ANALYSIS OF FOUR COMMON PLAY PATTERNS IN JUVENILE THIRTEEN-LINED GROUND SQUIRRELS *(SPERMOPHILUS TRIDECEMLINEATUS)*

INTRODUCTION

Young mammals spend a considerable amount of time engaged in activities which are called "play". The ethological literature contains much controversy concerning the definition and adaptive significance of play. Fagen (1974) characterizes play as active, oriented behavior with a highly variable structure, which apparently lacks immediate purpose, and which is often accompanied by specific signal patterns. He also notes that in playful behavior the adult sequences of behavior break down. Behavioral components such as threats, grooming and sexual posturing are performed in novel and rapidly changing sequences that would be nonadaptive in the serious contexts of adult life.

Play in young mammals has been described by several authors (e.g. Ewer, 1966; Poole, 1966; Schenkel, 1966; Muller-Schwarze, 1968; Fedigan, 1972; Steiner, 1971). However, literature on play in wild rodents is sparse. The objectives of this study of juvenile thirteen-lined ground squirrels *(Spermophilus tridecemlineatus)* were to describe common play patterns and to determine if they showed sequential ordering.

METHODS

This study was carried out at the UWM Field Station from May to Sept., 1973 in the mowed lawn area around the laboratory building. Observations were made from two burlap blinds situated in the N.E. and S.W. corners of the study plot and from the laboratory building in the middle of the study area. All sightings were made with 7 X 35 binoculars. Written descriptions of playful interactions between juveniles were entered in a field notebook. The ordering of motor patterns during play bouts was also recorded.

RESULTS

The most common kinds of play patterns in young ground squirrels are sparring, mounting, wrestling and chasing (Fig. 1).

SPARRING

A typical sparring match (Fig. 1, c) is characterized by two individuals facing one another, rearing up on their haunches or hind legs and engaging in mutual pushing or batting of the face, neck and shoulders with the forepaws. The animals may sit up and embrace one another before and during actual sparring or boxing behavior. A sparring match often ends when one animal pushes its partner over on its back and pounces on the downed animal. Pouncing usually leads to play fighting. The match may end in a draw, however, where neither interactant dislodges the other, and sparring is terminated by one or both squirrels assuming a four-legged stance and moving off.

Sparring sometimes occurs in the middle of a wrestling bout. The two opponents stop the match temporarily, sit upright and push or bat at each other with their forefeet. Wrestling is then resumed. Young squirrels first exhibit sparring at approximately five weeks of age. At this age boxing matches are short and consist of gentle slaps and pushes to the head and shoulders of the opponent. Older squirrels engage in longer, more intense contests.

MOUNTING

During play mounting, (Fig. 1, a, b) one individual approaches and mounts a second from the rear by grasping the back of the approachee with its forelegs. Play mounting takes on two forms in young squirrels. In one, the mounter simply employs a rear approach and places its front feet on the other squirrel's back. The mounted individual is not held or prevented from escaping, but moves away from the other animal. This break-away behavior often stimulates pursuit and repeated mounting attempts by the playful partner. On some occasions, however, probably when neither animal is highly motivated to play, the mounted squirrel is allowed to move off without additional pursuit by the other.

A second mounting pattern occurs when one squirrel forcefully clasps a conspecific by the back and restrains it from fleeing. The held animal then struggles to free itself from the grasp of its restrainer, and when this fails turns around and bites at its play partner. In both types of mounting play, the mounted animal is usually enticed into wrestling with its antagonizer. Play mounting becomes part of the play repertoire of young ground squirrels at approximately six weeks of age.

WRESTLING

One of the commonest play acts in young squirrels is wrestling or fighting with each other (Fig. 1, d, e, f). Wrestling bouts may be brief and of low intensity or involve rather intense, lengthy fighting. When two animals wrestle, they em-

brace with their forefeet, pull or push each other over and roll head first or sideways on top of one another. While tumbling on the ground, each contestant often nips at the face and neck of its opponent. Wrestling partners also push and kick at each other with their feet. An animal dominates its opponent by maneuvering into an upper position and pinning the other animal on its back against the ground. During the course of a typical match, each animal struggles to right itself and gain a dominant position. Animals, therefore, often exchange dominant and subordinate (defensive) positions during a wrestling bout. The squirrel on the bottom (the subordinate individual) often remains lying on its back with its mouth open and its forepaws raised in a submissive gesture, and holds its opponent at bay by pushing with its hind feet. This defensive behavior serves to inhibit, at least momentarily, subsequent fighting by the animal on top. If the dominant animal is persistent, it may pounce on its partner. This either provokes renewed fighting or escape behavior in the downed individual. Flight by one animal often elicits pursuit, capture and additional wrestling by the pursuer.

A wrestling bout is often terminated when one animal assumes a defensive posture (rolls over on its back with mouth open and legs outstretched ready to repel an opponent) or simply flees. Occasionally, however, an individual flips or somersaults over and away from the other. This temporarily ends the contest between the two. Young squirrels are roughly five weeks old when they first exhibit play wrestling.

CHASING

Littermates participate in playful chases (Fig. 1, g, h) as early as one or two days after emergence from the nesting burrow. At this age pursuit behavior is characterized by one animal chasing another down a burrow (usually the home burrow since very young squirrels do not stray too far from familiar territory at first), or one animal running toward a second who runs away with the first following for a short distance. The chase is not long and the chaser is usually not persistent.

As the squirrels mature, chases become longer and more intense. During a chase, the animals appear to run in a galloping or bounding manner, often with their tails flipped up and over their backs. Undoubtedly, some of the more intense chasing in older juveniles prior to hibernation is true aggression, but no attempt is made here to distinguish between play and aggressive chasing. In general, however, play chasing by young squirrels is less intense than chasing in adults.

A pursued animal often eludes its chaser by leaping into the long grass field surrounding the short grass study plot. A chase is also terminated when the individual being pursued turns around and begins sparring or wrestling. Play chasing was first observed in young squirrels at approximately four weeks of age.

PLAY SEQUENCES

The most common play patterns in juvenile squirrels (sparring, mounting, wrestling and chasing) did not always occur as isolated acts; rather certain patterns appeared to follow others with a high degree of regularity. Therefore, a sequential analysis of the above play patterns was performed.

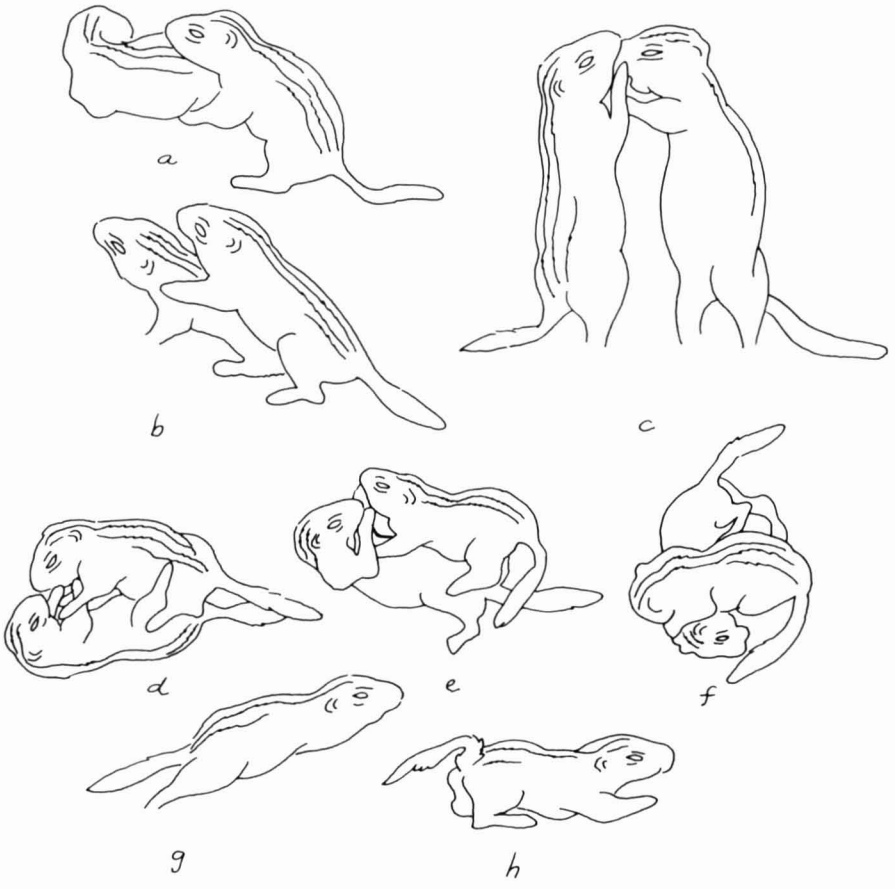

Fig. 1 Mounting, Sparring, Wrestling and Chasing postures in juvenile ground squirrels. (a) and (b) mounting. (c) sparring. (d) through (f) wrestling. (g) and (h) chasing.

Table 1 is a contingency table of preceding and following play acts performed during two-squirrel encounters among juveniles of both sexes. To determine whether or not the acts are independent of one another, the data in the table were subjected to a R X C Chi-square test. The Chi-square value for the entire table was highly significant ($p < 0.001$). This clearly shows that the acts are not independent of one another.

To determine which acts occur together more often than would be expected by chance, all possible pairings of two-act sequences in each row of the contingency table were tested for interdependency using the Chi-square test. Significant Chi-square values were obtained in three of the six comparisons in row 1. The number of times wrestling follows mounting was significantly greater than would be expected by chance in comparison with each of the other three two-act sequences in row 1 (i.e. mounting followed by mounting, mounting

Table 1. Contingency table of preceding and following play acts performed during two-animal interactions in juvenile thirteen-lined ground squirrels. Preceding acts read down and following acts read across.

		Following Acts				
		Mount	Spar	Wrestle	Chase	Row Totals
Preceding Acts	Mount	6	10	25	5	46
	Spar	5	3	29	5	42
	Wrestle	7	6	12	25	50
	Chase	9	4	13	11	37
	Column Totals	27	23	79	46	175

Row 1 specifies the frequency with which each play act follows mounting. Similarly, row 2 indicates the number of times each act follows sparring, row 3 the number of times each act follows wrestling and row 4 the frequency with which each act follows chasing. $df = 9$. $X^2 = 36.69$.

followed by sparring and mounting followed by chasing). In row 2, the frequency with which wrestling follows sparring was significantly greater than is expected by chance when compared to each of the other values in that row. In row 3, comparisons between 25 and 7, 25 and 6 and 25 and 12 all yielded significant results. Thus, the sequence of wrestling leading to chasing occurs significantly more often than the other three sequences in row 3. In row 4, only the comparison between 13 and 4 yielded a significant Chi-square value indicating that chasing followed by wrestling occurs more often than is expected by chance in comparison with chasing followed by sparring.

Fig. 2 is a diagramatic representation of the most common play sequences. Three arrows lead from sparring to wrestling. This means that the frequency with which wrestling follows sparring is significantly greater than would be expected by chance in comparison with each of the other three two-act sequences in row 2. One arrow leads from chasing back to wrestling. This illustrates that the frequency with which wrestling follows chasing is significantly greater than is expected by chance when compared to one other sequence in row 4. The most common play sequences which occur between juveniles are either mounting leading to wrestling followed by chasing or sparring leading to wrestling followed by chasing. Chasing occasionally leads to wrestling. Other play sequences observed did not occur with any degree of regularity.

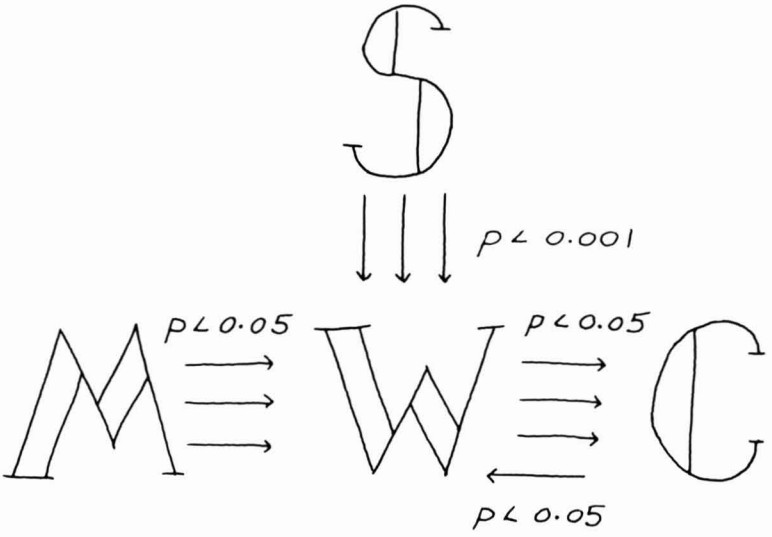

Fig. 2. Sequences of common play patterns and p values of the significant pair comparisons for juveniles. S-sparring, M-mounting, W-wrestling and C-chasing. Each arrow in the diagram represents one significant pairing of two-act sequences in the same row of the table.

DISCUSSION

Except for sparring, the play patterns just described were also observed in adult squirrels. Juvenile play, therefore, seems to have non-play counterparts in the reproductive and aggressive behavior of adults. However, the performance of these patterns in juveniles during play seems "not to be in earnest" and does not appear to be directed toward a specific goal or consummatory act (e.g. mounting in juveniles did not lead to copulation and chasing did not consummate in the removal of one animal from the territory of another). It has frequently been suggested that play serves as practice for adult activities (Pycraft, 1912; Mitchell, 1912) as cited in Steiner (1971). This may be a function of play in thirteen-lined ground squirrels. It is possible that experience gained during play increases the efficiency with which reproductive (mounting) and aggressive (wrestling and chasing) behavior patterns are performed at maturity. However, play sparring did not appear to have any non-play counterpart in adult behavior. Whether, in fact, play actually affects adult behavior remains to be determined by preventing young ground squirrels from playing and observing the efficiency with which they later perform reproductive and aggressive behavior.

It has often been reported that in play the motor patterns do not occur in the same order typical of serious contexts and that patterns may follow each other in any order (Meyer-Holzapfel, 1956) as cited in Muller-Schwarze (1968). The first part of the statement seems to be true for the ordering of certain play patterns in thirteen-lined ground squirrels. In the most common play sequence, sparring and mounting lead to wrestling which is followed by chasing. I did not observe mounting leading to copulation in adults, but there are no reports in the literature on the species of adult mounting followed by wrestling and then chasing. However, some of the ordering in juvenile play is similar to that in adult behavior. During aggressive interactions between adults, when fighting takes place it is often followed by chasing.

The second part of the statement is not consistent with the data obtained for thirteen-lined ground squirrels. There was a definite sequence of play patterns. Sparring and mounting most often led to wrestling which was followed by chasing. The sequence of wrestling leading to chasing in juvenile play may have a selective advantage in that it allows young animals to practice aggressive patterns important to survival in later life. When the animal matures, the successful acquisition and defense of a territory may involve occasional fighting with an intruder of the same species and subsequent chasing of the intruder from the territory. The sequences of sparring leading to wrestling and mounting followed by wrestling were not observed in adults. Fedigan (1972) and others suggest that the reordering of motor patterns into new sequences during play could, like recombination of genetic material, increase the phenotypic variation within a species. Whether or not the recombination of behavioral elements during play contributes to phenotypic variability in the thirteen-lined ground squirrel is unknown and deserves further study.

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Mary Melville
Department of Zoology
The University of Wisconsin–Milwaukee