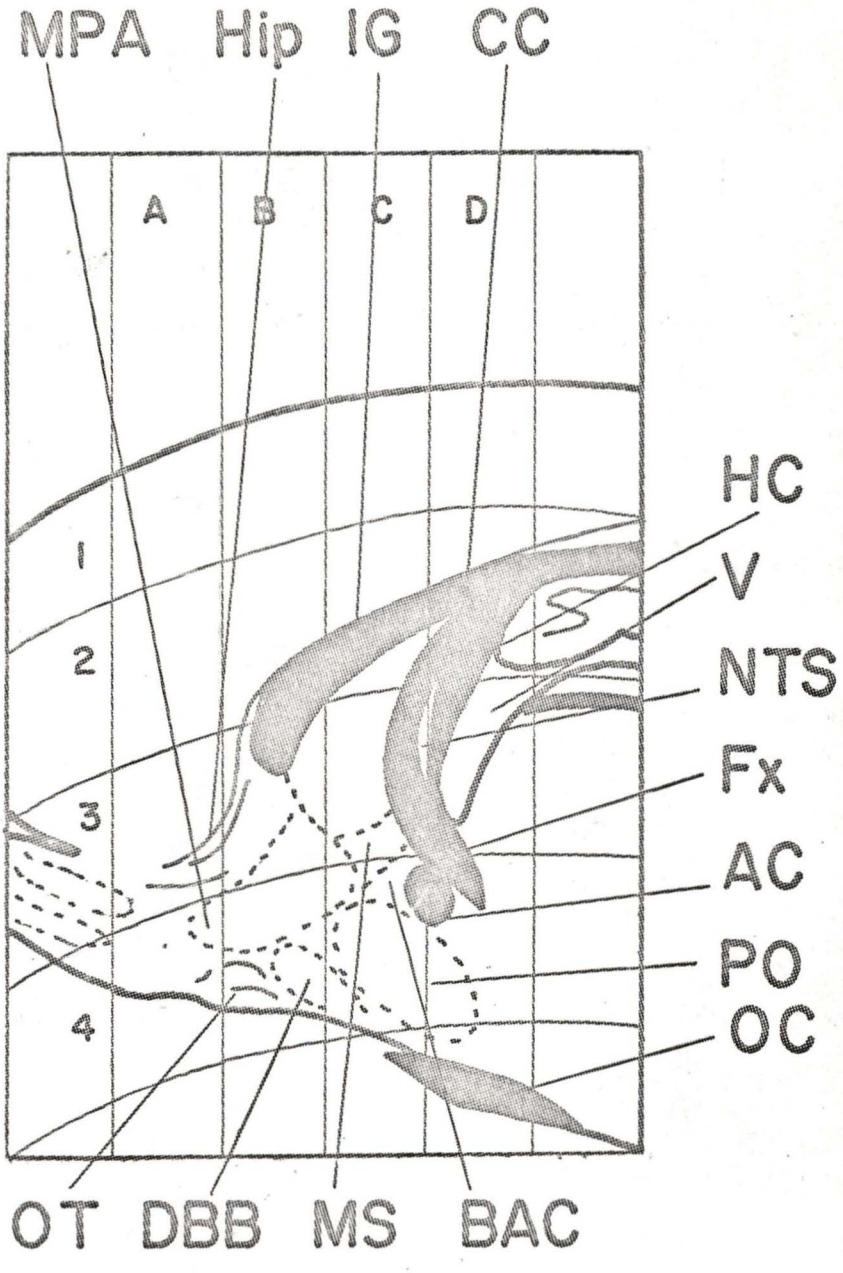

Figure 2. A parasagittal section showing brain areas A1 to D4. Abbreviations used: DBB, diagonal band of Broca; MPA, medial paraolfactory area; (see also Figure 1).

Figure 3. The frequency distributions for the behavioral indicators as well as for lesion size are illustrated.

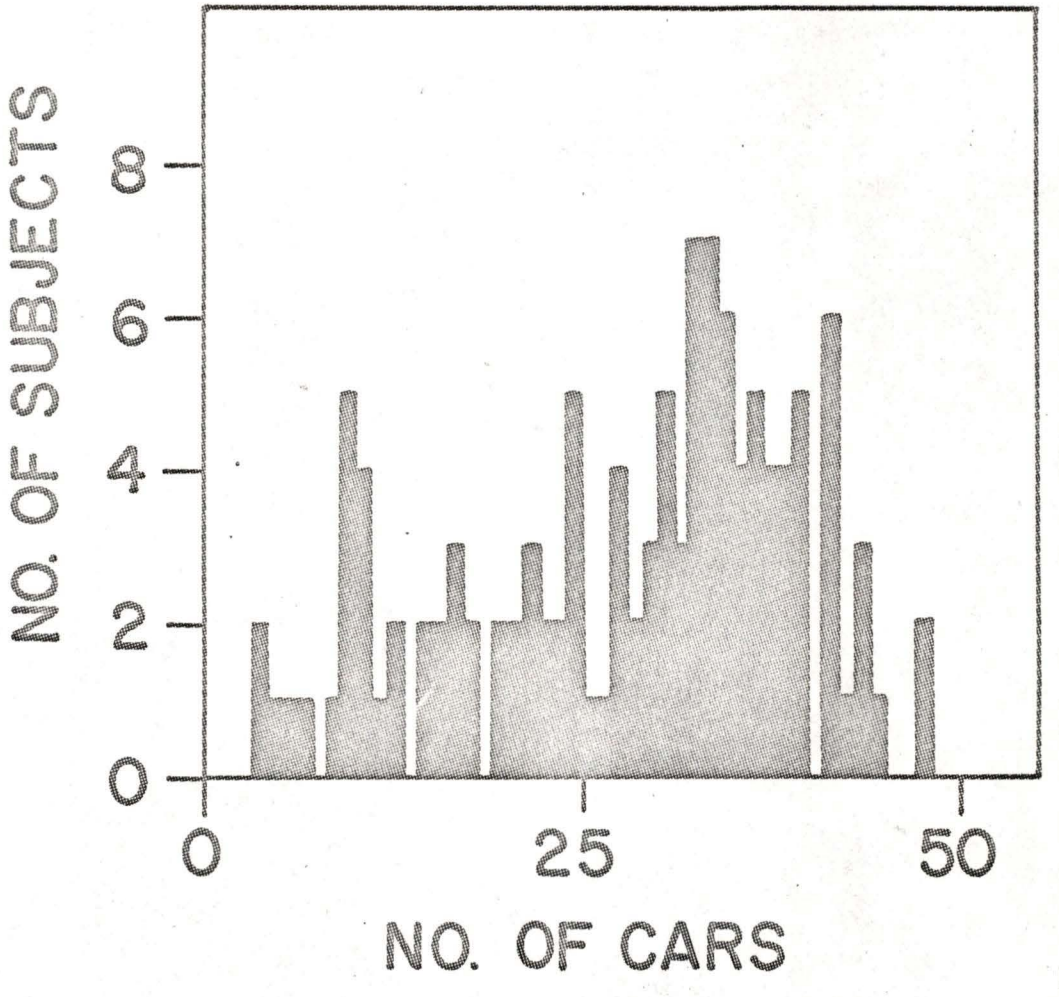

Figure 3.1. Frequency distribution of number of CARS made in 50 trials.

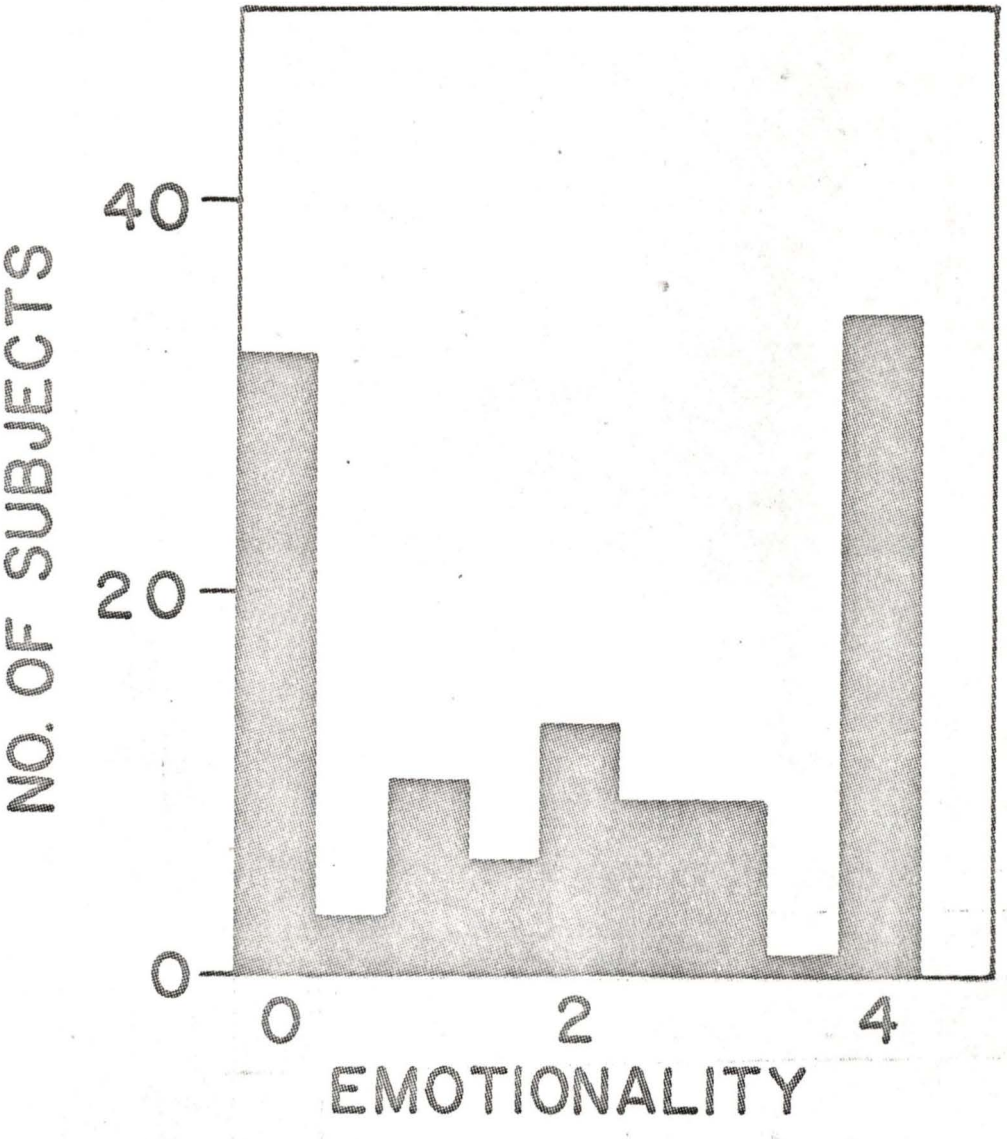

Figure 3.2. Frequency distribution of emotionality ratings.

Figure 3.3. Frequency distribution of lesion size i.e. amount of total brain damage (see Table II).

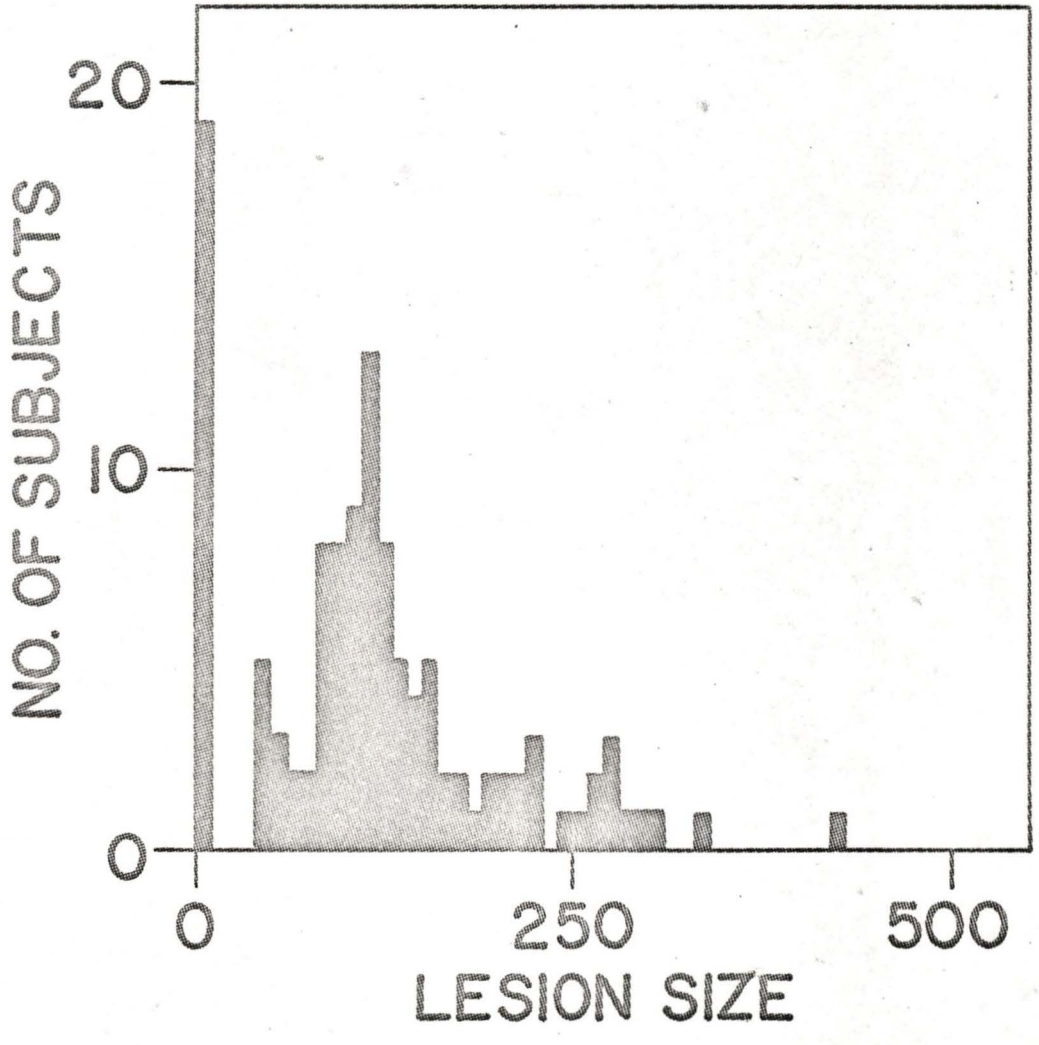

Figure 4. Facilitating and inhibiting areas involved in avoidance conditioning and emotionality.

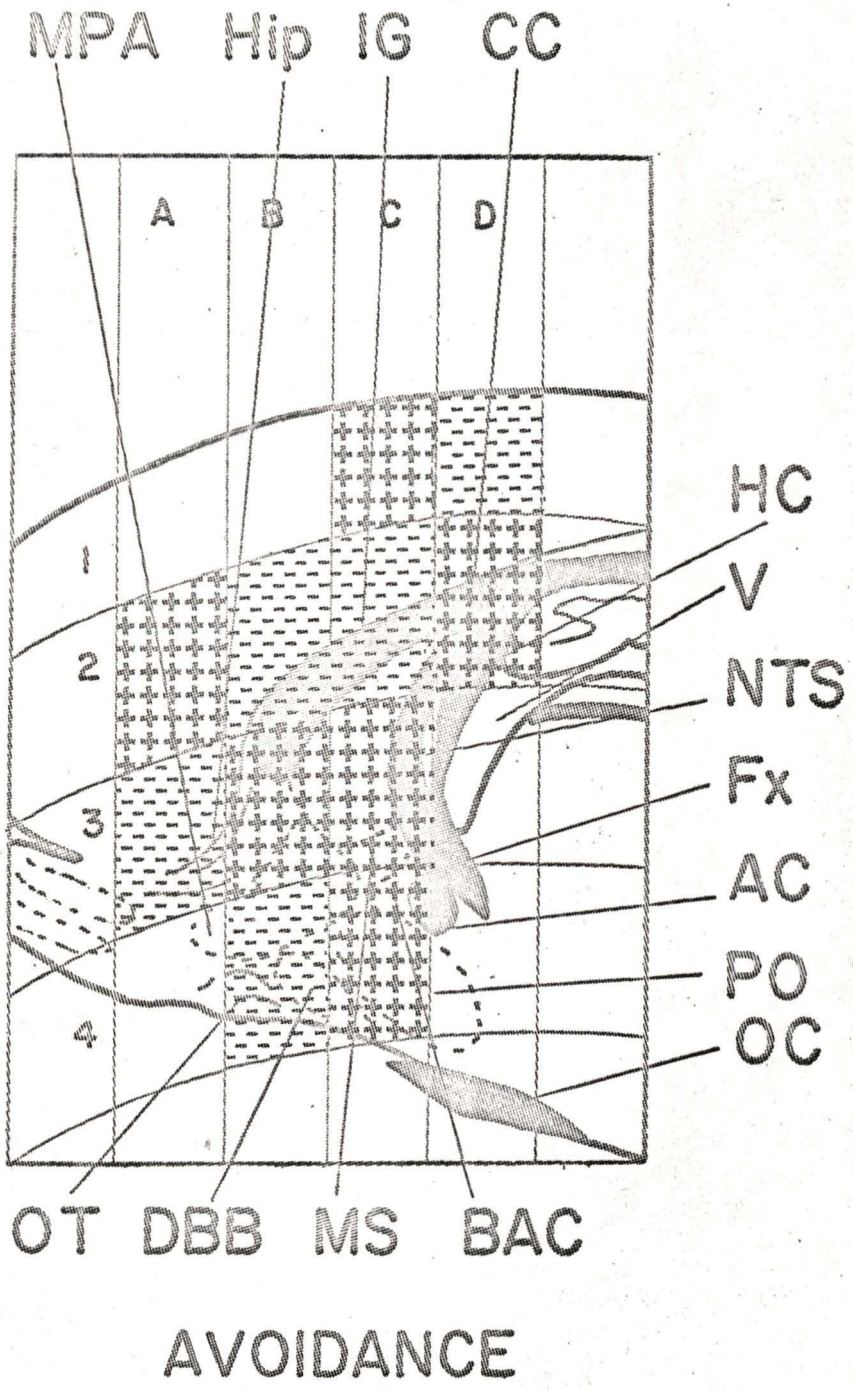

Figure 4.1. Facilitating and inhibiting areas involved in avoidance conditioning (see Table IV-A).

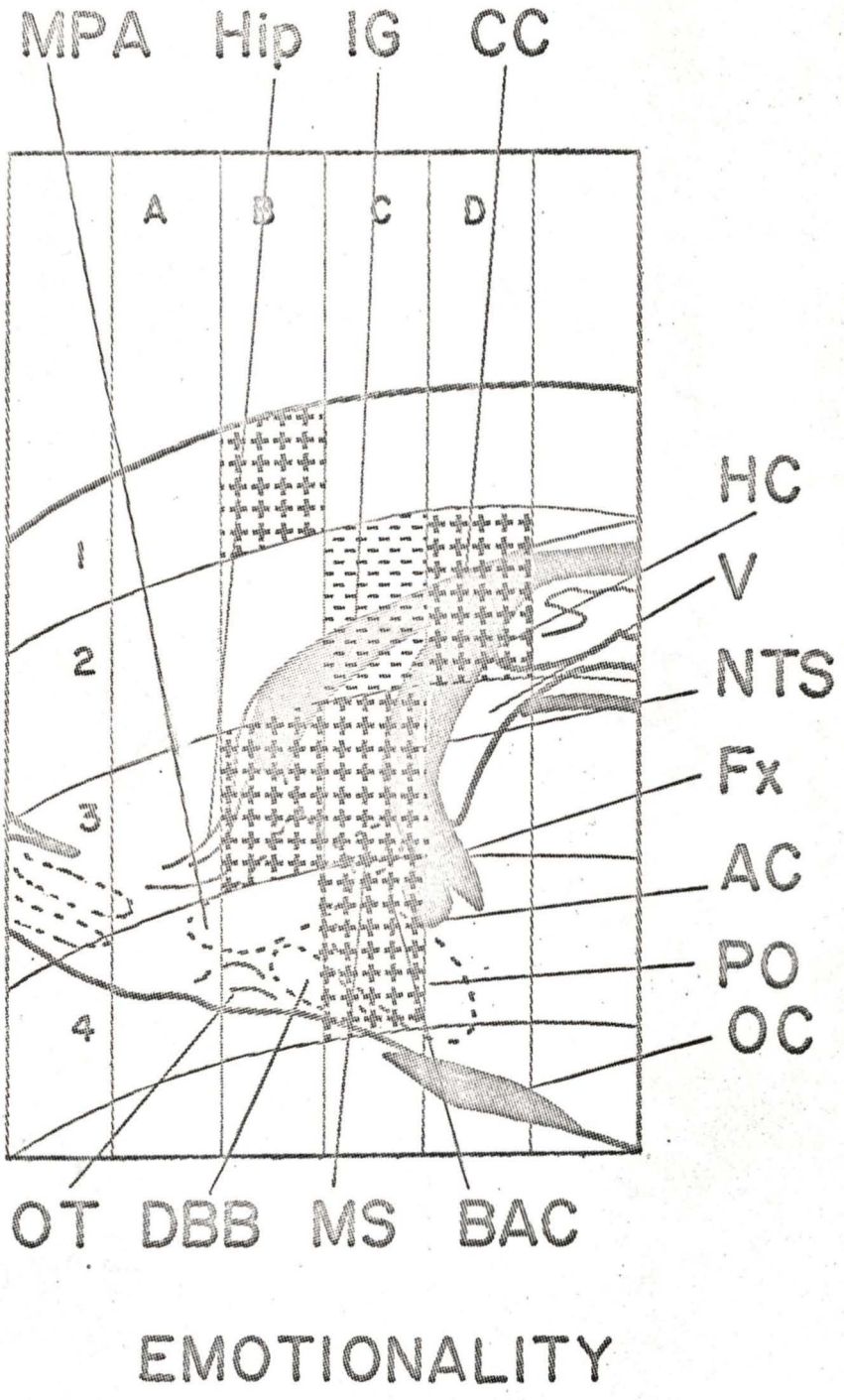

Figure 4.2. Facilitating and inhibiting areas involved in emotionality (see Table IV-B).

Appendix A

THE MORPHOLOGY AND EVOLUTION OF THE SEPTAL FOREBRAIN AREA

Abstract

The formation of the septum and its evolutionary development is presented. The evolution is traced through amphibians, reptiles, birds, and mammals. Alternative theories of the development of the septum pellucidum in mammals is discussed. The main portion of the paper is taken from Ariens Kappers, Huber, and Crosby (1960).

Formation of the Septum:

Peripheral influences lead to the formation of paired, telencephalic vesicles which become olfactory blubs. The manner in which the lateral walls of the telencephalon are formed behind these olfactory stalds is different in different vertebrates. Usually, in this lateral wall, two portions can be differentiated. In their earliest form they are continuous with each other and show only topographic differentiation. The upper part becomes designated as the pars laterodorsalis and the lower portion as the pars lateroventralis or striatum. In nearly all animals, from the pars lateroventralis or striatum, the parts medioventralis or septum arises through a medial growth. These can be seen in Figure 1. In the few animals in which the brain remains in this

form, there is a large unpaired ventricle with steep lateral walls and a small septum. Differentiation from this form may take place in either of two directions. The more usual one is indicated in Diagrams A, B, and C. Another developmental type is illustrated in D, E, and F.

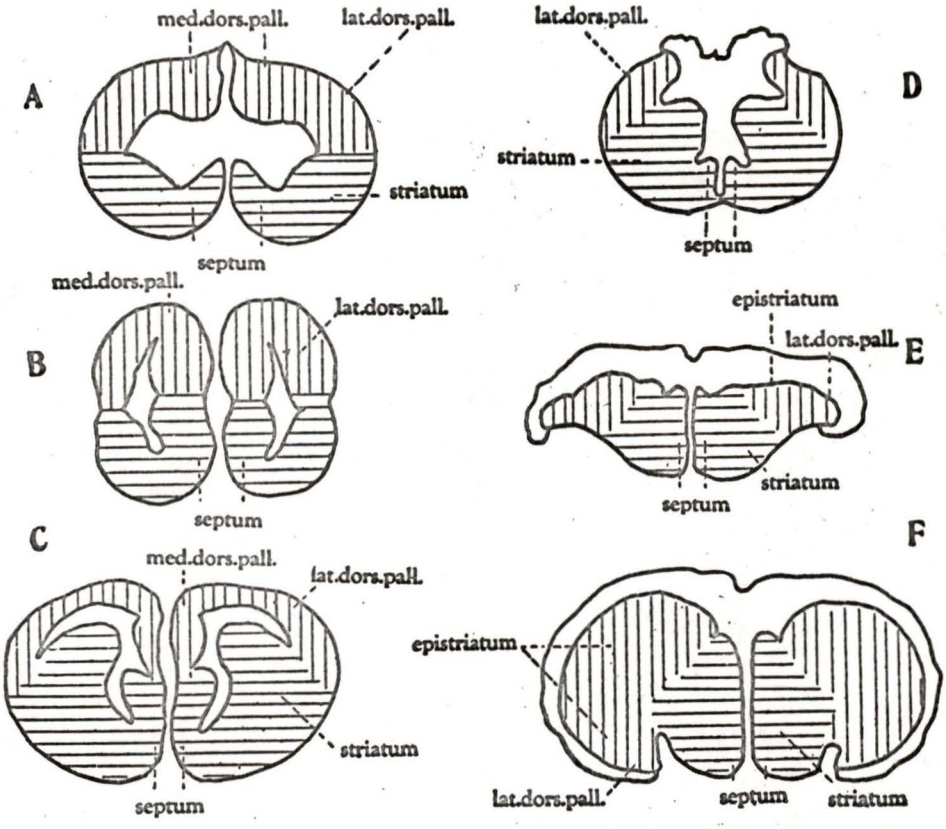

FIG. 533. A schematic representation of the different developmental types of forebrain in vertebrates.
A, Petromyzon; *B*, Amphibia; *C*, Reptilia; *D*, Holocephali; *E*, Holostei; *F*, Teleostei.

Figure A-1

In lower vertebrates, the secondary olfactory fibres supply practically all of the invaginated portions of the telencephalon. However, with the gradual growth of the nonolfactory fibre bundles from diencephalic centers and the increased invagination of the wall, progressively less and less of the hemisphere regions come directly under

the influence of these olfactory fibres. Throughout the vertebrate series the lateral olfactory fibres supply the lateral olfactory area, which gradually differentiate in higher forms into paleopallial and archistriatal regions.

The medial olfactory fibres supply the medial olfactory area, which differentiates into the various septal areas and the tuberculum olfactorium, and the dorsal olfactory area, which is the forerunner for the archipallium and hippocampus.

It is evident, then, that the olfactory areas of the telencephalon are not purely olfactory but are also correlation centers.

In Amphibians:

In the telencephalic arrangement of amphibains, the region usually termed the septum lies caudal to the nucleus olfactorius anterior pars medialis, and ventro-medial to the sulcus limitans hippcampi and sulcus septopallialis and the intervening cell-free band. This term, i.e. "septum" was applied by Edinger (1888) and Gaupp (1894) and is still used by most present day comparative neurologists. Johnson (1914) however, (in reptiles) used the designation of parolfactory area for the cephalic end of this region. Ariens Kappers, Huber, and Crosby, (1960) suggest that this name has not received general acceptance even though it is recognized that the area in question is neither septal in character nor homologous with the septum pellucidum of higher forms.

To differentiate this frontal portion of the region from the caudal portion, which is comparable with the septal areas of higher forms, it is designated the precommissural portion of the septum. This precommissural portion is homologous in general with the precommissural nuclei of teleosts, and is a derivative phylogentically of the medial olfactory area of lower forms. The part that extends back over the foramen for a short distance is what Ariens Kappers and Theunissen (1908) call the pars fibrialis septi and what Herrick (1910) calls the supraforaminal part.

In both tailed and tailless amphibians, the precommissural septal area usually includes two major nuclear masses. The nucleus lateralis septi lies close to the ependyma of the ventricle between that and the nucleus medialis septi. Soderberg (1922) suggests that the lateral septal nucleus is derived embryologically in the frog from the ventricular cell layers. Dorsally it extends to the level of the sulcus limitans hippocampi and ventrally it is bounded by the ventral part of the nucleus olfactorius anterior and, behind the level of this latter cell mass, by the ventromedial prolongation of the stratum, the nucleus accumbens. The caudal end of the lateral septal nucleus diappears in front of the interventricular foramen.

The medial septal nucleus, which is the larger of the two septal nuclei, begins in Amblystoma (Herrick, 1927) at about the same plane as the lateral septal

nucleus. However, it extends further caudalward than does the lateral septal nucleus. Part of the medial septal nucleus occpuies a position dorsal to the lateral ventricle, as this space extends down to a small branch which extends caudalward over the foramen with the pars fimbrialis of the septum. The ventral part of the medial septal nucleus becomes directly continuous with the bed nucleus of the decussating medial forebrain bundle.

The olfactory tracts arise from the neuraxes of mitral (and certain transitional) cells of the olfactory bulb. These tracts have been subdivided in various ways in amphibians. The only tract that is of interest to the paper is that of the medial olfactory tract. This tract carries some fibres to the septal region for distribution.

The tractus olfacto-corticalis septi, on the medial wall of the hemisphere (see Figure 2) plays an important role in furthering the differentiation of the archipallium or primordium hippocampi. In frogs this tract is partly medullated and well developed. It arises in the pre-commissural septal area, possible adjoining regions, and in the nucleus olfactorius anterior, and ascends to the primordium hippocampi or archipallium and the primordial dorsal pallium, where it terminates. Its fibres, which are scattered through the septal area, assemble as its dorsal portion is reached and pass along the sulcus septo-corticalis. It is not certain whether contralateral as well as homolateral septal fibres are present in the frog.

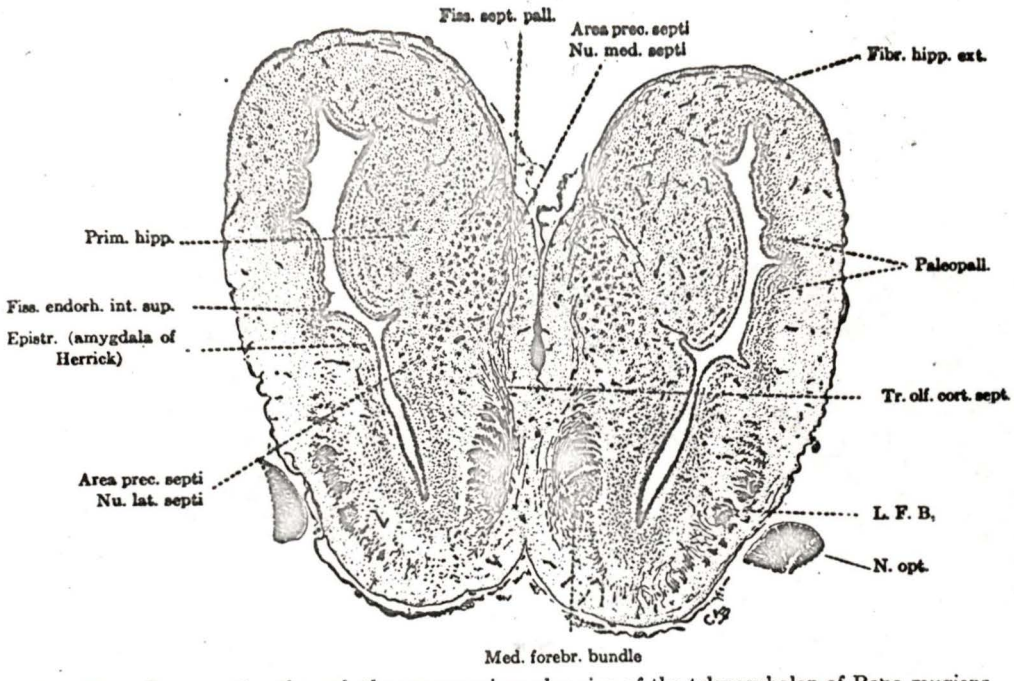

FIG. 566. Cross section through the precommissural region of the telencephalon of Rana mugiens. *Area prec.septi*, area precommissuralis septi; *Epistr.*, archistriatum of Ariëns Kappers, epistriatum of Röthig and Kuhlenbeck, probably amygdaloid nucleus of Herrick; *Fibr.hipp.ext.*, fibrae hippocampalis externae; *Fiss.endorh.*, fissura endorhinalis (internal superior part); *Fiss.sept.pall.*, fissura septopallialis of Ariëns Kappers; *L.F.B.*, lateral forebrain bundle; *N.opt.*, optic nerve; *Nu.lat.septi*, nucleus lateralis septi; *Nu.med.septi*, nucleus medialis septi; *Paleopall.*, paleopallium; *Prim.hip.*, primordium hippocampi; *Tr.olf.cort.septi*, tractus olfacto-corticalis septi with some fibers to medial forebrain bundle.

Figure A-2

Cortico-septal fibres from the primordial hippocampus through the medial cortico-hippocampus (archicortex) to the medial septal nucleus are present and Ariens Kappers et al. (1960) suggest that such fibres are probably represented in other amphibains. The caudal part of the septal area is connected, in many amphibians at least, with the primordial hippocampus through the medial cortico-olfactory tract. Another tertiary connection associated with the septal areas is the diagonal band of Broca. This connects the septal region with the amygdaloid complex and, in some amphibians at least, with the primoridal piriform area.

From the developing hippocampal area in amphibians, fibres pass caudalward in order to enter the stria medullaris. These fibres are joined, through the latter part of their course, by fibres from the septal areas, from the bed nucleus of the hippocampal commissure, and from the ventrocaudal part of the striatal region. Such fibres constitute a tractus septo-habenularis.

The medial forebrain bundle is the major connection between the ventrolateral quadrant of the hemisphere and the hypothalamic regions. It is believed to carry both ascending and descending fibres. The ascending fibres carry viseral and possible gustatory impulses from the hypothalamic areas forward to the olfactory center of the medial hemisphere wall, thus providing for olfacto-visceral correlations. The descending fibres serve as a discharge path for the ventromedial portion of the hemisphere and bring to the hypothalamus olfactory impulses from lower centers. The anterior portion of the medial forebrain bundle is associated with the nucleus olfactorius anterior and the septal nuclei; the more caudal portion can be traced to the primordium hippocampi and also the primordium pallii dorsalis.

It would appear that the olfactory areas of the telencephalon, even in fishes, are not purely olfactory but are also correlation centers. The connections of the telencephalic olfactory areas with the epithalamus

are as old as those with the hypothalamus and the ventral thalamus. In lower forms, such as cylostomes, these arise largely from the archipallial regions, but some of them come from the paleopallial areas and from the preoptic and septal regions. The majority of them terminate in the right habenular nucleus.

In amphibians, the customary tracts to the habenula are from the archipallium, the paleopallial areas, the developing archistriatum; the septal and preoptic nuclei and the tuberculum olfactorium. The connections with the hypothalamus and the ventral thalamus are through a primitive fornix system from the archipallial regions of the cortex, and by way of the medial forebrain bundle from the septal regions and the tuberculum olfactorium.

The Figures 3, 4, 5, and 6 showing the septal area of the Monopterus albus are good examples of this area in the submammalian telencephalon.

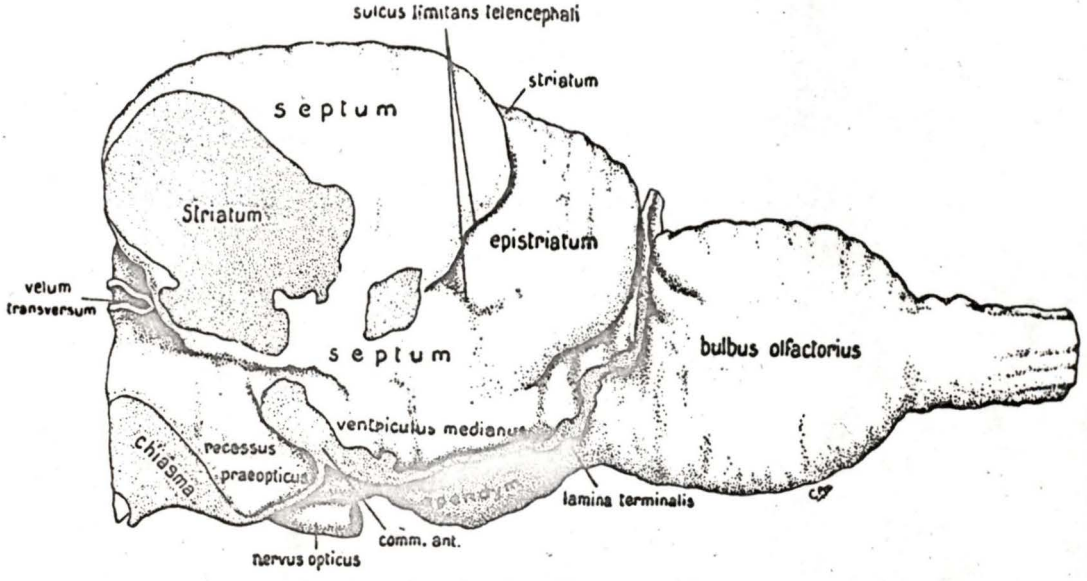

FIG. 554. A wax reconstruction of the forebrain of Monopterus albus. Median view. *van der Horst.*

Figure A-3

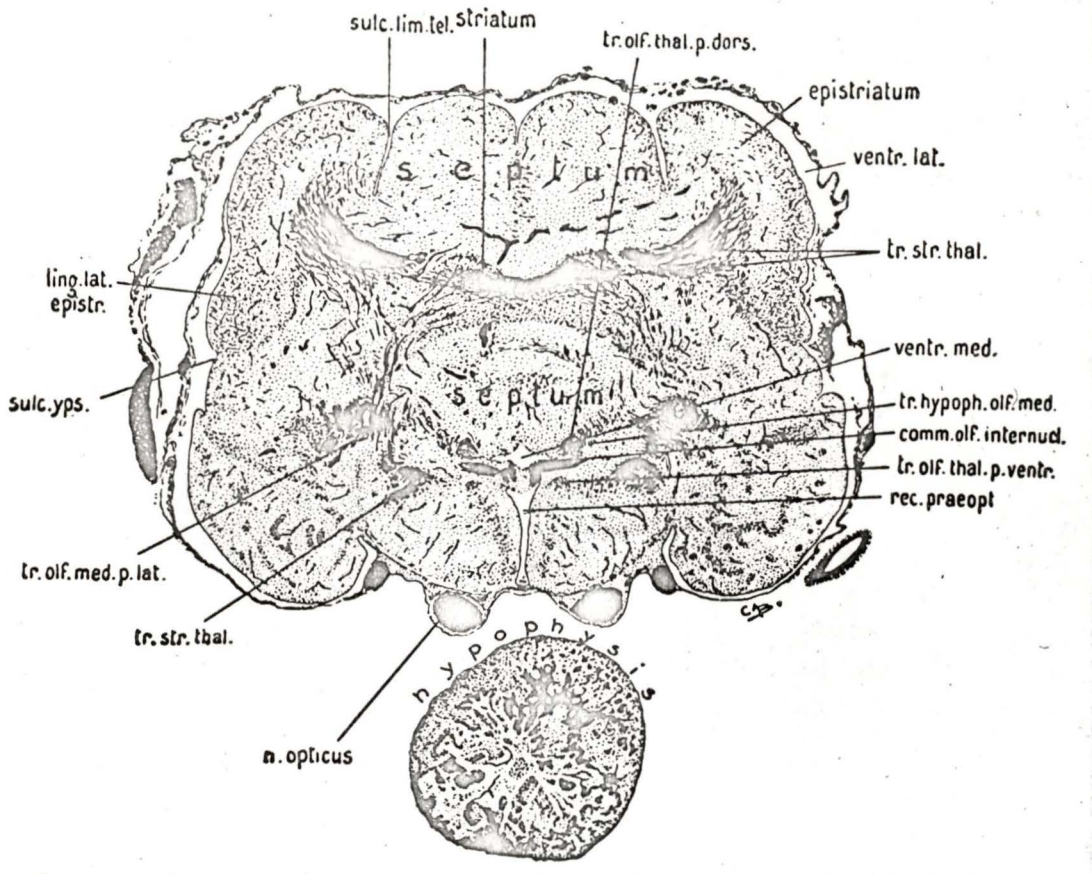

FIG. 556. A cross section at the level of the anterior commissure through the forebrain of Monopterus albus. *van der Horst.*

comm.olf.internucl., commissura olfactoria internuclearis; *ling.lat.epistr.*, lateral tongue of the epistriatum; *n.opticus*, nervus opticus; *rec.praeopt.*, recessus preopticus; *sulc.lim.tel.*, sulcus limitans telencephali; *sulc.yps.*, sulcus ypsiliformis; *tr.hypoph.olf.med.*, tractus hypopheosus olfactorius medialis; *tr.olf.med.p.lat.*, tractus olfactorius medialis pars lateralis; *tr.olf.thal.p.dors.*, tractus olfacto-thalamicus pars dorsalis; *tr.olf.thal.p.ventr.*, tractus olfacto-thalamicus pars ventralis; *tr.str.thal.*, tractus strio-thalamicus; *ventr.lat.*, ventriculus lateralis; *ventr.med.*, ventriculus medialis.

Figure A-4

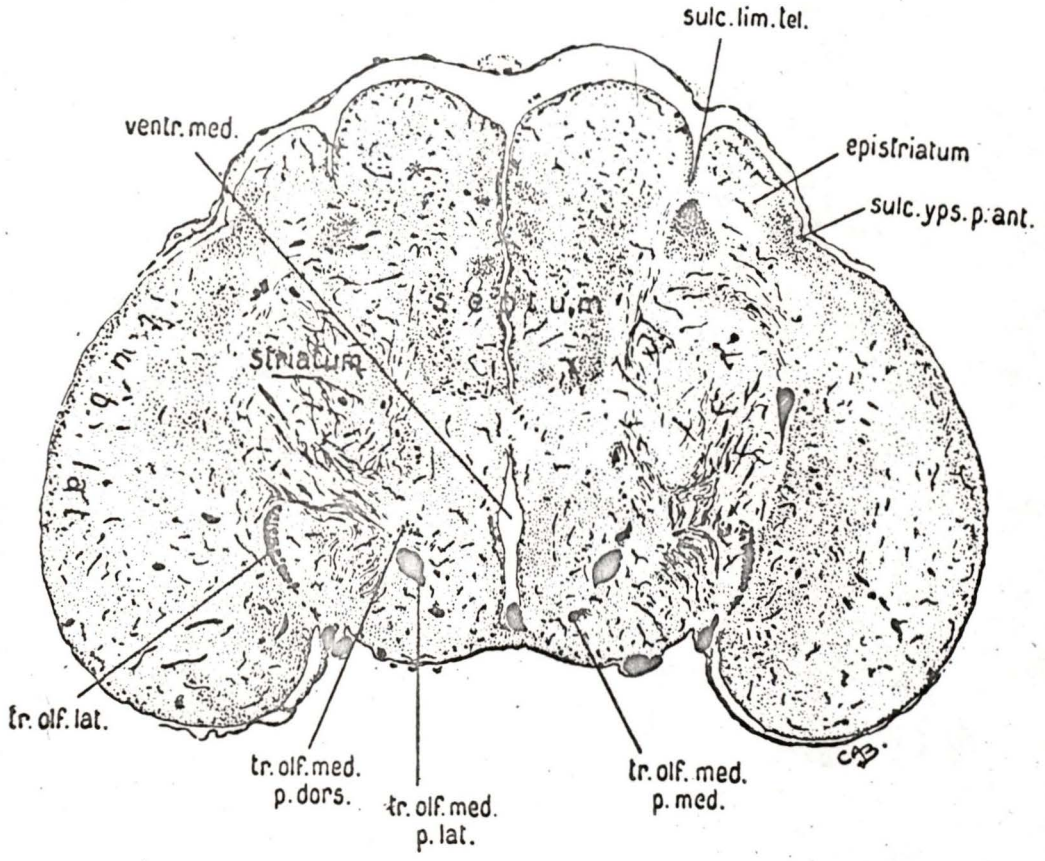

FIG. 557. A cross section of the forebrain of Monopterus albus in front of the level of the anterior commissure. *van der Horst.*

sulc.lim.tel., sulcus limitans telencephali; *sulc.yps.p.ant.*, sulcus ypsiliformis pars anterior; *tr.olf.lat.*, tractus olfactorius lateralis; *tr.olf.med.p.dors.*, tractus olfactorius medialis pars dorsalis; *tr.olf.med.p.lat.*, tractus olfactorius medialis pars lateralis; *tr.olf.med.p.med.*, tractus olfactorius medialis pars medialis; *ventr.med.*, ventriculus medialis.

Figure A-5

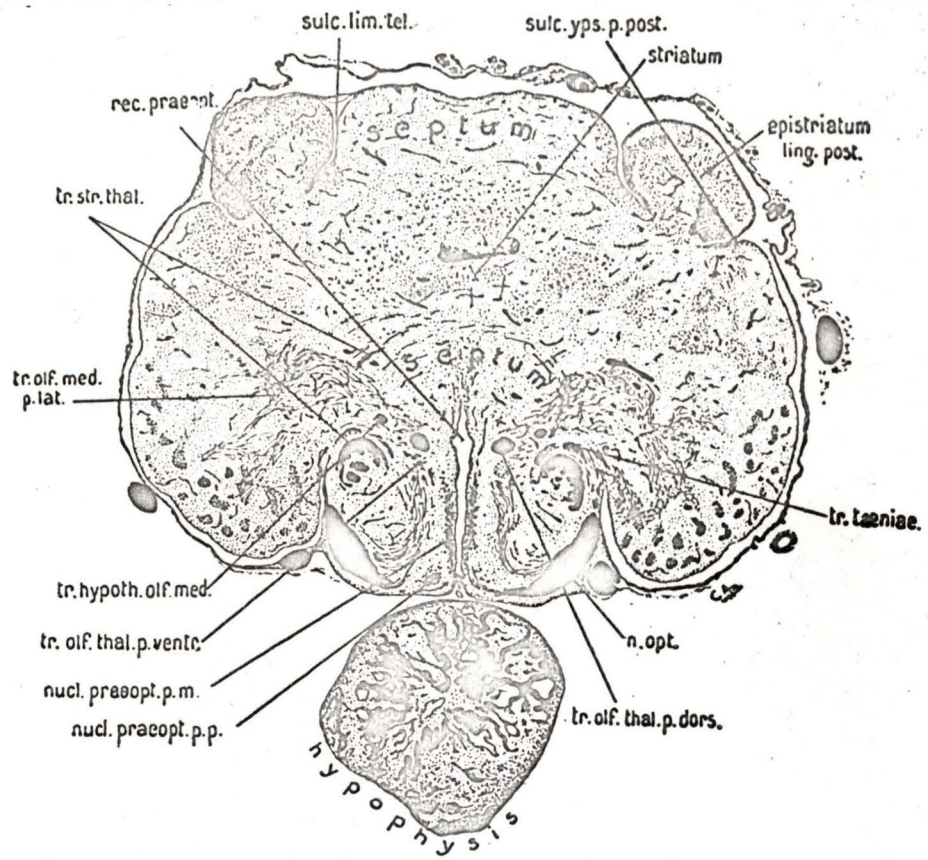

FIG. 558. A cross section of the forebrain of Monopterus albus behind the level of the anterior commissure. *van der Horst.*

epistriatum ling.post., posterior tongue of the epistriatum; *n.opt.*, nervus opticus; *nucl.praeopt.p.m.*, nucleus preopticus pars medialis; *nucl.praeopt.p.p.*, nucleus preopticus pars posterior; *rec.praeopt.*, recessus preopticus; *sulc.lim.tel.*, sulcus limitans telencephali; *sulc.ypsi.p.post.*, sulcus ypsiliformis pars posterior; *tr.hypoth.olf.med.*, tractus hypothalamo-olfactorius medialis; *tr.olf.med.p.lat.*, tractus olfactorius medialis pars lateralis; *tr.olf.thal.p.dors.*, tractus olfacto-thalamicus pars dorsalis; *tr.olf.thal.p.ventr.*, tractus olfacto-thalamicus pars ventralis; *tr.str.thal.*, tractus strio-thalamicus; *tr.taeniae*, tractus taeniae.

Figure A-6

In Reptiles:

The telencephalon of repitles is divided into basal and pallial areas. The basal areas include (1) the usual tertiary olfactory areas of the ventromedial wall--the nucleus olfactorius anterior, the septal or paraolfactory area with the associated nucleus of the diagonal band of Broca, the commissural nuclei, and the tuberculum olfactorium; (2) the nucleus basalis (or nucleus olfactorius lateralis) and the amydgaloid complex of the lateral wall; and (3) the striatal areas.

The cephalic end of the septal area begins at approximately the same level as the beginning of the tuberculum olfactorium but is dorsal to this area. Dorsal to the nucleus accumbens is the paraterminal body of South (1901), and Goldby (1934), the paraolfactory area of Johnston (1915) and Crosby (1917), or the precommissural portion of the septum (Herrick, 1910; Hines, 1923, Cairney, 1926; and others). It must be remembered, however, that by whichever name this area is designated, it is homologous in a general way with the paraolfactory areas and not with the septum pellucidum of higher forms.

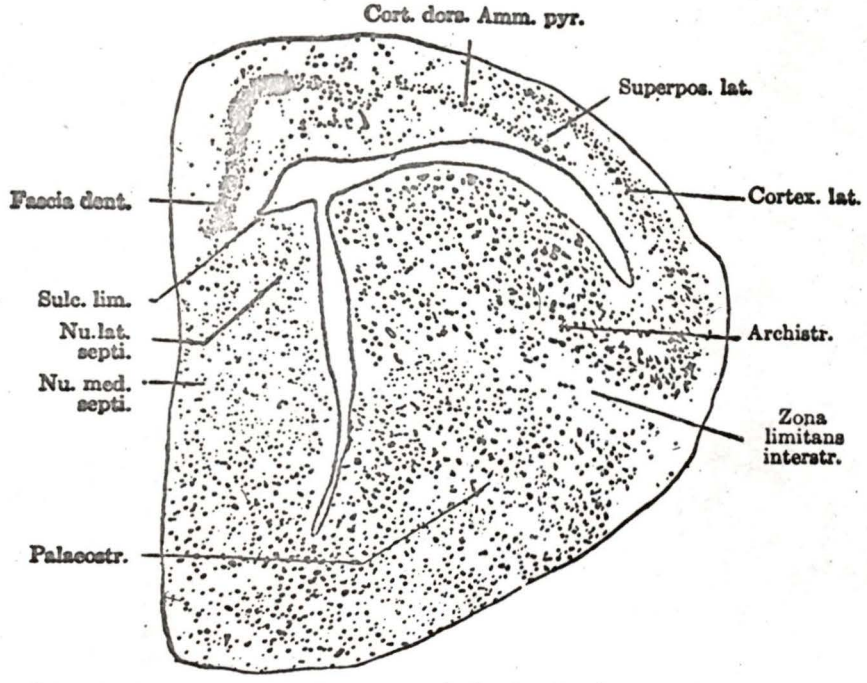

FIG. 572. A cross section through the forebrain of a lizard, Lacerta agilis. (Based on figure by *de Lange*, labeled by *Ariëns Kappers*.)

Archistr., archistriatum; *Cort.dors.Amm.pyr.*, dorsal cortex (*Ammon's* pyramidal cells); *Cortex lat.*, lateral cortex; *Fascia dent.*, fascia dentata; *Nu.lat.septi*, nucleus lateralis septi; *Nu.med.septi*, nucleus medialis septi; *Palaeostr.*, paleostriatum; *Sulc.lim.*, sulcus limitans; *Superpos.lat.*, superpositio lateralis; *Zona limitans interstr.*, zona limitans interstriata.

Figure A-7

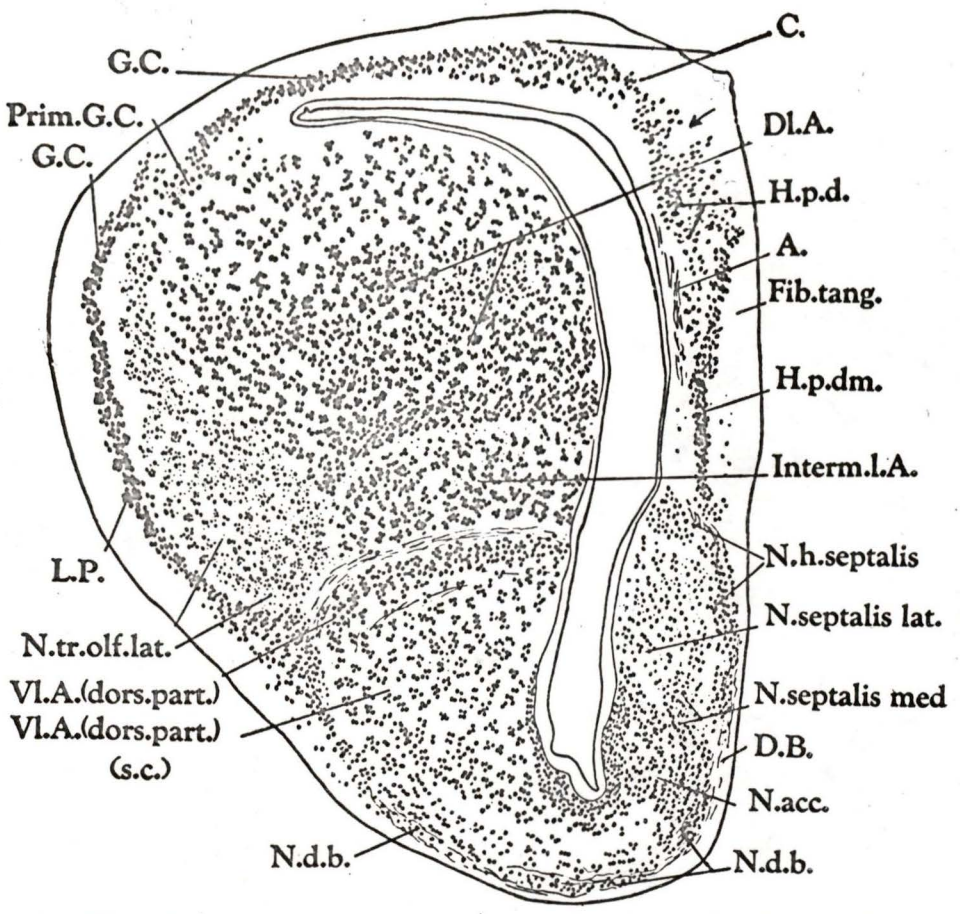

FIG. 578. Transverse section through the hemisphere of Alligator mississippiensis. Toluidin-blue preparation. *Crosby*.

A., alveus; *C.*, differentiated cortex (see text); *D.B.*, diagonal band of *Broca*; *Dl.A.*, dorsolateral area; *Fib.tang.*, fibrae tangentales; *G.C.*, general cortex; *H.p.d.*, hippocampus, pars dorsalis; *H.p.dm.*, hippocampus, pars dorsomedialis; *Interm.l.A.*, intermediolateral area (probably mesostriatum of *Edinger*); *L.P.*, lobus piriformis; *N.acc.*, nucleus accumbens; *N.d.b.*, nucleus of diagonal band of *Broca*; *N.h.septalis*, nucleus hippocampo-septalis; *N.septalis lat.*, nucleus septalis lateralis; *N.septalis med.*, nucleus septalis medialis; *N.tr.olf.lat.*, nucleus of tractus olfactorius lateralis; *Prim.G.C.*, primordial general cortex; *S.lim. hipp.*, sulcus limitans hippocampi; *Vl.A.(dors.part)*, ventrolateral area (dorsal part); *Vl.A.(dors.part)(s.c.)*, ventrolateral area (dorsal part) (small-celled portion).

Figure A-8

This precommissural portion of the septum makes its appearance dorsal to the nucleus olfactorius and the nucleus accumbens, and ventral to the hippocampal region. At these frontal levels it consists of scattered cells, which soon form a somewhat discrete nuclear group. Followed caudalward, it gradually becomes divided into a medial and a lateral portion, separated by the passage of fibre bundles. The cells of the lateral portion become more clearly packed and form the nucleus lateralis septi; those of the medial portion fall chiefly within the nucleus medialis septi, although a small dorsal portion of the medial area is characterized by a group of small cells, the nucleus septo-hippocampalis. Caudally the nucleus medialis septi goes over without sharp demarcation into the bed nuclei of the commissures.

Short fibre bundles relate the basal olfactory centers of the medial wall with the overlying cortical areas. When the precommissural regions of the septum begin to appear, many of the bundles swing medialward near the ventral border of the hippocampal cortex and separate the hippocampus from the primordium hippocampi and the cephalic end of the septal region. Some bundles swing directly ventralward into the underlying septal region. Some penetrate the precommissural septal region and separate it into medial and lateral portions. Many of them are in relation with these nuclei, arising in part from their cells. This system of fibres constitutes

the parolfacto-cortical or septo-cortical and cortico-septal systems of fibres. Work on various reptiles has indicated that, in general, bundles arising from the lateral septal nucleus pass to the hippocampal cortex while those connecting the hippocampal cortex with the medial septal area are largely efferent with respect to the cortical centers. Cortico-septal bundles swinging down from the dorsomedial hemisphere wall into the pre-commissural septal regions become intermingled with the medial forebrain bundle. Whether they join it or whether they are entirely in relation with the precommissural septal region is at present uncertain. Cortico-septal bundles are the more lateral bundles of the area. Septo-cortical fibres joined directly by medial forebrain fibres reach the dorsomedial hemisphere areas.

In reptiles the connections laid down in anlagen in lower forms are better developed and more directly comparable to those of mammals. The archipallial region or archicortex is connected with the lower diencephalic centers by means of ascending fibres from the hypothalamus through the medial forebrain bundles, either with or without a synapse in the system.

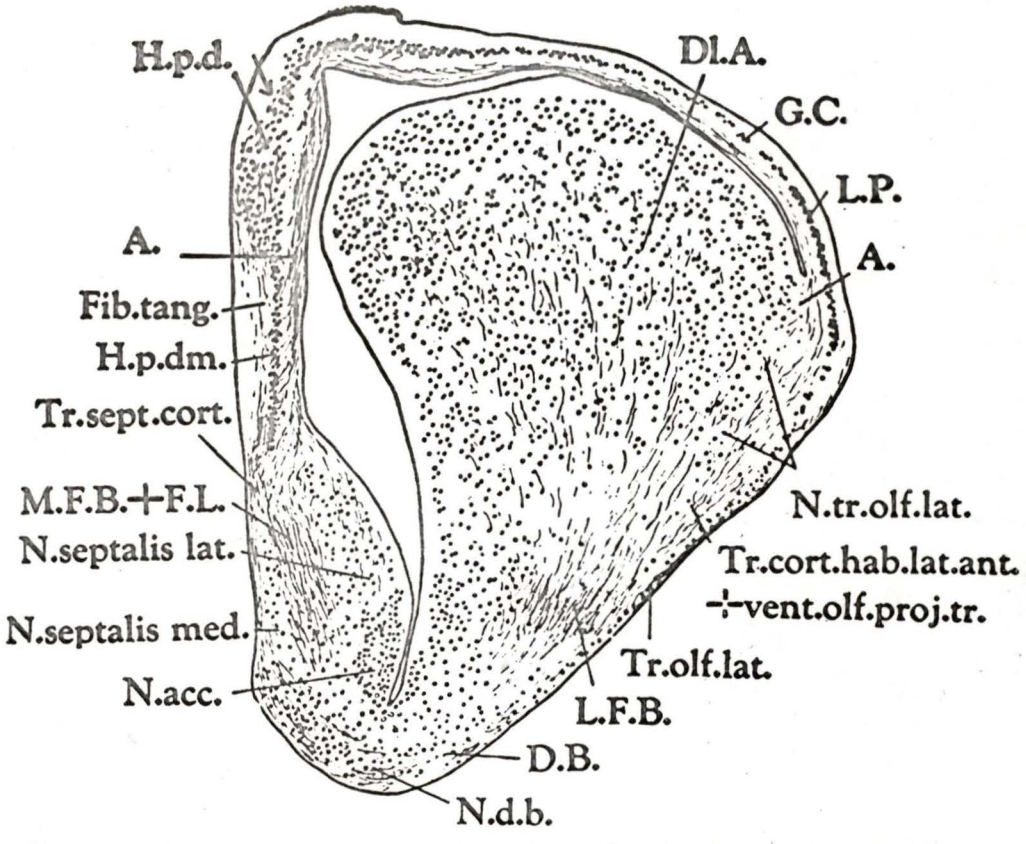

FIG. 583. A transverse section through the forebrain of Alligator mississippiensis a short distance anterior to the hippocampal commissure. *Crosby.*

A., alveus; *D.B.*, diagonal band of Broca; *Dl.A.*, dorsolateral area; *Fib.tang.*, fibrae tangentales; *G.C.*, general cortex; *H.p.d.*, hippocampus, pars dorsalis; *H.p.dm.*, hippocampus, pars dorsomedialis; *L.F.B.*, lateral forebrain bundle; *L.P.*, lobus piriformis; *M.F.B.+F.L.*, medial forebrain bundle + fornix longus; *N.acc.*, nucleus accumbens; *N.d.b.*, nucleus of diagonal band of Broca; *N.septalis lat.*, nucleus septalis lateralis; *N.septalis med.*, nucleus septalis medialis; *N.tr.olf.lat.*, nucleus of tractus olfactorius lateralis; *Tr.olf.lat.*, tractus olfactorius lateralis; *Tr.cort.hab.lat.ant.+vent.olf.proj.tr.*, tractus cortico-habenularis lateralis anterior + ventral olfactory projection tract.

Figure A-9

In Birds:

With the decrease in importance of the olfactory components in many birds, the septal area is considerably reduced and is difficult to analyse. It makes its appearance as scattered cells along the medial ventricular wall. These gradually increase in amount and ultimately form a well-developed nuclear mass. This nuclear mass is not sharply distinguishable at these levels from the nucleus accumbens laterally and is directly continuous ventromedially with the nucleus of the diagonal band of Broca. This nucleus of the diagonal band is infiltrated with layer cells which extend along the medial side and into relation with the septo-mesencephalic tract. It is comparable with the nucleus of the same name described for reptiles. Gradually, in the septal area in the sparrow, the medial and lateral septal nuclei become visible. The medial septal nucleus is comparable with the nucleus of the same name in the humming bird. It is a more or less round or oval cell mass in the sparrow, which continues caudalward dorsal to the bed nucleus of the commissures. Near the caudal end of the anterior commissure the medial septal nucleus becomes continuous with the bed nucleus of the pallaial commissure. The lateral septal nucleus becomes larger as it is followed caudalward, but decreases as the diencephalic levels are approached, and disappears near the level of the interventricular foramen. Medial and

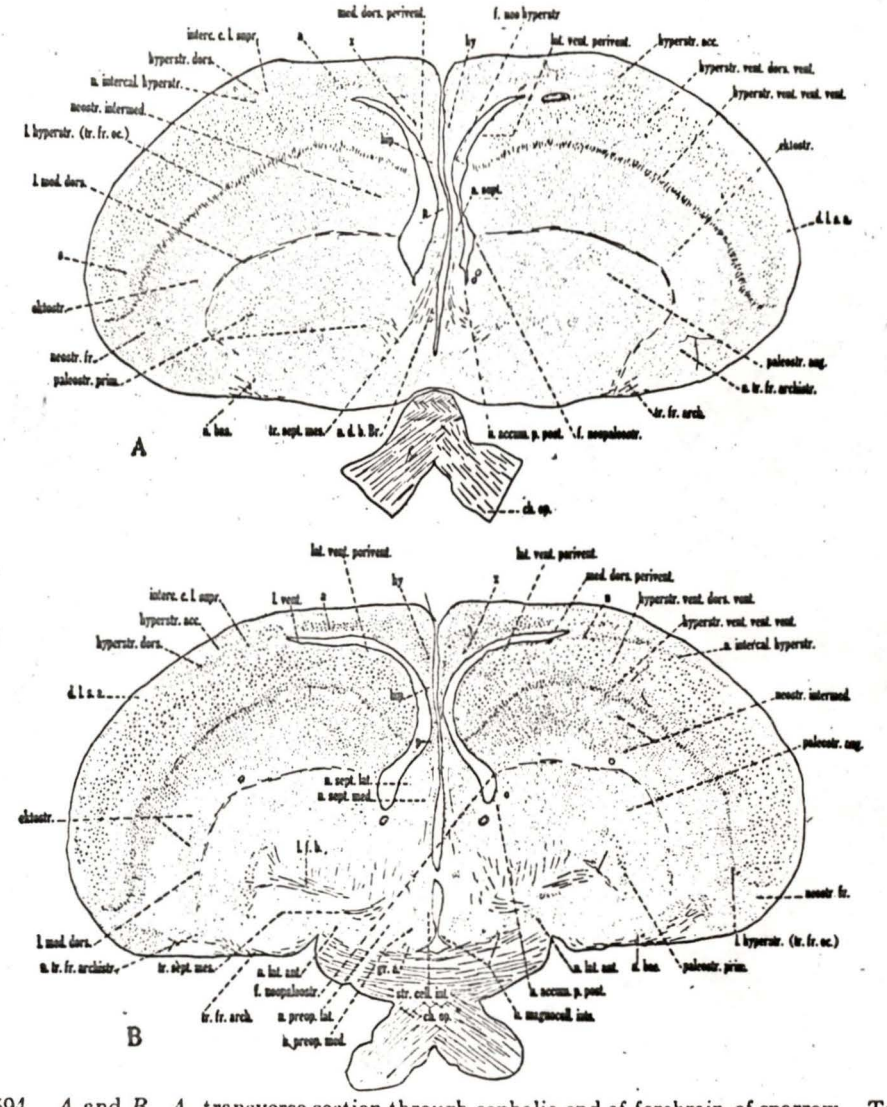

FIG. 594. *A* and *B*. *A*, transverse section through cephalic end of forebrain of sparrow. Toluidin blue preparation; *B*, transverse section of forebrain of sparrow through the level of the optic chiasma Toluidin-blue preparation. *Huber* and *Crosby*.

a, a differentiated portion of hyperstriatum accessorium; *a.sept.*, area septalis; *ch.op.*, chiasm opticum; *d.l.s.a.*, dorsolateral surface area (corticoid); *ektostr.*, ectostriatum; *f.neohyperstr.*, fissur neohyperstriatica; *f.neopaleostr.*, fissura neopaleostriatica; *gr.a.*, group *a* of Röthig; *hip.*, hippocampu pars medialis; *hy*, hippocampus pars dorsalis; *hyperstr.acc.*, hyperstriatum accessorium; *hyperstr.dors* hyperstriatum dorsale; *hyperstr.vent.dors.vent.*, hyperstriatum ventrale dorsoventrale; *hyperstr.vent.ven vent.*, hyperstriatum ventrale ventroventrale; *interc.c.l.supr.*, intercalated cells of lamina frontali suprema; *l.f.b.*, lateral forebrain bundle; *l.hyperstr.(tr.fr.oc.)*, lamina hyperstriatica (tractus fronto occipitalis); *l.med.dors.*, lamina medullaris dorsalis; *l.vent.*, lateral ventricle; *lat.vent.perivent.*, laterc ventral periventricular gray; *med.dors.perivent.*, mediodorsal periventricular gray; *n.accum.p.post* nucleus accumbens pars posterior; *n.bas.*, nucleus basalis; *n*, area of fusion of the intercalated cell of lamina frontalis suprema with nucleus intercalatus hyperstriati; *n.d.b.Br.*, nucleus of the diagons band of Broca; *n.intercal.hyperstr.*, nucleus intercalatus hyperstriati; *n.lat.ant.*, nucleus lateralis an terior; *n.magnocell.ints.*, nucleus magnocellularis interstitialis; *n.preopt.lat.*, nucleus preopticus late ralis; *n.preopt.med.*, nucleus preopticus medialis; *n.sept.lat.*, nucleus septalis lateralis; *n.sept.med* nucleus septalis medialis; *n.tr.fr.archistr.*, nucleus tractus fronto-archistriatici et neostriatici *neostr.fr.*, neostriatum frontale; *neostr.intermed.*, neostriatum intermediale; *p*, primordium hippo campi of Johnston; *paleostr.aug.*, paleostriatum augmentatum; *paleostr.prim.*, paleostriatum pri mitivum; *s*. sickle-shaped area in hyperstriatum ventrale; *str.cell.int.*, stratum cellulare internum *tr.fr.arch.*, tractus fronto-archistriaticus et neostriaticus; *tr.sept.mes.*, tractus septo-mesencephalicus *x*, area x (see text).

Figure A-10

lateral septal nuclei are better developed in the dove and the duck than in the parrakeet and the sparrow. In the kiwi, the medial and lateral septal nuclei are comparable to those described for Sphenodon (reptiles). Broadmann's (1909) classification of cortex regards the septum (pellucidum) and the area piriformis Rose as cortical in birds.

In birds there are a series of connections between the septal areas and other basal regions of the medial telencephalic wall and the overlying hippocampus. These may be termed the tractus septo-corticalis and the tractus cortico-septalis. They are homologous in relations and connections with the similarily designated tracts in reptiles, but are smaller. From the septal region, bundles joining the lateral forebrain tract and accompanying it to the preoptic and hypothalamic regions are reminiscent of similar fascicules in the reptiles to which the name of medial forebrain bundle is applied.

The tractus septo-mesencephalicus or cortico-septo-mesencephalicus connects the medial hemisphere wall with the ventrolateral hemisphere wall, with the diencephalic regions, and perhaps with the mesencephalic regions. The bundle in spite of its usual name of septo-mesencephalic tract, arises partly from the accessory hyperstriatal regions and the associated regions in the cephalic end of the dorsal hemisphere wall and perhaps might better be called the tractus cortico-septo-

mesencephalicus. The bundles swing ventralward and somewhat caudalward and run toward the ventromedial surface of the brain. They are joined by fibres from other areas and pass, as a relatively compact fibre mass, through the septal area where they are undoubtedly joined by fibre bundles. The tract takes up a position medial to the medial forebrain bundle in such a way that the latter system lies in the angle made by the lateral septo-mesencephalic tract. In this region the ramus basalis frontalis of Wallenberg is given off and it passes to the basal lateral wall of the hemisphere. It is homologous with the diagonal band of reptiles which forms a connection between the hippocampal region and the amygdaloid complex. The major mass of the septo-mesencephalic tract then swings dorsalward as the dorsal ramus, in a position lateral to the lateral forebrain bundle and dorsal to the optic tract. The third division of the septo-mesencephalic tract is the ramus baslais caudalis. This runs caudalward in close relation to the ventral peduncle of the lateral forebrain bundle and lateral to the tractus infundibuli. It appears to terminate in the hypothalamic regions and it is probably a part of the fornix longus.

The tractus cortico-habenularis and the tractus septo-habenularis are part of the stria medullaris of birds as also occurs in reptiles. These two tracts come from

the dorsalmedial wall (in small part), from the septal areas and the region of the bed nuclei of the commissures respectively to the stria medullaris. Another part of the stria medullaris in birds, as in reptiles, is the tractus archistriatico-habenularis et precommissuralis. This comes from the amygdaloid nucleus passing directly medialward, dorsal to the stria terminalis, and then distributing in part to the septal region and, in smaller part, to the stria medullaris.

The hippocampus proper in birds varies with the degree of differentiation of the olfactory system of the bird. The lateral forebrain bundle shows a marked increase in differentiation and the cortico-septo-mesencephalic system is large. The stria medullaris is, however, much reduced.

In Mammals:

Ariens Kappers, Huber and Crosby (1960) suggest that the septal regions, as the name, is applied at present, does not have reference, for the most part, to the septum pellucidum, but includes the basal gray from the region of the anterior commissure and its bed nuclei forward to the caudal end of the nucleus olfactorius anterior, between the overlying hippocampal areas and the underlying tuberculum olfactorium and nucleus accumbens. This region includes the gyrus subcallosal and the area parolfactoria as applied to human anatomy, and it has been

termed the precommissural area by Elliot Smith (1896, 1897, 1899, and 1902). In marsupials, it has been called the fasciculus annularis anterior. It is frequently spoken of as the precommissural portion of the septum, with the understanding that the word "septum" carries no significance excepting as the name of a region.

In general, in mammals the medial and lateral septal nuclei occupy the major portions of the area in front of the commissure. Their relations are essentially those described for the similarily named nuclei in reptiles. The medial nucleus is believed to send fibres from the medial forebrain bundle. The lateral nucleus is efferent with respect to the hippocampal cortex and, in part, to the hemisphere, for it receives cortico-septal fibres, and it contributes fibres to the medial forebrain bundle and to the septo-tubercular tract.

As the level of the commissures is approached, the medial septal nucleus becomes more or less continuous with a bundle of scattered cells and fibres which swing ventralward and lateralward toward the lateral wall of the hemisphere. This is the nucleus of the diagonal band of Broca and its associated tract. In addition to these generally recognized nuclei of the septal region, certain smaller nuclear masses have been described. In the opossum Loo (1931) recognized a nucleus septalis dorsalis, dorsal and medial to the caudal part of the

medial septal nucleus, which contributes a bundle of fibres to the tractus paracommisuralis.

Along the course of the fibres of the hippocampal commissure and bounding it, are cells which form a bed nucleus of the hippocampal commissure. These constitute the nucleus septalis triangularis of Loo (1931) for marsupials, the triangular nucleus of Ramon y Cajal (1911) for the mouse, and the bed nucleus of the hippocampal commissure of Gurdjian (1927) for the rat. Hines (1923) has described these in the developing telencephalon of man.

As the lateral septal nucleus is continued caudalward above the level of the commissures it is termed either the nucleus of the septum or, sometimes, the nucleus septo-fibrialis (Loo, 1931). This cell mass receives fibres from the finbria (tractus cortico-septalis). It gives rise to a septo-habenular tract, together with the bed nuclei of the commissures. This post commissural part of the septum undergoes certain marked changes in passing from marsupials to higher mammals and man. These changes are associated with the appearance and rapid increase in size of the corpus callosum in passing to higher mammals. This growth of the corpus callosum results in a drawing out forward and a thinning out of the septum, and the formation, finally, of a septum pellucidum. The septa of the two

sides may be fully fused together or a smaller space may be left between them. This interseptal space is designated the ventriculus of cavum septi pellucidi.

Various theories are current with regard to the presence of a cavum septi pellucidi in various mammals and its possible relations to the intracerebral or great horizontal fissure. While it is often termed the fifth ventricle, it is not ependymal lined and in normal brains has no connection ontogentically or phylogentically with the brain ventricular system. Elliot Smith (1896) regarded it as formed early in the higher microsomatic animals as a small space or recess, which is in connection with the great horizontal fissure and which is bounded above by the corpus callosum, laterally by the laminae of the septa, and behind and below by the fornix columns. Two factors that Elliot Smith (1896) termed as causative in the formation of the cavum septi pellucidi are (1) the progressive and relatively rapid increase phylogenetically of the corpus callosum (2) the decrease of the commissural bed in certain higher mammals such as man, with a diminution of the relative importance of the olfactory impulses. He also thought that the stretching of the thickened mass of the lamina terminalis by the extending arch of the dorsal commissure produces the septum pellucidum.

Others have regarded the decrease in the hippocampal commissure, which allows the lateral pull of the lateral elements of the fornix to be exerted upon the septum pellucidum during ontogeny as an important factor in the development of the cavum septi pellucidi.

Maclaren Thompson (1932) and others have concluded that the septum is solid and the cavum is absent in marsupials, monotremes, and in moles. It appears to be absent also in certain edentates, although it is present in the sloth. It is usually present in ungulates, such as the sheep, calf, bull and horse. There is some disagreement regarding the presence of a cavum in the rabbit and the dog. The cavum has been described in various primates and is generally recognized in man.

Maclaren Thompson also concluded that the cavum is open in certain mammals such as the cat and closed in others, including the chimpanzee and man. He presented a "kiphyletic theory" of the evolutionary development of the cavum. He believed that the open cavum of forms such as the cat developed phylogentically from the "primitive mammalian solid septum"; that from the same primitive septum, by way of the solid septum of insectivores, developed phylogentically the "primitive Primate open cavum" and that later this became the closed septum of higher primates. While there appears to be rather general agreement that in man the cavum septi pellucidi

is closed, there is still a difference of opinion as to whether it developed as a close space (Hochstetter, 1919) or become closed secondarily by the growth of the rostrum of the corpus callosum (Goldstein, 1903 and others). Hochsteter states that the cavum arose by interstital cleavage within the laina terminalis.

The septal area may be regarded, then, as (1) a basal center concerned in the correlation of olfactory impulses with ascending visceral or hypothalamic impulses and their discharge to the hippocampus and to the habenual, and (2) as an important way station between overlying hippocampal regions and the preoptic and hypothalamic areas.

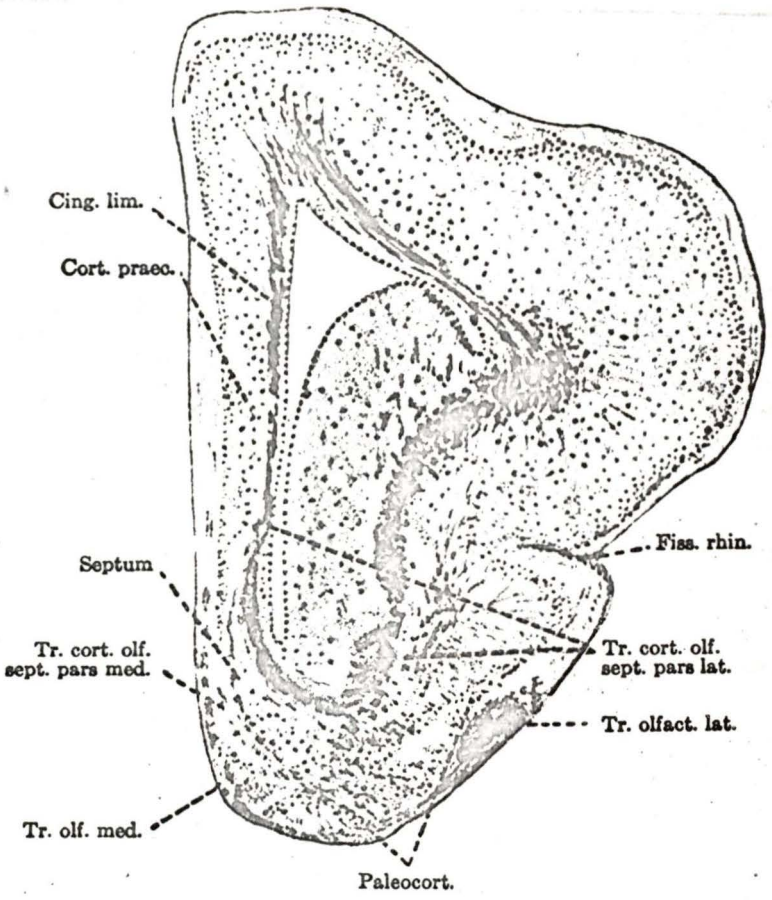

FIG. 622. A section through the anterior commissure of a marsupial (Hypsiprymnus rufescens). The figure presents the medial precommissural cortex, the beginning of the septum, and the overlying cortex.

Cing.lim., cingulum limitans; *Cort.praec.*, cortex precommissuralis; *Fiss.rhin.*, fissura rhinalis; *Paleocort.*, paleocortex; *Tr.cort. sept.* (or *Tr.cort.olf.sept.pars lat.*, Ariëns Kappers, '21), tractus cortico-septalis; *Tr.olf.lat.*, tractus olfactorius lateralis; *Tr.olf. med.*, tractus olfactorius medialis; *Tr.sept.cort.* (*Tr.cort.olf.sept. pars med.* of Ariëns Kappers, '21), tractus septo-corticalis.

Figure A-11

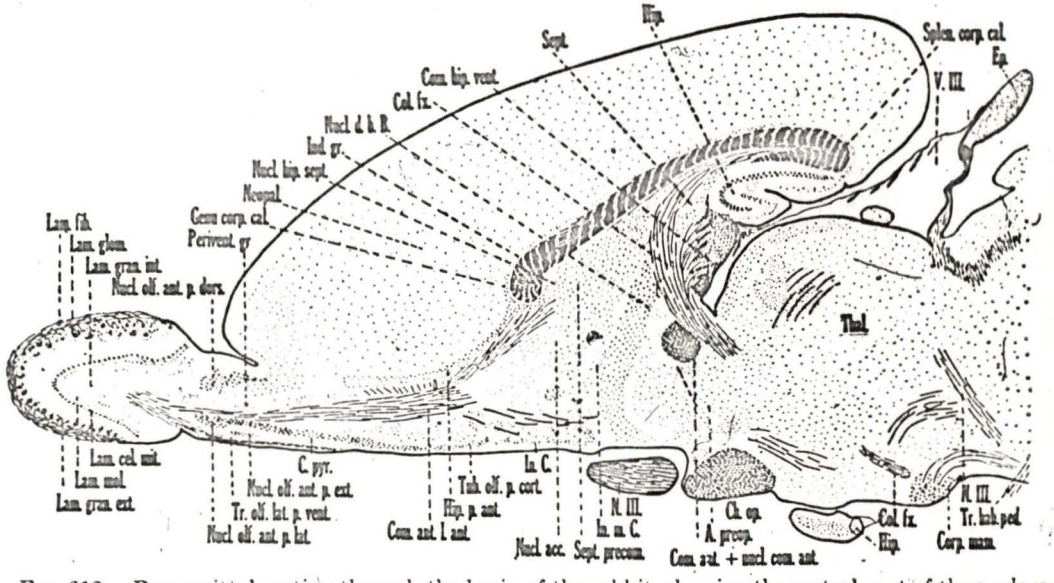

FIG. 612. Parasagittal section through the brain of the rabbit, showing the rostral part of the nucleus olfactorius anterior, the relations of the various portions of the hippocampus, and the septal nuclei. Toluidin blue preparation. *M. W. Young.*

A.preop., area preoptica; *C.pyr.*, cortex pyriformis; *Ch.op.*, chiasma optica; *Col.fx.*, columna fornicis; *Com.ant.l.ant.*, commissura anterior, limbus anterior; *Com.ant. + nucl.com.ant.*, commissura anterior and nucleus commissurae anterioris; *Corp.mam.*, corpus mamillare; *Ep.*, epiphysis; *Genu corp.cal.*, genu corporis callosi; *Hip.*, hippocampus; *Hip.p.ant.*, hippocampus, pars anterior; *In.C.*, island of Calleja; *In.m.C.*, giant island of Calleja; *Ind.gr.*, indusium griseum; *Lam.cel.mit.*, lamina cellularum mitralum; *Lam.fib.*, lamina fibrosa; *Lam.glom.*, lamina glomerulosa; *Lam.gran.ext.*, lamina granulosa externa; *Lam.gran.int.*, lamina granulosa interna; *Lam.mol.*, lamina molecularis; *N.III.*, nervus oculomotorius; *Neopal.*, neopallium; *Nucl.acc.*, nucleus accumbens; *Nucl.d.b.B.*, nucleus of the diagonal band of Broca; *Nucl.hip.sept.*, nucleus hippocampo-septalis; *Nucl.olf.ant.p.dors.*, nucleus olfactorius anterior pars dorsalis; *Nucl.olf.ant.p.ext.*, nucleus olfactorius anterior pars externa; *Nucl.olf.ant.p.lat.*, nucleus olfactorius anterior pars lateralis; *Perivent. gr.*, periventricular gray; *Sept.*, septum; *Sept. precom.*, septum precommissurale; *Splen.corp.cal.*, splenium corporis callosi; *Thal.*, thalamus; *Tr. hab.ped.*, tractus habenulo-pedúncularis; *Tr.olf.lat.p.vent.*, tractus olfactorius lateralis pars ventralis; *Tub.olf.p.cort.*, tuberculum olfactorium pars corticalis; *V.III.*, ventriculus tertius.

Figure A-12

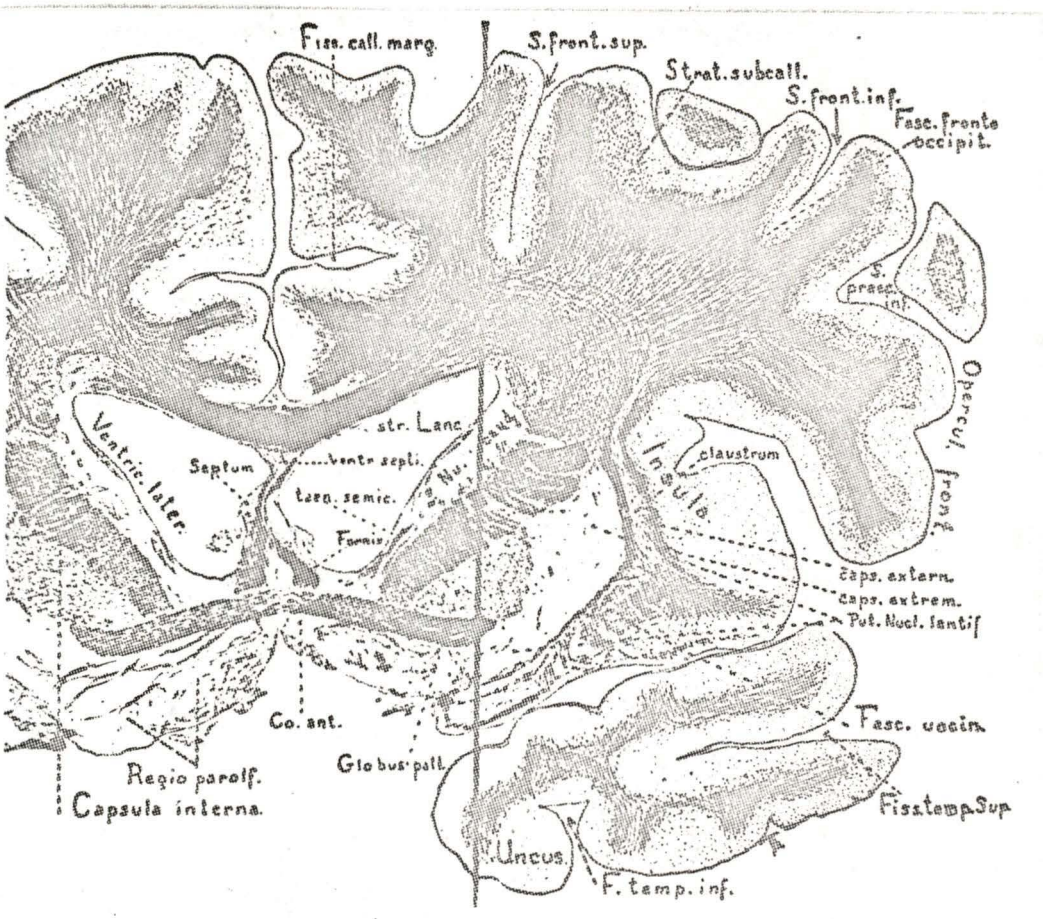

FIG. 630. A cross section through the human forebrain. The vertical line indicates the level of the sagittal section in figure 637. The abbreviations are as follows:

caps.extern., capsula externa; *caps.extrem.*, capsula extrema; *Co.ant.*, commissura anterior; *Fasc. fronto-occipit.*, fasciculus fronto-occipitalis superior; *Fasc.uncin.*, fasciculus uncinatus; *F.temp.inf.*, fissura temporalis inferior; *Fiss.call.marg.*, fissura calloso-marginalis; *Fiss.temp.sup.*, fissura temporalis superior; *Globus pall.*, globus pallidus; *Nu.caud.*, nucleus caudatus; *Opercul.front.*, operculum frontale; *Put.nucl.lentif.*, putamen region of nucleus lentiformis; *Regio parolf.*, regio parolfactoria; *S.front.inf.*, fissura frontalis inferior; *S.front.sup.*, fissura frontalis superior; *S.praec.inf.*, fissura precentralis inferior; *str.Lanc.*, striae of *Lancisius*; *Strat.subcall.*, stratum subcallosum; *Taen.semic.*, taenia semicircularis; *Ventric.later.*, ventriculus lateralis; *Ventr.septi*, ventriculus or cavum septi.

Figure A-13

Footnote

1. The diagrams employed in this appendix were reproduced from Ariens Kappers, Huber, and Crosby, (1936) with permission of the publisher.

Reference

Ariens Kapper, C. U., Huber, G. C., and Crosby, E. C. The comparative anatomy of the nervous system of vertebrates, including man. New York; Hafner Publishing Company, 1960.

Appendix B

BEHAVIORAL STUDIES OF THE SEPTAL AREA

Historically, little study was directed toward the role of the limbic system in emotional behavior until the early 1920's. Herrick's (1933) suggestion that rhinencephalic structures were involved in behavioral matters was further substantiated by Papez (1937) and Kluver and Bucy (1939). While Papez was concerned with a neural substrate for "emotion", Klüver and Bucy emphasized the behavioral modifications which resulted from lesions of various rhinencephalic structures.

Interest in the behavioral role played by the limbic system expanded greatly in the 1950's. It soon became obvious that this area was concerned with more complex functions than only olfaction (Pribram and Kruger, 1954). One area that has received much attention is the septal area which is "rostral and anterior to the anterior commissure and within the near margin of the corpus callosum" (Powell, 1963). Of particualr interest to this paper are the effects produced by lesions of this area in the rat. Research has produced many findings which may be summarized as follows:

a. the septal syndrome:

(1) the transformation of docile laboratory rats into vicious animals that readily attack objects brought into their environment and vigorously resist attempts

to handle them (Brady and Nauta, 1953, and 1955);

(2) sustained states of hyperemotionality with simultaneously prepared spetal-neocortical lesions (Clark, Meyer, Meyer, and Yutzey, 1967; Yutzey, 1967; Yutzey, Meyer, and Meyer, 1964);

(3) increased aggressiveness (Bunnell, Bemporad, and Flesher, 1966), shock induced fighting behavior (Wetzel, Conner, and Levine, 1967) and social dominance behavior (Bunnell et al., 1966);

b. metabolic changes:

(1) increased water consumption following septal lesions (Donovick and Burright, 1968; Harvey and Hunt, 1965; Harvey, Lints, Jacobsen, and Hunt, 1965; Pizzi and Lorens, 1967; Singh and Meyer, 1968) which is independent of a response inhibition mechanism (Carey, 1967 b);

(2) increased sodium chloride intake (Lubar, Boyce, and Schaeffer, 1968; Vilar, Gentil, and Covian, 1967);

(3) enhanced reactivity to quinine and saccharine solutions (Beatty and Schwartzbaum, 1967);

(4) finicky behavior when under food and water deprivation (Singh and Meyer, 1963);

(5) increased licking for a sucrose solution which is independent of deprivation conditions and sucrose concentrations (Beatty and Schwartzbaum, 1968) ;

(6) increased food intake (Reynolds, 1961; Singh and Meyer, 1968) and aphagia depending upon the anatomical

locus of the lesion (Reynolds, 1961);

(7) a decrease in activity level (Clody and Carlton, 1969; Douglas and Raphelson, 1966 b; Garber, 1966; Kenyon, 1962; Neilson, McIver, and Boswell, 1965);

c. chemical changes:

(1) depression of hyperirritability and activity following septal lesions by the use of various drugs (Horovitz, Furgiuele, Brannick, Burke, and Craver, 1963; Prich and Norton, 1965; and Raitt, Nelson, and Tye, 1963);

(2) increased sleeping time with injections of thiopental sodium or barbital (Heller, Harvey, Hunt, and Roth, 1960);

(3) greater sensitivity to the behavioral effects of meprobamate; alcohol, and mephenesin (Hunt, 1957);

d. perseverative behavior:

(1) decreased spontaneous alternation behavior (Douglas and Raphelson, 1966 a) and decreased alternation in a T-maze (Simmons, 1965);

(2) deficit in position reversal (Thomspon and Langer, 1963) and impaired reversal on a spatial discrimination taks (Schwartzbaum and Donovick, 1968);

(3) impaired performance on delayed reinforcement schedules (Burkett and Bunnell, 1966; Carey, 1967 c); Ellen, Wilson, and Powell, 1964; and Simmons, 1965) which may be dependent upon training method employed or the specific delay interval required for reinforcement

(Caplan and Stamm, 1967);

(4) a general inability to suppress preferred responses (Winocur and Mills, 1969) and over-responding to a positive reinforcement (Ellen and Powell, 1962; Pubols, 1966; and Schwartzbaum, Kellicutt, Spieth, and Thompson, 1964);

(5) abolition of lever pressing to escape an aversive noise stimulus but no interference with acquisition or retention of lever pressing for food reward until the same noise is used as a discrimination stimulus (Tracy and Harrison, 1956);

(6) deficiency in the acquisition of a conditioned suppression of activity (Trafton, 1967);

e. active and passive avoidance behavior;

(1) rapid acquisition of a two-way avoidance response (Garber, 1966; King, 1958; Schwartzbaum, Green, Beatty, and Thompson, 1967; Trafton, 1967; Vanderwolf, 1964) which independent of the septal syndrome (Kenyon, 1962, Krieckhaus, Simmons, Thomas, and Kenyon, 1964); associated with increased intertrial activity (Green, Beatty and Schwartzbaum, 1967); and which may be reporduced with small (Kenyon, 1962) or unilateral lesions (Green and Schwartzbaum, 1968; Kenyon and Krieckhaus, 1965 a);

(2) impaired one-way avoidance (Kenyon, 1962, Kenyon and Krieckhaus, 1965 b) and decrements in passive avoidance behavior following septal lesions Harvey et al., 1965; Kaada, Rasmussen, Wulff, and Kveim, 1962; Neilson, McIver, and Boswell, 1965; McNew and Thompson, 1966;

and Schwartzbaum and Spieth, 1964);

f. amygdaloid lesions block the hyperreactivity to stimulation and reverse the depression in open-field activity but do not counteract septal impairment in response inhibition expressed in F.I. performance (Schwartzbaum and Gay, 1966);

g. enhanced reactivity to photic stimuli by bilateral (Green, Beatty, and Schwartzbaum, 1967) and unilateral lesions (Green and Schwartzbaum, 1968);

h. increased resistance to response extinction (Carey, 1967 a; Clody and Carlton, 1969; Van Hoesen, MacDougall, and Mitchell, 1969; La Vaque, 1966) but poor retention of a pre-operatively acquired response (Carey, 1967 a; Harvey et al., 1965);

i. increased exploratory behavior (Neilson et al., 1965; Thomas et al., 1959);

j. contradictory findgs;

(1) impaired retention of a C.E.R. in septal rats (Brady and Nauta, 1953) versus no impairment of C.E.R. in septal rats (Lyon and Harrison, 1959);

(2) impairment of D.R.L. performance (Wilson et al., 1964; Simmons, 1965) versus no impairment of D.R.L. performance (Harvey and Hunt, 1965);

(3) increased water consumption in septal rats (Harvey and Hunt, 1968; Harvey et al., 1956) versus no increase in water consumption (Kaada et al., 1962);

(4) the presence of rage behavior (Brady and

Nauta, 1953; 1955) versus lack of rage behavior (Harrison and Lyon, 1957);

(5) increased food intake (Singh and Meyer, 1968) versus food intake which is only transiently affected (Pizzi and Lorens, 1967);

(6) impaired reversal on a spatial discrimination task (Schwartzbaum and Donovick, 1968) versus no impairment of performance on reversals of a spatial discrimination with unilateral lesions (Green and Schwartzbaum, 1968);

(7) facilitated two-way avoidance performance (King, 1958; Schwartzbaum, Green, Beatty and Thompson, 1967) versus interference with an active avoidance response (McNew and Thompson, 1966) and no difference from control rats in acquisition of a two-way avoidance response (La Vaque, 1966). Garber and Simmons (1968) have shown simultaneously impaired and facilitated C.A.R. performance in septal rats using a two-way shuttle-box in which each side was associated with different shock levels.

These findings, which are not entirely consistent have been explained by a number of theories, among which are (1) hyperemotionality, (2) hyperactivity, (3) altered reactivity to the motivational aspects of stimuli, and (4) lack of inhibitory motor control i.e. perseveration of a response. There is no one theory that explains all of the findings associated with septal lesions.

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Appendix C

PROCEDURAL DETAILS

Subjects. All subjects were housed in individual cages with free access to food and water at all times.

Surgical procedures. Surgery was performed under deep ether anesthesia. By means of earpins, which usually broke the subjects' eardrums, and by means of a tooth clamp, the subjects heads were positioned in a sterotaxic instrument so that the skull in the region of bregma and lambda were at the same vertical co-ordinates. After making a midline scalpel incision and exposing the skull, scalpel blades were used to make two bilaterally symetric holes in the skull 0.5 mm. lateral to the midline. The co-ordinates used for the various lesion placements were: anterior: 1.8 mm. and 2.0 mm. anterior to bregma; central: 0.8 mm. anterior to bregma; and posterior: 0.0 anterior to bregma. The electrode was inserted to a depth of 5.5 mm. below the surface of the skull at each anterior and central septal placement and to a depth of 5.0 mm. for the posterior septal placements. The depth used for cortical lesions was 2.0 mm.; for intended corpus callosum lesions, 4.0 mm.; and for lesions ventral to the septum, 6.0 mm.. The lesions were produced by discharging a 100-u.f. capacitor through the electrode, (positive pole to the electrode, negative to the ear bars). The extent of

the lesion was controlled by charging the capacitor to 90, 120, and 240 volts. After both lesions had been produced, the incision was closed with wound clips. Each experimental subject was weighed immediately following the operation and again before being sacrificed to ensure that the operation had not physically harmed the animal. Of the 102 animals which were operated, two died following surgery and one had a grossly misplaced lesion thus warranting its omission from the experimental groups.

Avoidance training. Each subject was allowed to explore the shuttle-box with the door open and the shock off, for approximately one to two minutes. He was then pushed (if necessary) into the safe (with light on) compartment and given two practice trials with shock before the 50 recorded trials were given. The boxes (A and B) and the starting compartments (white and black) were counterbalanced. Two experimenters ran the subjects in an assigned manner such that no one experimenter ran all of the subjects in any one group.

Appendix D

DETAILS OF DATA

Computor programmes used. The correlation programme used was: BMD02D Correlation with Transgeneration - Revised May 10, 1968; Health Sciences Computing Facility, UCLA. The programme used for discriminant analyses was: Discriminant Analysis - Two Groups - Version of June 9, 1966; Health Sciences Computing facility, UCLA.

Reanalysis of Harrison and Lyon's (1957) data. The data from Harrison and Lyon's Tables 2, 3, and 5 were used in the reanalysis. The damage shown was summed bilaterally and the obtained score was employed to derive discriminant coefficients. The median behavioral score of 30 or greater was used to split the animals into two groups. For purposes of reliability (consistency) discriminant analyses were also run with splits at 38 or greater and 21 or greater (i.e. five subjects above and below the median). The results of these analyses are shown in Table D-4.

Raw data. The raw avoidance latencies, emotionality ratings and amount of brain damage are represented in Table D-1, D-2, and D-3 respectively.

TABLE D-1

AVOIDANCE LATENCIES

RAT #	CARD #										
01	01	7.11	6.13	5.72	6.08	5.87	1.51A	6.42	6.29	6.83	1.64A
01	02	1.47A	8.95	6.03	1.37A	6.03	6.06	5.95	5.78	1.24A	5.85
01	03	3.47A	5.78	2.55A	4.20A	1.64A	1.53A	1.25A	1.54A	4.11A	5.85
01	04	1.57A	1.37A	1.62A	1.52A	5.95	1.29A	1.53A	1.90A	2.36A	4.70A
01	05	5.92	2.22A	1.58A	2.54A	1.52A	1.37A	2.89A	3.13A	6.05	1.61A
02	01	3.62A	6.32	5.69	4.72A	5.82	1.96A	5.55	3.37A	5.80	7.18
02	02	1.72A	4.83A	6.60	4.61A	6.10	5.19	6.56	6.56	6.93	1.49A
02	03	10.51	2.35A	6.60	4.12A	5.50	5.47	5.35	1.63A	1.66A	1.26A
02	04	6.74	6.93	4.32A	2.07A	2.23A	5.23	5.09	5.72	5.66	5.70
02	05	3.93A	3.20A	3.26A	1.92A	5.45	5.35	5.46	4.92A	6.94	4.66A
03	01	5.67	5.49	2.47A	5.57	5.60	2.60A	5.39	1.85A	4.95A	3.25A
03	02	3.67A	5.83	1.56A	2.42A	4.78A	3.01A	3.71A	4.80A	4.57A	5.57
03	03	2.00A	3.66A	3.63A	1.62A	5.73	1.13A	1.67A	1.43A	2.35A	0.96A
03	04	4.89A	0.94A	3.67A	0.89A	1.14A	1.54A	2.46A	1.29A	2.01A	1.09A
03	05	1.26A	5.31	1.16A	0.89A	1.10A	1.36A	2.76A	3.49A	2.74A	4.98A
04	01	6.29	6.00	1.82A	5.90	5.87	1.83A	5.94	5.60	5.50	3.28A
04	02	3.75A	5.86	5.34A	3.93A	5.81	5.81	1.76A	5.90	5.57	3.83A
04	03	5.86	5.78	3.29A	2.69A	5.88	5.60	3.16A	5.61	5.88	5.63
04	04	2.78A	5.97	2.02A	5.99	2.27A	5.89	1.98A	5.64	2.55A	5.59
04	05	1.86A	3.49A	4.52A	5.60	4.09A	4.05A	5.57	5.63	1.86A	2.17A
05	01	6.03	5.91	5.34	6.90	2.42A	6.98	1.89A	5.16	6.05	6.33
05	02	1.49A	2.47A	3.53A	2.02A	1.80A	2.58A	1.83A	3.57A	6.51	2.05A
05	03	2.12A	2.27A	1.68A	5.71	1.48A	1.96A	1.89A	1.88A	1.41A	4.81A
05	04	1.72A	1.89A	1.82A	1.68A	1.53A	5.70	1.33A	2.08A	1.28A	2.94A
05	05	1.67A	4.02A	2.62A	6.56	1.36A	3.85A	1.86A	2.85A	1.65A	1.97A
06	01	7.03	5.98	2.37A	5.55	3.40A	6.18	5.76	6.02	3.08A	3.85A
06	02	6.43	6.23	1.96A	5.68	2.39A	1.69A	2.45A	5.80	4.05A	5.49
06	03	6.00	2.39A	5.88	5.87	2.90A	6.72	3.01A	5.88	4.81A	2.44A
06	04	5.92	5.82	5.29	5.88	2.32A	2.08A	5.90	6.52	1.95A	4.05A
06	05	2.26A	4.01A	2.30A	6.04	2.02A	2.39A	2.45A	3.78A	2.87A	2.97A
07	01	6.05	6.10	7.32	6.63	2.53A	2.92A	2.91A	1.93A	8.74	6.16
07	02	7.32	5.54	4.54A	4.49A	5.90	1.75A	1.91A	1.65A	1.88A	2.16A
07	03	1.63A	1.61A	5.61	6.00	1.69A	1.69A	1.90A	1.67A	6.02	1.71A
07	04	1.65A	1.61A	1.93A	1.81A	2.48A	2.97A	1.31A	1.45A	1.36A	1.50A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
07	05	1.25A	1.30A	1.42A	1.37A	6.03	1.36A	6.84	1.38A	1.18A	1.98A
08	01	5.54	5.85	5.95	7.05	5.82	2.09A	5.69	2.11A	5.52	6.67
08	02	2.87A	5.67	5.86	3.38A	4.78A	3.97A	1.93A	3.48A	3.09A	5.22
08	03	5.66	5.62	2.57A	5.45	3.43A	1.89A	3.44A	4.52A	5.60	2.72A
08	04	2.05A	5.69	1.43A	5.70	1.82A	1.87A	1.99A	4.67A	5.63	2.22A
08	05	1.96A	2.19A	4.12A	1.88A	5.71	2.55A	4.31A	1.88A	1.93A	1.94A
09	01	44.40	15.33	2.12A	10.16	5.78	8.59	5.24	1.61A	6.84	4.15A
09	02	3.10A	2.62A	2.15A	3.80A	1.62A	6.12	1.55A	2.79A	1.45A	1.54A
09	03	1.65A	1.65A	5.65	2.68A	1.60A	3.59A	1.55A	1.52A	1.25A	1.63A
09	04	1.17A	1.26A	1.23A	1.12A	1.09A	1.28A	1.31A	1.09A	1.29A	1.33A
09	05	1.74A	1.19A	1.38A	1.33A	1.41A	1.21A	1.14A	1.19A	1.11A	1.07A
10	01	5.87	5.68	5.78	3.22A	4.42A	3.63A	5.69	5.83	5.70	3.43A
10	02	2.38A	5.35	2.42A	5.75	5.46	1.95A	2.28A	5.60	2.40A	5.88
10	03	2.45A	5.65	3.27A	1.47A	5.88	5.45	2.48A	5.26	2.70A	2.32A
10	04	1.90A	1.64A	5.43	1.66A	4.05A	1.82A	4.24A	1.91A	5.45	3.26A
10	05	3.90A	5.53	1.68A	4.91A	2.33A	2.00A	4.56A	1.58A	1.89A	3.31A
11	01	3.31A	6.04	5.60	6.32	4.97A	6.02	2.39A	2.05A	3.92A	5.81
11	02	3.04A	5.68	5.63	1.74A	1.99A	1.60A	3.04A	3.68A	1.87A	2.14A
11	03	1.77A	1.53A	1.99A	1.54A	1.88A	1.49A	4.91A	3.03A	1.82A	2.67A
11	04	5.38	2.53A	1.66A	1.24A	1.90A	2.50A	1.59A	1.22A	1.40A	1.21A
11	05	1.54A	1.16A	5.57	1.47A	5.53	1.11A	2.38A	1.10A	6.55	1.11A
12	01	1.58A	5.88	5.79	5.76	5.88	6.47	4.51A	8.29	2.13A	3.34A
12	02	5.99	7.72	5.70	5.83	5.73	1.31A	5.83	5.43	3.27A	3.25A
12	03	2.36A	1.20A	1.38A	2.70A	1.62A	1.95A	1.41A	4.10A	3.99A	5.87
12	04	4.33A	1.12A	5.82	1.11A	2.93A	2.25A	5.93	1.72A	5.66	1.36A
12	05	5.89	2.36A	4.42A	4.07A	1.17A	1.15A	1.69A	1.01A	2.18A	1.00A
13	01	6.29	6.18	4.79A	6.48	5.22	5.79	6.80	5.05A	5.18	2.04A
13	02	6.00	2.70A	1.92A	2.35A	1.85A	1.73A	2.58A	5.17	1.56A	1.74A
13	03	1.52A	2.00A	1.39A	1.46A	1.51A	1.50A	1.74A	1.64A	1.24A	1.41A
13	04	5.57	1.42A	1.17A	4.70A	1.62A	4.59A	1.27A	3.71A	1.56A	3.78A
13	05	1.36A	4.71A	3.11A	3.86A	1.61A	4.21A	1.36A	4.86A	1.24A	5.42
14	01	5.86	5.86	6.02	7.45	3.59A	8.75	7.55	7.55	5.80	7.49
14	02	4.64A	5.75	1.85A	6.21	2.82A	5.71	1.34A	5.82	1.26A	5.64
14	03	1.24A	2.90A	1.19A	5.86	5.35	5.75	1.48A	4.59A	1.44A	2.06A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
14	04	5.69	2.33A	1.20A	2.49A	1.47A	2.21A	6.05	5.72	2.75A	6.55
14	05	1.36A	1.99A	1.08A	1.84A	1.39A	5.92	1.60A	1.87A	5.64	2.29A
15	01	11.96	5.39	6.35	7.37	5.91	6.51	5.96	12.31	5.26	5.91
15	02	6.48	6.20	14.88	6.14	5.93	6.20	6.30	6.00	5.96	6.18
15	03	6.41	6.21	1.82A	6.07	4.95A	6.32	5.34	6.26	5.49	6.18
15	04	5.72	4.62A	2.95A	6.07	5.90	6.16	5.94	5.82	5.78	5.89
15	05	5.93	6.07	4.28A	5.94	5.88	6.38	6.39	5.96	5.86	6.00
16	01	3.06A	6.16	7.11	5.57	5.62	5.71	3.39A	6.40	6.46	3.56A
16	02	6.23	4.61A	5.08	2.62A	3.06A	4.60A	5.67	4.62A	6.05	1.63A
16	03	5.64	3.40A	4.06A	5.38	3.82A	5.20	1.70A	3.10A	4.08A	1.68A
16	04	1.88A	4.45A	6.22	2.47A	2.65A	3.17A	1.93A	1.69A	4.46A	2.08A
16	05	3.02A	2.00A	2.92A	1.98A	2.76A	4.83A	1.80A	1.98A	3.42A	5.49
17	01	6.31	6.31	6.31	6.60	6.54	7.50	6.53	6.79	6.21	6.90
17	02	6.12	7.18	6.15	2.01A	2.01A	5.16	6.05	2.90A	2.63A	6.32
17	03	2.20A	1.58A	2.95A	1.46A	2.33A	1.37A	5.05A	3.24A	1.65A	1.57A
17	04	1.44A	1.66A	1.18A	1.26A	1.46A	1.21A	1.53A	1.68A	2.92A	5.81
17	05	1.23A	1.28A	5.08A	2.94A	1.64A	1.43A	1.44A	1.62A	1.34A	5.90
18	01	5.61	5.75	10.82	5.27	5.48	2.45A	1.89A	1.42A	5.65	5.29
18	02	1.23A	5.46	1.43A	5.15	1.38A	2.01A	5.15	1.50A	1.68A	1.45A
18	03	3.55A	1.71A	1.34A	1.33A	1.28A	1.28A	5.07	1.76A	1.93A	3.18A
18	04	5.53	1.17A	1.46A	1.60A	1.60A	1.08A	1.06A	1.02A	1.54A	5.53
18	05	5.40	4.38A	5.92	1.36A	1.93A	1.89A	1.44A	1.39A	1.12A	1.39A
20	01	5.81	5.81	5.64	5.67	4.12A	1.41A	2.10A	2.47A	5.10A	5.66
20	02	2.54A	5.84	6.75	5.11A	3.65A	6.05	1.59A	1.94A	2.35A	1.37A
20	03	1.85A	1.54A	1.37A	1.70A	2.94A	6.20	4.12A	1.15A	1.35A	2.61A
20	04	5.23A	2.01A	3.77A	1.39A	1.28A	6.72	1.34A	1.57A	1.16A	5.69
20	05	2.21A	5.73	1.70A	1.35A	2.28A	5.64	1.27A	1.37A	1.46A	1.39A
21	01	2.36A	2.18A	5.61	5.65	6.40	5.24	1.45A	3.19A	5.42	2.72A
21	02	3.23A	2.07A	1.68A	5.83	2.22A	5.46	1.89A	2.02A	2.31A	2.42A
21	03	5.35	1.49A	1.28A	2.53A	1.53A	2.11A	1.34A	1.78A	1.52A	2.54A
21	04	1.48A	2.16A	2.08A	1.47A	1.24A	1.58A	2.78A	2.33A	5.31	2.00A
21	05	1.43A	2.66A	1.19A	1.62A	5.49	1.62A	4.97A	5.56	3.62A	4.73A
22	01	5.36	11.30	16.56	5.08	11.63	4.15A	1.70A	6.36	5.92	7.62
22	02	6.00	2.35A	4.20A	2.73A	10.00	1.76A	5.06A	3.14A	3.05A	2.23A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
22	03	3.23A	2.75A	6.33	6.98	5.27	2.66A	2.77A	3.50A	3.15A	2.46A
22	04	2.49A	1.83A	3.61A	2.08A	2.89A	3.03A	4.54A	3.29A	2.60A	4.79A
22	05	2.63A	3.45A	2.68A	2.28A	2.65A	2.42A	3.26A	3.72A	3.02A	3.06A
23	01	5.35	2.12A	6.00	5.97	8.21	3.49A	5.53	5.70	5.93	1.62A
23	02	4.41A	1.40A	1.60A	6.02	5.80	6.01	1.62A	3.27A	5.65	5.86
23	03	3.27A	1.49A	6.33	1.78A	5.80	1.95A	2.00A	5.47	5.74	3.83A
23	04	3.14A	2.09A	5.81	1.66A	1.79A	1.98A	3.78A	1.97A	1.94A	1.97A
23	05	2.10A	1.76A	7.60	1.82A	2.00A	2.09A	1.84A	6.08	2.98A	1.69A
24	01	6.52	2.84A	7.84	6.27	2.27A	6.49	1.98A	1.53A	6.52	2.16A
24	02	5.78	6.09	5.83	2.12A	3.02A	2.00A	3.75A	2.11A	6.36	3.45A
24	03	2.60A	1.93A	5.94	2.97A	6.08	2.10A	4.04A	2.61A	6.12	1.89A
24	04	1.60A	2.27A	4.82A	3.74A	2.47A	2.14A	3.08A	2.76A	7.89	3.43A
24	05	2.93A	2.35A	2.06A	2.28A	1.71A	1.75A	2.60A	1.78A	5.80	1.74A
25	01	6.41	6.11	6.32	5.65	6.14	7.08	6.62	6.00	5.38	6.04
25	02	6.14	6.15	6.22	6.29	6.46	5.90	6.01	1.93A	3.08A	3.08A
25	03	6.06	6.07	6.07	2.34A	5.43	3.76A	6.00	3.76A	2.60A	2.29A
25	04	5.94	3.46A	1.85A	6.31	5.93	2.24A	3.92A	1.83A	5.87	4.29A
25	05	3.87A	3.67A	2.21A	5.32	5.90	5.18	1.86A	2.65A	5.00A	2.35A
26	01	5.94	7.18	6.09	5.86	3.80A	6.00	5.93	2.96A	1.47A	1.72A
26	02	3.98A	5.16A	1.36A	6.00	1.44A	2.99A	4.77A	5.67	1.37A	2.97A
26	03	1.39A	4.79A	1.42A	1.71A	1.72A	1.82A	5.97	5.82	1.49A	5.81
26	04	1.36A	3.89A	1.56A	1.62A	1.32A	1.55A	2.07A	6.05	3.79A	4.68A
26	05	1.17A	2.22A	1.48A	1.67A	1.52A	3.91A	1.73A	3.13A	1.92A	2.05A
27	01	2.70A	2.11A	4.56A	5.90	1.41A	4.65A	2.55A	3.42A	2.05A	5.22
27	02	3.18A	2.36A	2.88A	2.93A	1.93A	1.49A	1.81A	1.54A	5.33	1.47A
27	03	2.07A	2.12A	1.94A	1.26A	1.48A	2.89A	1.99A	1.50A	1.84A	1.42A
27	04	1.72A	1.96A	2.36A	2.19A	1.61A	2.08A	1.46A	1.44A	1.40A	1.89A
27	05	1.75A	2.63A	2.06A	1.78A	1.42A	1.50A	2.32A	3.45A	1.73A	1.42A
28	01	6.41	2.10A	6.24	5.73	5.76	3.32A	5.74	5.33	5.45	5.33
28	02	5.48	5.31	5.51	2.97A	5.68	5.54	5.44	1.70A	5.58	3.16A
28	03	5.56	1.91A	5.62	2.05A	4.22A	5.41	4.69A	5.57	2.61A	5.56
28	04	2.30A	2.47A	2.80A	5.49	5.35	2.00A	2.78A	2.12A	5.42	2.25A
28	05	1.72A	1.48A	1.85A	2.56A	1.75A	5.65	1.82A	3.60A	4.10A	3.39A
29	01	5.97	5.97	5.92	5.92	5.80	5.80	5.07	5.07	5.96	5.86

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
29	02	1.43A	5.71	1.45A	5.72	5.05A	1.50A	2.53A	5.69	1.49A	2.42A
29	03	1.44A	3.20A	5.93	5.75	1.54A	2.05A	3.18A	5.71	1.50A	2.37A
29	04	1.43A	1.81A	2.32A	1.62A	2.87A	2.02A	2.31A	1.82A	1.53A	1.83A
29	05	1.34A	1.58A	2.46A	1.97A	1.19A	1.73A	1.44A	2.00A	2.98A	5.86
30	01	6.93	5.70	5.78	4.21A	2.81A	4.35A	2.08A	2.20A	1.97A	2.05A
30	02	1.77A	5.13A	6.10	5.62	1.38A	1.73A	1.68A	2.39A	1.64A	1.44A
30	03	1.65A	1.34A	2.52A	2.68A	5.66	1.67A	2.39A	2.88A	2.07A	1.30A
30	04	1.25A	1.29A	1.96A	1.36A	1.81A	1.71A	2.89A	2.32A	2.66A	5.62
30	05	1.56A	5.89	1.48A	5.85	1.48A	1.32A	1.42A	1.24A	1.31A	1.44A
31	01	5.78	5.77	5.74	5.85	2.53A	5.36	2.92A	5.79	2.36A	5.54
31	02	5.60	2.28A	2.27A	2.43A	3.35A	5.80	2.31A	3.49A	2.77A	4.19A
31	03	2.08A	2.87A	1.94A	3.14A	2.09A	4.83A	1.45A	2.54A	2.04A	1.90A
31	04	1.85A	2.43A	5.64	3.59A	3.29A	6.08	1.49A	2.10A	2.46A	1.93A
31	05	3.00A	1.38A	2.25A	1.24A	1.43A	1.80A	1.80A	1.67A	5.65A	2.78A
32	01	5.94	5.38	4.78A	1.33A	1.29A	2.54A	5.53	1.21A	2.59A	2.13A
32	02	3.36A	1.94A	5.87	1.24A	1.78A	4.48A	5.00A	1.40A	5.51	5.52
32	03	1.83A	5.30	1.47A	1.60A	1.51A	3.23A	1.35A	3.37A	1.94A	1.82A
32	04	1.09A	2.24A	1.79A	1.26A	1.72A	1.25A	2.57A	1.10A	2.65A	1.28A
32	05	2.42A	1.17A	1.43A	5.56	1.74A	0.91A	1.21A	3.08A	1.82A	5.30
33	01	6.00	6.00	6.09	5.86	3.85A	3.08A	14.17	5.95	5.61	5.55
33	02	1.30A	5.71	5.77	1.56A	1.23A	3.11A	5.86	1.49A	4.51A	5.62
33	03	1.25A	6.71	1.55A	1.69A	3.95A	1.82A	5.71	5.93	3.03A	2.04A
33	04	2.71A	1.94A	3.49A	1.27A	1.66A	2.64A	3.68A	1.66A	1.52A	2.06A
33	05	5.61	1.59A	2.16A	1.52A	2.51A	1.80A	2.32A	1.55A	1.62A	1.33A
34	01	6.95	7.02	6.38	2.43A	3.66A	5.34	2.59A	2.20A	5.41	7.52
34	02	5.51	3.52A	3.44A	1.77A	3.83A	1.57A	5.67	1.76A	4.56A	1.36A
34	03	5.28	2.53A	3.57A	1.26A	3.80A	1.39A	3.47A	1.24A	2.88A	1.14A
34	04	1.87A	1.66A	2.70A	1.97A	1.95A	2.68A	2.91A	1.63A	1.45A	1.62A
34	05	2.35A	1.46A	2.56A	1.33A	1.73A	1.55A	1.62A	1.09A	1.94A	1.20A
35	01	6.05	4.70A	8.51	6.03	2.48A	5.74	5.90	7.16	3.19A	6.36
35	02	2.70A	1.98A	5.98	2.00A	2.10A	1.88A	5.94	1.36A	3.34A	1.69A
35	03	5.66	1.21A	1.64A	1.75A	1.37A	5.77	1.35A	1.40A	1.97A	5.66
35	04	5.29	5.66	1.33A	5.64	1.24A	3.04A	5.75	3.89A	4.19A	5.79
35	05	1.52A	5.99	3.09A	6.05	1.58A	1.85A	5.74	2.89A	2.89A	4.02A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
36	01	4.88A	3.32A	5.65	5.41	5.36	4.05A	3.66A	4.83A	5.29	3.COA
36	02	2.21A	3.78A	3.05A	1.60A	3.76A	4.18A	5.35	1.87A	1.95A	1.11A
36	03	3.30A	1.30A	1.31A	4.04A	2.34A	3.67A	2.63A	2.83A	1.21A	1.65A
36	04	1.40A	3.92A	1.11A	1.49A	5.54	1.16A	3.29A	1.42A	1.72A	2.27A
36	05	3.12A	2.14A	0.85A	3.16A	3.64A	1.26A	3.02A	1.60A	2.61A	2.17A
37	01	6.57	6.06	6.29	6.02	6.29	5.94	8.03	6.04	6.00	6.C9
37	02	5.77	6.08	5.95	5.97	6.02	5.82	5.92	5.83	3.60A	5.93
37	03	3.88A	5.91	1.99A	5.88	6.08	2.95A	5.85	2.96A	6.05	5.77
37	04	3.61A	6.07	5.83	3.43A	5.82	3.27A	6.09	5.27	5.80	5.7C
37	05	5.81	5.89	5.85	5.70	5.90	2.85A	5.78	5.79	5.80	6.56
38	01	6.60	1.61A	5.64	5.89	2.07A	5.73	5.79	3.52A	5.68	2.80A
38	02	5.49	3.65A	5.51	1.98A	5.48	2.62A	5.67	5.48	5.57	2.36A
38	03	4.47A	5.65	5.48	3.90A	5.72	1.98A	3.63A	3.62A	3.20A	2.35A
38	04	2.90A	3.02A	5.83	4.49A	5.03A	3.23A	5.12A	3.17A	3.25A	3.37A
38	05	3.93A	5.60	1.74A	4.51A	3.05A	2.95A	2.08A	3.70A	4.77A	4.70A
39	01	6.53	6.41	6.22	5.88	7.24	2.57A	6.00	2.63A	5.93	1.42A
39	02	5.87	5.88	2.67A	5.85	4.68A	5.63	5.88	5.93	3.93A	1.94A
39	03	7.00	3.21A	2.27A	1.94A	2.19A	2.89A	2.50A	2.60A	1.68A	1.74A
39	04	1.66A	5.90	2.27A	1.93A	1.88A	5.13A	1.98A	1.59A	2.11A	1.55A
39	05	1.72A	1.69A	1.89A	1.62A	1.63A	4.46A	4.60A	1.54A	1.65A	3.68A
40	01	6.68	5.81	5.22	5.66	2.57A	4.72A	5.47	5.66	3.89A	5.53
40	02	4.13A	2.43A	2.05A	3.93A	2.80A	3.74A	3.78A	1.90A	2.48A	3.44A
40	03	2.43A	1.58A	1.93A	1.69A	2.25A	1.85A	2.24A	2.01A	2.13A	2.17A
40	04	1.90A	2.39A	1.48A	4.06A	1.54A	3.88A	6.31	3.40A	1.57A	5.66
40	05	1.90A	1.77A	1.67A	2.81A	1.63A	3.27A	1.25A	1.92A	1.29A	1.68A
41	01	7.35	8.56	8.91	24.19	21.30	15.98	23.51	13.90	25.02	15.62
41	02	8.97	5.86	6.16	6.07	6.16	6.17	6.06	3.02A	5.98	5.98
41	03	5.98	5.90	6.08	3.13A	6.24	6.05	6.01	4.68A	5.95	3.57A
41	04	5.80	6.09	6.19	3.44A	5.88	5.95	2.36A	7.04	5.83	6.9C
41	05	4.72A	6.78	3.90A	5.94	4.51A	4.11A	6.29	2.34A	5.83	3.92A
42	01	5.87	5.67	5.75	5.68	5.90	5.68	5.61	11.02	6.78	2.54A
42	02	5.80	5.53	5.57	5.80	5.71	1.51A	5.76	7.34	3.89A	5.48
42	03	5.58	5.53	4.89A	6.53	5.62	3.36A	1.30A	7.12	5.46	1.87A
42	04	5.60	7.03	5.60	5.82	5.62	6.47	5.50	2.50A	5.94	4.67A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
42	05	2.26A	5.76	3.90A	3.21A	2.10A	5.67	5.32	2.75A	1.93A	4.44A
43	01	5.81	3.84A	3.81A	3.44A	2.41A	3.56A	4.76A	3.33A	1.58A	1.54A
43	02	1.62A	1.99A	1.53A	5.89	1.19A	5.53	2.41A	1.38A	1.38A	1.93A
43	03	1.10A	1.89A	1.43A	4.25A	1.61A	1.35A	0.92A	1.43A	1.44A	1.20A
43	04	1.63A	3.29A	1.43A	1.36A	1.00A	1.48A	1.20A	1.11A	1.23A	1.48A
43	05	1.15A	1.36A	1.44A	1.41A	1.20A	1.00A	0.85A	1.72A	1.14A	1.33A
44	01	5.33	6.03	6.12	6.41	5.73	5.76	1.96A	5.56	0.95A	5.45
44	02	0.84A	5.59	6.34	5.59	5.72	5.60	3.63A	5.71	1.05A	1.58A
44	03	1.10A	5.30	0.76A	5.48	1.06A	1.31A	1.01A	1.48A	1.68A	2.68A
44	04	0.75A	0.97A	3.16A	0.95A	0.87A	0.79A	1.62A	3.45A	1.48A	1.65A
44	05	1.53A	0.95A	0.86A	1.16A	0.73A	1.15A	1.60A	1.01A	0.73A	1.25A
45	01	5.25	5.25	7.58	6.08	7.37	6.36	5.82	6.80	2.57A	6.49
45	02	5.89	6.09	5.92	5.89	5.93	5.78	3.28A	5.97	2.38A	2.53A
45	03	1.63A	4.74A	1.47A	1.62A	1.62A	2.08A	1.76A	2.36A	5.09A	2.97A
45	04	6.53	1.66A	2.60A	1.55A	1.61A	5.93	2.26A	3.07A	5.79	2.66A
45	05	6.11	0.97A	1.48A	1.65A	1.43A	1.64A	5.81	5.69	3.04A	1.54A
46	01	4.26A	5.50	4.25A	7.66	4.67A	2.19A	5.69	3.54A	2.39A	2.67A
46	02	1.42A	5.44	1.36A	4.16A	3.59A	1.45A	1.18A	4.22A	1.77A	1.70A
46	03	1.52A	3.35A	3.64A	3.64A	3.67A	4.33A	1.46A	3.62A	5.29A	1.09A
46	04	5.68	3.43A	2.82A	1.39A	2.99A	1.38A	3.09A	5.57	3.85A	3.65A
46	05	5.92	1.42A	1.35A	4.92A	2.29A	3.13A	2.72A	1.54A	2.39A	2.07A
47	01	6.33	6.25	6.30	7.93	8.66	8.13	5.91	6.13	6.40	6.10
47	02	4.79A	5.90	5.87	5.72	3.75A	5.97	3.09A	3.50A	5.76	5.64
47	03	5.70	3.29A	3.26A	5.71	1.94A	5.62	2.66A	1.59A	3.44A	4.43A
47	04	6.19	5.82	8.04	5.82	3.60A	5.67	7.24	5.75	3.10A	4.04A
47	05	8.62	8.62	2.89A	4.09A	3.69A	4.29A	3.54A	5.75	3.54A	5.79
48	01	3.68A	1.23A	5.55	5.42	5.49	2.73A	6.10	2.36A	5.78	1.76A
48	02	1.84A	2.76A	5.50	2.54A	5.39	1.48A	5.49	2.18A	5.39	2.63A
48	03	5.33	1.85A	5.32	5.19A	3.31A	5.37	5.25	1.75A	1.87A	1.48A
48	04	1.66A	2.12A	1.62A	4.34A	3.68A	5.35	2.06A	1.57A	1.78A	2.34A
48	05	5.21	2.23A	1.92A	2.07A	1.59A	3.58A	1.16A	2.07A	1.52A	2.18A
49	01	5.99	7.23	2.06A	6.13	4.16A	7.35	6.22	1.68A	6.47	4.98A
49	02	5.79	1.98A	3.90A	1.62A	3.14A	1.83A	2.17A	2.61A	2.66A	2.40A
49	03	2.24A	2.12A	2.93A	1.94A	1.67A	1.51A	1.59A	1.60A	1.62A	1.71A

TABLE D-1 AVOIDANCE LATENCIES . Cont'd

RAT #	CARD #										
49	04	2.27A	5.98	3.76A	1.54A	2.20A	1.78A	3.82A	3.59A	1.95A	1.68A
49	05	2.23A	2.18A	1.84A	2.02A	1.73A	1.62A	5.79	6.11	5.92	5.82
50	01	6.22	5.75	5.43	5.67	5.40	2.85A	4.58A	5.53	5.83	5.42
50	02	5.85	5.64	5.63	2.28A	4.58A	3.24A	6.08	5.62	5.60	5.69
50	03	5.45	2.58A	2.80A	2.50A	2.74A	2.23A	5.63	1.87A	3.09A	5.53
50	04	4.43A	1.91A	5.48	6.08	2.92A	5.72	2.37A	5.97	5.48	1.98A
50	05	2.86A	3.39A	5.62	3.06A	5.05A	5.63	4.88A	4.99A	5.82	5.84
51	01	30.93	27.76	17.56	6.62	6.05	6.00	8.94	6.47	6.25	6.35
51	02	5.89	5.90	6.43	6.57	6.00	5.90	6.01	5.75	1.33A	5.98
51	03	1.98A	5.89	4.93A	6.13	1.44A	1.52A	1.32A	1.70A	4.57A	1.97A
51	04	6.68	6.45	1.87A	6.37	6.19	5.85	2.10A	1.87A	5.57	5.74
51	05	5.84	5.87	5.88	5.67	6.74	1.88A	3.99A	5.80	6.07	5.79
52	01	5.73	5.47	5.77	5.99	1.77A	7.37	8.73	5.75	2.83A	5.77
52	02	1.37A	5.55	5.72	6.16	3.23A	4.00A	5.83	5.81	4.00A	2.08A
52	03	3.35A	4.02A	5.51	5.54	5.75	3.51A	5.42	4.75A	5.39	6.13
52	04	1.57A	1.48A	3.97A	2.10A	1.51A	1.86A	3.62A	2.85A	5.63	2.94A
52	05	3.48A	2.46A	1.61A	1.75A	1.50A	1.61A	1.41A	2.45A	4.17A	2.65A
53	01	7.30	11.01	5.86	6.88	6.42	5.78	5.98	5.96	5.72	6.95
53	02	5.48	5.73	3.19A	6.02	5.61	7.03	5.97	3.68A	7.66	7.48
53	03	5.60	6.19	5.67	6.33	5.73	5.56	5.49	6.56	5.50	5.93
53	04	6.02	6.85	5.49	7.04	6.58	3.61A	5.81	5.48	5.55	5.60
53	05	5.99	5.86	6.65	5.62	3.31A	5.55	5.92	5.95	6.17	5.48
55	01	6.38	6.38	5.56	2.76A	5.87	5.64	5.97	5.71	5.79	5.66
55	02	5.95	4.04A	3.54A	5.48	1.62A	5.67	4.33A	3.85A	4.74A	3.65A
55	03	1.83A	1.55A	1.76A	4.83A	1.70A	1.32A	1.55A	1.31A	1.13A	3.31A
55	04	4.18A	2.71A	5.70	1.26A	3.22A	1.52A	1.77A	5.52	5.29	5.92
55	05	1.97A	1.75A	2.62A	1.69A	4.10A	3.00A	1.68A	2.02A	4.17A	3.3CA
56	01	6.74	6.58	6.43	7.43	5.93	2.18A	7.22	6.04	5.67	6.25
56	02	6.13	6.52	2.89A	6.02	1.67A	8.15	5.78	5.76	5.16A	5.77
56	03	5.67	5.94	3.79A	5.76	2.51A	5.86	6.02	5.69	2.59A	5.80
56	04	5.69	5.79	2.66A	5.58	5.75	1.27A	1.41A	1.32A	1.82A	5.68
56	05	5.95	1.38A	3.21A	2.26A	2.82A	2.17A	2.60A	1.70A	1.59A	1.41A
57	01	5.57	1.31A	3.60A	1.67A	5.74	2.70A	5.72	2.59A	1.78A	1.69A
57	02	5.60	1.50A	4.00A	1.72A	1.31A	1.44A	3.40A	2.12A	3.45A	2.68A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
57	03	5.20A	3.48A	1.18A	1.36A	3.96A	1.93A	2.28A	5.38	3.51A	2.35A
57	04	2.49A	1.44A	1.50A	2.04A	4.73A	1.33A	1.69A	1.35A	5.45	3.85A
57	05	2.75A	1.45A	0.83A	1.09A	1.06A	3.01A	1.30A	5.47	3.28A	3.22A
58	01	2.49A	5.67	3.60A	6.49	7.05	1.75A	4.17A	3.75A	3.22A	5.55
58	02	5.64	5.26	2.31A	4.65A	5.36	5.36	2.92A	3.44A	5.28	5.55
58	03	2.52A	2.27A	1.97A	1.42A	3.96A	2.53A	3.25A	1.76A	5.40	5.32
58	04	3.55A	2.67A	4.41A	1.25A	2.62A	1.80A	1.73A	2.38A	2.50A	1.85A
58	05	1.35A	4.32A	2.14A	1.94A	2.85A	1.24A	2.15A	1.37A	2.94A	5.33
59	01	6.54	3.39A	3.28A	5.43	1.57A	2.01A	5.80	1.92A	3.22A	4.9CA
59	02	5.44	6.03	2.17A	2.80A	2.32A	3.39A	2.69A	2.92A	4.26A	4.66A
59	03	3.17A	5.42	2.24A	3.06A	2.17A	5.44	2.61A	3.81A	2.87A	3.83A
59	04	2.30A	3.67A	1.90A	1.39A	1.26A	1.12A	1.29A	3.23A	1.07A	1.44A
59	05	1.49A	3.11A	1.20A	1.46A	1.83A	1.30A	1.43A	1.58A	1.35A	1.27A
60	01	5.71	6.04	5.73	1.48A	5.97	1.43A	5.72	1.05A	2.66A	2.79A
60	02	6.43	1.50A	1.50A	1.63A	1.47A	1.09A	3.82A	1.52A	1.40A	1.40A
60	03	6.79	1.20A	1.41A	1.59A	1.05A	1.82A	1.36A	1.22A	1.26A	1.C9A
60	04	1.21A	4.51A	5.58	2.10A	2.83A	2.66A	1.88A	1.21A	1.04A	1.19A
60	05	2.25A	1.55A	1.21A	2.89A	1.95A	2.19A	1.26A	1.95A	1.61A	1.71A
61	01	7.27	6.71	7.43	6.72	10.45	6.36	6.38	6.04	5.96	6.40
61	02	6.44	5.93	6.38	5.84	3.18A	5.94	6.17	2.62A	6.14	5.89
61	03	6.22	6.11	3.95A	5.95	2.18A	1.87A	1.85A	2.01A	6.11	2.23A
61	04	1.63A	5.96	2.38A	1.70A	2.14A	1.72A	2.09A	1.95A	2.21A	1.92A
61	05	1.76A	1.71A	2.04A	3.86A	6.21	2.09A	1.70A	5.93	6.37	2.05A
62	01	6.74	6.26	6.13	6.20	8.16	6.66	7.29	6.32	6.57	5.89
62	02	6.13	5.85	5.80	2.06A	5.54	8.47	5.80	3.15A	2.53A	1.92A
62	03	5.81	2.14A	2.89A	2.25A	2.75A	5.81	5.75	5.57	5.60	2.67A
62	04	2.17A	5.70	3.19A	2.16A	5.93	5.56	3.83A	2.35A	7.03	6.02
62	05	3.17A	5.68	6.24	6.46	6.01	5.62	5.39	5.82	5.66	5.57
63	01	5.86	5.86	6.46	5.89	7.18	6.38	7.48	6.91	7.30	5.82
63	02	5.87	6.61	5.98	3.68A	6.35	5.80	5.79	5.89	4.04A	5.89
63	03	6.06	6.30	6.36	5.89	2.52A	5.68	5.78	5.77	5.78	5.87
63	04	6.20	5.97	3.60A	5.81	2.07A	5.68	2.87A	6.10	1.60A	5.82
63	05	2.08A	5.63	1.44A	5.57	1.95A	2.02A	5.73	1.55A	1.65A	1.57A
64	01	8.35	8.35	6.04	9.88	6.95	7.02	7.68	7.68	6.91	34.35

TABLE D-1 AVOIDANCE LATENCIES · Cont'd

RAT #	CARD #									
64	02	6.38	7.65	7.65	6.98	6.00	7.40	7.57	6.36	2.54A	6.68
64	03	6.05	6.79	7.63	6.33	2.25A	5.54	5.68	5.54	5.57	5.71
64	04	5.52	5.65	2.30A	5.63	5.41	5.57	1.99A	5.48	2.94A	5.60
64	05	1.40A	5.40	1.64A	5.46	8.37	5.32	2.92A	5.38	2.13A	5.45
65	01	6.01	6.01	1.73A	6.07	6.70	4.44A	5.59	5.42	6.83	6.23
65	02	1.71A	6.15	5.25	5.78	1.73A	5.61	1.56A	2.01A	2.04A	2.02A
65	03	1.26A	1.85A	1.60A	1.50A	1.48A	1.67A	3.32A	1.67A	1.27A	3.28A
65	04	1.72A	1.85A	1.40A	1.89A	1.35A	5.34	1.21A	1.39A	1.17A	1.42A
65	05	1.14A	1.38A	1.20A	1.15A	1.16A	1.36A	1.17A	1.16A	5.38	1.33A
66	01	6.08	6.07	5.90	6.01	3.32A	6.16	5.82	2.08A	5.82	5.78
66	02	3.51A	2.55A	5.80	3.12A	3.48A	1.99A	2.22A	1.60A	3.49A	5.94
66	03	5.98	2.08A	1.37A	3.20A	1.58A	1.43A	1.73A	1.69A	1.65A	1.48A
66	04	2.04A	1.62A	1.52A	1.55A	2.88A	1.55A	1.48A	1.62A	1.56A	1.53A
66	05	1.65A	5.83	1.99A	2.21A	5.05A	3.30A	5.57	1.54A	2.30A	1.57A
67	01	3.37A	5.94	5.85	2.11A	6.54	5.45	2.88A	5.52	3.02A	5.75
67	02	2.57A	2.94A	5.72	3.68A	5.50	4.89A	2.04A	1.95A	2.56A	5.72
67	03	1.87A	2.76A	5.63	4.63A	4.82A	1.60A	2.43A	2.06A	5.70	1.60A
67	04	2.84A	1.53A	5.78	1.67A	5.62	3.63A	3.64A	4.76A	2.14A	2.85A
67	05	5.75	5.73	1.92A	5.49	1.83A	4.01A	1.65A	1.78A	1.57A	2.21A
68	01	6.07	5.82	8.54	8.74	6.49	12.39	6.08	13.11	5.95	7.08
68	02	6.29	6.05	3.23A	5.95	5.86	6.75	7.33	6.21	3.14A	5.81
68	03	5.81	5.75	5.95	6.29	5.77	5.78	5.09A	4.51A	5.73	6.27
68	04	5.79	2.69A	5.75	5.77	5.82	5.97	4.69A	5.75	3.48A	1.53A
68	05	5.76	1.25A	5.16A	5.67	5.68	5.72	2.25A	5.73	5.73	5.96
69	01	5.90	5.99	6.92	5.60	6.96	5.69	2.31A	6.65	4.61A	4.78A
69	02	5.52	5.60	5.67	5.51	5.65	1.48A	3.41A	3.71A	1.98A	1.40A
69	03	1.68A	1.59A	2.22A	1.30A	3.23A	1.83A	1.23A	3.19A	3.05A	1.41A
69	04	1.24A	5.50	5.55	5.36	3.17A	1.17A	4.29A	1.56A	1.45A	1.41A
69	05	3.00A	2.59A	5.57	1.46A	1.92A	1.50A	1.30A	1.68A	1.36A	5.53
70	01	6.34	5.89	7.75	6.06	5.75	5.94	4.51A	3.82A	5.24	6.02
70	02	3.85A	6.90	5.63	3.34A	5.96	5.94	5.73	2.73A	3.74A	2.47A
70	03	3.93A	3.50A	5.62	6.26	3.02A	5.79	1.96A	5.91	5.57	3.36A
70	04	1.70A	6.08	5.94	4.80A	5.25	1.94A	5.80	6.53	3.78A	4.88A
70	05	1.67A	3.94A	2.43A	1.63A	2.49A	3.85A	2.45A	2.48A	4.59A	2.62A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #									
71	01	6.20	6.57	5.88	6.60	8.58	5.84	6.16	6.46	2.72A	6.35
71	02	2.30A	5.43	5.86	1.76A	4.57A	1.60A	1.87A	5.85	5.06	1.62A
71	03	1.95A	1.79A	1.65A	5.86	1.66A	4.65A	1.63A	2.04A	5.38	2.85A
71	04	6.28	2.29A	1.65A	6.01	2.55A	5.97	2.12A	3.21A	4.39A	2.53A
71	05	1.56A	1.81A	1.76A	1.53A	1.60A	1.35A	1.28A	1.75A	1.42A	1.91A
72	01	7.17	5.96	6.03	6.01	6.00	6.01	8.09	4.89A	6.00	6.73
72	02	5.87	5.97	7.33	5.09	6.01	5.87	6.31	8.12	3.95A	6.00
72	03	9.69	4.71A	6.05	6.37	13.30	5.30	6.02	6.15	6.63	4.27A
72	04	6.13	6.27	6.08	6.05	5.42	6.24	6.93	2.25A	4.73A	7.42
72	05	5.98	6.55	2.35A	5.07	5.94	5.95	2.62A	7.77	6.02	3.31A
80	01	7.35	8.49	6.43	6.43	6.48	6.96	7.57	6.78	6.57	6.85
80	02	6.20	6.41	1.49A	5.91	2.05A	5.03A	6.74	5.89	2.90A	5.09A
80	03	5.95	2.38A	7.27	5.87	5.99	4.89A	5.95	4.89A	6.04	1.39A
80	04	1.79A	6.15	3.04A	2.74A	1.48A	5.98	5.83	4.73A	2.93A	5.80
80	05	1.66A	1.60A	3.47A	6.10	2.61A	1.90A	3.80A	1.94A	1.55A	4.00A
81	01	6.13	6.42	5.95	6.83	5.52	1.44A	5.99	2.93A	6.04	1.55A
81	02	6.36	6.21	2.33A	1.57A	5.75	2.08A	5.90	1.92A	1.84A	3.02A
81	03	5.53	3.49A	6.11	4.32A	4.05A	2.42A	1.63A	2.31A	3.66A	4.04A
81	04	4.71A	5.94	2.11A	2.19A	1.47A	1.38A	1.75A	1.79A	1.86A	2.69A
81	05	2.29A	2.13A	1.37A	1.64A	1.45A	1.51A	3.09A	2.40A	2.84A	2.03A
82	01	6.45	11.21	7.03	7.50	7.55	3.37A	8.89	6.79	6.29	6.02
82	02	6.68	4.11A	6.27	6.41	6.25	6.18	6.16	6.29	5.97	5.90
82	03	6.41	2.04A	6.15	6.16	4.49A	5.82	4.70A	3.40A	6.08	2.29A
82	04	5.71	3.15A	5.74	3.66A	5.93	3.33A	5.83	5.06A	5.84	6.06
82	05	5.85	5.85	1.64A	5.85	6.66	5.93	2.23A	4.40A	4.33A	3.41A
83	01	6.08	6.71	2.44A	1.95A	6.04	5.80	6.22	6.05	2.17A	3.05A
83	02	7.07	5.91	6.00	6.70	5.41A	3.06A	6.29	7.29	6.10	6.02
83	03	5.93	6.06	1.43A	5.96	5.86	5.81	6.11	1.82A	2.47A	3.05A
83	04	3.27A	2.88A	4.01A	5.37A	3.05A	3.90A	1.89A	3.88A	1.78A	4.38A
83	05	2.24A	6.00	5.85	2.04A	6.09	2.58A	2.74A	2.00A	3.49A	3.15A
84	01	7.81	7.81	7.04	6.34	6.31	7.13	6.30	1.72A	7.51	6.30
84	02	6.53	7.14	1.80A	6.18	3.28A	6.57	6.05	7.16	6.72	6.80
84	03	1.67A	1.97A	6.29	1.23A	6.89	5.85	5.84	7.86	6.97	6.90
84	04	1.76A	5.85	5.81	7.41	6.39	6.62	1.86A	1.29A	2.59A	5.54A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
84	05	6.23	6.00	6.40	2.74A	4.97A	6.40	1.15A	6.01	5.75	3.73A
85	01	7.20	6.32	16.28	7.42	9.34	6.97	6.62	6.09	7.15	6.01
85	02	6.80	6.32	6.12	2.71A	6.18	5.93	5.91	5.93	5.96	6.13
85	03	5.85	2.90A	6.52	5.79	6.32	5.85	4.16A	5.97	5.89	5.86
85	04	5.90	4.49A	3.34A	9.07	5.87	5.92	6.07	2.48A	5.67	5.88
85	05	5.94	5.81	6.28	3.55A	3.52A	5.82	5.76	2.59A	4.49A	6.07
86	01	8.00	6.39	7.49	6.39	6.55	6.34	1.70A	6.10	2.36A	6.12
86	02	1.68A	6.09	2.13A	2.23A	1.99A	5.82	2.13A	6.25	1.38A	5.91
86	03	1.83A	1.71A	4.80A	2.02A	2.20A	1.84	2.20A	5.93	2.57A	1.49A
86	04	1.84A	1.51A	3.32A	1.38A	6.05	5.93	1.61A	1.23A	1.84A	5.78
86	05	1.84A	1.84A	2.67A	1.98A	1.46A	1.65A	2.36A	5.42A	2.99A	1.33A
87	01	7.03	6.05	6.10	5.89	5.90	6.03	5.77	1.91A	3.87A	5.71
87	02	2.63A	5.71	5.10A	5.78	5.91	3.60A	2.40A	5.99	1.75A	3.83A
87	03	5.80	5.64	5.89	1.82A	2.82A	1.28A	5.75	1.98A	2.23A	1.23A
87	04	2.90A	5.64	2.26A	5.38	2.36A	2.30A	6.01	5.87	5.79	1.70A
87	05	2.39A	5.24A	1.73A	2.60A	1.87A	1.46A	2.30A	3.15A	2.69A	1.50A
88	01	7.15	11.68	6.64	6.67	7.24	21.72	6.96	7.71	7.40	7.20
88	02	6.03	6.58	6.03	6.61	6.10	5.94	6.01	6.28	1.49A	6.24
88	03	6.54	6.13	6.05	6.50	6.75	6.34	2.63A	2.45A	5.84	6.23
88	04	5.98	6.15	6.32	6.10	6.21	5.94	6.07	6.88	6.05	5.95
88	05	8.08	6.99	5.97	6.08	6.01	6.16	5.66	6.46	7.11	6.10
89	01	6.08	5.85	6.00	5.81	5.94	6.25	1.53A	5.80	5.79	5.72
89	02	4.40A	2.58A	5.70	1.80A	5.65	3.91A	1.77A	6.11	2.48A	3.29A
89	03	5.86	1.25A	5.76	2.04A	5.78	4.55A	1.18A	1.37A	3.63A	5.66
89	04	1.31A	4.27A	1.35A	3.16A	5.55	3.04A	5.83	1.52A	1.86A	5.82
89	05	1.58A	5.97	2.44A	1.79A	1.68A	1.62A	1.63A	4.06A	2.80A	1.43A
90	01	6.34	6.17	7.24	5.85	6.92	6.10	5.89	2.67A	6.30	2.31A
90	02	6.10	3.79A	5.67	2.65A	5.64	3.65A	5.93	5.41A	2.51A	6.69
90	03	2.61A	2.21A	6.17	2.21A	1.96A	4.35A	2.28A	5.78	2.06A	2.19A
90	04	5.79	5.78	3.28A	2.12A	1.94A	4.13A	4.28A	5.93	3.83A	1.73A
90	05	4.70A	1.63A	5.73	5.76	2.49A	2.00A	5.86	1.63A	1.83A	2.30A
91	01	5.85	5.84	3.29A	5.66	5.85	2.07A	5.93	1.10A	5.97	3.09A
91	02	5.90	1.30A	5.90	5.87	5.84	1.70A	6.07	1.72A	5.80	5.90
91	03	5.88	1.55A	6.01	3.79A	5.89	5.71	5.15A	4.04A	5.92	4.13A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
91	04	5.75	1.94A	1.58A	1.73A	5.79	1.88A	5.76	2.19A	1.47A	5.15A
91	05	1.56A	1.45A	1.59A	1.98A	1.39A	2.45A	1.46A	1.41A	1.66A	2.14A
92	01	3.05A	6.28	5.03	6.71	6.34	4.92A	6.88	6.34	3.33A	7.50
92	02	1.91A	5.93	5.83	5.79	1.83A	1.66A	5.98	5.84	1.85A	3.41A
92	03	1.91A	5.93	5.83	5.79	1.83A	1.66A	5.98	5.84	1.85A	3.41A
92	04	3.75A	5.79	5.95	5.72	2.61A	5.85	3.10A	5.85	5.85	2.23A
92	05	1.25A	6.29	4.39A	1.55A	5.64	2.03A	1.70A	1.73A	5.78	1.71A
93	01	5.56	5.56	7.01	6.39	6.19	5.98	5.85	5.99	5.98	2.24A
93	02	5.99	5.89	3.50A	6.40	6.17	6.02	1.90A	6.05	6.06	5.39A
93	03	2.03A	6.08	5.84	5.75	2.18	3.42A	2.83A	1.98A	2.45A	1.95A
93	04	6.12	5.90	1.86A	3.55A	5.83	3.61A	2.26A	5.96	5.72	1.88A
93	05	6.08	5.80	1.76A	3.04A	6.07	3.81A	1.37A	6.28	5.71	1.76A
94	01	7.38	7.38	6.76	6.16	5.89	6.14	5.97	6.01	3.71A	2.81A
94	02	6.04	6.33	5.82	7.43	6.04	5.96	5.90	4.88A	4.01A	5.97
94	03	5.89	6.15	5.83	2.33A	5.94	3.21A	5.78	5.77	5.95	5.96
94	04	6.05	6.07	5.89	5.81	5.93	5.89	5.78	6.09	4.08A	5.98
94	05	6.32	3.43A	5.87	5.74	3.13A	5.82	2.01A	5.07	5.90	5.85
95	01	7.96	6.39	6.13	5.95	5.98	2.71A	3.73A	5.85	2.35A	4.09A
95	02	2.50A	6.38	5.90	1.39A	2.06A	1.39A	1.92A	5.85	2.03A	1.70A
95	03	5.95	1.58A	5.85	1.38A	1.61A	2.14A	2.81A	1.69A	1.60A	5.83
95	04	2.37A	1.41A	1.61A	1.45A	5.76	1.18A	1.76A	1.57A	5.79	1.96A
95	05	3.19A	1.49A	5.78A	1.36A	2.56A	2.11A	1.87A	2.75A	5.98	5.98
96	01	6.72	6.03	6.39	2.75A	6.29	1.82A	2.61A	6.12	6.20	6.20
96	02	6.55	6.17	3.07A	6.07	5.97	5.80	6.22	6.10	2.21A	5.57
96	03	1.41A	5.71	3.01A	2.20A	2.84A	6.96	2.42A	1.77A	5.99	3.27A
96	04	5.85	5.92	5.77	2.95A	6.07	5.45	2.82A	1.98A	3.17A	3.29A
96	05	5.90	1.76A	6.90	1.81A	6.02	3.39A	4.48A	3.50A	6.62	6.21
97	01	6.89	6.52	6.51	4.69A	8.31	6.26	2.28A	6.38	6.33	7.28
97	02	6.65	6.41	6.17	7.50	6.09	7.34	2.20A	6.11	2.36A	6.24
97	03	6.07	7.08	6.15	6.06	6.56	6.78	6.53	6.18	6.10	5.56
97	04	7.59	5.94	6.44	6.07	6.57	2.26A	6.02	5.69	6.36	5.96
97	05	6.66	8.77	6.97	1.05A	6.61	5.81	6.31	5.89	6.38	6.10
98	01	3.36A	19.48	6.29	10.83	4.39A	8.40	8.22	9.97	6.76	8.49
98	02	8.68	8.91	6.47	2.52A	6.47	6.75	8.73	4.44A	4.77A	5.96

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
98	03	9.71	6.22	1.85A	6.36	7.39	7.55	1.64A	7.27	6.76	6.6C
98	04	3.42A	5.74	6.14	6.28	8.31	2.66A	6.41	3.80A	5.00A	5.77
98	05	4.99A	7.60	10.23	2.37A	5.91	3.66A	3.04A	3.99A	5.49	3.42A
99	01	6.00	6.20	6.80	6.50	6.25	6.05	6.10	5.80	1.65A	6.05
99	02	6.00	5.90	2.45A	6.20	5.90	6.35	5.80	6.05	5.80	6.C5
99	03	5.90	6.00	1.90A	5.70	6.00	6.10	6.00	5.90	5.90	5.9C
99	04	6.10	6.25	5.90	5.85	5.75	5.90	5.90	6.00	1.25A	5.95
99	05	5.90	5.90	1.25A	5.80	4.30A	1.85A	3.45A	5.90	5.85	1.40A
100	01	6.30	5.60	6.10	6.55	6.80	5.80	2.95A	8.10	6.10	6.5C
100	02	6.00	6.35	6.65	6.80	5.70	5.75	2.00A	5.60	1.70A	4.80A
100	03	2.25A	6.60	5.75	5.65	5.55	1.45A	3.95A	5.60	5.65	5.65
100	04	2.90A	5.30	1.90A	5.00A	3.50A	5.10A	3.30A	5.60	2.15A	3.65A
100	05	7.50	5.75	4.70A	4.50A	5.60	5.50	1.60A	2.00A	1.80A	3.15A
101	01	4.20A	6.50	6.50	10.20	6.35	6.40	4.90A	4.35A	6.50	5.95
101	02	6.20	6.90	6.90	6.10	6.20	6.05	5.80	2.15A	6.60	3.60A
101	03	5.85	5.85	6.00	6.20	5.75	2.70A	2.45A	5.00A	5.85	3.30A
101	04	4.40A	5.90	2.95A	2.20A	3.60A	4.45A	4.15A	5.80	5.75	4.45A
101	05	2.00A	6.10	6.00	2.45A	2.00A	6.00	3.65A	2.65A	3.00A	5.9C
102	01	5.90	6.15	6.10	5.50	5.50	2.40A	5.60	5.55	2.05A	5.65
102	02	6.00	5.65	5.50	4.00A	5.50	2.65A	3.15A	5.50	5.75	2.00A
102	03	5.50A	2.10A	2.30A	4.50A	5.50	2.85A	5.40	1.95A	6.10	1.80A
102	04	4.50A	2.05A	2.45A	4.60A	5.75	2.50A	1.80A	3.00A	2.30A	3.2CA
102	05	3.25A	1.70A	1.40A	7.25	1.65A	1.40A	1.50A	1.30A	5.50	1.65A
103	01	5.80	5.10A	5.75	6.60	6.25	5.65	6.65	6.00	4.75A	5.75
103	02	5.95	2.05A	3.05A	5.75	2.15A	2.15A	5.75	2.70A	5.80	5.55
103	03	6.90	5.70	8.40	6.00	5.80	2.55A	5.70	5.80	1.45A	5.7C
103	04	5.65	1.80A	2.30A	1.45A	2.25A	1.55A	4.75A	6.15	1.50A	2.20A
103	05	5.75	1.40A	1.70A	5.50	1.85A	1.55A	1.65A	1.25A	5.85	1.60A
104	01	1.30A	6.20	6.40	6.25	6.50	7.05	6.10	6.80	2.85A	6.25
104	02	5.95	7.85	1.55A	7.50	6.25	5.95	1.25A	6.05	5.80	6.CC
104	03	2.50A	6.20	3.05A	6.55	6.00	9.65	6.05	6.50	6.10	6.55
104	04	6.00	6.00	5.65	6.00	5.00A	6.20	5.90	6.00	1.40A	6.CO
104	05	5.80	5.90	5.90	5.95	4.20A	5.80	4.60A	5.75	5.90	5.9C
105	01	6.20	6.10	8.15	5.85	1.90A	7.00	1.75A	5.90	6.30	2.85A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #									
105	02	6.40	1.80A	1.65A	1.90A	1.60A	5.00A	4.00A	2.55A	6.05	1.5CA
105	03	4.00A	1.30A	2.00A	3.85A	1.50A	2.85A	5.85	2.20A	1.15A	5.90
105	04	3.60A	2.50A	1.40A	2.60A	5.70	2.10A	6.50	1.65A	2.55A	4.75A
105	05	4.35A	2.40A	1.50A	4.75A	6.00	2.75A	2.60A	2.90A	3.50A	1.9CA
106	01	2.00A	2.35A	2.45A	1.45A	11.15	5.70	5.90	5.65	6.00	6.75
106	02	5.70	6.60	1.30A	6.80	1.80A	5.85	5.75	5.90	2.20A	5.55
106	03	6.10	6.50	7.15	5.85	5.75	5.70	7.00	5.85	5.75	5.95
106	04	6.05	7.10	10.17	5.55	5.75	5.60	5.50	5.80	5.75	5.6C
106	05	5.80	6.70	6.55	4.10A	5.65	5.55	4.50A	5.55	5.80	3.C5A
107	01	5.70	6.00	5.65	6.20	6.10	2.25A	5.70	5.70	4.90A	6.60
107	02	2.00A	6.00	2.20A	5.60	4.00A	6.65	5.00A	5.60	5.50	5.50
107	03	10.00	6.00	4.50A	7.40	5.00A	5.65	1.60A	5.60	6.45	9.8C
107	04	6.00	6.40	5.60	5.65	3.35A	3.35A	4.90A	5.70	5.50	3.COA
107	05	2.45A	5.45	5.60	5.75	2.05A	5.65	5.10A	6.65	4.60A	5.50
108	01	5.50	5.55	5.40	5.80	5.75	5.40	5.70	5.40	2.30A	6.55
108	02	5.70	5.60	1.65A	2.35A	5.50	6.00	3.00A	2.35A	1.50A	1.65A
108	03	5.75	5.75	3.10A	6.60	5.70	5.90	1.60A	1.70A	5.65	6.55
108	04	6.10	1.80A	5.50	5.55	3.20A	5.65	6.40	5.75	2.25A	5.75
108	05	2.15A	1.85A	1.75A	5.60	3.15A	1.50A	1.30A	5.75	5.55	5.55
109	01	6.00	6.00	5.85	5.85	6.16	7.00	4.59A	3.35A	6.20	3.35A
109	02	6.10	6.00	1.35A	3.50A	5.85	5.80	6.00	5.90	5.90	1.1CA
109	03	3.65A	1.10A	1.40A	6.10	1.00A	2.70A	5.90	1.40A	2.75A	2.45A
109	04	2.95A	3.10A	2.70A	1.50A	1.00A	1.85A	1.05A	1.15A	1.75A	4.05A
109	05	0.90A	1.00A	0.85A	0.90A	3.90A	0.85A	0.90A	1.00A	0.95A	5.95
110	01	6.45	1.40A	3.10A	6.00	7.50	5.75	6.15	6.00	6.20	6.CC
110	02	7.60	6.30	6.20	6.25	2.80A	1.45A	6.10	1.65A	1.50A	5.85
110	03	6.00	1.30A	4.30A	1.35A	4.75A	4.40A	3.00A	1.75A	4.70A	2.20A
110	04	4.00A	1.20A	2.70A	6.00	5.80	5.70	3.55A	6.00	3.20A	3.5CA
110	05	4.70A	3.80A	3.65A	1.35A	4.10A	1.55A	3.30A	1.70A	3.55A	1.8CA
111	01	4.90A	6.00	5.50	5.65	3.35A	5.60	3.00A	4.15A	5.65	5.70
111	02	3.00A	1.35A	1.35A	2.05A	5.80	4.40A	3.60A	5.50	1.80A	5.40
111	03	1.80A	2.30A	5.60	5.65	1.70A	3.45A	2.30A	1.80A	5.60	2.8CA
111	04	2.00A	1.45A	1.45A	3.70A	3.00A	1.60A	1.60A	5.50	1.20A	2.25A
111	05	1.15A	5.50	3.25A	1.40A	2.70A	1.30A	1.55A	4.20A	5.30	1.5CA

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
112	01	8.50	5.65	7.25	3.90A	7.25	5.65	5.69	2.25A	7.40	5.40
112	02	5.50	1.70A	6.25	1.20A	5.75	2.00A	2.70A	5.65	5.40	5.95
112	03	5.40	1.85A	1.70A	1.60A	1.45A	1.50A	5.65	5.45	2.25A	1.5CA
112	04	2.40A	1.60A	5.60	1.40A	5.65	5.40	5.55	3.50A	5.70	1.25A
112	05	5.60	1.70A	5.60	1.50A	4.85A	1.60A	1.55A	5.50	3.30A	5.75
113	01	6.10	4.90A	6.10	4.35A	6.15	6.00	5.90	6.45	5.95	6.05
113	02	6.00	1.30A	6.50	6.00	6.00	5.90	6.10	5.80	5.90	1.75A
113	03	6.25	6.00	3.15A	5.90	6.10	3.10A	5.85	3.25A	1.85A	2.2CA
113	04	5.75	5.75	5.60	4.10A	1.45A	1.35A	5.80	2.90A	3.80A	5.90
113	05	5.10A	5.75	5.65	2.50A	5.65	6.00	1.75A	5.75	1.85A	2.15A
114	01	3.45A	7.10	5.95	6.35	1.65A	6.25	6.55	6.50	6.60	7.9C
114	02	6.70	6.40	6.30	8.65	7.45	6.40	7.55	6.00	6.75	6.CC
114	03	9.25	6.25	4.85A	6.05	5.90	7.05	3.20A	8.05	6.70	5.90
114	04	5.95	6.55	6.30	6.20	6.05	6.10	6.10	5.00A	7.80	5.90
114	05	5.95	6.10	5.80	7.40	5.50	5.90	2.60A	4.90A	6.80	3.25A
115	01	0.00	7.00	6.25	5.85	6.40	1.80A	6.20	6.00	6.00	1.5CA
115	02	5.90	5.75	6.00	5.90	5.75	5.85	7.00	5.85	6.00	1.70A
115	03	2.10A	5.80	5.80	6.00	6.40	5.85	6.25	5.90	6.05	6.00
115	04	5.80	1.50A	6.40	6.25	5.90	6.00	4.15A	6.20	5.70	2.00A
115	05	6.10	4.00A	5.95	3.15A	5.70	1.65A	6.00	1.45A	5.80	1.95A
116	01	6.00	6.35	5.80	5.55	5.80	5.80	7.15	5.70	5.85	6.20
116	02	6.95	5.75	5.50	6.10	4.70A	5.85	1.25A	5.60	8.00	5.60
116	03	1.35A	5.90	5.60	5.70	1.90A	5.60	6.05	5.66	1.20A	5.8C
116	04	5.95	6.40	5.80	5.50	5.75	6.10	3.35A	6.60	5.90	5.25
116	05	5.25	4.50A	5.75	4.00A	7.50	5.40	5.85	4.40A	5.90	4.40A
117	01	6.15	6.50	7.15	7.95	7.30	6.05	6.65	6.25	6.40	6.25
117	02	6.30	6.20	6.10	6.20	7.10	5.90	2.10A	5.90	5.70	5.95
117	03	6.00	1.25A	6.00	6.00	6.20	5.85	6.00	6.40	6.70	6.45
117	04	6.00	6.15	6.60	5.65	6.50	5.85	6.15	6.20	5.85	5.85
117	05	5.75	5.80	5.70	6.20	5.80	5.70	5.80	1.30A	6.30	5.90
118	01	5.50	5.80	5.80	5.90	6.40	5.55	3.20A	5.65	5.50	5.70
118	02	5.45	4.20A	2.35A	5.85	5.50	5.80	3.00A	1.85A	2.50A	6.CC
118	03	5.65	5.13A	1.80A	4.06A	6.00	3.72A	5.14A	5.66	3.85A	5.60
118	04	5.75	4.00A	5.75	5.55	1.95A	5.20A	3.30A	5.50	2.65A	5.50

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #										
118	05	4.75A	3.80A	4.00A	5.45	2.70A	5.60	1.45A	2.65A	2.55A	4.95A
119	01	6.00	2.70A	5.10A	1.85A	6.75	3.40A	5.95	4.00A	6.00	1.85A
119	02	1.15A	6.00	1.30A	6.25	1.15A	5.90	6.05	5.40	1.35A	5.75
119	03	1.70A	4.84A	1.29A	3.72A	1.59A	6.14	5.93	6.00	4.90A	1.80A
119	04	1.90A	2.95A	2.75A	6.20	5.85	1.25A	2.95A	2.50A	5.75	1.40A
119	05	2.45A	2.20A	5.70	1.70A	4.15A	2.00A	5.80	3.60A	3.30A	1.40A
121	01	6.00	6.15	6.10	6.80	2.25A	5.90	3.70A	1.80A	5.80	3.30A
121	02	4.90A	2.30A	6.20	2.70A	2.50A	7.45	2.10A	3.50A	1.55A	6.00
121	03	1.95A	2.55A	1.40A	1.70A	5.85	1.65A	1.40A	2.00A	1.70A	2.80A
121	04	2.40A	5.35	5.80	1.85A	1.55A	2.35A	1.80A	2.30A	1.85A	1.65A
121	05	4.90A	2.45A	1.60A	1.60A	1.60A	2.00A	5.55	2.15A	1.90A	1.60A
122	01	5.95	4.95A	7.70	6.35	6.45	3.05A	2.60A	2.15A	6.00	1.80A
122	02	5.65	6.95	6.20	3.50A	2.10A	1.90A	2.70A	1.80A	5.95	1.45A
122	03	4.65A	1.70A	2.05A	1.70A	4.90A	1.70A	6.25	1.55A	2.80A	5.20
122	04	2.25A	6.10	2.35A	1.90A	1.75A	1.30A	2.45A	2.70A	5.80	2.00A
122	05	3.20A	1.55A	5.85	1.55A	1.20A	1.50A	6.00	1.80A	5.85	1.50A
123	01	3.60A	7.35	1.50A	6.10	5.25	6.00	2.00A	3.10A	2.20A	6.20
123	02	2.15A	7.45	2.75A	4.85A	2.00A	6.30	1.90A	6.25	2.30A	5.60
123	03	2.90A	6.10	2.90A	2.35A	1.75A	7.20	2.10A	6.80	1.40A	6.60
123	04	1.65A	6.90	1.70A	6.15	6.00	5.85	1.80A	6.10	1.70A	2.35A
123	05	6.00	6.15	2.20A	2.10A	1.55A	3.40A	6.15	6.25	1.90A	4.30A
124	01	6.25	2.90A	6.25	6.25	6.25	2.75A	6.55	6.00	1.70A	6.25
124	02	1.80A	1.15A	6.20	1.60A	1.60A	6.00	5.95	5.95	6.40	3.25A
124	03	6.30	3.10A	2.25A	2.40A	2.95A	3.50A	2.35A	1.40A	6.10	1.40A
124	04	1.65A	1.65A	2.15A	3.90A	1.30A	2.60A	2.05A	2.85A	4.50A	4.10A
124	05	6.20	1.20A	3.10A	2.90A	6.00	3.55A	2.55A	3.70A	3.40A	6.50
125	01	6.50	6.15	6.30	5.85	5.90	6.10	6.50	6.00	3.30A	6.30
125	02	5.90	6.45	6.65	6.30	6.00	2.15A	3.55A	7.10	2.15A	1.75A
125	03	5.65	5.65	6.00	2.00A	6.00	4.15A	6.00	2.00A	2.60A	5.90
125	04	6.85	6.00	7.65	2.45A	6.80	1.90A	3.45A	1.65A	6.25	6.00
125	05	4.35A	5.70	5.50	5.90	5.90	6.00	5.90	5.90	4.35A	3.40A
126	01	4.95A	6.40	2.60A	6.15	1.40A	6.65	4.75A	3.05A	5.90	5.20
126	02	5.85	1.65A	1.60A	1.90A	1.80A	3.00A	5.80	5.75	5.80	1.90A
126	03	2.30A	4.35A	2.80A	2.00A	1.70A	2.00A	1.25A	1.85A	5.80	4.25A

TABLE D-1 AVOIDANCE LATENCIES Cont'd

RAT #	CARD #									
126	04	1.35A	1.60A	5.70	5.80	2.65A	2.95A	5.90	2.25A	5.90	1.90A
126	05	5.95	1.40A	1.70A	1.65A	5.75	1.95A	5.75	2.05A	6.10	2.30A
127	01	7.60	6.70	6.10	3.85A	6.05	6.30	5.80	1.35A	1.50A	3.15A
127	02	2.55A	2.15A	2.00A	6.10	5.95	1.00A	2.15A	1.65A	2.65A	2.00A
127	03	1.50A	6.15	2.05A	1.30A	1.15A	6.10	2.30A	1.30A	2.00A	2.40A
127	04	3.05A	2.65A	3.40A	1.90A	3.75A	4.90A	4.80A	1.25A	2.95A	1.20A
127	05	2.35A	3.65A	2.70A	2.30A	1.75A	1.30A	2.85A	4.10A	6.00	1.60A

TABLE D-2 EMOTIONALITY RATINGS

RAT #	CARD #	RATER I	RATER II
01	15	4	4
02	15	3	3
03	15	4	4
04	15	0	0
05	15	3	2
06	15	4	4
07	15	2	3
08	15	3	3
09	15	0	0
10	15	1	2
11	15	3	3
12	15	4	4
13	15	2	3
14	15	0	0
15	15	1	0
16	15	4	4
17	15	4	4
18	15	4	4
20	15	4	4
21	15	1	1
22	15	1	2
23	15	1	1
24	15	4	4
25	15	2	2
26	15	1	1
27	15	4	4
28	15	0	0
29	15	3	3
30	15	0	0
31	15	2	2
32	15	2	3
33	15	1	1

TABLE D-2 EMOTIONALITY RATINGS Cont'd .

RAT #	CARD #	RATER I	RATER II
34	15	0	0
35	15	1	2
36	15	4	4
37	15	4	4
38	15	4	4
39	15	4	4
40	15	0	2
41	15	1	2
42	15	4	4
43	15	0	0
44	15	4	4
45	15	0	0
46	15	4	4
47	15	2	2
48	15	3	4
49	15	2	3
50	15	2	2
51	15	4	4
52	15	0	0
53	15	0	0
55	15	4	4
56	15	2	3
57	15	4	4
58	15	4	4
59	15	2	2
60	15	3	3
61	15	0	0
62	15	0	0
63	15	0	0
64	15	0	0
65	15	0	0
66	15	2	2

TABLE D-2 EMOTIONALITY RATINGS Cont'd

RAT #	CARD #	RATER I	RATER II
67	15	1	1
68	15	0	0
69	15	0	0
70	15	0	0
71	15	1	1
72	15	0	0
80	15	2	2
81	15	1	2
82	15	0	0
83	15	0	0
84	15	4	4
85	15	4	4
86	15	0	0
87	15	1	3
88	15	0	0
89	15	1	0
90	15	0	0
91	15	0	0
92	15	1	1
93	15	1	1
94	15	4	4
95	15	0	0
96	15	4	4
97	15	0	0
98	15	3	2
99	15	2	3
100	15	3	3
101	15	0	0
102	15	2	2
103	15	0	0
104	15	4	4
105	15	3	3

TABLE D-2 EMOTIONALITY RATINGS Cont'd

RAT #	CARD #	RATER I	RATER II
106	15	4	4
107	15	4	4
108	15	4	4
109	15	4	4
110	15	4	4
111	15	0	0
112	15	4	4
113	15	2	3
114	15	2	1
115	15	4	4
116	15	2	2
117	15	0	0
118	15	2	2
119	15	2	2
121	15	1	0
122	15	4	4
123	15	4	2
124	15	3	3
125	15	2	2
126	15	0	0
127	15	1	2

TABLE D-3

BRAIN DAMAGE

RAT #	CARD #	L	R	L	R	L	R	L	R
01	16	0	0	9	9	7	8	0	0
01	17	0	0	6	9	13	14	4	4
01	18	0	3	34	35	24	20	0	0
01	19	0	0	11	11	3	2	0	0
02	16	0	0	0	0	8	5	0	0
02	17	0	0	5	0	25	11	8	2
02	18	0	0	3	0	23	9	7	4
02	19	0	0	0	0	5	3	0	0
03	16	0	0	2	0	23	12	10	0
03	17	0	0	0	1	21	16	4	5
03	18	0	0	6	15	19	25	6	7
03	19	0	0	1	1	2	1	0	0
04	16	0	2	9	11	0	0	0	0
04	17	13	16	16	17	0	0	0	0
04	18	4	16	12	32	0	0	0	0
04	19	0	0	2	0	0	0	0	0
05	16	0	0	4	2	0	15	0	0
05	17	0	0	18	2	8	16	0	0
05	18	0	0	23	10	10	17	0	2
05	19	0	0	2	0	0	0	0	0
06	16	0	0	8	7	0	0	0	0
06	17	0	1	15	11	0	3	0	0
06	18	0	4	36	21	3	3	0	0
06	19	0	0	1	0	0	0	0	0
07	16	0	2	25	28	0	5	0	0
07	17	0	0	12	13	4	0	0	0
07	18	2	0	27	24	7	5	0	0
07	19	0	0	0	0	0	0	0	0
08	16	0	0	18	5	4	2	0	0
08	17	0	0	6	3	24	27	26	29
08	18	0	0	15	13	36	39	49	39
08	19	0	0	0	1	0	0	0	2

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
09	16	0	0	10	8	0	0	0	0
09	17	0	2	15	17	0	1	0	0
09	18	0	0	38	36	10	6	0	0
09	19	0	0	3	2	0	0	0	0
10	16	0	0	20	6	0	0	0	0
10	17	0	1	7	12	0	0	0	0
10	18	0	9	32	34	4	9	0	0
10	19	0	0	1	12	0	4	0	0
11	16	0	0	0	0	0	0	5	8
11	17	0	0	0	0	9	7	23	18
11	18	0	0	0	0	7	4	12	21
11	19	0	0	0	0	0	0	0	0
12	16	8	0	14	7	0	0	0	0
12	17	0	2	17	19	19	16	2	1
12	18	0	2	24	39	40	42	2	2
12	19	0	0	1	8	4	9	0	0
13	16	11	6	0	8	0	0	0	0
13	17	24	3	3	7	0	0	0	0
13	18	9	4	15	29	0	0	0	0
13	19	0	0	0	0	0	0	0	0
14	16	15	13	4	3	0	0	0	0
14	17	7	9	5	4	0	0	0	0
14	18	2	5	19	20	0	0	0	0
14	19	0	0	0	0	0	0	0	0
15	16	0	0	2	2	5	9	0	0
15	17	0	0	3	10	12	11	2	1
15	18	0	0	3	14	11	10	2	6
15	19	0	0	0	0	0	1	0	0
16	16	3	2	14	21	0	2	0	0
16	17	7	0	12	18	9	11	3	3
16	18	12	0	32	31	19	19	6	6
16	19	1	0	10	10	15	15	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
17	16	17	7	2	4	0	0	0	0
17	17	9	0	3	7	0	0	0	0
17	18	8	2	29	36	0	4	0	0
17	19	0	0	2	2	0	0	0	0
18	16	0	0	2	25	0	15	0	0
18	17	0	0	2	5	9	8	0	0
18	18	0	0	23	4	15	17	0	0
18	19	0	0	1	0	0	0	0	0
20	16	0	0	10	6	3	7	0	0
20	17	0	0	4	2	12	13	10	10
20	18	0	0	21	14	18	18	13	12
20	19	0	0	9	10	11	11	1	1
21	16	0	0	19	5	0	0	0	0
21	17	1	0	11	10	7	7	0	0
21	18	3	0	29	24	4	6	0	0
21	19	0	0	0	1	0	0	0	0
22	16	0	0	16	4	13	10	0	0
22	17	0	0	1	0	17	8	0	1
22	18	0	0	0	0	18	15	4	4
22	19	0	0	0	0	2	2	0	1
23	16	0	0	13	17	0	2	0	0
23	17	0	0	8	5	5	7	0	1
23	18	0	0	14	10	25	16	1	2
23	19	0	0	2	0	0	0	0	0
24	16	2	6	31	30	5	5	0	0
24	17	2	3	8	14	13	16	3	3
24	18	6	21	39	31	19	22	2	2
24	19	0	1	3	3	0	0	0	0
25	16	15	19	0	8	0	0	0	0
25	17	5	12	0	0	0	0	0	0
25	18	30	21	0	19	0	0	0	0
25	19	0	0	0	2	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
26	16	0	0	0	0	15	7	1	0
26	17	0	0	0	0	10	5	8	4
26	18	0	0	1	0	14	3	8	6
26	19	0	0	0	0	0	0	0	0
27	16	0	0	9	0	46	20	8	3
27	17	0	0	3	1	37	28	17	17
27	18	2	0	34	30	36	36	31	27
27	19	0	0	5	7	9	9	6	6
28	16	0	0	19	15	2	0	0	0
28	17	0	0	24	7	0	0	0	0
28	18	0	7	36	22	0	0	0	0
28	19	0	0	0	2	0	0	0	0
29	16	0	0	0	6	17	16	1	0
29	17	0	0	0	0	4	8	0	1
29	18	0	0	3	5	12	18	2	5
29	19	0	0	0	0	2	2	0	0
30	16	0	0	10	0	34	21	2	4
30	17	0	0	0	0	26	16	8	11
30	18	0	0	2	0	21	10	15	7
30	19	0	0	0	0	3	3	5	0
31	16	5	4	6	2	0	0	0	0
31	17	18	3	17	10	0	1	0	0
31	18	14	4	36	33	0	2	0	0
31	19	0	2	0	0	0	0	0	0
32	16	0	0	0	0	9	12	0	0
32	17	0	0	0	0	12	13	3	5
32	18	0	0	2	2	15	15	10	7
32	19	0	0	0	0	1	0	0	0
33	16	0	6	8	13	0	0	0	0
33	17	0	1	7	15	0	0	0	0
33	18	0	12	18	29	4	8	0	0
33	19	0	1	6	5	2	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
34	16	0	0	5	10	0	0	0	0
34	17	1	2	6	8	0	0	0	0
34	18	2	9	25	37	0	5	0	0
34	19	0	0	0	3	0	0	0	0
35	16	0	0	5	6	28	17	0	0
35	17	0	0	0	1	5	3	0	0
35	18	0	0	4	10	6	7	0	0
35	19	0	0	0	0	0	0	0	0
36	16	14	0	39	12	23	6	0	0
36	17	0	0	13	7	12	3	0	0
36	18	0	0	19	9	24	10	0	0
36	19	0	0	4	3	4	2	0	0
37	16	7	10	28	14	3	0	0	0
37	17	0	3	10	15	0	0	0	0
37	18	0	5	24	26	2	2	0	0
37	19	0	0	0	0	0	0	0	0
38	16	0	0	0	0	12	8	0	0
38	17	0	0	2	1	11	15	3	4
38	18	0	0	4	8	18	19	4	5
38	19	0	0	0	0	5	4	0	0
39	16	0	12	8	7	0	0	0	0
39	17	0	12	18	14	8	7	0	0
39	18	0	10	36	40	18	20	0	0
39	19	0	0	3	11	0	0	0	0
40	16	17	11	8	7	0	0	0	0
40	17	3	2	4	4	0	0	0	0
40	18	2	0	16	16	0	0	0	0
40	19	0	0	0	0	0	0	0	0
41	16	0	0	13	21	0	2	0	0
41	17	0	0	7	7	6	15	0	0
41	18	0	0	11	8	4	13	0	0
41	19	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
42	16	3	0	30	13	4	0	0	0
42	17	0	8	19	18	5	8	0	0
42	18	2	23	31	40	13	32	0	0
42	19	0	0	0	3	0	4	0	0
43	16	11	5	1	0	0	0	0	0
43	17	4	2	3	0	0	0	0	0
43	18	6	0	25	25	0	0	0	0
43	19	0	0	0	0	0	0	0	0
44	16	0	0	0	0	12	13	0	0
44	17	0	0	0	0	16	15	4	4
44	18	0	0	6	6	18	18	2	0
44	19	0	0	0	0	0	2	0	0
45	16	4	2	20	8	0	0	0	0
45	17	4	2	5	11	9	9	4	4
45	18	16	16	40	40	12	11	1	3
45	19	0	0	1	1	0	0	0	0
46	16	2	9	11	25	0	0	0	0
46	17	4	2	15	13	0	0	0	0
46	18	3	0	20	27	1	1	0	0
46	19	0	0	0	0	0	0	0	0
47	16	0	0	8	0	6	0	0	0
47	17	0	0	19	2	11	7	0	0
47	18	0	0	8	1	16	8	0	0
47	19	0	0	0	0	0	0	0	0
48	16	0	0	34	8	6	4	0	0
48	17	0	0	20	8	17	13	3	3
48	18	0	0	14	5	25	23	7	6
48	19	0	0	0	0	1	1	1	1
49	16	4	6	0	0	0	0	0	0
49	17	2	4	2	5	0	0	0	0
49	18	2	3	7	20	0	0	0	0
49	19	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
51	16	0	0	13	9	0	0	0	0
51	17	2	0	13	13	9	9	3	2
51	18	8	0	34	17	15	14	1	0
51	19	0	0	2	1	1	0	0	0
50	16	0	0	0	0	9	6	0	0
50	17	0	0	0	0	10	17	5	6
50	18	0	0	2	2	18	13	7	12
50	19	0	0	0	0	0	0	0	0
52	16	1	0	15	20	0	0	0	0
52	17	0	4	6	7	0	0	0	0
52	18	0	4	11	29	0	0	0	0
52	19	0	0	0	1	0	0	0	0
53	16	0	0	0	0	0	0	6	9
53	17	0	0	0	0	4	4	13	3
53	18	0	0	0	0	3	6	12	3
53	19	0	0	0	0	0	0	0	0
55	16	12	11	0	0	0	0	0	0
55	17	8	18	2	0	0	0	0	0
55	18	6	4	13	0	0	0	0	0
55	19	0	0	0	0	0	0	0	0
56	16	0	0	5	4	3	15	0	0
56	17	0	0	16	13	14	14	0	0
56	18	0	0	3	11	4	4	0	0
56	19	0	0	0	0	0	0	0	0
57	16	11	0	25	17	6	6	0	0
57	17	10	0	30	19	16	14	8	2
57	18	7	2	33	21	16	13	3	2
57	19	0	0	0	0	0	0	0	0
58	16	1	1	15	13	0	0	0	0
58	17	1	4	11	14	0	0	0	0
58	18	1	2	22	14	0	0	0	0
58	19	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
59	16	0	0	0	8	3	18	0	0
59	17	0	0	0	1	9	14	11	9
59	18	0	0	3	5	11	17	0	4
59	19	0	0	0	1	0	0	0	0
60	16	4	6	26	31	0	2	0	0
60	17	4	0	33	22	3	3	0	0
60	18	1	0	32	40	13	20	0	0
60	19	0	0	0	0	0	1	0	0
61	16	0	0	0	0	0	0	0	0
61	17	0	0	0	0	0	0	0	0
61	18	0	0	0	0	0	0	0	0
61	19	0	0	0	0	0	0	0	0
62	16	0	0	0	0	0	0	0	0
62	17	0	0	0	0	0	0	0	0
62	18	0	0	0	0	0	0	0	0
62	19	0	0	0	0	0	0	0	0
63	16	0	0	0	0	0	0	0	0
63	17	0	0	0	0	0	0	0	0
63	18	0	0	0	0	0	0	0	0
63	19	0	0	0	0	0	0	0	0
64	16	0	0	0	0	0	0	0	0
64	17	0	0	0	0	0	0	0	0
64	18	0	0	0	0	0	0	0	0
64	19	0	0	0	0	0	0	0	0
65	16	0	0	0	0	0	0	0	0
65	17	0	0	0	0	0	0	0	0
65	18	0	0	0	0	0	0	0	0
65	19	0	0	0	0	0	0	0	0
66	16	0	0	0	0	0	0	0	0
66	17	0	0	0	0	0	0	0	0
66	18	0	0	0	0	0	0	0	0
66	19	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
67	16	2	2	2	0	0	0	0	0
67	17	8	3	3	1	0	0	0	0
67	18	9	6	6	9	0	0	0	0
67	19	0	0	0	0	0	0	0	0
68	16	0	0	0	0	0	0	0	0
68	17	0	0	0	0	0	0	0	0
68	18	0	0	0	0	0	0	0	0
68	19	0	0	0	0	0	0	0	0
69	16	0	0	0	0	0	0	0	0
69	17	0	0	0	0	0	0	0	0
69	18	0	0	0	0	0	0	0	0
69	19	0	0	0	0	0	0	0	0
70	16	0	0	0	0	0	0	0	0
70	17	0	0	0	0	0	0	0	0
70	18	0	0	0	0	0	0	0	0
70	19	0	0	0	0	0	0	0	0
71	16	0	0	0	0	0	0	0	0
71	17	0	0	0	0	0	0	0	0
71	18	0	0	0	0	0	0	0	0
71	19	0	0	0	0	0	0	0	0
72	16	0	0	0	0	0	0	0	0
72	17	0	0	0	0	0	0	0	0
72	18	0	0	0	0	0	0	0	0
72	19	0	0	0	0	0	0	0	0
80	16	49	0	0	0	0	0	0	0
80	17	0	0	0	0	0	0	0	0
80	18	0	0	0	0	0	0	0	0
80	19	0	0	0	0	0	0	0	0
81	16	1	6	0	0	0	0	0	0
81	17	13	19	9	7	0	0	0	0
81	18	0	2	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
81	19	0	0	0	0	0	0	0	0
82	16	4	5	4	7	0	0	0	0
82	17	3	0	1	0	0	0	0	0
82	18	1	2	6	12	0	0	0	0
82	19	0	0	0	0	0	0	0	0
83	16	26	33	0	11	0	0	0	0
83	17	0	0	0	0	0	0	0	0
83	18	0	0	0	0	0	0	0	0
83	19	0	0	0	0	0	0	0	0
84	16	0	0	0	0	0	0	0	0
84	17	0	0	3	4	0	0	0	0
84	18	0	0	0	0	0	0	0	0
84	19	0	0	0	0	0	0	0	0
85	16	15	13	0	0	0	0	0	0
85	17	0	1	0	0	0	0	0	0
85	18	2	10	0	0	0	0	0	0
85	19	0	0	0	0	0	0	0	0
86	16	3	0	10	6	0	0	0	0
86	17	0	1	2	1	16	8	1	1
86	18	1	0	30	18	11	9	0	0
86	19	0	0	0	0	0	0	0	0
87	16	16	7	3	3	0	0	0	0
87	17	0	0	3	1	0	0	0	0
87	18	0	0	10	18	0	0	0	0
87	19	0	0	0	0	0	0	0	0
88	16	0	0	0	0	0	0	0	0
88	17	0	0	0	0	0	0	0	0
88	18	0	0	0	0	0	0	0	0
88	19	0	0	0	0	0	0	0	0
89	16	17	10	12	0	0	0	0	0
89	17	0	0	1	0	0	0	0	0
89	18	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
89	19	0	0	0	0	0	0	0	0
90	16	22	50	0	6	0	0	0	0
90	17	0	13	0	2	0	0	0	0
90	18	0	0	0	0	0	0	0	0
90	19	0	0	0	0	0	0	0	0
91	16	10	10	11	3	0	0	0	0
91	17	0	5	12	19	1	1	0	0
91	18	2	2	22	32	2	2	0	0
91	19	0	0	6	1	0	0	0	0
92	16	31	31	0	0	0	0	0	0
92	17	14	14	2	2	0	0	0	0
92	18	20	17	7	9	0	0	0	0
92	19	0	0	0	0	0	0	0	0
93	16	27	24	13	12	0	0	0	0
93	17	2	6	0	4	0	0	0	0
93	18	0	0	0	0	0	0	0	0
93	19	0	0	0	0	0	0	0	0
94	16	19	34	13	12	0	0	0	0
94	17	4	13	5	5	0	0	0	0
94	18	0	0	0	0	0	0	0	0
94	19	0	0	0	0	0	0	0	0
95	16	10	8	5	7	0	0	0	0
95	17	2	3	9	14	0	0	0	0
95	18	0	2	6	21	0	0	0	0
95	19	0	0	0	0	0	0	0	0
96	16	9	10	12	0	0	0	0	0
96	17	7	6	0	0	0	0	0	0
96	18	0	2	0	0	0	0	0	0
96	19	0	0	0	0	0	0	0	0
97	16	0	0	0	0	0	0	0	0
97	17	0	0	0	0	0	0	0	0
97	18	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
97	19	0	0	0	0	0	0	0	0
98	16	0	0	0	0	0	0	0	0
98	17	0	0	0	0	0	0	0	0
98	18	0	0	0	0	0	0	0	0
98	19	0	0	0	0	0	0	0	0
99	16	29	28	39	24	2	1	0	0
99	17	0	0	0	0	0	0	0	0
99	18	0	0	0	0	0	0	0	0
99	19	0	0	0	0	0	0	0	0
100	16	13	9	0	0	0	0	0	0
100	17	33	15	0	0	0	0	0	0
100	18	33	13	6	0	0	0	0	0
100	19	0	0	0	0	0	0	0	0
101	16	12	14	1	17	0	0	0	0
101	17	7	8	3	6	0	2	0	0
101	18	18	19	25	26	7	8	0	0
101	19	1	1	3	2	0	0	0	0
102	16	0	0	0	3	9	13	0	0
102	17	0	0	0	2	6	17	7	6
102	18	0	0	6	5	12	15	8	6
102	19	0	0	0	0	0	0	0	0
103	16	2	2	26	30	8	15	0	1
103	17	0	1	7	13	6	7	0	0
103	18	0	0	0	0	0	0	0	0
103	19	0	0	0	0	0	0	0	0
104	16	4	16	0	1	0	0	0	0
104	17	5	5	1	1	0	0	0	0
104	18	23	14	12	11	0	0	0	0
104	19	0	0	0	0	0	0	0	0
105	16	0	0	0	0	0	0	0	0
105	17	0	0	0	0	11	8	15	16

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
105	18	0	0	26	20	19	13	28	20
105	19	0	0	0	0	0	0	0	0
106	16	0	0	1	8	0	0	0	0
106	17	3	4	1	1	7	11	0	0
106	18	6	7	39	22	29	16	1	1
106	19	0	0	0	2	4	0	0	0
107	16	0	0	4	4	25	23	17	6
107	17	0	0	2	2	24	21	33	28
107	18	0	0	4	0	28	10	24	23
107	19	0	0	0	0	0	0	0	0
108	16	3	3	27	38	9	16	0	0
108	17	0	0	0	0	0	0	0	0
108	18	0	0	0	0	0	0	0	0
108	19	0	0	0	0	0	0	0	0
109	16	12	0	19	5	0	0	0	0
109	17	0	0	10	6	16	15	2	4
109	18	0	0	20	27	27	25	9	5
109	19	0	0	4	4	1	3	0	0
110	16	0	0	8	12	11	12	18	12
110	17	0	0	0	0	12	11	41	8
110	18	2	0	29	20	21	21	38	26
110	19	0	0	0	0	0	0	0	0
111	16	0	0	10	12	16	16	0	0
111	17	0	0	2	8	20	23	10	10
111	18	0	0	12	7	19	18	5	5
111	19	0	0	0	0	0	0	0	0
112	16	15	19	11	3	0	0	0	0
112	17	3	6	4	7	0	0	0	0
112	18	7	6	21	17	0	3	0	0
112	19	0	0	0	0	0	0	0	0
113	16	12	13	36	20	7	0	0	0
113	17	0	0	0	0	0	0	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
113	18	0	0	0	0	0	0	0	0
113	19	0	0	0	0	0	0	0	0
114	16	0	0	7	11	18	18	3	4
114	17	0	0	9	8	28	28	14	19
114	18	0	0	11	8	27	22	8	19
114	19	0	0	0	0	0	0	0	0
115	16	0	0	0	0	0	0	0	0
115	17	0	0	0	0	0	0	0	0
115	18	0	0	0	0	0	0	0	0
115	19	0	0	0	0	0	0	0	0
116	16	0	0	0	0	0	0	0	0
116	17	0	0	0	0	0	0	0	0
116	18	0	0	0	0	0	0	0	0
116	19	0	0	0	0	0	0	0	0
117	16	0	0	0	0	0	0	0	0
117	17	0	0	0	0	0	0	0	0
117	18	0	0	0	0	0	0	0	0
117	19	0	0	0	0	0	0	0	0
118	16	0	0	0	0	0	0	0	0
118	17	0	0	0	0	0	0	0	0
118	18	0	0	0	0	0	0	0	0
118	19	0	0	0	0	0	0	0	0
119	16	7	18	7	0	0	0	0	0
119	17	11	9	4	5	7	8	10	10
119	18	29	31	40	26	7	11	0	0
119	19	0	11	8	10	4	2	0	0
121	16	0	0	0	0	11	10	0	0
121	17	0	0	0	0	9	7	13	12
121	18	0	0	0	0	11	4	10	6
121	19	0	0	0	0	0	0	0	0
122	16	0	0	11	16	0	0	0	0
122	17	0	0	3	10	2	2	0	0

TABLE D-3 BRAIN DAMAGE Cont'd

RAT #	CARD #	L	R	L	R	L	R	L	R
122	18	0	0	29	31	4	11	0	0
122	19	0	0	0	0	0	0	0	0
123	16	0	0	0	0	1	0	4	1
123	17	0	0	0	0	5	4	16	15
123	18	0	0	0	0	4	7	22	22
123	19	0	0	0	0	0	0	0	0
124	16	0	0	3	2	7	3	0	0
124	17	0	0	0	0	12	13	1	0
124	18	0	0	3	0	30	19	8	9
124	19	0	0	0	0	2	3	0	0
125	16	0	0	0	0	9	4	1	0
125	17	0	0	0	0	11	13	3	3
125	18	0	0	0	0	17	13	3	3
125	19	0	0	0	0	0	0	0	0
126	16	0	0	23	16	6	6	0	0
126	17	0	0	15	9	8	13	0	2
126	18	0	0	12	9	9	21	0	6
126	19	0	0	0	0	0	0	0	0
127	16	0	0	0	0	7	2	4	4
127	17	0	0	0	0	6	5	9	8
127	18	0	0	0	0	7	7	10	11
127	19	0	0	0	0	0	0	0	0

Table D-4. The normalized discriminant coefficients for emotionality scores derived from a reanalysis of Harrison and Lyon's (1957) data are shown. Abbreviations include: Ac, nucleus accumbens; Cor, cortical; F, fornix columns; FS, fornix superior; GC, genu corpus callosum; IG, induseum griseum; LS, lateral septal nucleus; MS, medial septal nucleus; PF, precommissural fornix; PH, precommissural hippocampus; SH, septo-hippocampal nucleus; ST, septo-tubercular tract; Ste, stria terminalis; VHC, ventral hippocampal commissure.

Table D-4

Normalized discriminant coefficients for emotionality scores derived from a reanalysis of Harrison and Lyon's (1957) data.

Area	Criteria			Assigned Value
	21 or Greater	31 or Greater	38 or Greater	
VHC	-14.84	0.55	-12.10	
FS	8.30	-1.05	9.08	
F	4.09	4.89	2.62	+
PF	-1.13	-9.12	-3.26	-
Ste	-6.35	-9.65	-5.01	-
SH	0.72	1.87	1.36	+
MS	19.14	16.88	18.89	+
LS	-1.27	0.80	-2.43	
Ac	-7.51	-7.66	-6.92	-
ST	8.07	10.97	9.70	+
PH	-8.46	-7.08	-10.30	-
IG	-7.53	-13.08	-7.77	-
CG	12.19	13.52	10.43	+
Cor	0.40	-2.88	0.13	

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