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A COMPARISON BETWEEN AGONISTIC BEHAVIOR OF RATS OF WISTAR AND WEZOB STRAIN *(RATTUS NORVEGICUS)*

A. Nijssen and M.J. van Rijswijk

ABSTRACT: Agonistic behavior of rats of the Wistar and WEzob strain was compared. Two male rats of the same strain or two male-female pairs of the same strain were confronted with each other for a period of one hour. Individuals and pairs were unknown to each other. In the week before the pairs or the single males were placed in the two compartments of a box. By removing a separating panel, encounters could take place. Behavior was videotaped and analyzed afterwards. During the confrontation session, males from pairs displayed far more consummatory acts (clinch fights and attacks, i.e., biting or attempting to bite) than the individual housed males. The individually housed males, however, showed overall longer agonistic behavior, but this consisted of mainly appetitive agonistic behavior such as lateral attack, keeping down, keep off lying, than males from pairs. There were striking differences between strains: Wistar males from pairs showed more frequent and longer clinch fights and attacks than those of the WEzob strain. The former got far more wounds. It seems that belonging to the losing strain in interstrain encounters is not a good predictor of the amount of intrastrain aggression. The WEzob females displayed more frequent and longer appetitive behavior than the Wistar females. In male-female interactions the WEzob rats displayed more frequently some appetitive behaviors than the Wistar rats, but the Wistar rats displayed more and longer clinch fights than the WEzob rats. The enhancement of male aggression by the presence of a female seems to be a strain-dependent phenomenon.

Usually male rats display agonistic behavior against intruders in their residence, especially if this intruder is a male. This agonistic behavior of the resident male is labelled as territorial behavior, i.e., behavior to retain territory. Rats trying to extend their territory at the cost of neighbouring rats also display agonistic behavior (Calhoun, 1962; Moyer, 1971). The resident rat is usually the winner. This phenomenon is known as the prior residence or ownership effect (Waser and Wiley, 1979). If the loser cannot flee, as is common in experimental situations, a dominant-submissive relation is established. Social isolation enhances agonistic behavior of male rats (Blanchard & Blanchard, 1979) and so does the presence of a female or her odor in the cage (Flannely & Lore, 1977).

In interstrain encounters WEzob rats (a Dutch strain) are defeated by S3 rats (Tryon Maze dull rats) but win over Wistar rats (Van de

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Poll, Smeets, Van Oyen & VanderZwan, 1982). This suggests that S3 rats are more aggressive than WEzob rats and WEzob rats more than Wistar rats. This is in agreement with the statements of many investigators that Wistar rats are tame or dull animals. In the catalogue of the Dutch governmental institute for breeding laboratory animals the WEzob is characterized as aggressive. In the experiments of Van de Poll, et al. (1982), interstrain encounters between WEzob and Wistar rats were observed. Pilot studies of intrastrain encounters in Wistar rats as well as in WEzob rats showed there might be differences between intra- and interstrain agonistic behavior.

Environmental conditions are very important for the appearance of fighting and fleeing. Environmental factors can be the origin on strain differences. Rats must be housed in the experimental closure at least a couple of days to establish a territory. A simulation of a natural territory is impossible because in nature home ranges amount to several hundreds of meters in length with a width of 15 meters (Taylor, 1978). As it is known that social isolation, especially in youth, can increase aggressive behavior, the males that would be housed individually during the experiment, had to grow up in same sex male groups to make sure that the agonistic behavior of the single males could not be attributed to social isolation. A short period of isolation, one week, either does not or minimally influences that behavior (Adams, 1976; Timmermans, 1978).

The Wistar and WEzob rats were investigated under two conditions. In one condition, two individually housed male rats from the same strain were confronted with each other. In the other condition, two male-female pairs from the same strain were confronted with each other. In both conditions the rats stayed in the experimental box the week before testing. This set up presents a problem in the case of the male-female pairs. When the two male-female pairs confront each other, the males will try to copulate with the unknown female. But in the week before testing when the females were in the company of a male, they tended to be in oestrus at least once. Therefore, they were pregnant at testing if the male and female were typical. The pregnant female would then reject the males and a fight between them would arise.

Agonistic behavior has two aspects: attack and flight. Attack behaviour consists of a number of acts and postures which ultimately lead to biting the opponent. Biting and attempts to bite are the end or the goal of the whole offensive behavioral pattern and were therefore considered the consummatory acts of the offensive or attack behavior. The other acts of this pattern leading to the goal behavior were considered appetitive attacking behavior. Flight behavior, too, is divided into these two categories. Flight behavior either leads the rat to a place in which it does not meet danger, or to behavior which minimizes attacking behavior. Fleeing therefore was seen as consummatory; other non-

combative withdrawing acts were considered appetitive flight behavior (Archer, 1976).

Rats which chased away the others or were avoided were classified as winners and dominant; fleeing rats or rats which avoided other rats were classified as losers and submissive. Most probably the winners would be in control of the whole enclosure: its own chamber and that of the loser.

METHOD

Animals:. 100 rats of the *Rattus norvegicus* species (Central Institute for the breeding of Laboratory Animals, TNO, Zeist, The Netherlands) were studied. 58 were of the strain Cpb: (WU) Wistar and 42 of the strain Cpb: (WE) WEzob. Age varied from 60 to 65 days on arrival at the laboratory. The males weighed from 200 to 224 g; the females from 175 to 199 g.

Housing. The Wistar rats were housed in same sex groups of ten, the WEzob in same sex groups of seven, in macrolon cages (55x38x18 cm) (RUCO, Valkenswaard, The Netherlands) with foodpellets (Hope Farms, Woerden, The Netherlands) and water always available.

The groups from which opponents came, were housed in different air conditioned rooms, on a 12:12 reversed light/dark cycle with lights out at 0400, maintained at a temperature of 23°C, and a relative humidity of 50%. Light came from four neon bulbs on the ceiling four meters above the floor; in the dark period a red lamp was on.

Apparatus. Testing took place in a plexiglass enclave, 180x120x30 cm, covered with a wire netting, mesh width 0.5 cm. The enclosure was separated into two 90x120x30 cm chambers by a divider of plexiglass with two trap doors 15x15 cm, one 30 cm from the front wall, the other 30 cm from the back wall.

1. The floors of both chambers were covered with sawdust. In both of them there were some small bricks and a piece of wood on the floor.
2. In the left rear corner of the left chamber and in the right rear corner of the right chamber was a plexiglass sleeping box of 20x20x15 cm.
3. In the front part of both chambers, there were food pellets in the sawdust. In both chambers a waterbottle hung vertically, in the left cage from the left wall, in the right cage from the right wall.
4. A videocamera (JVC, model GS-1500), videotimer (FOR, VTG-33) and monitors (Sony) were in a room next to the testing room.

Procedure. In the middle of the dark period, a female-male pair of the same strain, or a single male of the same strain, was placed in each of the two chambers of the testing enclosure. Six days later, after 144 hours, the trap doors were opened in the middle of the dark period for one hour; videorecordings were made of the behavior of the animals. Light was provided by two red neon bulbs. The animals were selected at random from the home cages. Age varied from 90 to 165 days at the time of observation. In any test the animals were of the same age. After testing the animals were put back in their original housing conditions. Twenty female-male Wistar pairs (40 Ss) were housed pair by pair, 18 Wistar males individually, 14 WEzob pairs (28 Ss) pair by pair and 14 WEzob males individually. The coding of the registered behavior on video was independently done by two observers. In case of disagreement about the coding of a behavioral element it was analyzed again until there was agreement between the observers. Time was registered by means of the videotimer. For each experimental condition the frequency of each behavioral element was determined in addition to the duration in seconds of each clinch fight. The total duration of agonistic behavior per experimental condition was estimated by means of a combination of time and event sampling. Every period of ten seconds of the whole hour videoregistration was screened if the interval contained offensive or defensive acts. The number of intervals with such acts x ten seconds was used as the estimation of the duration of agonistic acts.

Behavior coding. 22 elements of behavior, based on the scheme of Timmermans (1978) were distinguished as follows: (see Figure 1)

1. Lateral posture, aa. The rat shows an arched back, one of its flanks is directed to the head of the opponent. The head and the muzzle are in a wry position, bent to the floor and directed towards the opponent. Sometimes one or both forelegs, and sometimes a hindleg, are off the floor.
2. Lateral attack, aa. From a lateral posture the rat pushes, punches and kicks the opponent.
3. Keeping down, aa. The rat bends over the opponent and presses the opponent against the floor with one or both forelegs on the trunk and/or head of the opponent.
4. Social grooming, m. The rat licks and combs the fur of the opponent, often combined with keeping down. The opponent is standing, lying or sitting.
5. Crawling underneath, m. The rat passes under the head, or wriggles under the trunk of the opponent, which often stands half upright. The movement occurs from a frontal or lateral position.
6. Following, aa. The rats walks or runs after the opponent which moves away.

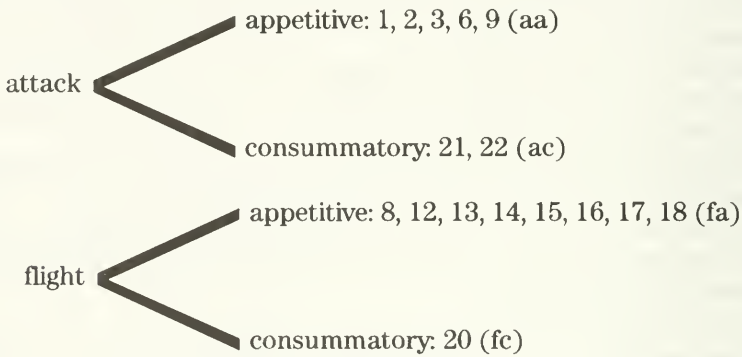
7. Mounting, m. The mounting rat puts its forelegs on the back and the flanks of the opponent, pressing chest and head against the mountee.
8. Kicking backwards, fa. The standing or waking rat, straight before the opponent, kicks with hindlegs if the opponent approaches too closely, follows or mounts.
9. Leaping up, aa. From an upright posture two rats leap up perpendicularly with stretched forelegs, or one of the two leaps up, with the other in a different posture.
10. Lying/crawling, m. The rat, broad backed, lies with its abdomen pressed against the floor. The rat crawls with sliding genitals.
11. Marking, m. The rat rubs an object with abdomen and/or genitals.
12. Keep-off lying, fa. The rat lies on its back and moves its legs in the direction of the opponent.
13. Keep-off sitting, fa. The rat raises its forelegs, genitals and the part of the abdomen close to the genitals remain on the floor. The rat may be pressed to the wall of the cage. The forelegs move in the direction of the opponent.
14. Half upright parry, fa. The rat in half upright posture moves and eventually pushes in the direction of the opponent.
15. Boxing, fa. The rats stand upright and move their forelegs in the direction of the opponent.
16. Standing upright, fa. Both rats stand motionless on their hind legs against each other with forelegs and sometimes noses touching each other.
17. Half upright, fa. The rat stands with an arched back and with forelegs lifted; it is directed to the opponent.
18. Pushing, fa. The standing or lying rat pushes with its head, forelegs or trunk the opponent from its spot.
19. Tail rattling, m. The rat makes a horiziontal undulating movement with its tail; across the floor.
20. Fleeing, fc. The rat runs away fast from the standing or following opponent.
21. Attack, ac. The rat's head moves fast toward the opponent in an attempt to bite it (not followed by clinch fight).
22. Clinch fight, ac. The rats roll over the floor together while they try to bite each other; often one gets bitten.

STATISTICS

For the male-male encounters an Anova with strains and conditions as factors was executed for each behavioral element and for the total duration of the agonistic behavior. A total of 23 Anova's were executed.

FIGURE 1

Categorization of the behavioral elements



The elements 4, 5, 7, 10, 11 and 19 appear in agonistic situations, but are difficult to categorize as attack or flight and so they were classified in the category "miscellaneous" (m).

As the same data were used for many statistical tests the chance to make a type I error is larger than the planned level of significance. Therefore each Annova was compared with a multivariate significance level of alpha/n, where n is the total number of the Anova's (Miller, 1966). In this case the significance level is .05.23 = .0022.

As a second step in preventing unwarranted conclusions, multiple comparisions were made with the Fisher LSD or protected t test. This t test makes use of the MS_w of the Anova's (Welkowitz, Ewon & Cohen, 1976; Hays, 1963; Winer, 1962). The same procedure was used for the testing of the female-female and the male-female encounters, with only the strain as a factor.

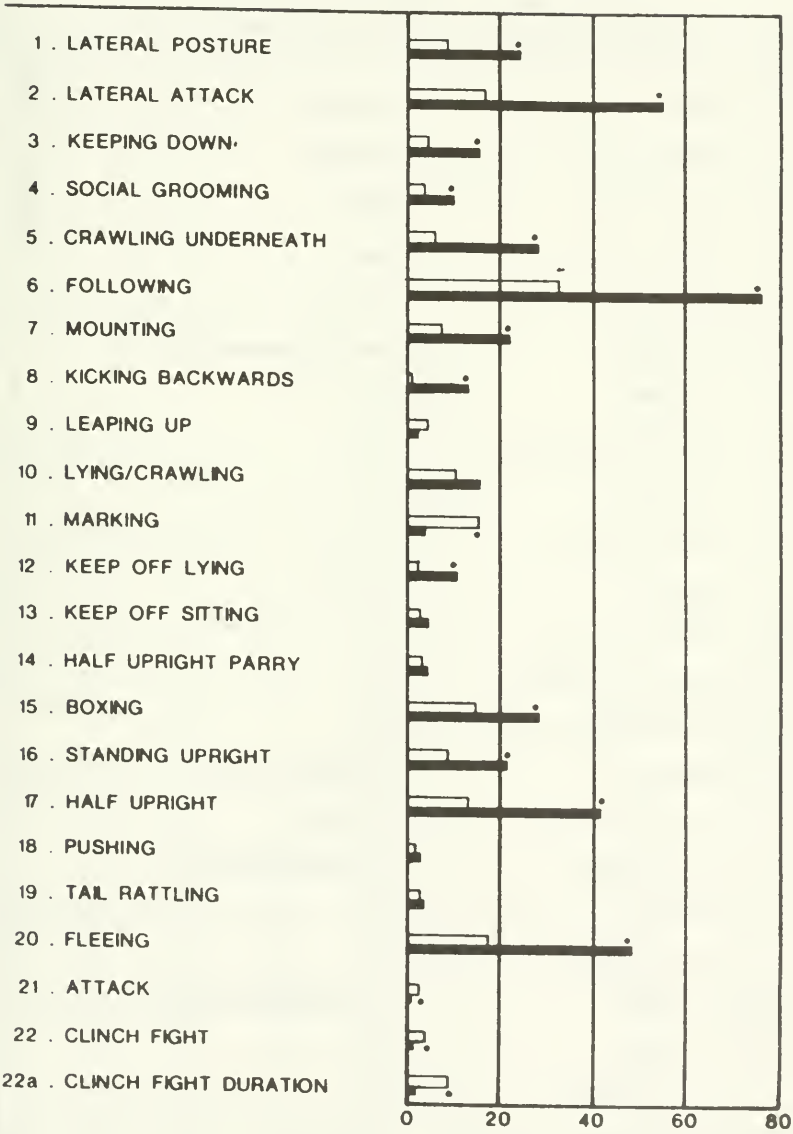
RESULTS

After opening the trap doors, generally, the rats first explored the enclosure of their opponents, then within five minutes they made body contact, sniffing muzzles and genitals. As the animals had been neighbors for 144 hours before the meeting they probably knew the sounds and odor of each other.

1. *Male-male encounters.* Six of the 23 Anova tests with conditions and strains as factors were significant at the .0022 level. So there was a difference between males from pairs and single males, main effect, and between Wistar and WEzob rats, main effect (Figure 2 and 3).

FIGURE 2

*Males From Pairs Versus Single Males: Both Strains Combined (Main Effect)***

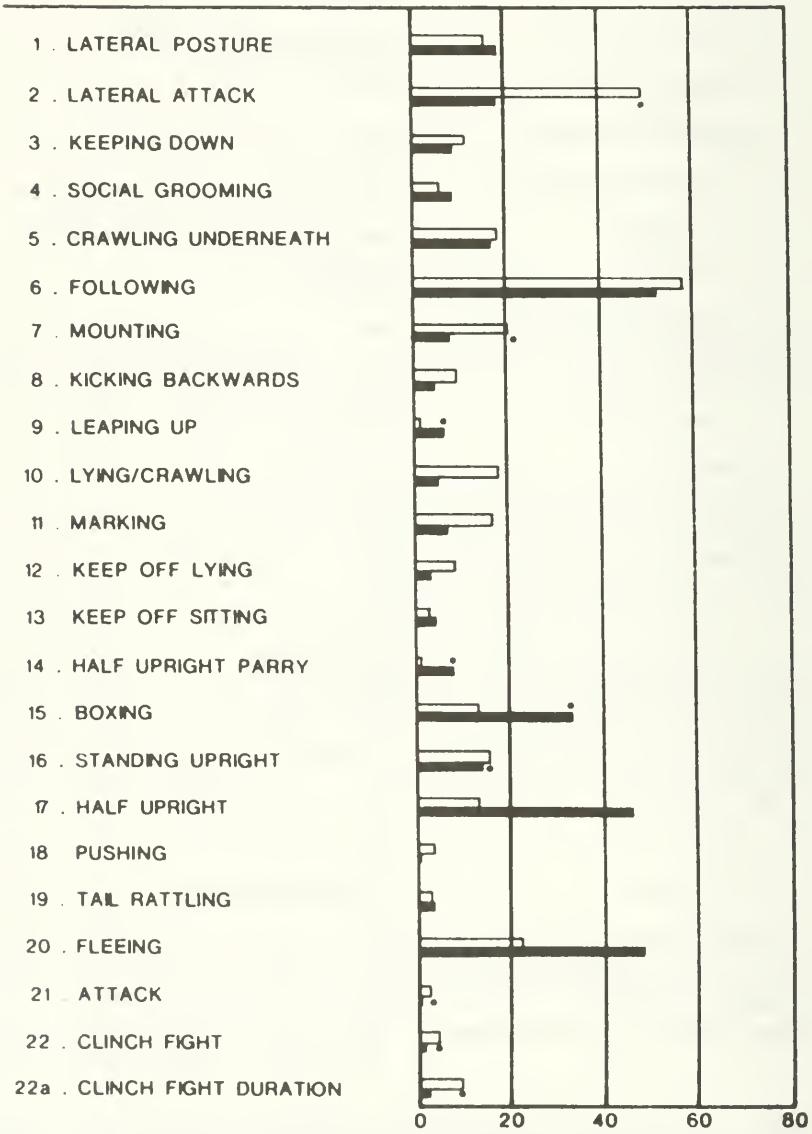


Mean frequencies of behavioral elements and mean duration of clinch fights in seconds. White bars = males from pairs: black bars = single males.
**$p < .05$: ANOVA F TEST
*$p < .05$, multiple comparisons

FIGURE 3

*Wistar Versus WEzob Males: Both Single and Paired Males Combined (Main Effect)***

Mean Frequencies of Behavioral Elements and Mean Duration of Clinch Fights in Seconds



White bars = Wistar Males: black bars = WEzob males.
**$p < .05$: ANOVA F Test
*$p < .05$, multiple comparisons

Computation of the t-values according to Fisher LSD procedures made clear which variables account for the differences (Table 1).

TABLE 1

Male-male encounters: Fisher LSD t test of every ANOVA F test significant at .05 level. wip = Wistar males from pairs; wis = Wistar single males; wep = WEzob males from pairs; wes = WEzob single males.
aa = attack appetitive; ac = attack consummatory; fa = flight appetitive; fc = flight consummatory.

Behavioral element	Intragroup & Interstrain	Fisher LSD t	p
1. Lateral posture - aa	wip-wis	- 1.71	.10
	wep<wes	- 2.02	.05
2. Lateral attack - aa	wip<wis	- 3.41	≤ .001
	wep-wes	- .45	.66
	wip-wep	.28	.78
	wis>wes	2.97	.01
3. Keeping down - aa	wip<wis	- 2.53	.02
	wep-wes	- .93	.36
4. Social grooming - m	wip<wis	- 2.4	.02
	wep-wes	- .93	.36
5. Crawling underneath - m	wip<wis	- 3.12	.006
	wep<wes	- 2.72	.02
6. Following - aa	wip<wis	-30.8	≤.001
	wep<wes	-27.7	≤.001
7. Mounting - m	wip<wis	- 3.44	≤.001
	wep-wes	- .40	.69
	wip-wep	.10	.85
	wis>wes	2.97	.01
8. Kicking backwards - fa	wip<wis	- 3.29	≤.001
	wep-wes	- 1.21	.24
9. Leaping up - aa	wip<wep	- 4.29	≤.001
	wis<wes	- 2.62	.01
10. Lying/crawling - m	wip>wep	2.4	.02
	wis<wes	- 1.44	.16
11. Marking - m	wip>wis	3.86	≤.001
	wep-wes	.02	.98
	wip>wep	4.67	≤.001
	wis-wes	1.18	.25

TABLE 1 *(cont.)*

Behavioral element	Intragroup & Interstrain	Fisher LSD t	p
12. Keep off lying - fa	wip<wis	- 2.8	.01
	wep-wes	- .8	.43
14. Half upright parry - fa	wip<wep	- 3.39	≤.001
	wis<wes	- 3.47	≤.001
15. Boxing - fa	wip<wis	- 2.18	.04
	wep-wes	- 1.00	.33
	wip<wep	- 2.8	.01
	wis-wes	- 1.96	.06
16. Standing upright - fa	wip<wis	- 2.44	.02
	wep-wes	- 1.46	.15
17. Half upright - fa	wip-wis	- .8	.43
	wep<wes	- 4.89	≤.001
	wip-wep	- .8	.43
	wis<wes	- 5.4	≤.001
18. Pushing - fa	wip-wep	1.10	.28
	wis>wes	2.28	.03
19. Tail rattling - m	wip<wis	- 2.4	.02
	wep-wes	- 1.44	.16
20. Fleeing - fc	wip-wis	- .80	.43
	wep<wes	- 3.50	≤.001
	wip-wep	- .19	.85
	wis<wes	- 3.24	≤.001
21. Attack - ac	wip>wis	3.34	≤.001
	wep-wes	- .16	.87
	wip>wep	3.96	≤.001
	wis-wes	.78	.44
22. Clinch fight - ac	wip>wis	3.6	≤.001
	wep-wes	.46	.65
	wip>wep	3.24	≤.001
	wis-wes	.17	.87
22a. Clinch fight duration	wip>wis	4.17	≤.001
	wep-wes	.06	.95
	wip>wep	3.9	≤.001
	wis-wes	.18	.86
Cumulative duration agonistic behavior	wip<wis	2.78	.013
	wep<wes	4.06	.002

Interaction effects were not significant at the .0022 level.

1.1 Conditions.

a. Wistar males from male-female pairs showed more marking (m), attack (ac), clinch fights (ac) than single males and the duration of clinch fights of males from pairs was longer than that of single males. Single Wistar males showed more lateral attack (aa), keeping down (aa), social grooming (m), crawling underneath (m), following (aa), mounting (m), kicking backwards (fa), keep off lying (fa), boxing (fa), standing upright (fa), tail rattling (m), than Wistar males from pairs.
b. Single WEzob males showed more lateral posture (aa), crawling underneath (m), following (aa), half upright (fa) and fleeing (fc) than the WEzob males from pairs.
c. The cumulative duration of agonistic behavior of single Wistar and WEzob males was longer than that of Wistar and WEzob males from pairs.
d. Besides this, 16 of the 18 Wistar males from pairs had at least one but usually more wounds; none of the Wistar males had a wound. Of the 14 WEzob males from pairs only one animal had a wound; none of the single males had one.

1.2 Strains.

a. Comparison between males from pairs. Wistar males showed more lying/crawling (m), marking (m), attack (ac), clinch flight (ac) than WEzob males. The duration of clinch fights and the overall duration of agonistic behavior were longer in Wistar than in WEzob males. WEzob males showed more leaping up (aa), half upright parry (fa) and boxing than Wistar males.
b. Comparisons between singles. Wistar males showed more lateral attack (aa), mounting (m) and pushing (fa) than the WEzob males. WEzob males showed more leaping up (ac), half upright parry (fa), half upright (fa) and fleeing (fc) than Wistar males.
c. Most Wistar rats had several wounds and blood on their fur; only one WEzob rat had a wound.

1.3. Winners and losers.

a. Wistar pair condition. Winners could be easily distinguished from losers. Losers fled to the platform of the sleeping box and if they came down they were chased back by the winners. Winners showed more lateral attack (aa), following (aa), lying/crawling (m), crawling underneath (m) and attacks than losers ($p < .05$); losers displayed

more half upright parry (fa) and fleeing (fc) than winners did ($p < .05$).

b. WEzob pairs condition. In the WEzob groups it was more difficult to distinguish winners from losers. However, one male always showed a greater tendency to flee than the other. The latter was considered to be the winner, the former the loser. It turned out that in WEzob pair condition winners displayed more lateral posture (aa) and lateral attack (aa; for both $p < .0179$) than losers.

c. The single condition. In the WEzob single condition the winner showed more lateral posture (aa), lateral attack (aa), following (aa), lying/crawling (m) and crawling underneath (m) ($p < .02$) than the loser. In the Wistar single condition the winner showed more lateral attack (aa) than the loser ($p = .023$).

2. Female-female encounters.

Three of the 23 Anova tests with strains as a factor were significant at the .0022 level. So there is a significant difference between the Wistar and WEzob female rats (Figure 4).

Calculation of Fisher's LSD t-values (table 2) leads to the conclusion that WEzob females showed more lateral attack (aa), keeping down (aa), crawling underneath (m), following (aa), mounting (m), kicking backwards (fa), keep off sitting (fa), half upright parry (fa), half upright (fa), fleeing (fc) than the Wistar females.

The accumulative duration of agonistic behavior of WEzob females was longer than that of the Wistar females.

3. Male-female encounters.

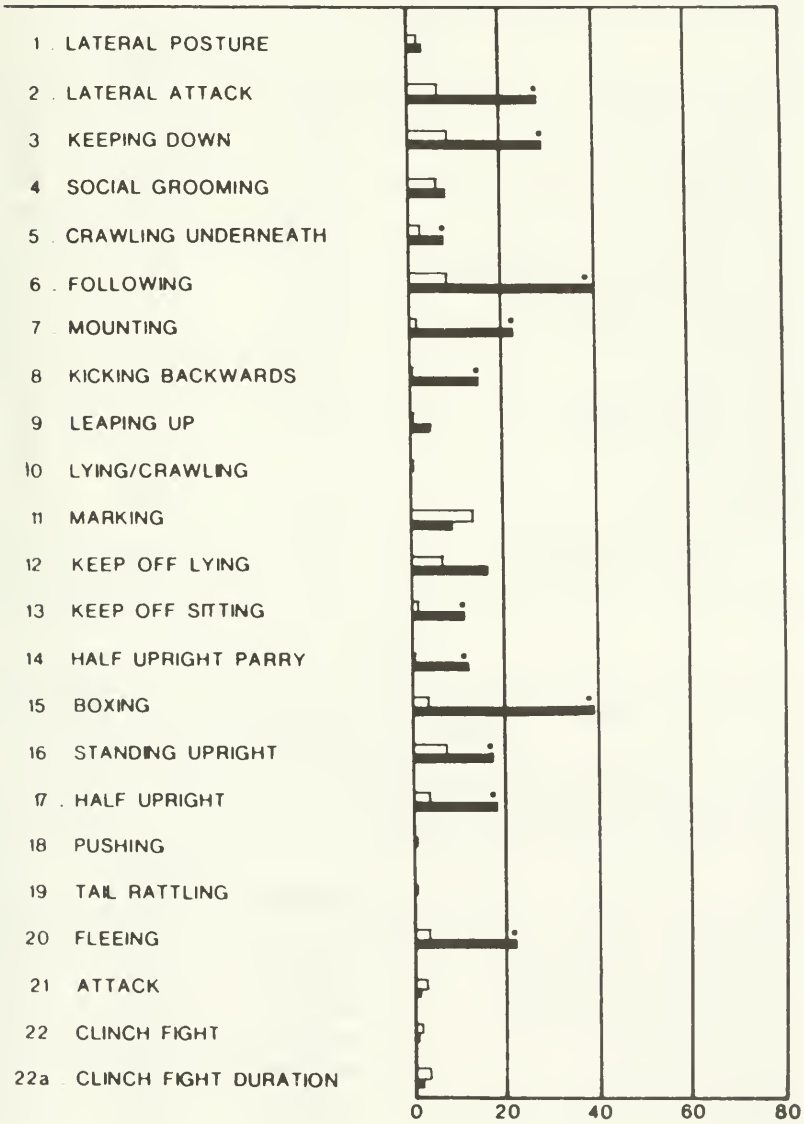
The behavioral elements of both sexes builded up the score of the interactions. So the total frequencies or durations of a behavioral item for the male-female pair, rather than for individual animals, were analyzed. Two of the Anova's with strains as a factor were significant at the .0022 level. There is a difference between Wistar and WEzob male-female interactions (Figure 5).

The results of the Fisher LSD procedure (table 3) lead to the conclusion that in WEzob male-female interactions there is more crawling underneath (m), kicking backward (fa) half upright parry (fa), boxing (fa), half upright (fa) than in Wistar male-female interactions.

In Wistar male-female interactions there is more pushing (fa), clinch fight (aa) and the duration of clinch fight is longer than in WEzob male-female interaction. The cumulative duration of agonistic behavior of the WEzob male-female interactions was longer than the Wistar male-female interactions.

FIGURE 4

Wistar Versus WEzob Females: Mean Frequencies of Behavioral Elements and Mean Duration of Clinch Fights in Seconds



White Bars = Wistar Females: Black Bars = WEzob Females: *$p \leq .05$, multiple comparisons

TABLE 2

Female-female encounters: Fisher LSD t test of every ANOVA F test significant at .05 level.

aa = attack appetitive; ac = attack consummatory;
fa = flight appetitive; fc = flight consummatory

Behavioral element	Interstrain	Fisher LSD t	p
2. Lateral attack - aa	we<wi	-2.47	.03
3. Keeping down - aa	we>wi	-2.6	.02
5. Crawling underneath - m	we>wi	-2.78	.01
6. Following - aa	we>wi	-3.26	.01
8. Kicking Backwards - fa	we>wi	-4.72	≤.001
7. Mounting - m	we>wi	-4.2	.001
13. Keep off sitting - fa	we>wi	-3.37	.005
14. Half upright parry - fa	we>wi	-3.47	.004
15. Boxing - fa	we>wi	-4.48	.001
16. Standing upright - fa	we>wi	-2.20	.05
17. Half upright - fa	we>wi	-2.98	.01
19. Tailrattling - m		.265	.75
20. Fleeing - fc	we>wi	-2.96	.01
Cumulative duration agonistic behavior	we>wi	-4.767	.001

TABLE 3

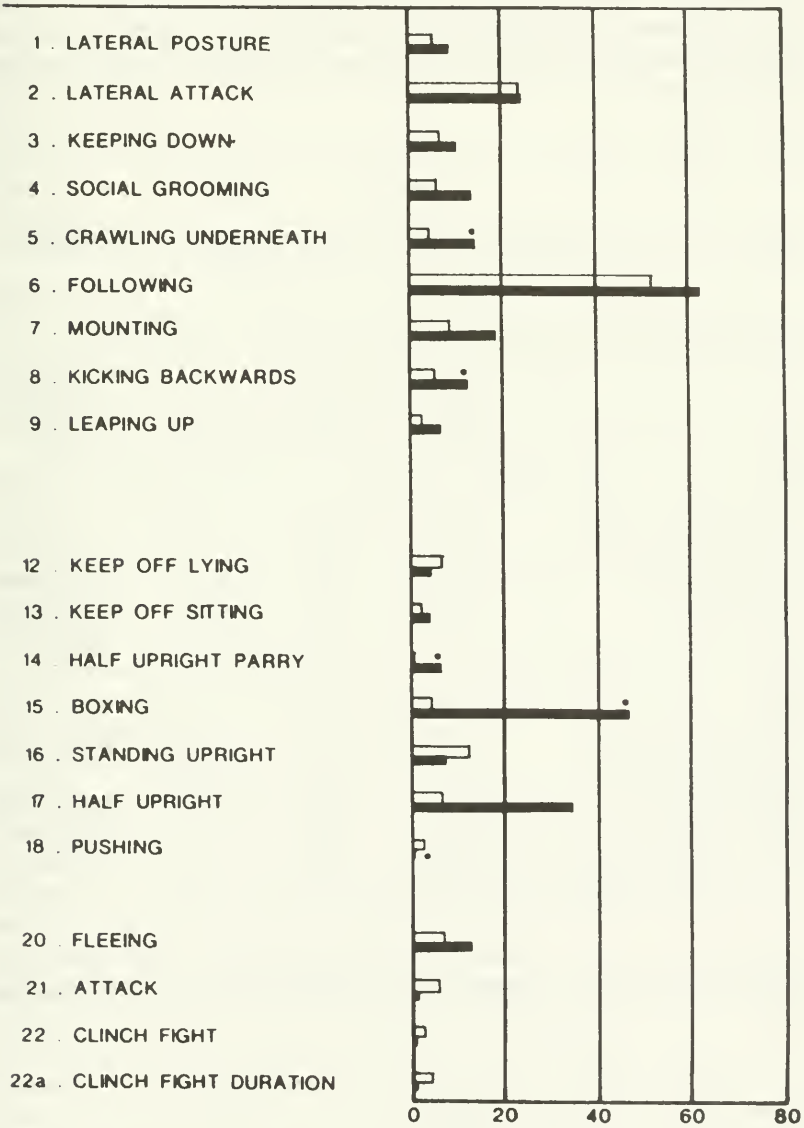
Male-female encounters: Fisher LSD t test of every ANOVA F test significant at .05 level.

aa = attack appetitive; ac = attack consummatory;
fa = flight appetitive; fc = flight consummatory

Behavioral element	Interstrain	Fisher LSD t	p
5. Crawling underneath - m	we>wi	-2.95	.01
8. Kicking backwards - fa	we>wi	-2.6	.02
14. Half upright parry - fa	we>wi	-6.76	.001
15. Boxing - fa	we>wi	-2.88	.01
17. Half upright - fa	we>wi	-4.46	.001
18. Pushing - fa	wi>we	2.19	.05
22. Clinch fight - ac	wi>we	2.42	.03
22a. Clinch fight duration	wi>we	2.38	.03
Cumulative duration agonistic behavior	we>wi	-2.97	.01

FIGURE 5

Wistar versus WEzob Male-Female Interactions: Mean Frequencies of Behavioral Elements and Mean Duration of Clinch Fights in Seconds: Fisher LSDT test.



White Bars = Wistar Male-Female Interactions:
Black Bars = WEzob Male-Female Interactions: *$p \leq .05$, multiple comparisons

4. Further explorations

There were some differences between males and females from the male-female pairs in their interactions (table 4). a. Wistar males showed more keeping down (aa), following (aa), mounting (m) than Wistar females. Wistar females showed more kicking backwards (fa) than Wistar males. b. WEzob males showed more following (aa), mounting (m) than the WEzob females; the latter showed more lateral attack (aa) and kicking backwards (fa).

TABLE 4

Differences between males and females of the male-female interaction. Anova, F test, $p < .05$, two-tailed.

wim = Wistar male; wif = Wistar female; wem = Wistar male; wef WEzob female.

Behavioral element	Mean frequency Male	Female	p-value	Male vs Female
Wistar				
2. Lateral attack - aa	3.67	20.44	.0256	—
3. Keeping down - aa	6.22	1	.011	wim>wif
6. Following - aa	38.44	14.89	.006	wim>wif
7. Mounting - m	8.78	0	.005	wim>wif
8. Kicking backwards - fa	.11	6.71	.012	wim<wif
Wezob				
2. Lateral attack - aa	3.86	20.71	.012	wem<wef
3. Keeping down - aa	8.57	3.43	.102	—
6. Following - aa	42.29	20.14	.017	wem>wef
7. Mounting - m	15.86	2.86	.018	wem>wef
8. Kicking backwards - fa	1.14	11.43	.011	wem<wef

Although there were different behavioral patterns for males and females, at the .05 level of probability a firm conclusion is not warranted.

DISCUSSION AND CONCLUSIONS

The most striking outcome is that the Wistar males in the presence of females showed more vehement attacking behavior than the WEzob

males in the same conditions and than the single males of either of the two strains. They showed the highest frequency of attack and clinch fights, the cumulative duration of the latter was longer than in any other group. Besides that they had by far the most wounds and they had clearly perceptible blood on their fur. As the single Wistar male also showed more aggression than the single WEzob male this might mean that belonging to the losing strain in interstrain encounters is not a good predictor of the amount of intrastrain aggression. The second surprise was that the presence of females had only an influence on the behavior of males in the Wistar strain. So the influence of the female presence on male aggressive behavior seems to be strain-dependent and prominent in the Wistar strain, a strain that showed already more attack behavior.

Single males of both Wistar and WEzob strain showed a greater variety of agonistic behavior than males in the company of females. The cumulative duration of their agonistic behavior was longer too. Maybe the activation of their agonistic system was high enough to release various elements of appetitive behavior, but not high enough to release consummatory acts such as biting and clinch fighting.

A clearly dominant and submissive relationship could only be spotted among the Wistar males in company of females: After the fighting took place the loser fled to a safe spot. It seems plausible to assume that there is a relation between the high attack level and the accompanying wounds of these male Wistars and the establishment of a definite dominance-submission relationship. In the other conditions only the number of flights distinguished winners from losers.

In females no dominance and submissive relationship was found. Three hours after the beginning of their meeting, when the light period started, several females even slept together in the sleeping boxes. There were some differences between WEzob and Wistar females. The former showed a higher frequency of 12 out of the 22 behavioral elements, but this did not lead to a dominance and submission relationship.

Agonistic interactions between females and males occurred on two occasions: 1) either when the males tried to mount the females (all pregnant and all had a litter approximately two and half weeks later) who reacted by kicking backwards and after that with lateral attack: 2) or when two males in their joint agonistic interactions bumped on a female and continued their agonistic behavior but now with her as a target until they noticed their mistake. Females display agonistic behavior only after undesired body contacts. So, it appears that in both strains the competition for territory is between males. Wistar rats are more attack prone than WEzob in intrastrain encounters. Only the female Wistar stimulates a high "vehemence" in the already more aggressive male of her strain.

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