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Influence of Hashish Extract on the Social Behaviour of Encountering Male Baboons (*Papio c. anubis*)

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SIEBER, B. *Influence of hashish extract on the social behaviour of encountering male baboons* (Papio c. anubis). PHARMAC. BIOCHEM. BEHAV. 17(2) 209–216, 1982.—The effects of hashish extract (2 mg Δ^9-THC/kg)on the social behaviour of encountering male baboons were tested by ethological methods. In the "approaching" male the drug reduced "approach" and the aggressive elements "hit-ground", "brows-back" and "attack" but increased the frequency of "retreat". Social interactions were generally diminished. In the "retreating" male friendly social interactions as "lipsmack" and "touch-back/handle-genitals" were suppressed but the threatening elements "open-mouth" and "tooth-grind" were stimulated. "Retreat" was additionally more frequent. Non-social activities and locomotion were not affected in either of the males. Treating both subjects with hashish resulted in a reduction of "lipsmack", "approach", "fight" and "chase" in the approaching and "lipsmack", "touch-back/handle-genitals", "chase", "retreat" and "flee" in the retreating male. Social activities were generally reduced in both animals. Comparing the behavioural effects of hashish in male baboons to those described in other non-human primates, in rodents but also in man revealed analogous effects in all species. The drug generally impaired social interactions, induced social withdrawal and led to social isolation of the drugged subject.

Hashish extract Male baboons Social behaviour

PREVIOUS studies, concerning behavioural effects of hashish in mice [11, 12, 13] revealed that well-controlled behavioural experiments with rodents can provide instructive information about a drug's action on social behaviour. Nevertheless the relevance of these studies to the situation of man remains questionable due to species differences in behaviour and physiology. However the characterization of drug effects on emotional and social behaviour of humans is very difficult, since the influence of sample selection and of environmental variables can hardly be controlled.

As it was demonstrated before [9,10], investigations on social behaviour of non-human primates might be a useful model to bridge the difficulties of species differences between rodents and man. Nevertheless there exist only a few studies on the effects of hashish or its active component Δ^9-THC on social interactions in monkeys. The studies, investigating the behavioural changes induced by cannabis in female Chacma baboons [5] or by Δ^9-THC in Squirrel monkeys [7] has additionally been limited to a very small number of animals. Moreover acute as well as short- and long-term chronic effects of Δ^9-THC on spontaneous behaviour had been performed in different groups of macaques [1,9].

Although the comparison of drug effects in different species of animals might provide very interesting information about the relevance of a behavioural drug study, there is only one author [7] who tried to find parallels between the effects of Δ^9-THC in rodents and monkeys, focusing mainly on agonistic behaviour in a resident-intruder situation. The design of the present study was therefore a detailed ethological and statistical analysis of the effects of hashish extract on behaviour and social relations of male baboons while encountering an unfamiliar partner. This experimental situation was comparable to that of previous mouse studies [11]. It was the aim of this study to discuss similarities and differences of behavioural effects of hashish extract in primates and rodents as determined by the respective behavioural test system.

METHOD

Animals

Six adult male olive baboons (*Papio c. anubis*) at an estimated age of 10 to 15 years and with body weights between 26.0 and 30.0 kg were used. All the animals were trapped in 1977 in the East African Rift Valley near Narok (Kenya). Subsequently the monkeys were kept in captivity in outdoor

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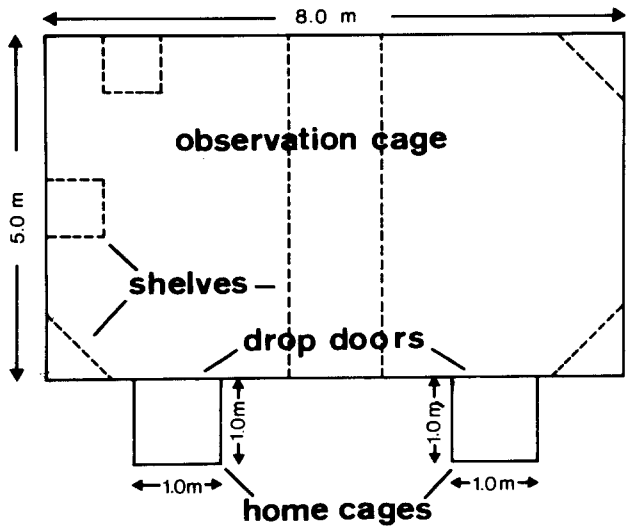

FIG. 1. Experimental enclosure.

TABLE 1

SCHEDULE OF TREATMENT AND ENCOUNTER OF TWO MALE BABOONS

Meeting Number	Treatment of ♂A	Treatment of ♂B
I	no	no
II	no	no
III	no	no
IV	drug	no
V	no	no
VI	no	drug
VII	no	no
VIII	drug	drug
IX	no	no

TABLE 2

ELEMENTS OF BEHAVIOUR AND BEHAVIOURAL CATEGORIES DURING A 30 MINUTES ENCOUNTER OF TWO MALE BABOONS

Category	Elements
Social attention and social contact	attend, lipsmack, contact noise, approach, follow, present, touch-back/handle-genitals
Aggression: Threatening	hit-ground, brows-back, open-mouth, tooth-grind
Aggression: Aggressive contact	attack, fight, chase, bite
Submission and flight	retreat, crouch, scream, flee
Non-social activities	eat, drink, scratch, yawn, self-groom, touch-noise, shake
Locomotion	walk, run, climb, jump

This ethogram is based on a list of behavioural elements from *Papio hamadryas*, which was placed at our disposal by H. Kummer, University of Zurich, Switzerland.

enclosures and fed with commercial monkey cubes (Unga Ltd., Kenya) with local fruit and vegetable supplement. During six months preceding the experiment all the males were individually caged and there was no physical contact between either of the animals before the experiment.

Drug and Drug Administration

The hashish extract [11] contained Δ^9-tetrahydrocannabinol (Δ^9-THC, 40%), cannabidiol (45%), cannabinol (9%) and other cannabinoids (6%). The extract was dissolved in pure olive oil (40 mg Δ^9-THC/ml) and administered orally in honey bred or in bananas at a dose of 2 mg Δ^9-THC/kg body weight. This drug dose was chosen due to the literature [1,9] and showed clear but not generally sedating effects in preliminary studies. Drugs were always given before feeding the animals in the morning. Behavioural observations began $2^1/_2$ hours after drug administration when, as ascertained by preceding pilot studies, the drug showed maximum behavioural effects.

Procedure

For an experiment two males were transferred into two separate cages, which both were attached to one big observation cage (Fig. 1). A drop door prevented the animals from walking into the observation cage. After 4 weeks of accustoming to the new environment, each male of the pair was separately released into the observation cage and trained to return to his home cage after a few minutes. During training of one male, the home cage of his partner was shielded by a metal plate which prevented any contact be-

tween the animals. When the training showed to be successful, the animals were treated once a week as scheduled in Table 1.

For the encounter both males were simultaneously released into the observation cage and the door to the home cage was closed. During the subsequent 30 minutes of encounter the behavioural elements (Table 2), shown by both males were recorded on a tape recorder. The observation time was divided into intervals of one minute and at the beginning of a new interval a persisting behavioural element was recorded again. After 30 minutes both animals were brought back to their home cage where they stayed until the next encounter one week later. After nine meetings, each male was regrouped randomly with a new partner and then tested again in all nine encounters. All together nine pairs of baboons were tested.

For every subject the total frequency of each behavioural element as well as that of the whole behavioural category (Table 2) were evaluated. In addition, the total number of social activities as well as of overall activity, including all behavioural elements observed, were recorded. Social activities as well as non-social activities and locomotion were calculated in proportion to overall activity.

Since there were distinct individual differences in behaviour, every male had to serve as its own control. Therefore the mean value of behaviour, shown during the first three encounters without any drug treatment (encounters I to III), was determined as control. The behaviour shown during the following encounters (IV to IX) was compared to this control value and the differences in behaviour were estimated by the non-parametric Wilcoxon-matched-pairs test.

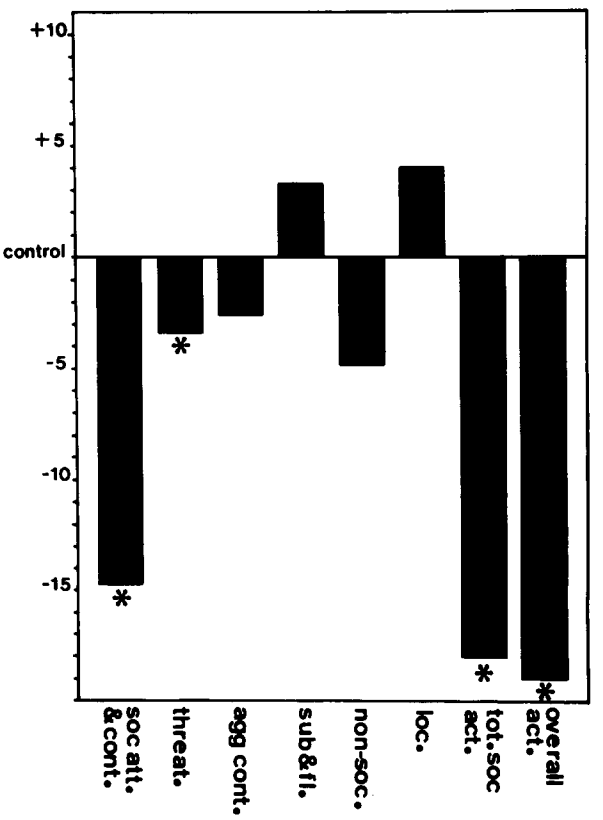

FIG. 2. Changes in frequencies of behavioural categories during encounter IV or VI, 2½ hours after the application of hashish extract to the approaching male. * $p \leq 0.05$, Wilcoxon-matched-pairs.

RESULTS

Control Sessions

In all the pairs one male showed to be the initiator for social contact. This "approaching" animal frequently attended his partner, approached, lipsmacked and presented his back to him. Compared to the partner male (Mann-Whitney U-test) the elements "attend" ($p \leq 0.1$), "approach" ($p \leq 0.01$) and "present" ($p \leq 0.05$) were significantly elevated. In addition the approaching male more frequently attacked ($p \leq 0.05$) and showed a higher locomotive activity ($p \leq 0.05$). The partner animal either remained sitting and, as a friendly reaction to the presenting of the approaching male, he lipsmacked and touched his back or handled his genitals, or he threatened the approaching partner but finally retreated from him. The elements "touch-back/handle-genitals" ($p \leq 0.1$) and "retreat" ($p \leq 0.02$) were significantly elevated in these subjects and they were consequently defined as "retreating" animals. The role of the approaching or the retreating male within one pair was established during the first two or three encounters and remained stable throughout all the sessions without any drug treatment (I, II, III, V, VII, IX). When meeting a new partner after regrouping all the males a previous approaching male could change his behaviour and became the retreating male in the new pair and vice versa.

Studying the effects of hashish extract on social behaviour of encountering male baboons, either the approaching or the retreating male was treated first (encounter IV) with the extract. The respective partner male was drug-treated in encounter VI (Table 1).

Treatment of the Approaching Animal

There was no difference in behavioural drug effects whether the approaching male was treated in encounter IV or VI. In the approaching male the drug significantly reduced the frequency of "approach" ($p \leq 0.02$) and as a result the category social attention and social contact was generally diminished (Fig. 2). Drugged males additionally showed a decrease of the aggressive elements "hit-ground" ($p \leq 0.02$), "brows-back" ($p \leq 0.01$) and "attack" ($p \leq 0.05$). The category "threaten" was significantly reduced (Fig. 2). In contrast the element "retreat" was more frequent in drugged animals ($p \leq 0.05$). Non-social activities as well as locomotion were not affected by the drug, but the total of social activities as well as overall activity were reduced (Fig. 2). Calculating the total of social activities, non-social activities and locomotion in proportion to overall activity, again a significant reduction of social interactions was found (Fig. 5).

The undrugged partner males (retreating animals) showed a slight but not significant reduction of threatening and aggressive contact and "retreat" was significantly reduced ($p \leq 0.05$). Corresponding to the drugged subjects, the undrugged partner animals showed a decrease in the frequency of social activities ($p \leq 0.05$).

One week after treating the approaching male (encounter V or VII) the previously drugged animals as well as their

partners compared to controls did not show any significant changes in individual and social behavioural elements and the total of social activities as well as locomotion even exceeded control levels ($p \leq 0.05$).

Treatment of the Retreating Animal

Again there was no difference in behavioural drug effects whether the retreating male was drugged in encounter IV or VI. Hashish extract significantly reduced "lipsmack" ($p \leq 0.02$) and "touch-back/handle genitals" ($p \leq 0.05$) in the retreating male. As a result the category social attention and social contact was reduced (Fig. 3). On the other hand a significant elevation of the threatening elements "open mouth" and "tooth-grind" ($p \leq 0.05$) was found and also the frequency of "retreat" was significantly increased ($p \leq 0.05$). Compared to controls "scream" was less frequent in drugged retreating males ($p \leq 0.05$). Non-social activities and locomotion were not affected by the drug and there was no effect on the total of social activities as well as an overall activity (Fig. 2 and 5).

The undrugged partner male (approaching animal) when compared to controls showed an increase in the frequency of "approach" ($p \leq 0.05$) but the threatening element "tooth-grind" and the aggressive element "attack" were significantly less frequent in these animals ($p \leq 0.05$). The total of social activities as well as overall activity were not affected in the untreated approaching male.

One week after treating the retreating animal (encounter V or VII) neither of the males showed any significant changes in the frequencies of behavioural elements but the total of social activities, locomotion as well as overall activity again exceeded control levels ($p \leq 0.05$).

Simultaneous Treatment of Both Animals

The simultaneous treatment of both males resulted in a reduction of "lipsmack" ($p \leq 0.05$) and "approach" ($p \leq 0.05$) as well as of the aggressive elements "attack" ($p \leq 0.05$), "fight" ($p \leq 0.02$) and "chase" ($p \leq 0.05$) in the approaching animal. As a consequence the categories social attention and social contact and aggressive contact were generally reduced (Fig. 4). In the retreating male a significant reduction of "lipsmack" ($p \leq 0.05$), "touch-back/handle genitals" ($p \leq 0.05$), "fight" ($p \leq 0.02$) and "chase" ($p \leq 0.05$) as well as of the elements "retreat" ($p \leq 0.02$) and "flee" ($p \leq 0.05$) was found. The changes in the respective behavioural categories of the retreating male did not reach significance (Fig. 4) but in both males the total of social activities as well as overall activity were significantly reduced. Non-social activities and locomotion were not affected by the drug. Compared to controls, locomotion was even increased (Fig. 4). Calculating the total of social activities, non-social activities and locomotion in proportion to overall activity, again a significant suppression of social interactions in the approaching male was found (Fig. 5).

Testing the animals again one week after drug treatment, the threatening element "brows-back" ($p \leq 0.01$) as well as the elements "attack" ($p \leq 0.02$), "fight" and "chase" ($p \leq 0.05$) were still reduced in the approaching animal and the retreating male showed a reduction of "hit-ground" and "brows-back" ($p \leq 0.02$ and 0.05). The total of social activities as well as overall activity again reached or even exceeded control levels and both animals showed a significantly elevated locomotive activity ($p \leq 0.05$).

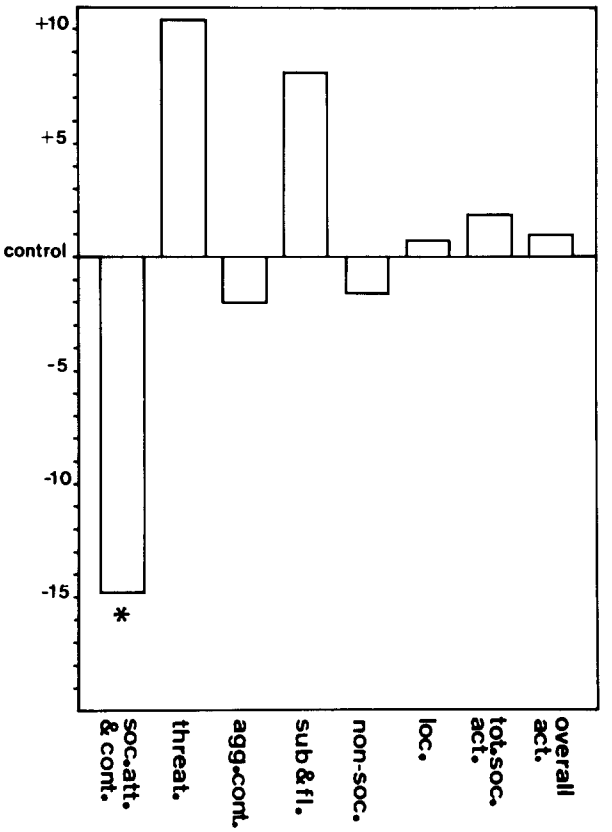

FIG. 3. Changes in frequencies of behavioral categories during encounter IV or VI, $2^1/_2$ hours after the application of hashish extract to the retreating male. * $p \leq 0.05$, Wilcoxon-matched-pairs.

DISCUSSION

In accordance with previous findings [5] a large variation of behavioural effects of hashish extract was found in the present experiment. This may be explained by a certain individuality of the behaviour of every animal but also by the distinct differences in social relations within the different pairs of males. Whereas there was no physical contact between the partners of one pair and an approach was always followed by a retreat, reciprocal presenting and touching was very frequent in another pair. Even if the behaviour of the same individual was followed when meeting different partners, quality and intensity of behaviour varied distinctly. Thus, the action of hashish extract on baboon behaviour differed, depending on the behavioural pattern of the drugged individual as well as on the behavioural response of his partner. Nevertheless, testing nine different pairs of males, some of the drug effects were consistent and statistically valid (Table 3).

Analysis of the behavioural effects of hashish extract as a whole revealed that the drug suppressed the inclination for social communication in the approaching and the retreating animal. The effects were manifested differently in either of the males (Table 3). Whereas a drugged approaching male avoided social contact with an undrugged partner by decreasing the frequency of approach, the drugged retreating animal escaped from social contact with the approaching male by enhanced threatening and retreat.

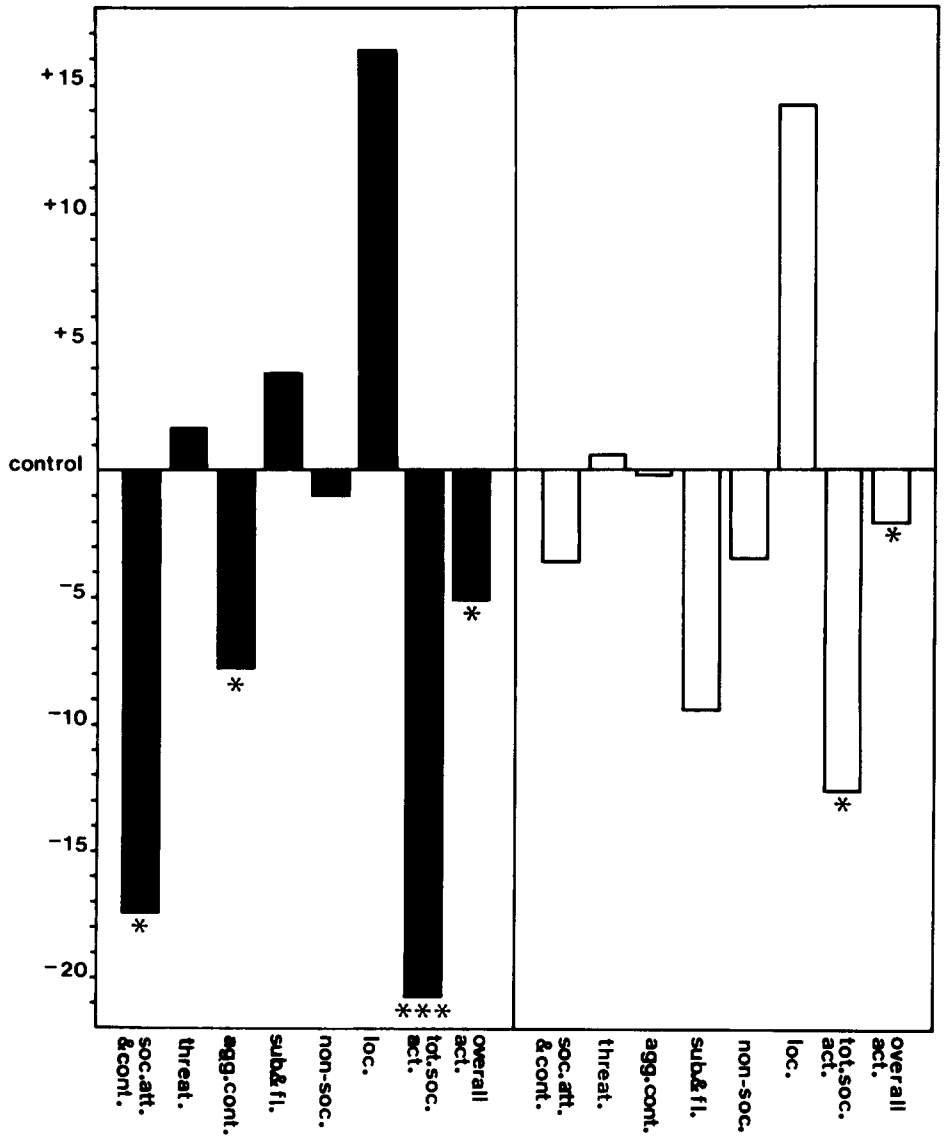

FIG. 4. Changes in frequencies of behavioural categories during encounter VIII, $2^1/_2$ hours after the simultaneous treatment of the approaching and retreating male. * $p \leq 0.05$, *** $p \leq 0.01$, Wilcoxon-matched-pairs.

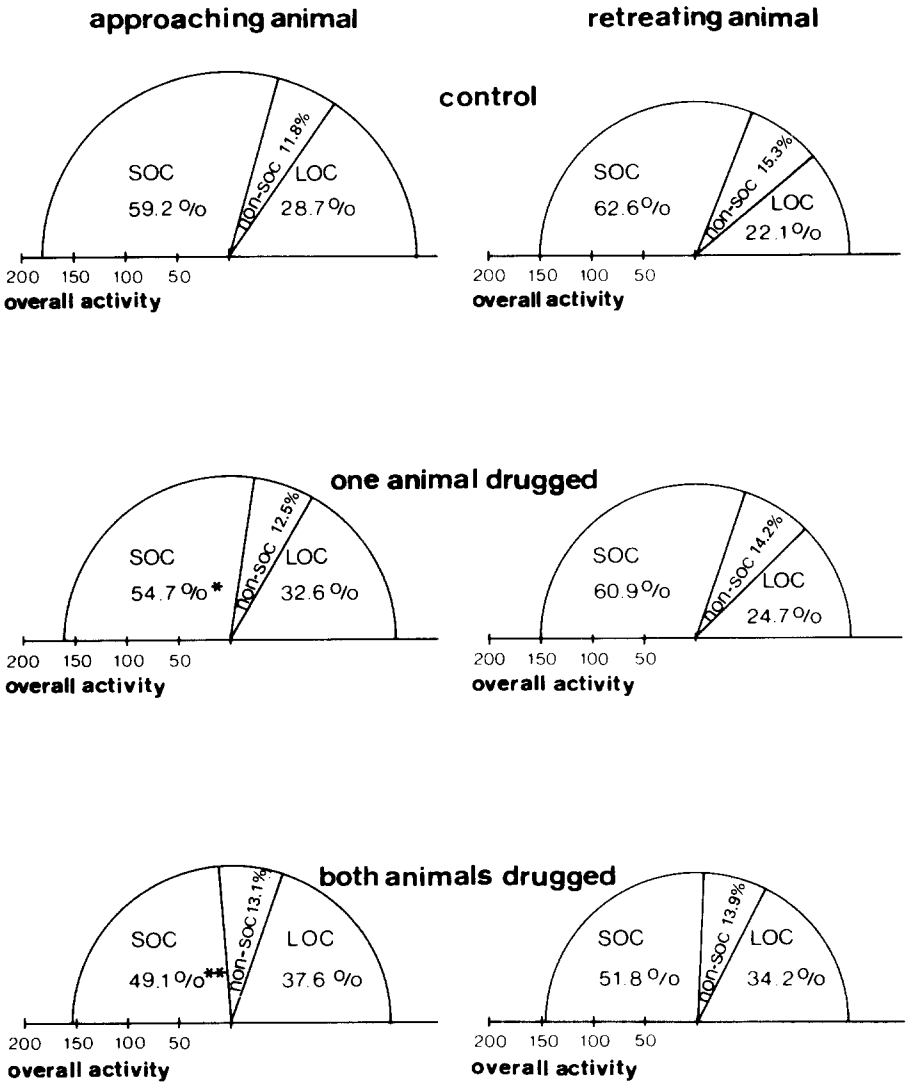

FIG. 5. Total of social activities, non-social activities and locomotion in proportion to overall activity in controls and after treating the approaching or the retreating or both animals with hashish extract. * $p \leq 0.05$, ** $p \leq 0.02$, Wilcoxon-matched-pairs.

It was stated before [9] that the altered behaviour of drugged animals was generally recognized by their untreated partners. In our experiment an untreated retreating male hardly compensated for the lack of approach from his drug treated partner and he did not show any signs of taking over the role of initiating social contact. Thus, the social interactions between a treated approaching male and an untreated retreating male were minimal. On the other hand, an approaching male, meeting a drugged partner, enhanced the frequency of "approach" and thus induced increased threatening and retreat behaviour in the drug treated retreating male. As a result, the social interactions between the two animals reached control levels. If both males were drugged simultaneously, active avoidance was rare, as social interactions were reduced to a minimum. Both males showed little interest in social communication and ignored the presence of the partner. One week after treatment, all the subjects took over their previously established role as an approaching or a retreating animal; hence the drug had no irreversible influence on the animals' social relationship.

The reduction of aggressive behaviour observed in drugged approaching males agrees with previous findings [1,9], where a suppression of aggression in dominant group members was found. In squirrel monkeys Δ^9-THC reduced the frequency of attack but did not have any effects on the aggressive elements of threat functions only [7]. In our experiment threatening behaviour was reduced in the approaching male but was significantly increased in drugged retreating males.

From the present results it can be concluded that an acute dose of hashish extract reduces the motivation for social interactions in male baboons and thus leads to a certain social isolation of the drugged animal. Since non-social activities as well as locomotion were not affected by this drug dose, the decrease of social interactions can hardly be assigned to sedative effects. These results are in contrast to

TABLE 3

CHANGES IN FREQUENCIES OF BEHAVIOURAL ELEMENTS AFTER TREATING THE APPROACHING, THE RETREATING OR BOTH MALES WITH HASHISH EXTRACT

	One animal drugged		Both animals drugged	
Elements	Approaching male	Retreating male	Approaching male	Retreating male
Social attention and social contact				
attend	—	—	—	—
lipsmack	—	↓↓	↓	↓
contact noise	—	—	—	—
approach	↓↓	—	↓	—
follow	—	—	—	—
present	—	—	—	—
touch-back/ handle-genitals	—	↓	—	↓
Aggression				
hit-ground	↓↓	—	—	—
brows-back	↓↓↓	—	—	—
open-mouth	—	↑	—	—
tooth-grind	—	↑	—	—
attack	↓	—	↓	—
fight	—	—	↓↓	↓↓
chase	—	—	↓	↓
bite	—	—	—	—
Submission and flight				
retreat	↑	↑	—	↓↓
crouch	—	—	—	—
scream	—	↓	—	—
flee	—	—	—	↓
non-social activity	—	—	—	—
locomotion	—	—	—	—

↓$p \leq 0.05$, ↓↓$p \leq 0.02$, ↓↓↓$p \leq 0.01$, Wilcoxon-matched pairs.

other findings [9] showing that sedation effects predominated in Rhesus monkeys during early stages of drug exposure.

Comparison of these findings to those obtained from previous mouse studies [11, 12, 13] revealed analogous effects of hashish extract in baboons and male mice tested in a resident-intruder situation [13]. Like an approaching male baboon, a resident mouse showed intense social investigation and aggressive behaviour, which was subsequently impaired by the drug. On the other hand, analogous to a retreating baboon, flight behaviour was frequent in the intruder mouse and this type of behaviour was even stimulated by the drug. In both species this enhancement of flight behaviour seemed to result from increased levels of social attention or aggression shown by the undrugged partner male.

From these and previous findings it is clear that administration of hashish extract induced social withdrawal in mice and monkeys. An impairment of interpersonal relations by hashish, manifested by a reduction of empathy, genuineness and affective resonance was also reported in man [2, 3, 8]. Comparable to the baboons of the present experiment, drugged people were often friendlier and calmer but they were less able to pay attention to their partners. As a result social involvement was diminished and intoxicated subjects were perceived as being socially more withdrawn. The relevance of the present study to the situation of man was additionally emphasized by the fact that the effects of hashish are very subjective in humans and monkeys, depending on the personality as well as on the "set" and the "setting" [4,6]. Thus, the present and previous experiments [9,10] demonstrate that the behavioural response of monkeys to hashish or Δ^9-THC mimics many aspects of the "marihuana high" in man. The parallels in the behavioural effects of hashish in mice and monkeys show that even a well-controlled test system of rodent behaviour, which is less sensitive to outside stimuli, can provide some relevant information about how a drug like hashish might affect social relations in man.

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