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Ethanol Effects on Female Aggression Vary With Opponent Size and Time Within Session[1]

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BLANCHARD, D. C., K. FLANNELLY, K. HORI, R. J. BLANCHARD AND J. HALL. *Ethanol effects on female aggression vary with opponent size and time within session.* PHARMACOL BIOCHEM BEHAV 27(4) 645–648, 1987.—Female rats displayed different patterns of attack to large and small male intruders into their home cages, as a function of ethanol dose levels. In confrontations with small male intruders, female attack increased significantly at 0.3 g/kg ethanol, declining to saline levels with higher doses (0.6 and 1.2 g/kg). Attack toward large intruders was (nonsignificantly) higher at 0.3 g/kg ethanol, and declined to significantly lower than saline levels with the higher ethanol doses. The attack increases seen with low ethanol doses came in the initial 5-min block of the 30 min test session, and did not persist. These findings suggest that low ethanol doses may especially increase overt aggression in situations in which the tendency to attack is only moderately inhibited by factors such as opponent size or the potential danger of retaliatory attack.

Ethanol Aggression Attack Maternal aggression Rat Behavior

ANALYSIS of the pharmacological control of aggression has recently included a consistent division between offensive and defensive attack patterns [13], based on a body of research (for reviews, see [1–3, 20]) indicating situational, behavioral, and physiological differences between the two patterns. The status of maternal aggression with reference to these modes has not been established. However, it is notable that the specific behaviors seen in attack by female rats on a male intruder are considerably different from those of resident males [6,10]. Moreover, variations in intensity of female attack as a function of postparturitional time [8,10] and experience of being suckled by the young [18,19] obviously have no parallels in male attack.

DeBold and Miczek (1981) have reported that different hormonal mechanisms may be responsible for aggression in male and female rats. Female aggression generally, and maternal attack on intruders, specifically, may thus respond differently to pharmacological manipulations than does male aggression. The effect of ethanol on male offense in rodents has been extensively investigated (see Smoothy and Berry [16], for a review): Higher ethanol doses (about 1.0 g/kg and above) consistently depress offensive behavior toward a conspecific, while both increases [11, 12, 21] and decreases [15,17] in offense have been reported after lower ethanol doses. The inconsistency with reference to effects of low ethanol doses on aggression may reflect a variety of factors, such as initial levels of aggressiveness of the subject [5,12], or features of the situation in which behavior is measured [16]; it is not, however, well understood at present. Maternal aggression also appears to be sensitive to such features, varying substantially as a function of the size and age of the opponent [9]. Additional information on the relationship between ethanol intake and aggression, using a maternal aggression model, may help to clarify both the relationship of ethanol to aggressive behavior, and the relationship between maternal aggression and male aggression patterns.

METHOD

Subjects

The subjects were 36 female Long-Evans rats averaging 120 days of age when bred. The subjects were randomly divided into three groups of 12, with the animals of each group receiving a single dose level of ethanol, either 0 (saline), 0.5 g of ethanol per kg body weight, or, 1.2 g/kg body weight.

Apparatus

Subjects were bred, housed and tested in standard 30×35 cm plastic breeding cages, containing wood chips for bedding.

Procedure

Each subject was placed into a standard breeding cage

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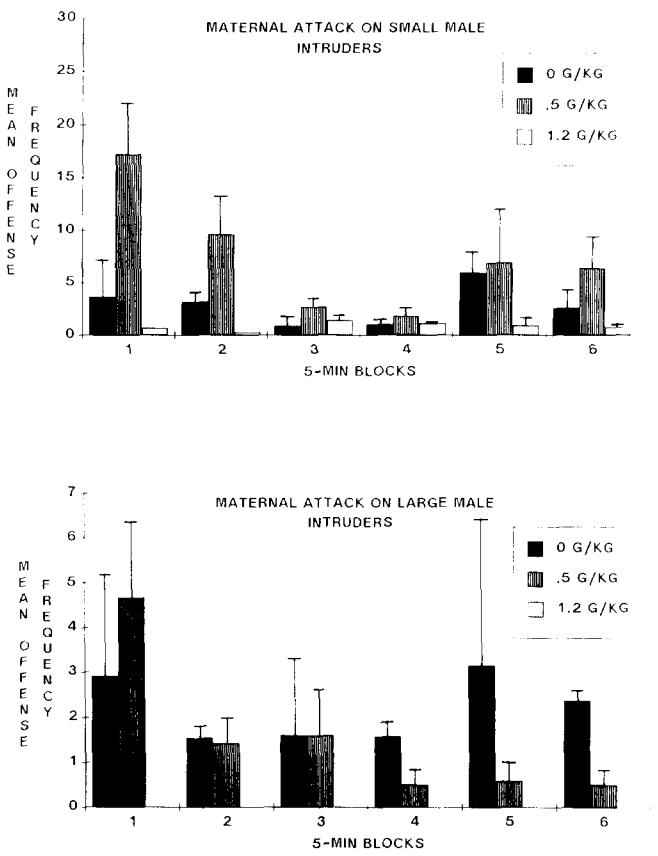

FIG. 1. Total frequency of offensive acts by female residents to small (top graph) and large (bottom graph) male intruders during six successive five-min blocks in a thirty-min test session, as a function of ethanol dose.

with an adult Long-Evans male, and the pair was housed together with ad lib food and water, until approximately one week before parturition was expected, based on observed sexual activity of the pair. The male was then removed and the female left in the cage.

On the second and third days post parturition, each female was given a standard volume IP injection of saline or ethanol and replaced in its breeding cage. After 15 minutes, pups were removed from the cage, and a strange male intruder was introduced. Half of these intruders were adult males of the same age as the females and averaging 370 g in weight (large intruders), while the remaining animals were juvenile males weighing within 20 grams of the female's own weight (small intruders). The intruder was left in the cage for a 30-min session, and the following reactions of the female toward this intruder were scored: Lateral attack (subject's lowered head is oriented toward the intruder with back and hind legs arched; its body curves longitudinally toward, and moves laterally against, the opponent); on-top-of (subject stands over or on top of its supine opponent); chase (subject runs after the fleeing opponent); bites; stretch-attacks (subject stretches its body forward to bite at the opponent's head or shoulder); and jump-attack (subject jumps at the head or shoulder of the opponent). The last two of these appear to be much more typical of female, as opposed to male, attack toward male intruders [10]. Both jump-attacks and stretch-attacks may result in bites, but this does not necessarily occur. In fact, the proportion of lesions following such stretch- or jump-attacks is quite low [10].

All sessions were videotaped and later scored for the frequency and, where appropriate, duration of each of these behaviors.

Statistical analysis of these results involved analysis of variance with one between subjects factor (drug level) and two within subjects factors, intruder size, and time, followed by appropriate *t*-tests.

RESULTS

Figure 1 presents the total frequency of all offensive behaviors, including lateral attacks, chases, on-top-of, bites, stretch-attacks, and jump-attacks, for females of the different groups toward small or large intruders, over five-min blocks in the 30 minute test period. This figure suggests that offensive reactions to the intruders were systematically different for the three groups. Toward both small and large intruders, the saline group initially displayed an intermediate level of offense, which declined over the next several five-min blocks and then rose again, forming something of a "U" shaped curve over the 30 min test period. The 0.5 g/kg ethanol group initially displayed a somewhat higher (to large intruders) or very much higher (to small intruders) level of offense, with this declining to levels approximately equal to (for small intruders) or lower than (for large intruders) those of the saline group during latter portions of the session. The 1.2 g/kg group displayed very little offense to either large or small intruders at any time. It might be noted that, although motor functioning was not specifically measured in this study, neither of these dose levels appeared to have any impact on motor functioning in a study of a wide range of defensive acts in rats [4].

Analysis of this data indicated that both drug $F(2,33)=5.04$, $p<0.02$, and intruder size, $F(1,66)=13.17$, $p<0.002$, effects were reliable. The interaction of these effects was also reliable, $F(2,66)=6.88$, $p<0.005$. In view of the significant interaction subsequent comparisons of both small and large intruder conditions were made. These indicated that drug levels produced a reliable effect for tests involving small intruders, $t(33)=6.91$, $p<0.005$, but not for large intruder tests, $t(33)=1.89$, $p>0.05$. For the small intruder tests only, aggression for the 0.5 g/kg group was reliably higher than for the saline group, $t(33)=2.43$, $p<0.02$, while aggression scores for the 1.2 group were not significantly lower than those of the saline control group, $t(33)=1.22$, $p>0.05$.

The effect of time (successive 10-min blocks in the 30 min test situation) was also reliable, $F(2,66)=3.42$, $p<0.05$, as was the time by drug level interaction, $F(4,66)=2.67$, $p<0.05$. For the first 10-min block only, aggression scores for the 0.5 g/kg group were reliably higher than those for the saline group, $t(33)=3.03$, $p<0.005$, while the saline group was higher, but not reliably so, than the 1.2 g/kg group, $t(33)=1.09$, $p>0.05$.

Table 1 presents the frequencies of each of the specific attack behaviors measured. As this table suggests, the increase in attack toward small intruders for subjects given 0.5 g/kg ethanol was a general phenomenon, involving each component of the attack pattern: These behaviors were all approximately twice as frequent in the 0.5 g/kg ethanol group as in the saline group. Moreover, each behavior was substantially reduced for the group given 1.2 g/kg ethanol, and confronted with a small intruder.

TABLE 1

MEAN FREQUENCY AND (STANDARD ERROR) OF VARIOUS ATTACK BEHAVIORS TOWARD LARGE AND SMALL MALES FOR FEMALE RATS GIVEN SALINE, 0.5, OR 1.2 g/kg ETHANOL

	Attack Behaviors					
To:	Lateral Attack	On-Top	Chase	Stretch-Attack	Jump-Attack	Bites
Small Intruder						
Saline	5.33	3.08	0.58	1.67	1.67	5.33
	(1.4)	(0.39)	(0.40)	(0.58)	(0.94)	(2.11)
0.5 g/kg	12.08	7.50	1.08	4.08	3.08	15.17
	(4.44)	(2.77)	(0.54)	(1.47)	(1.16)	(5.07)
1.2 g/kg	0.83	0.92	0.00	0.67	0.58	1.17
	(0.44)	(2.35)		(0.51)	(0.49)	(1.08)
Large Intruder						
Saline	2.25	3.92	2.50	3.17	1.50	2.50
	(1.52)	(2.57)	(1.42)	(1.95)	(0.66)	(1.26)
0.5 g/kg	3.83	0.00	0.00	1.42	1.08	1.25
	(3.45)			(0.54)	(0.59)	(0.58)
1.2 g/kg	0.00	0.00	0.00	0.00	0.00	0.00

In contrast, when larger intruders were the target stimuli, five of the six attack behaviors were less frequent for the subjects receiving a low ethanol dose, measured over the entire session. These data should, however, be seen in conjunction with the results presented in Fig. 1, suggesting that this overall tendency for lower attack to larger intruders with the low ethanol dose varies as a function of time in the test session, with attack being somewhat higher during the initial portion of the test session, and declining later to lower than control levels.

DISCUSSION

The results of the present study suggest a very potent response enhancing effect of ethanol at low doses for maternal aggression. As appears to be the case with ethanol and male offense patterns, this effect is not uniform across situations and eliciting stimuli: Instead, it appears very specifically in the present task to small male intruders, and, in the initial moments of the test period.

Both of these effects are interesting in terms of the previous literature on ethanol and male aggression. The effect of time within the test encounter is consonant with the use of short (5 or 10 minute) test sessions for those studies finding low dose ethanol enhancement of male aggression in rats and mice [11,12]. The present results additionally indicate that, if the test encounter is extended, this difference does not persist.

Since aggression for females receiving low ethanol doses declined over time more sharply (relative to the saline control group) when a large male, as opposed to a small male, was the opponent, the mechanism of this decline may lie in the subject-opponent interaction. Male intruders attacked by a resident female do tend to retaliate by offense toward the female [6,10], and it seems likely that the effect of large vs. small intruders may reflect higher levels of fear elicited by the larger males, or actual experience of defeat from retaliatory attack by them. Either or both of these might suppress further female attack. The finding of very low attack on larger males in later portions of the test session for females receiving the 0.5 g/kg ethanol dose certainly suggests that the increase in attack with low ethanol doses is responsive to the consequences of that attack. This pattern suggests that this dose may primarily interfere with the female subject's initial appraisal of the threat potentialities of an intrucer, an error which is subsequently corrected by direct experience.

The high magnitude difference in ethanol effects in tests involving large vs. small intruders, like the finding of a high level of initial aggression for the 0.5 g/kg group, appears to be relevant to a view that some form of inhibition mechanism is involved in the low dose ethanol-aggression link. This concept, that ethanol reduces a mechanism which normally acts to inhibit aggression, has come to be a leading explanation for the effects of ethanol on aggression [14]. The present intruder size difference is congruent with an inhibition view, given assumptions that the ethanol effect on this putative inhibitory mechanism is only partial (else attack on large intruders should be as high as on small intruders), and, or, that a threshold effect is involved. The present data suggest that when there is a relatively close balance between tendencies to attack, and inhibitions regarding such attack, then the disinhibiting effect of low ethanol doses may greatly increase attack tendencies. However when inhibition is very high (as with the large intruders here), or, when it is forcefully re-emphasized (as when the male intruders respond with offense to the female attack), the effect of low ethanol doses is less apparent.

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