

# A DESCRIPTION OF VARIABILITY IN PARENTAL BEHAVIOUR OF "NAIVE" LABORATORY MICE FROM BRW: PGCI OUTBRED STOCK<sup>1</sup>

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**Summary.** Parental behaviour of mice from the outbred (Brw : PGCI) stock and from 4 inbred strains was tested with Maternal Behaviour Test (MBT). The frequency of maternal activities (sniffing, licking, retrieving the pup, lactation position and nestbuilding) as well as aggression towards the pups were compared separately for males and females between consecutive generations of outbred stock and inbred strains; from which the described stock was derived. Differences between the succeeding generations concerning MBT results and latency time ( $t_{or}$ ) were statistically nonsignificant in outbred stock Brw : PGCI. Variability in parental behaviour was discussed.

Parental behaviour of laboratory mice has been the subject of studies for many years. Nagai et al. (1979) described the behaviour of lactating female. Similar studies were performed by Bielecka (1976). Noirot (1972) thoroughly analysed individual activities of parental behaviour and worked out a description method of such a behaviour. Cummis, Lavery and Hay (1976) compared maternal behaviour of mice from three inbred strains and inferred that survival of the young depends on the behaviour of the female-mothers. Differences between inbred strains were described by Strózik (1980). In the present paper we compared the parental behaviour of females and males from four inbred strains and six succeeding generations (IV - IX) of an outbred stock obtained from intercrossing of these strains.

## MATERIAL AND METHODS

Parental behaviour of 76 females and 46 males of laboratory mice from 4 inbred strains (DBA 2W, BN aW, BALB cW, C57BL 10PhW) originating from the Cancer Institute in Warsaw and that of 239 females and 129 males from six succeeding generations of an outbred stock Brw:PGCI was described. The mice consist the outbred stock were mated according to Hanover system of mating with avoidance of inbreeding (Rapp 1972).

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Maternal Behaviour Test (MBT) was performed on males and "naive" females (i.e. such, which had no contact with pups except siblings of the same litter) aged 42 - 56 days. Each animal was isolated in a cage provided with food and water for 18 - 24 hours prior to the test. After that, two 2-days old pups were placed into a cage and observed for 5 minutes from the first contact with the pups. If the animal showed no interest to the pups for 10 minutes, the observation was interrupted. The following actions were noted (modified after Noirot 1972):

- sniffing the pup (O) — if the female sniffed the pup touching it with her snout for minimum 2 seconds,
- licking the pup (L) — if the female licked the pup, keeping it with her fore-paws for no less than 2 seconds,
- retrieving the pup (P) — if the female retrieved the pup for no less than 2 cm,
- lactation position (PK) — if the female crouched over the pup for no less than 2 seconds,
- nest building (BG) — if the animal carried, pushed or dug the nest material for no less than 2 seconds,
- aggression (A) when the female attacked the pup.

Each activity of female was noted only once and scored as follows: O — score, L — 2 scores, P — 4 scores, PK — 4 scores, BG — 4 scores. The sum of scores constituted a result of the Maternal Behaviour Test (MBT). Aggressive animals as a result of the MBT were not taken into account. Latency time ( $t_{or}$ ) from the moment of placing pups into a cage until the first contact with the female was also noted

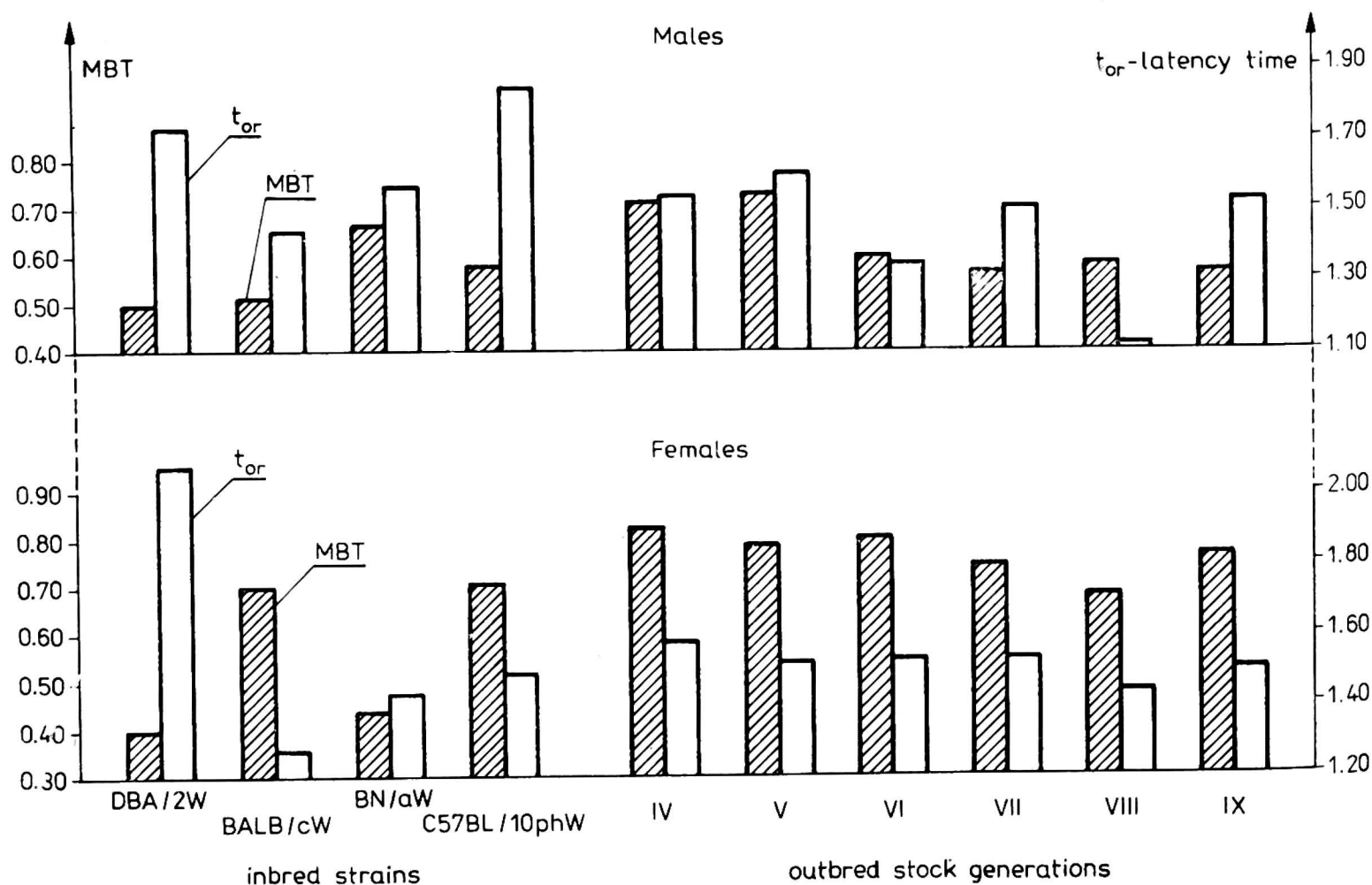


Fig. 1

Statistical calculations and presentation of data were made on transformed data:

a)  $x' = \log(x+1)$

where  $x'$  — a result of MBT after transformation,  $x$  — a result of MBT before transformation (scores)

b)  $x' = \log x$

where  $x'$  — a result of  $t_{or}$  after transformation,  $x$  — a result of  $t_{or}$  before transformation (seconds).

The analysis of variance were carried out separately for each sex according to the following linear model:

c)  $x'_{ij} = \mu + \alpha_i + e_{ij}$

where  $x'_{ij}$  — a result of MBT (or  $t_{or}$ ) of an  $j$ -individual from  $i$ -generation,  $\mu$  — overall mean,  $\alpha$  — effect of  $i$ -generation,  $i=1 \dots 6$ ,  $e_{ij}$  — random error  $N(0 \sigma_e^2)$ .

Differences in the occurrence of particular activities in the maternal response in succeeding generations in outbred stock were described using *Chi-square* criterium.

## RESULTS AND DISCUSSION

### A. RESULTS OF MATERNAL BEHAVIOUR TEST (MBT)

Differences between the mean of consecutive generations of outbred stock were nonsignificant in both females and males (Tab. 1 and 2, Fig. 1) whereas differences between the means of inbred strains were highly significant (Strózik 1980).

Comparing results of MBT in succeeding generations of outbred stock (Tab. 1) it can be noticed that they are close to the overall mean. The heritability of MBT results estimated by Strózik (1980) ranged from:  $h^2=0,14$  to  $h^2=0,35$  in females. The stability of MBT results obtained in the present paper in 6 consecutive genera-

Table 1. Maternal behaviour test (MBT), latency time ( $t_{or}$ ) in 4 inbred strains and in 6 generations of outbred stock. Data transformed : means ( $\bar{x}$ ) and standard errors (s.e)

Groups	MBT						$t_{or}$					
	males			females			males			females		
	$n$	$\bar{x}$	s.e.	$n$	$\bar{x}$	s.e.	$n$	$\bar{x}$	s.e.	$n$	$\bar{x}$	s.e.
Inbred strains												
DBA/2W	13	0.4942	0.0830	21	0.3979	0.0740	13	1.7300	0.1351	21	2.0759	0.1352
BN/aW	11	0.6703	0.0863	13	0.4382	0.0997	15	1.5639	0.1533	13	1.4317	0.1534
BALB/cW	6	0.5102	0.1467	20	0.7001	0.0660	6	1.4422	0.3150	21	1.2746	0.3150
C57BL/10PhW	16	0.5769	0.0757	22	0.7116	0.0690	19	1.8367	0.1033	22	1.4956	0.1033
Outbred stock												
generation IV	4	0.7166	0.0435	10	0.8293	0.1127	16	1.5323	0.1426	11	1.5794	0.1619
„ V	16	0.7306	0.0684	39	0.7903	0.0576	22	1.5999	0.3411	44	1.5196	0.0833
„ VI	21	0.6010	0.0936	44	0.8060	0.0575	22	1.3416	0.1602	44	1.5281	0.0874
„ VII <sup>a</sup>	14	0.5660	0.1012	41	0.7484	0.0582	22	1.5085	0.1429	44	1.5326	0.1016
„ VIII	12	0.5812	0.0943	35	0.6845	0.0578	22	1.1107	0.1363	44	1.4384	0.1202
„ IX	13	0.5650	0.0984	41	0.7733	0.0506	21	1.5207	0.1118	42	1.5088	0.1000
„ VII <sup>b</sup>	63	0.6537	0.0330	124	0.7820	0.0898	100	1.4187	0.0589	131	1.6016	0.0565

<sup>a</sup> animals selected for breeding

<sup>b</sup> all animals from the stock

Table 2. Analysis of variance (MBT and  $t_{or}$ ) in the outbred stock

Source of variation	Degrees of freedom	Mean squares
<b>MBT</b>		
Males		
Generations	5	0.0677
Error	74	0.1275
Females		
Generations	5	0.0761
Error	204	0.1276
$t_{or}$		
Males		
Generations	5	0.7051
Error	119	0.4050
Females		
Generations	5	0.06338
Error	223	0.4249

tions of outbred stock confirms genetic determination of the above trait in males and females. Variability of MBT results in the succeeding generations is similar, which is supported by the absence of differences between the means as well as by a similar value of standard deviations of the means. This is in agreement with methodical objectives of the performed outbred stock.

#### B. LATENCY TIME ( $t_{or}$ )

No significant differences were found between the means in succeeding generations of the outbred stock (Tab. 1, Fig. 1) whereas differences between the means of inbred strains were significant (Strózik 1980). The range of means in the outbred stock in males is lower than that in inbred strains, which means that animals from the outbred stock responded to the pups faster than animals of the inbred strains. Unfortunately, this is associated with a higher frequency of aggression in outbred males (Tab. 3).

Table 3. The frequency of activities in maternal response

Groups	Activities													
	males							females						
	<i>n</i>	O	L	P	PK	BG	A	<i>n</i>	O	L	P	PK	BG	A
<b>Inbred strains</b>														
DBA/2W	16	0.92	0.38	0.15	0.00	0.15	0.00	21	0.76	0.19	0.10	0.05	0.14	0.00
BN/aW	6	0.83	0.17	0.00	0.00	0.50	0.00	21	1.00	0.52	0.00	0.14	0.52	0.05
BALB/cW	15	1.00	0.67	0.27	0.13	0.13	0.27	13	0.46	0.08	0.15	0.08	0.15	0.00
C57BL/10PhW	19	1.00	0.26	0.16	0.00	0.32	0.16	22	0.96	0.50	0.27	0.09	0.50	0.00
<b>Outbred stock</b>														
Generation IV	16	1.00	0.56	0.38	0.00	0.00	0.75	12	0.92	0.75	0.58	0.17	0.42	0.08
„ V	22	1.00	0.50	0.27	0.05	0.27	0.27	44	0.93	0.57	0.48	0.30	0.30	0.11
„ VI <sub>a</sub>	22	0.82	0.59	0.46	0.23	0.09	0.05	44	0.91	0.77	0.77	0.39	0.36	0.00
„ VII	22	0.96	0.36	0.23	0.09	0.14	0.36	44	0.93	0.57	0.41	0.41	0.18	0.07
„ VIII	22	0.91	0.46	0.18	0.00	0.09	0.46	44	0.89	0.43	0.43	0.05	0.21	0.21
„ IX	21	0.91	0.10	0.24	0.00	0.19	0.38	42	1.00	0.52	0.55	0.07	0.45	0.02
„ VII <sup>b</sup>	100	0.96	0.39	0.37	0.07	0.08	0.37	131	0.93	0.59	0.44	0.18	0.33	0.05

<sup>a</sup> — animals selected for breeding, <sup>b</sup> — young animals from the stock, *n* — number of animals, O — sniffing, L — licking, P — retrieving the pup, PK — lactation position, BG — nest building, A — aggression

## C. ACTIVITIES OF PARENTAL RESPONSE

Generally it may be noticed that in outbred males and females the occurrence of parental activities and aggression is more frequent than that in animals from inbred strains (Tab. 3).

Using the *Chi*-square criterium it was found that males of consecutive generations do not differ significantly from males of generation VII b (taken as standard) with regard to the occurrence of particular activities (Tab. 4), whereas in outbred

Table 4. *Chi*-squares for frequency of maternal activities in comparison with standard generation (VII b)

Sex	Activities*					
	O	L	P	PK	BG	A
Males	0.62	9.16	4.12	9.91	14.71	13.46
Females	0.30	5.27	12.79	34.45	7.19	29.47

$$\chi^2_{0.05; 6} = 11.07$$

$$\chi^2_{0.01; 6} = 15.09$$

\* see tab. 3

females there occurred significant differences in the frequency of lactation position (PK) as well as in the occurrence of aggression as compared to females of generation VII b.

## CONCLUSIONS

On the basis of the presented results it may be inferred that both outbred males and females are more parental than inbred strain animals and response to the pups more rapidly. Outbred animals were also more aggressive towards the pups.

Regarding both traits under study i.e. MBT results and latency time ( $t_{or}$ ) no differences were found between the means in succeeding generations of outbred stock with a similar distribution of variability, which indicates the established variation of these traits in the described outbred stock (Brw: PGCI). The frequency of different activities in the maternal response of the succeeding generations of the outbred stock was similar.

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## OPIS ZMIENNOŚCI ZACHOWANIA OPIEKUŃCZEGO „NAIVE” MYSZY LABORATORYJNYCH STADA OUTBRED BRW : PGCI

### Streszczenie

Przetestowano zachowanie opiekuńcze 293 samic i 129 samców „naive” myszy laboratoryjnych ze stada outbred Brw : PGCI z sześciu kolejnych pokoleń.

Porównano częstotliwość wykonywania czynności opiekuńczych wchodzących w skład Testu Zachowania Matecznego (obwąchiwanie oseska, lizanie oseska, przenoszenie oseska, budowa gniazda, pozycja karmienia) oraz agresji w poszczególnych pokoleniach hodowli outbredowej oraz w szczepach wsobnych, z których wyprowadzono opisywane stado (DBA 2J, BN a, BALB cw oraz C57BL10 ScSnPh) osobno dla samic i samców.

Wykonano analizę statystyczną wyników Testu Zachowania Matecznego oraz czasu opóźnienia reakcji opiekuńczej. Różnice między kolejnymi pokoleniami były nieistotne statystycznie.

## ОПИСАНИЕ ИЗМЕНЧИВОСТИ В РОДИТЕЛЬСКОМ ПОВЕДЕНИИ ЛАБОРАТОРНЫХ МЫШЕЙ „NAIVE” СТАДА OUTBRED BRW : PGCI

### Резюме

Подвергнуто тестам родительское поведение 293 самок и 129 самцов лабораторных мышей „naive” из стада Brw : PGCI из шести последовательных поколений.

Сравнивалась частота произведения родительских движений, входящих в состав Теста Материнского Поведения (обнюхивание сосуна, лизание, перенесение, устройство гнезда, позиция кормления), а также агрессивность в отдельных поколениях ауторединга и в ауторедных линиях, из которых было выведено описанное стадо (DBA/2J, BN/a, BALB/cW и C57BL10/ScSnPh) отдельно для самок и самцов.

Произведён статистический анализ результатов Теста Материнского Поведения и времени опаздывания родительской реакции; различия между последовательными поколениями были статистически несущественны.