ARL-TR-67-24

AD 662619

DOMINANCE IN MONKEYS: BEHAVIOR AND BIOCHEMISTRY

W.F. Angermeier
John B. Phelps
Florida Presbyterian College

November 1967

This document has been approved for public release and sale; its distribution is unlimited.

6571st Aeromedical Research Laboratory
Aerospace Medical Division
Air Force Systems Command
Holloman Air Force Base, New Mexico

21

The animals used in this study were handled in accordance with the "Guide for Laboratory Animal Facilities and Care" as promulgated by the National Academy of Sciences - National Research Council.

This report may be reproduced to satisfy needs of U.S. Government agencies. No other reproduction is authorized except with permission of the 6571st Aeromedical Research Laboratory, Holloman AFB, NMex.

This report is made available for study with the understanding that proprietary interests in and relating thereto will not be impaired. In case of apparent conflict or any other questions between the Government's rights and those of others, notify the Judge Advocate, Air Force Systems Command, Andrews Air Force Base, Washington, D.C.

Do not return this copy. Retain or destroy.

DOMINANCE IN MONKEYS: BEHAVIOR AND BIOCHEMISTRY

W.F. Angermeier
John B. Phelps
Florida Presbyterian College

FOREWORD

This experimentation, which began on 1 November 1966 and was completed on 31 August 1967, was performed by the Neuro-Sciences Laboratory at Florida Presbyterian College, St. Petersburg, Florida. The research was conducted under contract F29600-67-C-0011 with the 6571st Aeromedical Research Laboratory, Holloman AFB, New Mexico, in coordination with the Office of Aerospace Research. The research was conducted under the monitorship of Lt Colonel Herbert H. Reynolds under Project 7906, Task 790603.

This technical report has been reviewed and approved for publication.

C.H. Kratochvil

C.H. KRATOCHVIL, Colonel, USAF, MC
Commander

ABSTRACT

Dominance tests were conducted with male rhesus monkeys from a colony of 28 Ss. The following conclusions seem to be warranted: (1) differential early rearing has no effect upon later dominance status; (2) there were virtually no biochemical differences between the least and most dominant monkeys in the colony; (3) previously achieved dominance status was important in the formation of a new hierarchy; (4) cage-mates always seem to act in concert; and (5) a "group-effect" was seen to be operating, much like the relationship among feral monkeys, usually referred to as territory or home range.

TABLE OF CONTENTS

BLANK PAGE

INTRODUCTION

In a recent study Uyeno and White (1) showed that rats reared in social isolation were inferior to socially reared Ss when paired for an underwater dominance test. The authors stated that their findings were consistent with those of Ginsburg and Allee (2), Janssen, Jageneau, and Niemegeers (3), Kuo (4), Uyeno and Benson (5), and Yen, Stanger, and Millman (6), but inconsistent with those of Hutchinson, Ulrich, and Azrin (7), King and Gurney (8), Rosen and Hart (9), and Thompson and Melzack (10).

Since all of these studies were concerned with dominance of non-primate species, it was thought important to obtain data on dominance interaction among primates reared differentially. The literature cites a number of dominance studies where the interaction of primates was observed in their natural habitat (Altmann, 11; Southwich, 12; and Manocha, 13 among others), but there have been very few dominance tests of rhesus monkeys reared under standard laboratory conditions (14). Mason (15) found that dominance relationships of wild monkeys are more stable than those of restricted laboratory subjects. Data from a study by Biernoff, Leary, and Littman (16) resulted in intra-session dominance determination correlation coefficients (rho) of .60 to .90.

Study 1 reported here sought to determine the relationship between dominance status and differential early rearing in a colony of male rhesus monkeys (Macaca mulatta).

Southwick, Beg, and Siddigi (17) have recently provided evidence that rhesus monkeys living in overcrowded conditions defend the boundaries of their "territory" and "home range" against others of their own species. It appears that under these conditions fights between males of different groups and between males of the same group are quite frequent.

An important question to ask now is this: Do nonhuman primates living in the laboratory, such as rhesus monkeys, develop anything akin to the social relationship generally recognized as territory or home range in feral animals of the same species? Study 2 reported here was designed to examine this question in a group of 28 rhesus monkeys which were separated into 4 distinct living conditions.

In Study 2 it was found that during the establishment of dominance, two monkeys from the same living condition, although they were not cage-mates, always acted in concert when placed with a third animal from a different living condition. A notable exception to this rule was observed when two of the three animals came from a strict isolation environment, a living condition which prevented visual and tactual interaction among its members. Since only two tests were run under the latter condition, no definite trend in the interaction between the three animals was evident.

Study 3 was designed to explore the formation of a dominance hierarchy as it exists in three animals selected from three different rearing and living conditions.

In Study 3, concerned with the formation of a new dominance hierarchy in a group of three monkeys from different rearing and living environments, it was shown that previous dominance status was the single most important factor. In Study 2 it was demonstrated that the laboratory home environment was important when noncage-mates from one living environment were paired with an animal from another living environment. Aside from the statistical evaluation of the data, behavioral observations were made which yielded some information about the dynamics of the social processes involved in the establishment of dominance.

It was thought important to investigate possible trends which would emerge when two well-established dominance hierarchies are paired with each other. Study 4 is concerned with this question.

In an earlier study, Angermeier and Phelps (18) found significant differences in the values of blood cholinesterase and cholesterol of rhesus monkeys when dominant and subdominant cage-mates were compared. These differences were rather short-lived and held true only for the first of three blood samples, obtained during a 10-week period. In that study, the determination of dominance and subdominance was made solely on the basis of home cage behavior.

Study 5 was designed for the following purpose: (1) to improve the method of dominance determination and (2) to determine possible biochemical differences between the most and least dominant animals of the colony.

Subjects

Male rhesus monkeys from a colony of 28, 28-30 months of age at the time of testing, were used as Ss. Ss were drawn from each of the following rearing conditions where they had been since the age of 2-4 months: (1) Strict Isolation (SI), an environment which permitted no visual or tactual contact between individual Ss; (2) Partial Isolation (PI), a condition which permitted visual and moderate tactual contact between cage neighbors; (3) Social (S), where two Ss were housed in one cage and visual and moderate tactual contact was permitted between cages; (4) Enriched Social (ES), where animals were treated as in (3) with the additional presence of play objects, swings, and television. The animals had also been used previously in a match-to-sample shock-escape task for a period of 8 months.

Apparatus

The dimensions of the testing cages in which the animals were paired for dominance fights were 48 x 50 x 61 centimeters high for Ss weighing less than 5440 grams and 53 x 61 x 86 centimeters high for Ss weighing more than 5440 grams. These cages were constructed of heavy galvanized steel rods. When more than two Ss were tested, a clear plastic cage, 86 x 121 x 182 centimeters, was used as apparatus. The respective cage was placed in a testing room 270 x 450 x 240 centimeters high, where Ss could be observed from an adjacent room through a large one-way window.

Observational Criteria

The following behavioral aspects were observed to be characteristic of the dominant animal: (1) sexual - inspection of genitals, pre-mounting posture, pulling genitals, full erections, mounting, and thrusting, and pulling up rear; (2) aggressive - pushing; shoving; swiping, hitting; biting (particularly head and neck area); threatening head movements in horizontal plane; stalking; circling; pulling tail, ears, and skin; and grooming; (3) positional - preferred cage position; free movement and dominant posture (with head and tail pointing up). In the same behavioral categories, the submissive animal showed these characteristics: (1) sexual - presenting to be mounted; and partial erections, if any; (2) submissive - baring of teeth and fletching; not responding to being pushed, hit, bitten or held; running away when approached; screaming; frequent defecation and urination; moving head to side and upwards; disorganized jumping; facial tics; self-biting; crouching and cowering; and moving out of the path of dominant animal; (3) positional - restricted space to move; and submissive posture (half-crouch, looking down).

STUDY 1: EARLY REARING AND DOMINANCE

Procedure

In this study 6 animals from each rearing condition were ranked by weight. Only equally ranked Ss from each rearing condition were paired with each other.

Animals stayed in the testing cage between 15 and 30 minutes, the time-interval it took to reach unanimous agreement among four observers regarding the outcome of the test. Each animal was paired with an animal of equal weight rank from a different rearing condition once a day.

Statistical Analysis and Discussion

The results of this study can be seen in Table I. In a gross comparison between rearing groups, the PI animals received the highest dominance rating. When t-tests for differences between correlated means were computed, only one significant difference between number of dominance-fights won was established between the PI and the S animals. When weights (taken before dominance testing began) were compared, it was evident that the PI animals were significantly heavier than the animals from the three other rearing conditions.

It is evident from Table I that the rather large average weight differential between the PI animals and the ES, S, and SI animals was responsible for the high dominance rating of the PI group. When the data of the PI group are disregarded, no significant differences in number of dominance fights won existed between the ES, S, and SI groups.

The data presented here for nonhuman primates seem to support the conclusion that differential early rearing has no effect upon the dominance status which rhesus monkeys will achieve. This study furthermore points out the importance of considering phylogenetic differences in the area of social relationships, of which dominance is an important aspect.

TABLE I

DOMINANCE IN MONKEYS REARED DIFFERENTIALLY

Group	Average Weight/gms	Weight Rank	Dominance Fights Won	Dominance Fights Lost	Dominance Rank
PI	6130	1	16	2	1
S	5380	2	3	15	4
ES	5090	3	10	8	2
SI	4990	4	7	11	3

Group Comparisons

Groups	Dominance Difference t	p	Group Favored	Weight Difference t	p	Group Favored
ES-S	2.17	-	ES	1.33	-	S
ES-PI	2.22	-	PI	9.64	.001	PI
ES-SI	$<$1.00	-	ES	1.97	-	ES
S-PI	5.42	.01	PI	2.54	.05	PI
S-SI	1.37	-	SI	2.09	-	S
PI-SI	1.97	-	PI	4.82	.01	PI

STUDY 2. LIVING ENVIRONMENT AND DOMINANCE

Procedure

One large and one small animal from one living condition (A) were paired with an animal (sometimes larger, sometimes smaller) from a different living condition (B). The animals from living condition (A) were not cage-mates in that living condition. In all tests, the smallest of the three animals was placed into the testing apparatus first. The other two animals followed within a 60-second period. Results of this study can be seen in Table II.

TABLE II

THE LABORATORY LIVING ENVIRONMENT AND DOMINANCE

Test Group	Weights in gm	Previous Dominance Record Won-Lost	Rank in this Test[a]	Living Condition Important
S	7360	2-1	1	
S	5860	1-2	2	YES
SI	4190	3-0	3	
ES	4300	2-1	3	
ES	5070	2-1	2	YES
SI	4700	2-1	1	
ES	5440	2-1	1	
ES	4250	2-1	2	YES
SI	4900	1-2	3	
S	5210	0-3	1	
S	4980	0-3	2	YES
PI	4810	1-2	3	
PI	6620	3-0	1	
PI	6500	3-0	2	YES
S	7360	2-1	3	
ES	5400	2-1	1	
ES	5350	1-2	2	YES
PI	5860	3-0	3	
ES	5070	2-1	3	
ES	5440	2-1	2	YES
PI	6850	3-0	1	
SI	4360	1-2	3	
SI	4190	3-0	1	NO
ES	6110	1-2	2	
SI	6370	None	3	
SI	6400	None	1	NO
S	7360	2-1	2	

[a]Rank of 1 is most dominant

It is evident from the data in Table II, that for the animals from the ES, S, and PI living conditions, the living condition seemed important during the dominance tests. This was not the case for the animals from the SI condition. The one basic difference between the SI animals and the ES, S, and PI animals was visual interaction with the other animals from the same colony. When the binomial test, suggested by Siegel (19), was applied to the number of times living condition was important, the resulting probability was found to be .008. Neither weight differential nor origin of the single animal (B) was found to be significant when tested by the binomial test.

The following conclusions seem to be warranted: (1) when two monkeys, living in one laboratory condition, are tested with one monkey from a different laboratory condition, like living condition seems to be the single most important factor in the establishment of dominance; (2) visual (and possibly tactual) experience among the animals of one living condition is important for the development of this "group effect"; (3) this group effect seems to be somewhat akin to the social relationship among feral monkeys, generally described in the literature as territory or home range.

STUDY 3: DOMINANCE HIERARCHY

Procedure

Three animals, one each from a different rearing environment, were placed into the testing apparatus.

Results and Discussion

The results of Study 3 appear in Table III. The data in Table III indicate that, without prior visual and tactual contact experience among the animals in a laboratory colony, previous dominance experience seemed to be the determining factor in the establishment of dominance which involved three animals, one each from one of three rearing and living conditions. A binomial test suggested by Siegel (19) was applied to the number of times in which the previous dominance record was important in the establishment of an entirely new and different dominance hierarchy. The previous dominance factor was found to be significantly involved at the .001 level. Tests for the significant involvement of weight differentials and origin of living condition were not significant.

This study suggested the following conclusions: (1) in the absence of any previous social interaction among nonhuman primates (rhesus monkeys), the formation of a new dominance hierarchy seems to depend upon a previously established dominance record.

TABLE III

ESTABLISHMENT OF A DOMINANCE HIERARCHY

Test Group[a]	Weights in gm	Previous Dominance Record Won-Lost	Rank in this Test	Previous Dominance Record Important
ES	4300	2-3	1[b]	
SI	4360	1-4	2	YES
S	4100	0-3	3	
SI	4190	5-2	1	
ES	4250	3-2	2	YES
S	4780	0-3	3	
PI	6120	3-0	1	
ES	6120	2-3	2	YES
SI	5920	0-3	3	
SI	4700	4-1	1	
S	5860	2-2	2	YES
PI	4560	1-4	3	
PI	5860	3-3	1	
SI	6170	1-4	2	YES
S	4980	0-3	3	
PI	6620	5-0	1	
S	5210	2-3	2	YES
ES	5070	3-5	3	

[a] Combination of animals from living condition and their weights were matched as closely as possible.

[b] Rank of 1 = most dominant S.

STUDY 4: PAIRING OF DOMINANCE HIERARCHIES

Procedure

Each pair of cage-mates from one living condition was placed into the apparatus once with a pair from the other living condition. This permitted a total of six separate experimental comparisons between the six pairs of monkeys.

Results and Discussion

The results of this investigation appear in Table IV. The raw data presented in Table IV were analyzed by the binomial test, suggested by Siegel (19).

The importance of the cage-mates for the outcome of the dominance tests was significant at the .016 level. The importance of the weight differential also was significant at the .016 level. The importance of the previous dominance record was found not to be significant.

TABLE IV

PAIRING OF DOMINANCE HIERARCHIES IN MONKEYS

Test Group	Weights in gm	Previous Dominance Record Won-Lost	Rank in this Test	Cage-Mates Important
ES[a]	11550	10-6	1, 2[b]	
S	8890	0-10	3, 4	YES
S	11070	6-7	1, 2	
ES	8550	8-5	3, 4	YES
S	12340	5-10	1, 2	
ES	10420	4-9	3, 4	YES
ES	11550	10-6	1, 2	
S	11070	6-7	3, 4	YES
ES	10420	4-9	1, 2	
S	8890	0-10	3, 4	YES
S	12340	5-10	1, 2	
ES	8550	8-5	3, 4	YES

[a] Each rearing condition consisted of two cage-mates
[b] 1 = most dominant

The data of this study seem to warrant the following conclusions: (1) when well-established dominance hierarchies are paired with each other, both weight and the presence of a cage-mate are important factors; (2) cage-mates always achieve dominance ranks of 1 and 2 or 3 and 4 when paired with other cage-mates from different living environments; and (3) the pairing of dominance hierarchies seems to result in a number of predictable behavior patterns.

STUDY 5: BIOCHEMISTRY AND DOMINANCE

Behavioral Procedures

Dominance testing was conducted when the animals were 28-30 months of age. The dominance status of each S was computed by the following formula:

$$\frac{\text{Number of tests won - number of tests lost}}{\text{total number of tests involved}}$$

This procedure yielded a coefficient from +1.00 (most dominant) to -1.00 (least dominant).

Biochemical Procedures

Blood was obtained from the great saphenous vein of all monkeys at ages 16-18 months and again at ages 24-26 months, four months before dominance testing. The blood samples were analyzed by standard biochemical techniques for values of (1) Cholinesterase (Michel, 20; and Reinhold, Tourigny, and Yonan, 21); (2) Calcium (Wallach and Steck, 22); (3) Tyrosine (Waalkes and Udenfriend, 23); (4) Cholesterol (Pearson, Stern, and McGavack, 24); (5) Serum Total Protein (Gornall, Bardawill and David, 25); and (6) Serum Glutamic Oxalacetic Transaminase - SGOT - (Reitman and Frankel, 26). All, except two of the animals used here (one in each group) were exposed to extensive match-to-sample testing between the two blood drawings.

Results and Discussion

The raw data of all biochemical determinations appear in Table V.

TABLE V

RAW VALUES OF BLOOD BIOCHEMISTRY

1st Test: 16-18 months

Cholinesterase (Michel units) M[a]	L[b]	Calcium (mg/100 ml) M	L	Tyrosine (ug/ml) M	L	Cholesterol (mg/100ml) M	L	Serum Total Protein (gm/100ml) M	L	SGOT (units) M	L
1.03	0.94	11.0	11.5	16.0	15.5	180	182	7.5	8.2	112	76
1.06	0.98	10.9	10.7	19.5	20.5	161	295	7.3	8.1	53	46
1.09	0.59	11.0	11.5	17.5	18.0	150	202	7.9	7.4	32	46
1.00	1.09	11.2	11.7	14.5	16.0	192	195	7.0	7.7	82	88
1.03	1.08	11.0	12.0	15.0	17.0	227	205	7.4	8.2	35	44
1.12	0.60	10.9	10.0	10.0	9.3	247	175	8.2	6.4	29	57
1.02	0.91	11.8	10.8	20.0	14.5	205	190	7.8	7.6	22	50
0.67	0.96	12.3	11.7	12.5	22.5	190	227	8.3	7.7	43	50

2nd Test: 24-26 months

Cholinesterase M	L	Calcium M	L	Tyrosine M	L	Cholesterol M	L	Serum Total Protein M	L	SGOT M	L
1.29	1.17	10.7	10.8	15.4	26.7	177	140	7.7	7.7	52	31
1.12	0.95	10.2	10.8	17.7	22.9	162	212	6.8	7.7	35	40
1.43	0.36	9.7	10.7	16.8	13.5	112	192	6.8	7.6	28	41
1.31	1.34	9.3	10.0	14.9	17.0	170	148	6.6	7.3	32	46
1.46	1.41	10.7	10.7	15.4	13.5	230	140	7.9	8.3	25	36
1.42	0.39	10.6	10.7	13.9	14.9	172	181	7.7	7.5	33	46
1.33	1.25	10.0	10.2	19.6	16.0	155	140	8.2	7.4	30	34
0.51	1.25	9.7	10.2	13.0	19.0	155	175	7.9	7.7	38	68

[a] Most dominant monkeys (most dominant S on top of column).
[b] Least dominant monkeys (most dominant S on top of column).

These raw data were subjected to a t-test to determine differences between the means of the most dominant and the least dominant Ss. The comparison was performed for both blood samples taken eight months apart. The results of this analysis can be seen in Table VI.

TABLE VI

BLOOD BIOCHEMISTRY AND DOMINANCE

Biochemical Measure	M_D	S. D. $_{M_D}$	t	dfs	p
		1st Test: 16-18 months			
Cholinesterase	0.11	0.74	< 1.00	8	N/S
Calcium	0.02	0.26	< 1.00	8	N/S
Tyrosine	1.04	1.52	< 1.00	8	N/S
Cholesterol	2.37	13.71	< 1.00	8	N/S
Serum Total Protein	0.01	0.33	< 1.00	8	N/S
SGOT	6.12	7.34	< 1.00	8	N/S
		2nd Test: 24-26 months			
Cholesinterase	0.22	0.21	1.05	8	N/S
Calcium	0.40	0.12	3.25	8	.02
Tyrosine	1.25	1.94	< 1.00	8	N/S
Cholesterol	0.62	61.95	< 1.00	8	N/S
Serum Total Pro[illegible]	0.20	0.21	< 1.00	8	N/S
SGOT	8.65	5.07	1.71	8	N/S

From Table VI it is evident that none of the biochemical differences between the most and least dominant Ss reached statistical significance, except in the measure of Calcium. The differences observed favor the least dominant animals. It is possible that this difference stems from the difference in general excitability between the two groups.

This study seems to warrant the conclusion that there is little or no difference in blood biochemistry between the most dominant and the most subdominant monkeys of a laboratory colony.

REFERENCES

1. UYENO, E. T., & WHITE, M. Social isolation and dominance behavior. J. comp. physiol. Psychol., 1967, 63, 157-159.

2. GINSBURG, B., & ALLEE, W. C. Some effects of conditioning on social dominance and subordination in inbred strains of mice. Physiol. Zool., 1942, 15, 485-506.

3. JANSSEN, P. A. J., JAGENEAU, A. H., & NIEMEGEERS, C. J. E. Effects of various drugs on isolation-induced fighting behavior of male mice. J. pharmacol. exp. Ther., 1960, 129, 471-475.

4. KUO, Z. Y. Studies on the basic factors in animal fighting. IV. Developmental and environmental factors affecting fighting in quails. J. genet. Psychol., 1960, 96, 225-239.

5. UYENO, E. T., & BENSON, W. M. Effects of lysergic acid diethylamide on attack behavior of male albino mice. Psychopharmacologia, 1965, 7, 20-26.

6. YEN, H. C. Y., STANGER, R. L., & MILLMAN, N. Isolation-induced aggressive behavior in ataractic test. J. pharmacol. exp. Ther., 1958, 122, 85A.

7. HUTCHINSON, R. R., ULRICH, R. E., & AZRIN, N. H. Effects of age and related factors on the pain-aggression reaction. J. comp. physiol. Psychol., 1965, 59, 365-369.

8. KING, J. A., & GURNEY, N. L. Effect of early social experience on adult aggressive behavior in C57BL/10 mice. J. comp. physiol. Psychol., 1954, 47, 326-330.

9. ROSEN, J., & HART, F. M. Effects of early social isolation upon adult timidity and dominance in peromyscus. Psychol. Rep., 1963, 13, 47-50.

10. THOMPSON, W. R., & MELZACK, R. Early environment. Scient. American, 1956, 194(1), 38-42.

11. ALTMANN, S. A. A field study of the sociology of rhesus monkeys, Macaca mulatta. Ann. N. Y. Acad. Sci., 1962, 102, 338-435.

12. SOUTHWICK, C. H. An experimental study of intragroup agonistic behavior in rhesus monkeys. Behavior, 1967, 28, 182-209.

13. MANOCHA, S. N. A comparative study of rhesus monkeys and langurs: Free social behavior. Psychol. Stud., 1966, 11, 23-30.

14. JAY, P. Field Studies, in "Behavior of Nonhuman Primates" II, (Schrier, A. M., Harlow, H. F., and Stollnitz, F., ed.) pp. 525-591. Academic Press, New York: 1965.

15. MASON, W. A. The effects of social restriction on the behavior of rhesus monkeys: I. Free social behavior. J. comp. physiol. Psychol., 1960, 53, 582-589.

16. BIERNOFF, A., LEARY, R. W., & LITTMAN, R. A. Dominance behavior of paired primates in two settings. J. abn. soc. Psychol., 1964, 68, 109-113.

17. SOUTHWICK, C. H., BEG, M. A., & SIDDIGI, M. R. A population survey of rhesus monkeys in northern India: II. Transportation routes and forest area. Ecology, 1961, 42, 698.

18. ANGERMEIER, W. F., & PHELPS, J. B. The effects of differential early experience upon learning, performance, and biochemical responses of nonhuman primates (rhesus monkeys). 6571st Aeromed. res. lab. tech. rep. No. ARL-TR-67-10, Holloman Air Force Base, New Mexico, V, 1-64.

19. SIEGEL, S. Nonparametric statistics. New York: McGraw-Hill, 1956.

20. MICHEL, H. O. An electrometric method for the determination of red blood cells and plasma cholinesterase activity. J. lab. clin. Med., 1949, 34, 1564-1568.

21. REINHOLD, J. G., TOURIGNY, L. G., & YONAN, V. L. Measurement of serum cholinesterase activity. Amer. J. clin. Path., 1953, 23, 645-653.

22. WALLACH, D. F. H., & STECK, T. L. Fluorescence techniques in microdetermination of metals in biological materials. Anal. Chem., 1963, 35, 1035-1044.

23. WAALKES, T. P., & UDENFRIEND, S. A fluorometric method for the estimation of tyrosine in plasma and tissues. J. lab. clin. Med., 1957, 50, 733-736.

24. PEARSON, S., STERN, S., & McGAVACK, T. H. Determination of total cholesterol in serum. Anal. Chem., 1953, 25, 813-814.

25. GORNALL, A. G., BARDAWILL, C. J., & DAVID, M. M. Determination of serum proteins by means of biuret reactions. J. biol. Chem., 1949, 177, 751-766.

26. REITMAN, S., & FRANKEL, S. Colorimetric method for the determination of serum transaminase activity. Amer. J. clin. Path., 1957, 28, 57-63.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Florida Presbyterian College St. Petersburg, Florida	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

DOMINANCE IN MONKEYS: BEHAVIOR AND BIOCHEMISTRY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
1 Nov 66 - 31 Aug 67 Final

5. AUTHOR(S) (First name, middle initial, last name)

W.F. Angermeier and John B. Phelps

6. REPORT DATE November 1967	7a. TOTAL NO. OF PAGES 13	7b. NO. OF REFS 26

8a. CONTRACT OR GRANT NO. F29600-67-C-0011 b. PROJECT NO. 7906 c. Task No. 790603 d.	9a. ORIGINATOR'S REPORT NUMBER(S) ARL-TR-67-24 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES In coordination with Office of Aerospace Research.	12. SPONSORING MILITARY ACTIVITY 6571st Aeromedical Research Laboratory Holloman AFB, New Mexico 88330

13. ABSTRACT

Dominance tests were conducted with male rhesus monkeys from a colony of 28 Ss. The following conclusions seem to be warranted: (1) differential early rearing has no effect upon later dominance status; (2) there were virtually no biochemical differences between the least and most dominant monkeys in the colony; (3) previously achieved dominance status was important in the formation of a new hierarchy; (4) cage-mates always seem to act in concert; and (5) a "group-effect" was seen to be operating, much like the relationship among feral monkeys, usually referred to as territory or home range.

DD FORM 1 NOV 65 1473

Unclassified
Security Classification

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Primates						
Rhesus monkeys						
Behavior						
Dominance determination						
Social relationship						
Biochemistry						
Environment						