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## Equid play ethogram

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### Abstract

An ethogram of play behavior among equids was developed. Several key English-language studies on equids were reviewed to derive a preliminary inventory of specific behaviors to be included in the ethogram. Our primary observations were based on a herd of semi-feral Shetland-type ponies kept at New Bolton Center, University of Pennsylvania School of Veterinary Medicine, Kennett Square, PA. Greater than 100 h of direct observation and photo-documentation focused specifically on play in order to identify play behaviors to be added to the preliminary inventory and to obtain detailed descriptions of each behavior. Additionally, these observations were supplemented with photographs obtained during several years of observational study of this herd for other purposes, and with the cumulative equid observational experience and study notes of the principal investigator with other equid species. An initial draft was sent out to 18 equine behavior colleagues for review.

A total of 38 individual behaviors classified into four distinct categories were included in the ethogram. These included object play (14 entries), play sexual behavior (3 entries), locomotor play (14 entries) and play fighting (7 entries). All of the behaviors catalogued from direct observation of the herd were also found in the equid literature.

The resulting ethogram offers a practical tool as a field guide or reference for quantitative research and other studies of equid play behavior as well as for teaching of equid behavior.

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*Keywords:* Equine; Pony; Zebra; Donkey; Przewalski horse; Play behavior; Ethogram

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### 1. Background and purpose

Equid behavior has historically been a topic of great interest to animal keepers, biologists, animal scientists, veterinarians, and ethologists. Numerous descriptive accounts of equid behavior as well as a few systematic studies focusing on particular species or types of behavior are available in the lay and scientific literature. In this body of published

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information, there are notable apparent inconsistencies in the terminology and interpretations of behavior.

An ethogram is a formal description of a species behavioral repertoire or a major segment of it. It may be a complete list of all behaviors or it may focus on particular functional classes of behaviors (Grier, 1984). To our knowledge, a complete ethogram for equids has not been published. Our laboratory's long-term goal is to prepare a concise comprehensive catalog-style equid ethogram, with the primary objective of establishing standard nomenclature for equid behavior. To date, we published an ethogram of agonistic intermale behavior of equid bachelor bands (McDonnell and Haviland, 1995). The objective of the present work was to complete an ethogram of equid play behavior.

Play has been broadly characterized as activities appearing to have no immediate use or function to the animal, involving a sense of pleasure and elements of surprise (McFarland, 1987). Across species, play behavior in large part appears to be a modified form of serious survival activities such as locomotor, aggressive, and reproductive behavior. In any species, play is usually distinguished from serious forms of behavior by postures and expressions denoting less serious "intent" (Schilder et al., 1984). In most species, play behavior occurs both as a solitary activity and as a social interactive behavior. Play is believed to serve a variety of adaptive functions, including enhancing general musculoskeletal and cardiovascular fitness, practicing and honing specific survival skills, gaining familiarity with the particular environment, or building social relationships and communication skills (Fagen, 1981; Bekoff and Byers, 1998).

Play behavior is a remarkably conspicuous feature of equid developmental behavior (Fagen and George, 1977; Fagen, 1981). Study of play among free-running (wild, feral, semi-feral) or domestic equids (mare and foal groups) has been limited mostly to relatively informal mention, description, and/or simple classifications, with some exceptions. Fagen and George (1977) quantified the percentage of exercise attributable to play and non-play activities of pony foals from birth to 6 weeks of age pastured in natural family bands. Crowell-Davis (1983, 1986) reported the frequency, length, and type of play bouts in domestic Welsh Pony foals at pasture with their dams in a mare and foal group, as well as developmental changes, sex differences, and effect of environmental temperature on play in young horses (1987). In addition, several authors included a considerable amount of play in their descriptive studies of behavior and ecology of various equid populations. These include Feist (1971), who studied feral horses in the Pryor Mountains along the Wyoming–Montana border, USA; Tyler (1972), who described differences in play among domestic foals of different ages and gender among a population of domestic horses and ponies kept under semi-feral conditions for several months each year in the New Forest area of England; Blakeslee (1974), who studied Appaloosa horses pastured under semi-natural conditions in Idaho, USA; Moehlman (1974), who studied feral African wild asses of Death Valley, CA, USA; Gardner (1983), who studied Grevy's zebra in Kenya; Schilder et al. (1984) who studied plains zebra in a semi-preserve, differentiating facial expressions of play from serious aggressive behavior; Penzhorn (1984), who studied Cape Mountain zebra in South Africa; Keiper (1985), who studied feral ponies on the Assateague Island off the coast of Maryland, USA; Hoffmann (1985), who studied a feral horse population off the coast of North Carolina, USA; and Boyd et al. (1988), who studied time budgets in Przewalski horses in a semi-preserve in Virginia, USA.

## 2. Methods

### 2.1. General approach

The methods followed those used in the previously published intermale agonistic ethogram for equids (McDonnell and Haviland, 1995). The general method included review of existing equid behavior literature, original observations of equids, and incorporation of critical comment from equine behaviorists worldwide. A catalog format was selected for simplicity and consolidation of information, as likely to be the most useful as a practical field or laboratory guide for equine behavior research.

### 2.2. Play behavior inventory from the equid literature

Literature (English-language) pertaining to semi-feral, feral, and domestic horses as well as other captive or free-running equids was reviewed to generate an inventory of behavioral elements and sequences displayed during play interactions.

### 2.3. Original observations

Our primary original observations were conducted within the context of a semi-feral herd of Shetland-type ponies that resides at the University of Pennsylvania School of Veterinary Medicine at New Bolton Center in Kennett Square, PA. This herd has been maintained for approximately 8 years with minimal intervention. It includes multiple harem groups with foals, yearlings and some young adult offspring, as well as bachelor and young juvenile groups totaling 50–75 animals. With the objectives of developing a complete inventory of play behavior, obtaining photo-documentation of each behavioral entry, and preparing precise text descriptions and a line drawing depicting each entry, over 100 h of direct observation focused specifically on play behavior. These observations were done during the late spring and summer of 2000. The observations were supplemented with photographs obtained during several years of observational study of this herd for other purposes, and with the cumulative equid observational experience and study notes of the principal investigator with other equid species.

### 2.4. Collaborative review

A preliminary draft of this ethogram was circulated to 18 equine behavior researchers for critical review; 12 responded with critical review (see ‘Acknowledgements’ section).

## 3. Results

Table 1 represents our resulting ethogram. We classified play into four categories, similar to classifications proposed for mammals in general (Fagen, 1981). Object play includes 14 entries, play sexual behavior includes 3 entries, locomotor play includes

Table 1

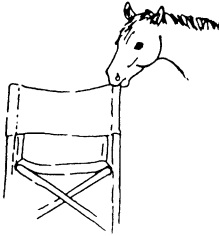
The resulting ethogram comprising object play, sexual behavior, locomotor play and play fighting

### 1. Object play

Object play involves contact and manipulation of an object. The target object may be either inanimate such as an environmental object, or an animate object such as the mane, tail or other body part of a herd mate or even of an animal of another species. Object play has also been called *object manipulation* or *manipulative play* (Crowell-Davis, 1986; Crowell-Davis et al., 1987; Waring, 1983). The following 14 entries represent commonly observed equid object play behaviors.

Some of these behaviors, for example, *circle* and *to and from*, obviously involve locomotion. Although they could easily be classified as locomotor play, they so clearly seem focused on an object, and often appear to be stimulated by the object that we have included them with object play.

#### Nibble



With jaws closed the upper lip is moved upward and downward against an object, typically without dental contact of the object.

*Comments:* Nibbling of an object is typically one of the first play responses associated with an investigative approach of the object. In many instances, nibbling appears to be a means of moving an object on the ground (see Fig. 1).

*Species:* Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); feral horses (Waring, 1983); feral ponies (Keiper, 1985); Welsh Pony mare and foal groups (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1998).

#### Sniff/Lick



The tongue is extended through the teeth and border of the mouth, making contact with an object. It is then retracted back into the mouth and chewing may follow. This sequence is typically repeated.

*Comments:* Sniffing and/or licking an inanimate object may be as if to investigate the odor, texture, shape, taste, and size of an object. Sniffing and licking of a herd mate sometimes precedes and appears to initiate mutual grooming.

*Species:* Horse—feral ponies (Keiper, 1985).

#### Mouth



An object, whole or part depending on size, is taken into the mouth with upper and lower lips and tongue then placed between the lips, incisors (front teeth) or molars. The head is usually elevated once the object is in the mouth (see *pick up*). The animal may move around with the object in the mouth (see *carry*).

*Other names:* *Manipulate by mouth* (Waring, 1983).

*Comments:* The animal may shake the object by tossing the head and neck while the object is being mouthed. A dam's mane or tail is a common target of mouthing or chewing.

*Species:* Horse—free-ranging Appaloosa horses (Blakeslee, 1974); domestic and feral horses and ponies (Waring, 1983); Welsh Pony foals and mares (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1974).

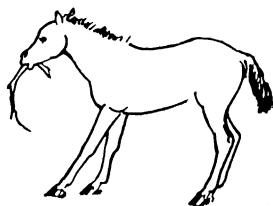
Table 1 (Continued)

**Chew**

An object is taken into the mouth with a side-to-side grinding motion of upper and lower jaw. May include head tossing and/or forward movement of the tongue through the front teeth ending with the object falling out of the mouth.

*Comments:* This behavior appears to be for the purpose of investigating the texture, shape and/or size of the object, rather than for nourishment. The mother's mane and/or tail are common target objects for chewing or mouthing by the foal. In horses and ponies, all ages have been observed to chew inanimate objects or animate objects (McDonnell and Poulin, unpublished observations).

*Species:* Horse—semi-feral ponies (Tyler, 1972); domestic and feral horses and ponies (Waring, 1983).

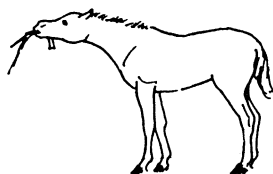
**Pick Up**

An object is held between the lips, front teeth or molars. The head is elevated with object in the mouth so that the object is lifted from the ground. The height at which the object is lifted can vary from a few inches to several feet.

*Other names:* Lift (Waring, 1983).

*Comments:* See Figs. 2 and 3.

*Species:* Horse—semi-feral ponies (Tyler, 1972); domestic and feral horses and ponies (Waring, 1983); Welsh Pony foals and mares (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1974).

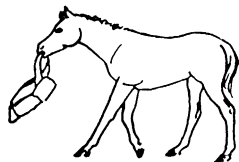
**Shake**

Following *pick up*, the object may be moved in a side-to-side, up-and-down, or circular motion.

*Other names:* Swing head (Crowell-Davis, 1983; Crowell-Davis et al., 1987); wave about (Crowell-Davis, 1983); scrape along ground (Moehlman, 1974)

*Comments:* See Figs. 2 and 3.

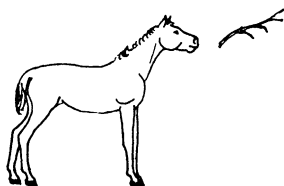
*Species:* Horse—Welsh Pony foals and mares (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1974).

**Carry**

Following *pick up*, the object is held between the jaws as the animal moves.

*Other names:* Drag (Moehlman, 1974; Crowell-Davis et al., 1987).

*Species:* Horse—Welsh Pony foals and mares (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987).

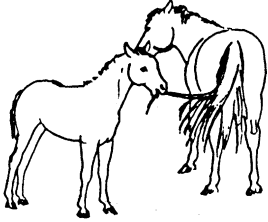
**Drop or Toss**

Following *pick up*, the upper and lower jaws open, releasing the object (drop) or throwing the nose upward as the object is released (toss). A toss may alternately be effected without *pick up* by using the muzzle to flip an object from the substrate into the air.

*Comments:* Crowell-Davis (1983) notes that Welsh Pony foals have been observed tossing the mane and tail of their dam with their nose.

*Species:* Horse—semi-feral ponies (Tyler, 1972); domestic and feral horses and ponies (Waring, 1983); Welsh Pony foals and mares (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1974).

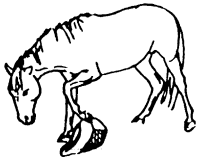
Table 1 (Continued)

**Pull**

An object is held between the lips or front teeth, followed by a dragging motion of the object with forward and back or side-to-side movement. The head and neck or full body may move in any direction.

*Other names:* Drag (Crowell-Davis et al., 1987).

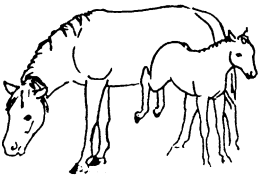
*Species:* Horse—semi-feral ponies (Tyler, 1972); domestic and feral horses and ponies (Waring, 1983); Welsh Pony mares and foals at pasture (Crowell-Davis, 1983; Crowell-Davis et al., 1987); feral ponies (Keiper, 1985).

**Paw**

With an object as an apparent target, one foreleg is lifted off the ground slightly, extended quickly in a forward direction followed by a backward, toe-dragging movement as if digging. The movement is typically repeated several times in succession (McDonnell and Haviland, 1995). The foot may have direct contact with the object thus moving the object. Alternatively, the foot may be slightly behind the object touching the ground.

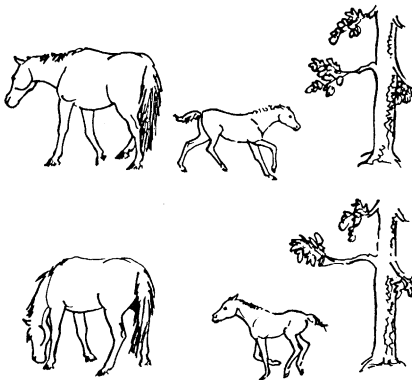
*Comments:* Investigative sequences and water play typically include pawing (see Figs. 4 and 5). Pawing an animate object also occurs as an apparent play initiation gesture (see Fig. 6a and b).

*Species:* Horse—semi-feral ponies (Tyler, 1972); feral horses (Boyd, 1980); Welsh Pony mares and foals (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987); domestic and feral horses (Waring, 1983); feral ponies (Keiper, 1985). Donkey—feral asses *Equus africanus* (Moehlman, 1974). Przewalski horse—feral mares and foals (Boyd, 1980).

**Kick Up**

Standing at right angles to a herd mate target (usually the dam), with the butt toward and often touching the abdomen of the target, weight is transferred to the front legs as the hindlegs are raised in a hopping motion a few inches off the ground toward the target. Typically, no extension of the hindlegs, as in *kicking*, occurs.

*Species:* Horse—semi-feral ponies (Tyler, 1972); feral horses (Boyd, 1980). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).

**To and From**

The equid moves, usually at a trot or gallop, away from an object, such as the dam or a tree, and then returns to the object at any gait.

*Other names:* Runs in opposite directions (Moehlman, 1974).

*Comments:* This behavioral sequence could also be considered as locomotor play, but is classified here as object play because the action so obviously involves a landmark object.

*Species:* Horse—semi-feral ponies (Tyler, 1972); pastured domestic ponies in natural herd (Fagen and George, 1977); feral horses (Boyd, 1980); domestic and feral horses and ponies (Waring, 1983); feral ponies (Keiper, 1985). Donkey—feral asses *Equus africanus* (Moehlman, 1974). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).

Table 1 (Continued)

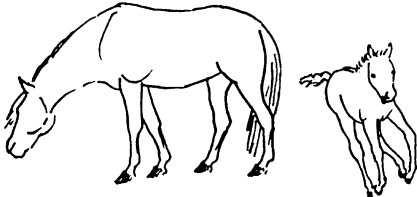
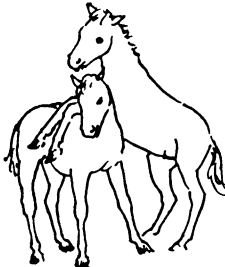
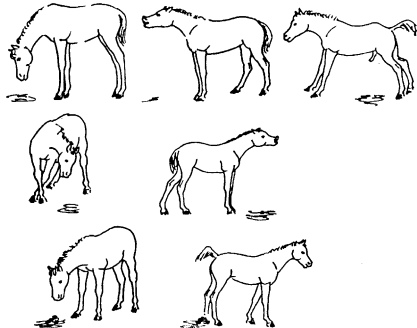
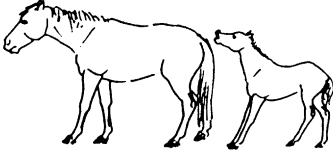
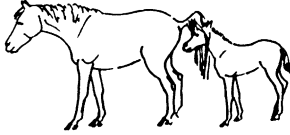
<p><b>Circle</b></p> 	<p>The animal moves in a path, generally circular, around an object so that the beginning and ending point are in the same general vicinity. This behavior can be performed at any gait and may be repeated.</p> <p><i>Other names:</i> <i>Running in loops</i> (Blakeslee, 1974).</p> <p><i>Comments:</i> The circling to be around an object. From our observations, this most frequently occurred in foals or adolescents, and was rarely observed in mature animals. The focal animate object was usually the dam (see Fig. 7a and b). The most common inanimate focal object was a tall weed, or tree. May also be classified as a locomotor behavior, but included here with object play because of the distinct focus on an object.</p> <p><i>Species:</i> Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); feral horses (Boyd, 1980); Welsh Pony foals and mares (Crowell-Davis, 1983; Crowell-Davis et al., 1987); feral ponies (Keiper, 1985). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).</p>
<p><b>Resting Rear</b></p> 	<p>The animal raises its chest and forelegs so that one or both limbs rest across the body of a herd mate, typically with lateral orientation.</p> <p><i>Comments:</i> See Fig. 8. The animal rearing may rotate around the partner's body so that it ends up in the mounting position, part of sexual play. In our observations of ponies, a considerable proportion of occurrences of <i>resting rear</i> are not within the context of sexual play per se, but rather dispersed within bouts of locomotor play and play fighting.</p> <p><i>Species:</i> Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); domestic Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); feral ponies (Keiper, 1985). Donkey—feral asses <i>Equus africanus</i> (Moehlman, 1998).</p>
<p>2. Play sexual behavior</p>	
<p>Sexual play is conspicuous and frequent in foals and young adolescents of both sexes, and among young and adult bachelor stallions. The elements of the precopulatory and copulatory sequences may be out of order or exaggerated from that of a mature adult in a breeding context. The following three entries represent commonly observed play sexual behavior in equids.</p>	
<p><b>Elimination Marking Sequence</b></p> 	<p>The animal approaches and sniffs voided urine or feces, performs the flehmen response, and covers the urine or feces with urine and/or feces, and then again sniffs and performs flehmen response, in the stylized postures typical of a mature stallion but in less organized sequences.</p> <p><i>Comments:</i> Usually performed by foals and more frequently by yearlings after elimination of a mature animal. Sequence is often quite similar to adult form, except that it may not proceed in the order typical of adult elimination marking sequence and the elements may be interspersed among play sequences of other types, for example, <i>frolic</i>.</p> <p><i>Species:</i> Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); feral ponies (Keiper, 1985). Przewalski horse—feral mares and foals (Boyd, 1980).</p>

Table 1 (Continued)

**Tease**

One animal sniffs and/or nuzzles the head, shoulder, abdomen, flank, inguinal, tail and/or genital areas of another in a similar, but more playful, manner to that of an adult stallion investigating a mare before copulation.



*Comments:* Foals of both sexes and particularly yearling colts often tease a mare during or following a mature stallion's teasing or breeding of the mare. The precopulatory sequence may or may not be complete or in the order typical of a stallion. In play sequences, the flehmen response occurs, but the tip of the nose is typically not raised as high as a mature stallion (Keiper, 1985).

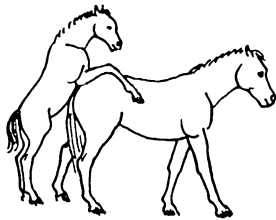
*Species:* Horse—semi-feral domestic ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); feral ponies (Keiper, 1985). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).

**Mount**

The animal raises its chest and forelegs onto the back of a herd mate (same or opposite sex) as during copulation in mature adults. The mount may be oriented from the side or rear.

*Other names:* Sexual mounting of mother (Blakeslee, 1974); sex without coition (McFarland, 1987).

*Comments:* Usually performed by foals and immature young of both sexes to their mother and other immature herd mates. It may occur with or without either precopulatory (teasing, elimination marking) and copulatory (thrusting) behavioral elements. Sexual arousal as in an adult is usually not apparent, although erection can be present. Lateral mount, though similar in form to resting rear, by context and form appears distinct from resting rear. Fig. 9 illustrates a typical play mounting sequence. An abbreviated form of the mount may include only resting the chin and head on the hindquarters of the target animal (as if about to mount).



*Species:* Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); feral horses (Boyd, 1980); domestic horse (Fagen, 1981); domestic and feral horses and ponies (Waring, 1983); Welsh Pony foals and mare groups (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987); feral ponies (Keiper, 1985). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Zebra—Grevy's zebra in natural social groups (Gardner, 1983); Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).



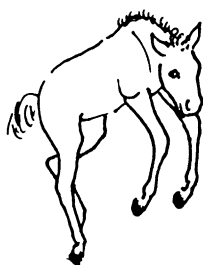
Table 1 (Continued)

## 3. Locomotor play

Locomotor play involves any play behavior response or sequence that is performed while in motion at any gait. *Circling* and *to and from* were included in object play because the action appears to be directed toward or around an object/s, but each can also be considered locomotor play.

The following seven entries represent common locomotor play behaviors in equids. Certainly, there are many more movements that could be considered as distinct behaviors. For example, play also includes a variety of head movements, including *head toss*, *head twist*, and *head shake* (Fagen and George, 1977).

With the exception of *chase*, which is by definition social, each of these locomotor play behaviors can occur either in a solitary or a social context.

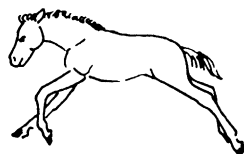
**Frolic**

Fore- and hindlegs simultaneously propel off the ground along with apparently exuberant, random bucking, head shaking and body twists. May take off from a stationary position to an instantaneous gallop.

*Other names:* *Cavorting* (Fagen, 1981); *gamboling* (McFarland, 1987; Fagen, 1981); *capering* (Fagen, 1981); *prop* (Fagen and George, 1977).

*Comments:* May interrupt an episode of running.

*Species:* Horse—domestic pony foals pastured in a natural herd (Fagen and George, 1977); domestic horse foals at pasture with dams (Fagen, 1981); domestic and feral horses and ponies (Waring, 1983); Welsh Pony foals and mares (Crowell-Davis, 1983; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).

**Run**

With no apparent destination to reach or threat to escape, the animal moves at the canter or gallop in a seemingly spontaneous burst of motion.

*Other names:* *Galloping* (Keiper, 1985; Tyler, 1972); *exuberant galloping* (Waring, 1983).

*Comments:* Fagen and George (1977) reported that greater than two-thirds of all running in pastured pony foals from birth to 6 weeks was in a play context. Fig. 10 illustrates solitary running in a young foal.

*Species:* Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); domestic pony foals pastured in a natural herd (Fagen and George, 1977); domestic horse foals with mares (Fagen, 1981); domestic and feral horses and ponies (Waring, 1983); Welsh Pony mare and foal groups (Crowell-Davis, 1983; Crowell-Davis et al., 1987); feral ponies (Keiper, 1985); feral horses (Berger, 1986). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Przewalski horse—feral mares and foals (Boyd, 1980). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).

Table 1 (Continued)

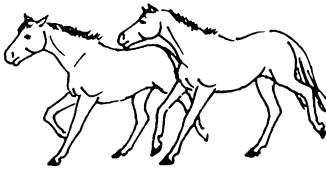
**Chase**

At the trot, canter or gallop, an animal is pursued, with the apparent effort to catch up to and overtake it.

*Other names:* Charge (Keiper, 1985); race (Penzhorn, 1984).

*Comments:* The animal often attempts to nip at or bump (similar to push at speed) the pursued play partner while chasing. The participants may reverse roles of chasing and being pursued. Play chasing can occur as what appears to be simple locomotor “games” or “tag” or can occur within the context of play fighting. Fig. 11 illustrates a group chase. Chasing, particularly in play among bachelors, can also appear to be herding similar to that of a harem stallion herding and driving his mares (McDonnell and Haviland, 1995).

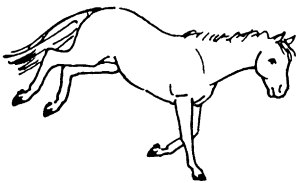
*Species:* Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); domestic ponies pastured in a natural herd (Fagen and George, 1977); feral horses (Boyd, 1980); domestic and feral horses and ponies (Waring, 1983); immature male feral horses (Hoffmann, 1985); feral ponies (Keiper, 1985); feral horses of the Great Basin (Berger, 1986). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

**Buck**

With the head and neck lowered and the weight shifted to the forelegs, both hindlegs lift off the ground and extend backwards simultaneously, often repeatedly in rapid succession.

*Other names:* Kicking of hindlegs into the air (Feist, 1971; Keiper, 1986); kicking up (Blakeslee, 1974); kick out (Tyler, 1972; Fagen, 1981); rear kicking (Fagen, 1981).

*Species:* Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); domestic ponies pastured in a natural herd (Fagen and George, 1977); feral horses (Boyd, 1980); domestic horse foals at pasture with dams (Fagen, 1981); domestic and feral horses and ponies (Waring, 1983); Welsh Pony mare and foal groups (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987); feral ponies (Keiper, 1985); feral horses (Berger, 1986). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Zebra—Grevy’s zebra in natural social groups (Gardner, 1983).

**Jump**

With mostly hindlimb propulsion, the animal suddenly moves forward with the forelegs leaving the ground first followed by the hindlegs. Can either appear to be jumping over a target obstacle or not.

*Species:* Horse—semi-feral ponies (Tyler, 1972); domestic horse foals at pasture with dams (Fagen, 1981); domestic and feral horses and ponies (Waring, 1983). Donkey—feral asses *Equus africanus* (Moehlman, 1998).



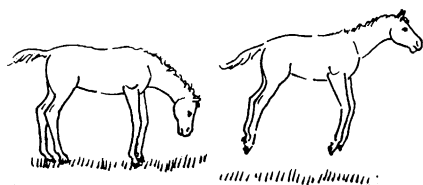
Table 1 (Continued)

**Leap**

In a combination of *jump* and *frolic*, the animal propels itself off the ground with its forelegs and hindlegs over an object, away from an object, or toward an object.

*Comments:* In the context of foal locomotor play and play as an adult, leap can sometimes resemble frolic, however, the leap action is directed toward or against another animal (Crowell-Davis, 1983, 1986; Fagen, 1981; McFarland, 1987).

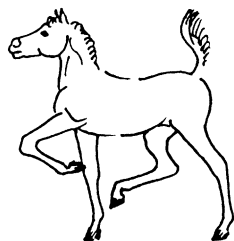
*Species:* Horse—domestic horse foals (Fagen, 1981); Welsh Pony foals and mares (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1998).

**Prance**

The animal walks or trots forward with neck arched, ears forward, tail elevated, and exaggerated knee action. The head and neck may bob up-and-down while in motion, and a snorting sound may be emitted with each stride.

*Comments:* Often occurs at the end of a play bout.

*Species:* Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); feral horses (Boyd, 1980); Welsh Pony mare and foal groups (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987); feral ponies (Keiper, 1985).

**4. Play fighting**

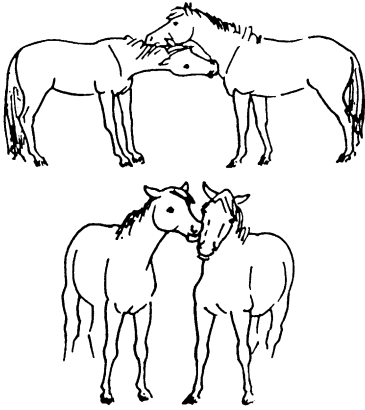
Play fighting involves behavioral elements and sequences similar to serious adult fighting behavior, but with more of a sporting character than serious fighting. In contrast to serious fights, the cohorts appear to alternate offensive and defensive roles, spar on as if to “keep the game going,” and stop short of injury.

Initiation of play fighting has been observed to follow the head threat tossing motion in which the head is rapidly flipped up-and-down, either while the animal is standing still or moving. Play fighting has been described by Berger (1986), Keiper (1985), Moehlman (1998) and Schilder et al. (1984). Play fighting has also been termed interactive (contact or combat) play (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987) and aggressive play (Tyler, 1972). The following 14 entries represent common play fighting behaviors in equids.

For the behaviors involving mouth aggression, we distinguished three types of action. We used the term *nip* to refer to a slight opening of the jaw to take and quickly release small pieces of skin or flesh between the teeth; *bite* to refer to a wider opening of the jaws and teeth to take and quickly release a larger piece of flesh and skin between the teeth; and *grasp* to refer to an extended clamping hold of a larger piece of flesh and skin, or a limb, between widely opened jaws.

Most play fighting occurs in a social context. However, we have observed certain elements such as *stamp* and *rear* within solitary play bouts of young foals.

Table 1 (Continued)

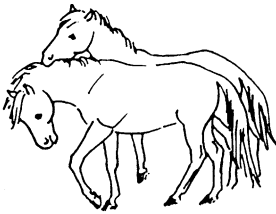
**Head/Neck/Chest Nip and Bite**

*Nip*: the jaws and teeth are opened and closed slightly taking a small piece of hair or flesh of a cohort between the teeth. *Bite*: the jaws and teeth are opened widely, closed and quickly released on a large piece of flesh and skin of a cohort between the teeth. The ears are upright and lips may be retracted.

*Other names*: Neck biting (Gardner, 1983); face nip (Blakeslee, 1974).

*Comments*: Fig. 12 illustrates nipping the head. Nipping and biting may occur in various areas of the body, including in addition to the forebody, the stifle and flank. Fig. 13 depicts a recumbent foal biting the chest of a cohort that has just nudged to invite play.

*Species*: Horse—semi-feral ponies (Tyler, 1972); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); free-ranging Appaloosa horses (Blakeslee, 1974); domestic and feral horses and ponies (Waring, 1983); feral ponies (Keiper, 1985). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Zebra—Grevy's zebra in natural social groups (Gardner, 1983); Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

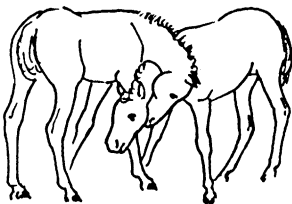
**Neck Grasp**

With the jaws open and clamped, the mane and neck of a cohort are held at the crest and sometimes moved back and forth.

*Other names*: Grip neck or mane (Keiper, 1985); holding mane (Feist, 1971); neck grip (Boyd, 1980; Tyler, 1972); holding crest (Crowell-Davis, 1983); grasp (McDonnell and Haviland, 1995); mane grip (Schoen et al., 1976); biting (Moehlman, 1974).

*Comments*: May precede (as if to initiate) or follow (as if initiated by) mutual grooming (McDonnell, unpublished observations), ponies.

*Species*: Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); Shetland and Welsh Pony mare and foals at pasture (Schoen et al., 1976); feral horses (Boyd, 1980); domestic horse mare and foal groups (Fagen, 1981); Welsh Pony mare and foal groups (Crowell-Davis, 1983; Crowell-Davis et al., 1987); immature male feral horses (Hoffmann, 1985); feral ponies (Keiper, 1985); feral horses (Berger, 1986); semi-feral bachelor bands (McDonnell and Haviland, 1995). Donkey—feral asses *Equus africanus* (Moehlman, 1974, 1998). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984); plains zebra (Berger, 1986).

**Neck Wrestle**

Sparring with the head and neck. One or both partners may remain standing, drop to one or both knees, or raise the forelegs during a bout of neck wrestling. This activity may include pushing and slamming with the shoulder against the shoulder or abdomen of the partner.

*Other names*: Neck fencing (Berger, 1986); wrestle (Hoffmann, 1985).

*Species*: Horse—feral horses (Feist, 1971); semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); feral horses (Boyd, 1980); domestic horse groups (Fagen, 1981); immature male feral horses (Hoffmann, 1985); feral ponies (Keiper, 1985); feral horses (Berger, 1986). Donkey—feral asses *Equus africanus* (Moehlman, 1974, 1998). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

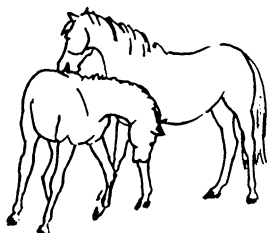
Table 1 (Continued)

**Fore Leg Nip/Bite/Grasp**

*Nip*: the jaws and teeth are opened and quickly closed and then released on a small amount of hair or skin of a foreleg of the target animal. *Bite*: the jaws and teeth are opened and closed slightly taking a large portion of flesh of the target animal between the teeth. *Grasp*: the jaws and teeth are opened and clamped in an extended hold of the limb of the target animal between the teeth and jaws.

*Comments*: Typically causes the recipient to buckle at the knees and partially drop to the ground with the front end, in an attempt to evade continued contact (See Fig. 14). As in that photograph the two participants may continue nipping each other from the ground position. In bachelor stallions, this ground position has been called *kneeling* (McDonnell and Haviland, 1994). Keiper (1985) noted that this has also been called the “turtle posture.”

*Species*: Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); domestic and feral horses and ponies (Waring, 1983); feral ponies (Keiper, 1985); feral horses of the Great Basin (Berger, 1986); Welsh Pony foal and mare groups (Crowell-Davis, 1986). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984); plains zebra (Berger, 1986). Onagers (Berger, 1986).

**Hind Leg Nip/Bite/Grasp**

*Nip*: the jaws and teeth are opened and quickly closed and then released on a small amount of hair or skin of a hindleg of the opposing participant. *Bite*: the jaws and teeth are opened and closed slightly taking a large portion of flesh of the target animal between the teeth. *Grasp*: the jaws and teeth are opened and clamped in an extended hold of the limb of the play partner between the teeth and jaws.

*Comments*: Fig. 15 illustrates a young foal grasping the hindleg of a yearling. Mutual hindleg nipping, biting, and grasping typically lead to circling of two participants in an apparent attempt of each to avoid being bitten while continuing to bite (see Fig. 16).

*Species*: Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); Shetland and Welsh Pony mares and foals at pasture (Schoen et al., 1976); domestic and feral horses and ponies (Waring, 1983); feral ponies (Keiper, 1985). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

**Rump Nip or Bite**

The jaws and teeth are opened and closed and then quickly released taking a small (nip) or large (bite) piece of flesh on the posterior section of the rump.

*Comments*: May be followed with a buck from the recipient. Schoen et al. (1976) note that tail biting is a component of play fighting.

*Species*: Horse—semi-feral ponies (Tyler, 1972); free-ranging Appaloosa horses (Blakeslee, 1974); domestic and feral horses and ponies (Waring, 1983); feral ponies (Keiper, 1985). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

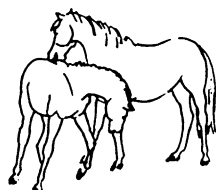


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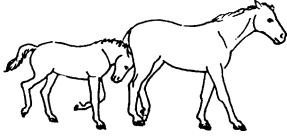
**Push**

The head, neck, shoulders, chest, body or rump is pressed against the play partner in an apparent attempt to displace the other (McDonnell and Haviland, 1995). Sometimes in a single episode, two participants alternate roles of pushing and being pushed.

*Other names:* *Bump against* (Gardner, 1983); *push* and *bunt* (Crowell-Davis, 1986).

*Comments:* Fig. 17 illustrates a young foal pushing an older foal.

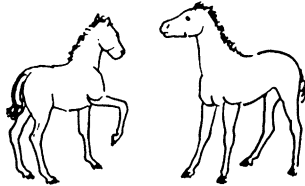
*Species:* Horse—feral horses (Feist, 1971); domestic and feral horses and ponies (Waring, 1983); Welsh Pony mare and foals (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987); feral horses (Berger, 1986). Zebra—Grevy's zebra in natural social groups (Gardner, 1983).

**Stamp**

One foreleg is raised and lowered, sharply and firmly striking the ground, sometimes repeated in a quick burst typically within the context of a play fight sequence. May serve to emit an acoustical signal.

*Other names:* *Strike* (Boyd, 1980; Crowell-Davis, 1983; Waring, 1983); *front hoof beating* (Hoffmann, 1985); *paw* (Schoen et al., 1976); *stomp* (McDonnell and Haviland, 1995).

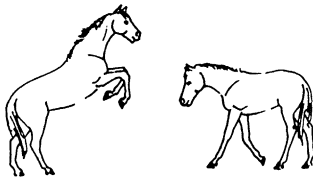
*Species:* Horse—Shetland and Welsh mare and foals at pasture (Schoen et al., 1976); feral horses (Boyd, 1980); domestic and feral horses and ponies (Waring, 1983); Welsh Pony mare and foal groups (Crowell-Davis, 1983); immature male groups of feral horses (Hoffmann, 1985).

**Rear**

The forequarters are raised high while the hindlegs remain on the ground, resulting in a near-vertical position (McDonnell and Haviland, 1995).

*Comments:* Fig. 18 illustrates a rear. May result in the *resting rear* position or the partial mount or dancing or boxing (McDonnell and Haviland, 1995; see Fig. 19). Commonly interpreted as related to establishment of dominance during a play fight sequence.

*Species:* Horse—domestic ponies pastured in a natural herd (Fagen and George, 1977); feral horses (Berger, 1986); free-ranging Appaloosa horses (Blakeslee, 1974); feral horses (Boyd, 1980); semi-feral ponies (Keiper, 1985); Welsh Pony mare and foal groups (Crowell-Davis, 1983, 1986; Crowell-Davis et al., 1987); domestic horse (Fagen, 1981); Shetland and Welsh mare and foals at pasture (Schoen et al., 1976); semi-feral ponies (Tyler, 1972); domestic and feral horses and ponies (Waring, 1983). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

**Hind Quarter Threat**

Usually with ears back and the rump turned toward a herd mate, an animal raises one leg as if aiming to kick, often simultaneously backing toward the target.

*Other names:* *Kick threat* (McDonnell and Haviland, 1995).

*Comments:* May occur in the context of a play fight sequence, sometimes appearing to signal the termination of the play fight (Keiper, 1986).

*Species:* Horse—free-ranging Appaloosa horses (Blakeslee, 1974); domestic and feral horses and ponies (Waring, 1983). Donkey—feral asses *Equus africanus* (Moehlman, 1974). Zebra—Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

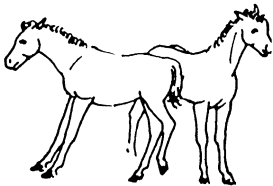


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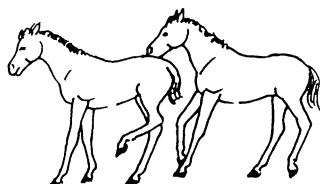
**Kick**

One hindleg is lifted off the ground and extended backwards usually toward the play partner, rarely with sufficient reach or force to touch or cause injury to the recipient. May be repeated in succession.

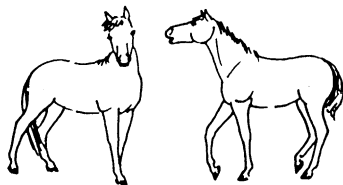
*Other names:* Hindkicking (Boyd, 1980); kick out (Gardner, 1983; Tyler, 1972).

*Comments:* A double hindleg kick seems more forceful than play, and often seems to terminate the play fight sequence, so may not represent play.

*Species:* Horse—semi-feral ponies (Tyler, 1972); feral horses (Boyd, 1980); domestic and feral horses and ponies (Waring, 1983); Welsh Pony mare and foal groups (Crowell-Davis et al., 1987). Donkey—feral asses *Equus africanus* (Moehlman, 1998). Zebra—Grevy's zebra in natural social groups (Gardner, 1983); Cape Mountain zebra *Equus zebra zebra* (Penzhorn, 1984).

**Evasive Balk**

As two cohorts approach, one stops abruptly, reversing direction of the forebody, typically withdrawing the head and neck (and sometimes forebody) in a sweeping dorsolateral motion while the hindbody remains or pivots in place.

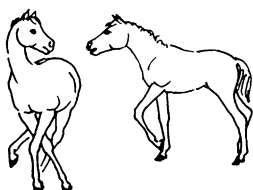


*Other names:* Swerving (Waring, 1983); quick stop (Moehlman, 1974).

*Species:* Horse—semi-feral pony bachelor bands (McDonnell and Haviland, 1995). Donkey—feral asses *Equus africanus* (Moehlman, 1974).

**Evasive Jump**

During social locomotor play and play fighting, contact is avoided by propelling the fore, rear, or entire body off the ground away from the offensive gesture.

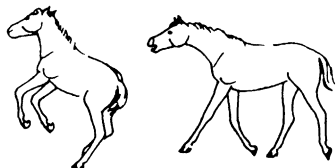


*Comments:* In a given sequence play opponents often alternate evading and attacking roles.

*Species:* Horse—free-ranging Appaloosa horses (Blakeslee, 1974); feral ponies (Keiper, 1985).

**Evasive Spin**

During social locomotor play and play fighting, contact is avoided by turning away from the offensive gesture in a quick, sharp motion pivoting around one hindleg.



*Other names:* Whirling to avoid being bitten (Boyd, 1980).

*Species:* Horse—feral horses (Boyd, 1980); Welsh Pony mare and foal groups (Crowell-Davis, 1983; Crowell-Davis et al., 1987); domestic and feral horses and ponies (Waring, 1983).



Fig. 1. Foal *nibble* novel paper.

7 entries, and play fighting includes 14 entries. Within these categories comments were included on social and solitary forms (Figs. 1–21).

The references to literature were chosen as readily available sources of further information. We did not attempt to provide an exhaustive inventory of all citations nor did we attempt to find the earliest description of the behavior. Photographs illustrating context and interactive sequences were appended.



Fig. 2. Solitary object play—*shake* novel object (paper bag).





Fig. 3. Social object play—*shake* novel object (paper bag).



Fig. 4. *Paw* in water.



Fig. 5. Solitary object play—*paw* novel object (tarp).



(a)



(b)



(c)



(d)



(e)

Fig. 6. Play initiation sequence: (a) *nip neck*, (b) *paw back* of recumbent, (c) *paw back* of rising participant, followed by (d) *resting rear*, and (e) *foreleg grasp* of standing participant.

#### 4. Discussion

Included in our final list of equid play behaviors were what appeared in our original observations and in reports from the literature to be the most common play behaviors of equids. Some of our decisions concerning inclusion or exclusion from the ethogram may be questionable. Certainly, there could easily have been many more entries, further delineating



(a)



(b)

Fig. 7. Foal *circle* dam.



Fig. 8. *Resting rear*.

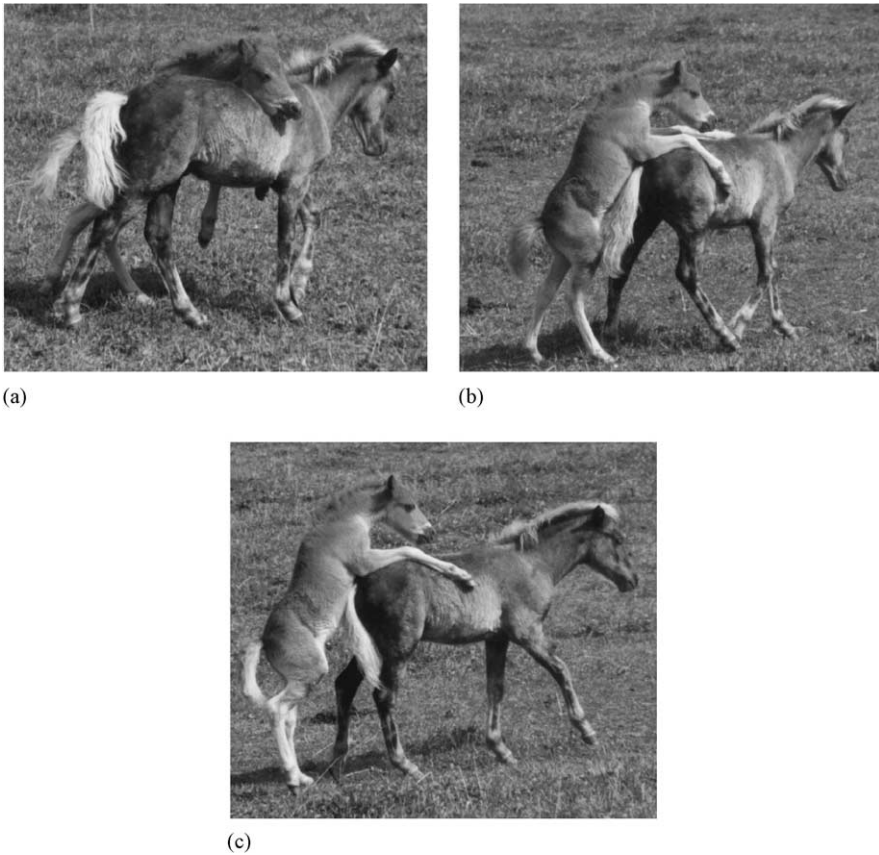


Fig. 9. Male foal *mount* another male foal (a) from side, (b) from rear, and (c) from rear (note commencing erection).

specific elements within play sequences. For example, *elimination marking sequence* could have been presented as several separate entries, i.e. *flehmen*, *urinate on*, *defecate on*, *sniff feces*, *sniff urine*. Another example would be in play fighting sequences. Elements such as *kneeling*, *levade*, *lunge*, and various threat gestures such as *head toss* have in other works been considered distinct ethogram entries.

Similarly, decisions were not always clear as to whether particular behaviors associated with play should be considered as elements of play or as initiators or terminators of play. For example, social play bouts often are preceded by a mutual *head toss* or *alert* posture (McDonnell and Haviland, 1995). It is not clear to us whether these represent play or play initiation gestures. A related difficulty was deciding whether or not certain behaviors had a play form or were always serious behavior in young foals. For example, some authors have considered mutual grooming, self-grooming, or rolling as play behavior (McGreevy, 1996; Tyler, 1972). It is difficult to know whether or not these behaviors serve a serious grooming purpose as in adults or represent play forms of the behavior. In our observations of ponies



Fig. 10. Solitary *run*.

and horses, for each of these examples, the behavior occurred in complete form and sequence with seemingly serious intent similar to that of adults. So, for example, in mutual grooming the nips were as complete as those among adults, even in week-old foals. One reviewer (S. Ralston, personal communication) indicated that she had observed rolling in domestic foals that she interpreted as play rolling in response to novel substrate or a fresh puddle.

An example where the distinction was not as clear concerns grazing or drinking behavior. Before foals begin ingesting grass or drinking water, they all appear to go through a brief developmental stage during which they seem to mimic the grazing or drinking behavior of adults in a playful investigative manner, mouthing and chewing, but not ingesting (Blakeslee, 1974). In our observations of pony and horse foals, this phase of playful grazing and drinking is typically very brief, often less than a day. Once a foal begins



Fig. 11. Group *chase*.



Fig. 12. *Head nip.*



Fig. 13. *Bite chest* during play initiation interaction.



Fig. 14. *Foreleg bite and grasp.*

ingesting the grass or drinking water, the playful, investigative form is not seen again. The foal may occasionally play with an unusual piece of vegetation, for example, a tall weed encountered while grazing. It was with that logic that we did not include in this ethogram behaviors for which the play form was very brief and apparently developmentally transitional.

An interesting feature of play, particularly in young foals, is that typically sequences do not include the vocalization included in the serious adult form of the behavior with the exception of frolic. For example, play fighting does not include the grunts and squeals so



Fig. 15. *Hindleg grasp.*



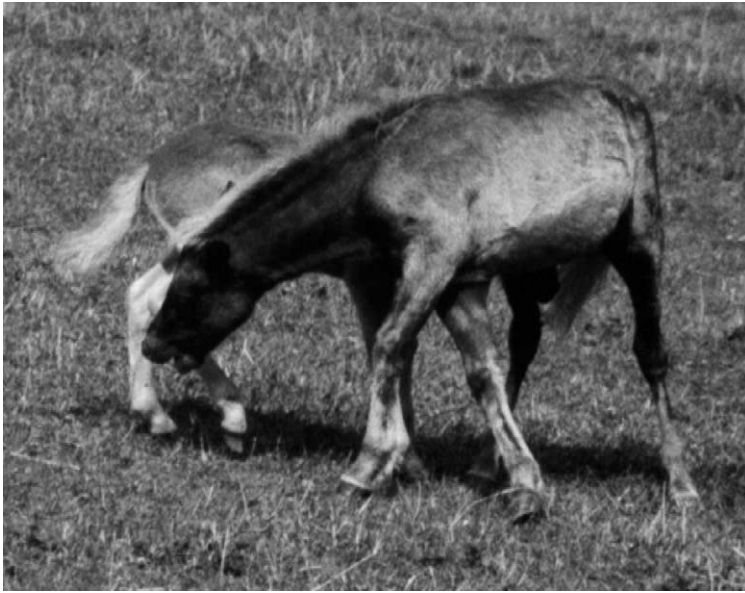


Fig. 16. Older and younger foals circling as each *nips* or *bites* the other's *hindleg*.

typical of serious fighting. As reported by [Fagen and George \(1977\)](#), vocalizations of young foals (approximately 3 months of age and younger) are almost exclusively limited to calls and answers to the dam. During *frolic*, pony and horse foals may snort and emit audible squeals.



Fig. 17. *Push*.





Fig. 18. *Rear*.

In our laboratory work over the years, we have had opportunities to observe young equids in natural family groups, in domestic mare and foal pairs, and in pasture herds of mare–foal pairs. Those observations suggest that there may be some differences in the quantity and quality of play dependent on the social environment in which a foal develops. First, among equids living in natural social harem and bachelor group organization, there seems to be considerably more play in foals, yearlings, young adults, and some mature



Fig. 19. *Rear* with “dancing” (within a play fighting sequence of young adult male ponies).



Fig. 20. Nose-to-nose investigation preceding play bout.

adults than in mare and foal pairs or herds. Several factors may account for these perceived differences, including mixed ages, a preponderance of young animals, presence of bachelor and harem stallions, and general social facilitation. For example, young foals and yearlings appear to mutually stimulate play, seemingly increasing the amount of locomotor social play in the younger foals, and likely increasing the distance that young foals play away from the dam. Also, harem stallions engage in play with the foals and yearlings, seemingly increasing the amount of play compared to that seen in mare–foal only groups. Similarly, in natural equid populations, the bachelor stallions play fight and chase with yearlings and 2-year-old, possibly further increasing the amount of social locomotor play and play fighting. In a study of ten Shetland and Welsh Ponies kept at pasture in a fairly natural social band (Fagen and George, 1977) play accounted for most locomotor exercise of foals from birth to 6 weeks of age (from 54 to 84% of locomotor steps and from 85 to 100% of turns). In



Fig. 21. Mutual grooming in this instance preceding social play bout.

comparing species, it has similarly been suggested that social organization likely affects the amount and type of play (Fagen, 1981). Among the territorial zebra and donkeys, where mares and their offspring travel together unassociated with others, the frequency of social play among foals is rare compared to that of the harem equids (Moehlman, 1974; Gardner, 1983).

Our observations were similar to reports in the literature (Blakeslee, 1974; Moehlman, 1974) that play frequently appears to be stimulated by novel conditions or stimuli, and so is often interspersed with investigation and exploration. This seems particularly the case for young foals. Novel situations such as changes in weather, for example, wind or precipitation, or encounter of novel objects, or movement of the herd to areas not yet traveled by the neonate are associated with an apparent increased frequency and duration of play (see Figs. 1–3 and 5).

There are several distinct behaviors that appear to invite or initiate play. These include nose-to-nose approach, nudging, nipping, tossing the head, and pawing at the prospective play partner. Fig. 20 illustrates the common nose-to-nose investigation greeting commonly preceding play bouts. Fig. 6 illustrates a commonly observed play initiation sequence involving a standing foal pestering a recumbent foal until it rises and joins in the play. As noted by others (Schoen et al., 1976; Crowell-Davis et al., 1987) mutual grooming is sometimes associated with play, either preceding or following a play bout (see Fig. 21).

There also appear to be certain actions associated with termination of a play bout. Pinning the ears back, forceful biting, turning the rump toward the other animal and kicking or striking with apparent serious intent often abruptly terminate a play bout. While these actions are very similar to those occurring in play, when observed in the context of terminating a play bout there are distinct differences in the apparent force and intent. Another common ending event of social play bouts include one or more participants prancing off.

It is worth noting that, while play is likely most frequent and conspicuous in foals, yearlings, and bachelors, play also occurs in mature adults. Among adults, it appears most common in bachelor stallions. Within harem groups, it appears to be more common in harem stallions than in harem mares.

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## References

- Bekoff, M., Byers, J.A., 1998. *Animal Play Evolutionary, Comparative, and Ecological Perspectives*. Cambridge University Press, Cambridge, UK.

- Berger, J., 1986. Wild Horses of the Great Basin Social Competition and Population Size. The University of Chicago Press, Chicago.
- Blakeslee, J.K., 1974. Mother–young relationships and related behavior among free-ranging Appaloosa horses. Master's thesis, Idaho State University, Pocatello.
- Boyd, L.E., 1980. The natality, foal survivorship, and mare–foal behavior of feral horses in Wyoming's Red Desert. Master's thesis, University of Wyoming, Laramie.
- Boyd, L.E., Carbanaro, D.A., Houpt, K.A., 1988. The 24 hour time budget of Przewalski horses. *Appl. Anim. Behav. Sci.* 21, 5–17.
- Crowell-Davis, S.L., 1983. The behavior of Welsh Pony foals and mares. Ph.D. thesis, Cornell University, Ithaca, NY.
- Crowell-Davis, S.L., 1986. Developmental behavior. In: Crowell-Davis, S.L., Houpt, K.A. (Eds.), *The Veterinary Clinics of North America, Equine Behavior*. Saunders, Philadelphia, pp. 573–590.
- Crowell-Davis, S.L., Houpt, K.A., Kane, L., 1987. Play development in Welsh Pony (*Equus caballus*) foals. *Appl. Anim. Behav. Sci.* 18, 119–131.
- Fagen, R.M., 1981. *Animal Play Behavior*. Oxford University Press, New York.
- Fagen, R.M., George, T.K., 1977. Play behavior and exercise in young ponies (*Equus caballus* L.). *Behav. Ecol. Sociobiol.* 2, 267–269.
- Feist, J.D., 1971. Behavior of feral horses in the Pryor Mountain Wild Horse Range. Master's thesis, University of Michigan, Ann Arbor.
- Gardner, C.D., 1983. Grevy's zebra of Samburu Kenya: mothers and foals project in wildlife ecology. Master's thesis, Yale University, New Haven, CT.
- Grier, J.W., 1984. *Biology of Animal Behavior*. Times Mirror/Mosby College Publishing, St. Louis, MO.
- Hoffmann, R., 1985. On the development of the social behavior in immature males of a feral horse population (*Equus przewalskii* f. *caballus*). *Z. Saugetierkd.* 50, 302–314.
- Keiper, R., 1985. *The Assateague Ponies*. Tidewater Publishers, Centreville, MD.
- McDonnell, S.M., Haviland, J.C.S., 1995. Agnostic ethogram of the equid bachelor band. *Appl. Anim. Behav. Sci.* 43, 147–188.
- McGreevy, P., 1996. *Why does my horse...?* Trafalger Square Publications, North Pomfret, VT, USA.
- McFarland, D., 1987. *The Oxford Companion to Animal Behavior*. Oxford University Press, New York.
- Moehlman, P.D., 1974. Behavior and ecology of feral asses (*Equus asinus*). Ph.D. dissertation, University of Wisconsin, Madison.
- Moehlman, P.D., 1998. Behavioral patterns and communication in feral asses (*Equus africanus*). *Appl. Anim. Behav. Sci.* 60, 125–169.
- Penzhorn, B.L., 1984. A long-term study of social organization and behavior of Cape Mountain zebras *Equus zebra zebra*. *Z. Tierpsychol.* 64, 97–146.
- Schilder, M.B.H., van Hoof, J.A., van Geer-Plesman, C.J., Wensing, J.B., 1984. A quantitative analysis of facial expression in the plains zebra. *Z. Tierpsychol.* 66, 11–32.
- Schoen, A.M.S., Banks, E.M., Curtis, S.E., 1976. Behavior of young Shetland and Welsh Ponies (*Equus caballus*). *Biol. Behav.* 1, 192–216.
- Tyler, S.J., 1972. Behavior and social organization of the semi-feral ponies. *Anim. Behav. Monogr.* 5.
- Waring, G.H., 1983. *Horse Behavior: The Behavioral Traits and Applications of Domestic and Wild Horses, Including Ponies*. Noyes Publications, Park Ridge, NJ.