

Investigation of the Effects of Social Experience on Snapping Intensity  
in *Equus caballus* Foals

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ABSTRACT

This study attempted to examine three aspects of *Equus caballus* foal snapping behavior. First, it suggested that the previous theoretical explanation for snapping established by behavioral researchers was incorrect. Second, as a means of suggesting an alternative hypothesis, this study proposed that snapping behavior could be a modified play response that was elicited when foals were confused by the complex social signals displayed by conspecifics. Finally, this project tested the aforementioned hypothesis by recording interactions between foals and conspecifics and analyzing the snapping intensity with each subject's previous level of social experience. There were two indicators utilized to establish social experience. First, the 'age' of the foal was employed as a measure of overall life experience and development. Second, the number of hours per day the foal was exposed to conspecifics gave an effective measure of the amount of time the subject had an opportunity to learn the complex *Equine* visual communication (referred to as 'out-time').

*Dedicated to Martha and Charles McCusker for all of their love and support, without  
which, I would never have succeeded.*

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## **1.0 INTRODUCTION**

### *1.1 Deciphering Horse Behavior: The Enigma of Snapping*

One of the greatest challenges to animal behavior researchers has been the development of experimental procedures that can produce descriptions and assessments of species typical behaviors while avoiding the pitfalls of overstated inferences and exaggerated comprehension of the animal's intent. A behavioral record of motor responses through extensive observation is incomplete without a complementing analysis of the complex physical, biological, and social interactions that drive specific behaviors. It is through this type of analysis that researchers make testable hypotheses regarding the cause, purpose, and effect of a particular action within the framework of a species' physical and social environment. Due to factors such as accessibility, maintenance, and economic value, research on domesticated species has accumulated a far greater data reserve of behavioral observations than animals that exist in the wild. One species that has been examined extensively is the domestic horse (*Equus caballus*).

As a result of selective breeding as part of domestication, efforts at understanding rudimentary aspects of horse behavior have been proceeding since at least 1000 B.C. (Fraser, 1992). This extensive, but primarily anecdotal history has resulted in a number of relatively unexamined assumptions regarding the nature and function of particular aspects of equid behavior. One example of this is the established explanation of a behavior exhibited by young horses and foals known as snapping. Snapping is a behavior pattern during which a yearling horse or foal will extend its head and neck, retract its lips, and rapidly open and close its teeth in a chomping motion (see Figures 1 and 2). Beginning

with Zeeb (1959, as cited in Crowell-Davis et al., 1985), snapping (also known as Unterlegenheitsgebarde, champing, teeth clapping, and teeth blecking) has been accepted by most researchers of horse behavior to be a submissive action exhibited by foals and yearlings, utilized to avoid aggression from individuals that maintain a higher rank in the social structure (Feist and McCullough, 1976; Fraser, 1992; Mills and Nankervis, 1999; Zeeb, as cited in Crowell-Davis et al., 1985)).

The study put forth by Zeeb (1959, as cited in Crowell-Davis et al., 1985) utilized the term ‘Unterlegenheitsgebarde’ to describe what he viewed as a submissive posture that was an imitation of allogrooming. The study recorded the number of snapping incidents by foals, yearlings, two year-olds, three year-olds, and four year-olds. Zeeb found foals to exhibit the behavior most (147 snaps), followed by a distinct drop in incidents with age (yearling, 81; 2 yrs., 13; 3 yrs., 11; 4 yrs., 0). There was no difference in gender for snapping incidence rate, but colts were found to snap to stallions more often than other social partners. Zeeb argued that some submissive gestures in other animal species are actually exaggerated invitations to perform a service such as grooming, food offerings, mating, or nuzzling.

Zeeb’s explanation has been utilized in the preponderance of equine research conducted over the past four decades. However, the current study suggested that the majority of researchers in equid behavior have misidentified snapping as submissive. In addition, this study proposed a new hypothesis regarding a seemingly misunderstood behavior pattern. This research suggested that snapping is a response rooted in play behavior and is elicited when foals are presented with an uncertain or ambiguous

situation. It is also proposed that as social experience increases, confusion will also decline and thereby reduce snapping times.

A reassessment was undertaken incorporating experimental interactions, a cataloging of horse gestures and behavior, and a review of the generally accepted principles regarding equid submission, dominance, and play interactions. A review of horse communication provides a beginning background for establishing the importance of visual gestures in the development of social behavior and hierarchical organization.

### *1.2 Horse Communication*

In view of the long history shared by humans and equid species, a great deal of research has been directed toward the documentation and analysis of gestures used in Equid social communication. Visual displays have received a great deal of focus, due to horses' propensity to depend on sight for detailed communication. For example, Pfungst (1907, as cited in Feist and McCullough, 1976) described the ability of domestic horses to perceive even the slightest visual cues through the case of a horse named 'Clever Hans'. Trainers had advertised the horse as having the ability to do arithmetic, however, it was discovered that the horse was cueing in on almost unperceivable gestures delivered by human bystanders.

Various parts of the body are used in gestures which can be perceived visually; their effectiveness for communication may be over the entire body (multiple body parts oriented collectively), as individual units (i.e., only head gestures), or discretely

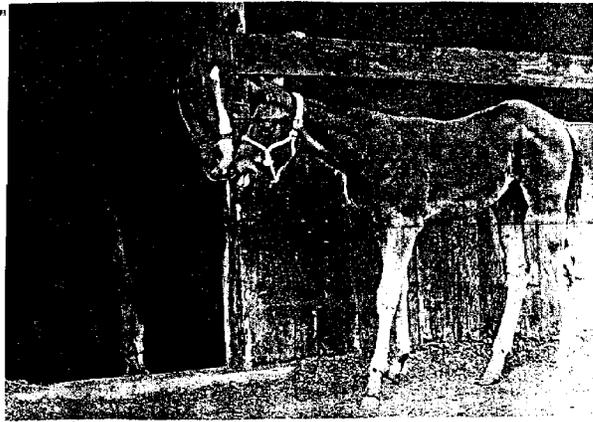


Fig. 1: Foal snapping to dam. (Houpt, 1997)

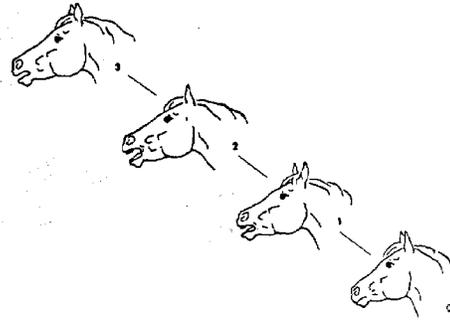


Fig. 2: Outline of mandible motions of snapping. (Waring, 1983)



Fig. 3: Aggressive play behavior. (Houpt, 1997)



Fig. 4: Aggressive fighting behavior. (Waring, 1983)

(i.e., ear orientation) (Mills and Nankervis, 1999). A simple change of ear position can alter the meaning of an interaction from spirited play to actual aggression (see Figures 3

and 4). Gradations of a particular gesture are often exhibited in correlation with both the degree of the animal's stimulation and any influencing factors present in the immediate environment. Feist and McCullough (1976) noted that the intensity of communicative signals between stallions battling for dominance was a measure of the seriousness of the fight. For example, intense exchanges were marked by exaggerated postures and powerful attempts to bite and kick. Oppositely, battles that were less engaging to the stallions included more subdued visual gestures and seemingly symbolic bite and kick attempts.

Equines generally utilize visual cues to communicate greetings, warnings, submissions, and alerts. Feist and McCullough (1976) observed a population of feral (wild) horses and created a list of visual signs and the mood or intention that was most often associated with a particular signal. For example, aggression was found to be represented in two modes: biting and kicking. Biting, the most common aggressive action, consisted of a series of progressive acts that began with a mild threat and increased incrementally. The ritual commenced with the horse's ears laid back, a head swing was then added, followed by opening the mouth, and ending with an attempt to bite (see Figures 5 and 6). Kicking followed a similar progression beginning with a turn away so that the rump faced the opponent, the horse then lifted and replaced one leg, followed by a false kick with one leg, and ended with a full kick back with both legs (see Figures 7 and 8). Worthy of note, Wells and Goldschmidt-Rothschild (1979) suggested that kicks occur in specific contexts (i.e., mating), and tend to be used against dominant

animals, whereas bites are given to subordinate animals in more general situations such as grazing, herd movement, and incidental contact.

Hoffman (1985) conducted behavioral observations on a group of feral horses residing on an island off the coast of North Carolina. Through extensive preliminary observations, Hoffman's analysis utilized a behavior list developed in the pilot study that was categorized into nine behavior groups (Greeting, Grooming, Play, Submission, Agonistic Behavior, Feeding, Urination, Defecation, and Sexual Behavior) and then further divided into multiple behavioral stereotypes that were thought to be consistent with intention. For example, agonistic behavior was composed of a total of eleven distinct behavioral stereotypes that were actually combinations of even more discrete behaviors. Some examples of agonistic behavior were: 1) Ears flat back, head-beating movement; 2) Ears flat back, hind hoof kick, vocalizations; 3) Ears flat back, front hoof beating, hind hoof kick, chase, vocalizations; etc.

It is interesting to note that Hoffman's category of submissive behavior was composed of only four stereotypes: 1) Ears flat back, stretch neck, teeth blecking; 2) Ears flat back, stretch neck, teeth clapping; 3) Ears up, walk away; and 4) Ears up, run away. It is accepted that teeth clapping and teeth blecking are synonyms for snapping, the latter (blecking) inferring that the teeth do not actually touch. However, it is unusual to describe the ear position of the foals as 'flat back' when referring to snapping. In most behavioral descriptions (Crowell-Davis, Houpt and Burnham, 1985; Mills, 1999; etc.) the ear position is described as up, facing backwards, or spread. This distinction is important because it has been established in the large majority of equid research that ears pinned

flat back is an aggressive posture (Carson and Wood-Gush, 1983; Fraser, 1992; Houpt, 1997)(see Figures 9 and 10). Given the large repertoire of visual signals utilized to convey rank, an evaluation of equine hierarchies demonstrates the importance of dominance and submission to the cohesion of the herd.

### *1.3 Dominance and Submission*

The different species of *Equidae* are all gregarious, grazers with similar body-size and shape. However, the mountain zebra, the plains zebra, and the horse are all terrestrially non-territorial species. This social structure consists of stable family groups that stay together and depend on a single stallion to protect his harem and offspring (Fraser, 1992). Interestingly, there is some controversy as to whether the stallion maintains the same social status with the mares of his harem that he has with competing stallions. Typical migration structure shows the dominant mare at the front of the herd, and the stallion at the rear. It has previously been assumed that the stallion was driving the harem by running behind and forcing the mares to go in the direction the stallion desired. Klingel (1974) suggested an alternate explanation that maintained the dominant mare was leading the group and the stallion was merely protecting his assets by making sure that the herd stayed together and no competing males were able to make successful theft attempts. This theory is credible when considering the following: (a) the leader is in the front in most species that travel in packs; (b) utilizing a system of driving is an inefficient method of expending energy when compared with a pack leader; and (c) behavioral observations have shown that the dominant mare can lead a herd from the front when there is no stallion present (Tyler, 1969).

Non-dominant stallions and young male feral horses form bachelor herds that migrate together as the members search to establish their own harem through either unseating a dominant stallion, theft of a mare from an established family group, or the adoption of a young mare that has left her parental group. It is not known if young mares leave voluntarily or are forced out, but it is obviously an effective method of avoiding inbreeding (Carson & Wood-Gush, 1983).

The hierarchy of the non-territorial horse is normally linear, and individuals within groups tend to associate with individuals of similar rank and age. Houpt and Wolski (1980) reported that there is little correlation between the rank of individuals and their age, weight, or sex; with the exception that juveniles (horses 3 years old or less) are always subordinate to adult animals. In addition, Tyler (1972) recorded a pattern that demonstrated the offspring of dominant horses show a likelihood of controlling their social groups in the future. Interestingly, Glendinning (1974) conducted behavioral observations on orphaned foals being raised on milking machines. The study concluded that, when kept in groups of three, foals would develop a hierarchy. The dominant foal would exhibit his status through the rank-order suckling of the milk machine. When considering the early hierarchical orientation horses demonstrate, a brief examination of the specific visual gestures that communicate dominance and submission presents a backdrop for a more in depth analysis of snapping.



Fig. 5: Biting attempt by adult horse. (Waring, 1983)

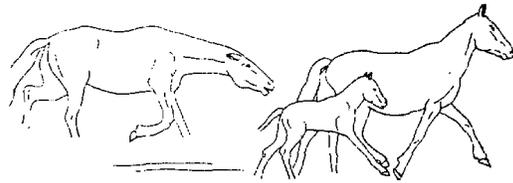


Fig. 6: Outline of biting and driving behavior. (Feist and McCullough, 1976)



Fig. 7: Threat to kick posture. (Houpt, 1997)

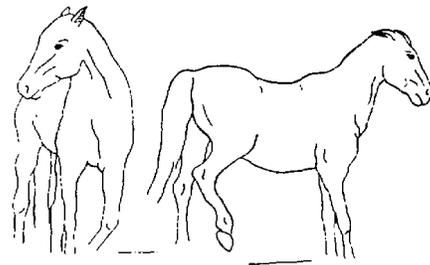


Fig. 8: Outline of threat to kick posture. (Feist and McCullough, 1976)



Fig. 9: Ears pinned back aggressive threat display. (Houpt, 1997)

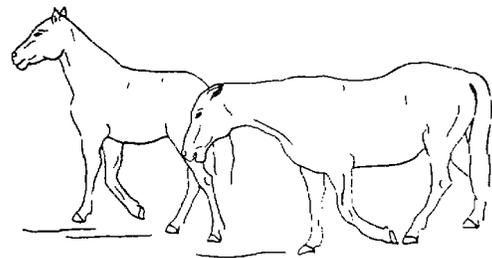


Fig. 10: Outline of aggressive threat display. (Feist and McCullough, 1976)

### *1.31 Aggressive and Compliant Signals*

In most animal species, aggression has a number of sub-steps that eventually lead to a physical attack. These sequential actions allow less dominant individuals the opportunity to escape and thereby avoid injury to both the alpha and omega participants. As a means of rapidly staving off an attack by a more dominant animal, the signs demonstrating submission are usually quick and unmistakable. According to Feist and McCullough (1976), equines typically exhibit submissive behavior through two behavioral strategies. First, and by-far most commonly, a horse will avoid conflict by turning its head and moving away. This is a popular method of accepting an alpha's authority that is utilized in many species. The second method identified by Feist and McCullough is snapping. The Ethological Dictionary defines a submissive behavior as a "Behavior of subordination in order to prevent attack; defensiveness" (Heymer, 1977). To define snapping utilizing the above definition seems counter-intuitive to the generally accepted traits that define an effective submissive gesture.

Mills (1998) discussed the appeasement signals of various species and found that submissive gestures are often the opposite of a threatening gesture. Examples include: hiding weapons, looking away, exposing a vulnerable portion of the body, or quickly moving into a position to be mounted (exhibited by both males and females). Oppositely, snapping requires multiple motor actions directed toward the face of the dominant animal, does not distance the foal from the other horse, and often times does not stop the aggressor's assault (see Figures 11a, 11b, and 12) The non-submissive nature of snapping is further suggested by the works of both Boyd (1980) and Tyler (1972). Both researchers

conducted extended observations of wild horses and neither recorded a significant deterrence on the part of the aggressor when foals exhibited snapping behavior toward an attack. This suggests that the long-held notion that snapping is a submissive behavior may be faulty. A brief review of foal behavior sets the stage for a more critical examination of the function and significance of snapping.

#### *1.4 Foal Behavior*

Ungulate species have been classified with one of two types of mother-infant relationship: hiders or followers. The ‘hider’ species (cervids, gazelles, antelopes) are found in thick vegetation, which allows the offspring to avoid detection by staying low and immobile. The ‘follower’ species (ovids, large bovids, and equids) are found in open habitats and requires offspring to be able to locomote very quickly after birth. It is important for ‘follower’ species to create strong mother-infant bonds quickly to minimize the time that the pair is vulnerable to predation (Lent, 1974).

Wolski, Houpt, and Aronson (1980) conducted a study to establish the relative roles of auditory, visual, and olfactory cues in the mutual recognition of mares and their suckling foals. The experiment altered or eliminated visual cues, modified olfactory cues, and recorded the frequency of calls from separated dams and foals. Results showed that neither the elimination of visual cues nor the alteration of olfactory cues alone resulted in the detrimental effects observed when multiple sensory cues were attenuated. Playback trials also showed that mares were able to recognize their own foal’s call, but the reverse did not occur. Interestingly, snapping towards both maternal and non-maternal mares was recorded by all but one of the foal test subjects for the visual discrimination trials, during

which the foal was forced to choose between two similar looking lactating dams.

However, this point was not developed in the author's discussion.

#### *1.41 Foal Behavioral Development*

Infant *Equidae* are precocious animals and are able to follow their dams soon after birth. Foals have the ability to exhibit a wide variety of well-coordinated behaviors within the first few hours postpartum. Waring (1983) conducted a literature review of studies that recorded neonatal foal activity and found that newborns have the ability to stand, mobilize (walk, trot, and gallop), investigate their surroundings, seek care, suckle, orient towards sights and sounds, perform agonistic withdrawal, engage in play, and exhibit snapping behavior during the days following birth.

As foals develop, their increased coordination becomes more evident and time allotments begin to be dominated by play, as well as sleep and nursing. Foals initially orient most of their behavior towards their dam, however, Tyler (1969) found that there were several key age ranges during which interaction with the mother was superceded by peer relations and exploratory behavior. Tyler observed that at approximately 9 to 12 weeks of age, the time spent suckling showed a marked decline, while the incidence of grazing began to increase from 10 minutes per hour (12 weeks) to 50 minutes per hour at the age of 30 weeks. Tyler also noted that foal-resting time began to decline at the age of 12 weeks from 37 minutes per hour to only 14 minutes per hour at 30 weeks of age. Interestingly, play behavior shifted from a focus on the dam, to time spent with peers and other members of a herd at approximately three to four weeks. Tyler found that nearly all of the playtime was devoted to the mother or alone in the first week of life, however, at

approximately one-month of age foals spent the same percentage of time playing with the dam as they did with peers. It was discovered that by seven weeks, foals had made a reversal and spent most of their playtime interacting with other foals and yearlings. Tyler suggested that this steady distancing from the dam for nourishment and play is instrumental in creating social contacts, learning behavior patterns, and establishing a hierarchy both within the group of young horses and within the larger herd.

#### *1.42 Foal Allogrooming*

Given the fact that Zeeb (1959, as cited in Crowell-Davis et al., 1985) suggested snapping is a response rooted in allogrooming, it is important to explain this behavior. Allogrooming is an important method of establishing social contacts. This behavior typically involves two animals standing side by side, facing in opposite directions, and grooming each other's neck, withers, back, and rump with their incisors (see Figure 13). Feh and De Mazieres (1993) established that mutual grooming not only functions as a method of reducing social tension and cleansing ectoparasites, but also reduces heart rate by stimulating an area next to a major ganglion of the autonomic nervous system.

Crowell-Davis, Houpt, and Carini (1986) focused on the occurrence of mutual grooming sessions between foals. Observations showed that allogrooming partnerships were often established between two foals, and although these relationships were not exclusive, they were preferred. It was also found that fillies mutually groomed more often overall, and only exhibited a slight preference for other fillies as grooming partners. In contrast, colts allogroomed nearly exclusively with fillies, even when the ratio created a situation where two colts would go without grooming. Given the fact that mares live in

social groups that remain stable throughout life, while stallions usually live either alone or in temporary bachelor herds, the results are consistent with expectations that females would be more oriented towards developing and maintaining strong social bonds.

#### *1.43 Foal Play Behavior*

Since this study suggests that snapping is an altered play response, it seems prudent to review the basic tenets of foal play behavior. Fagen (1981) outlined six advantages of play behavior:

1. Development of physical strength, endurance and skill; particularly in those acts or combination of acts used in social interactions having potentially lethal combinations.
2. Promotion and regulation of developmental rates.
3. Experience yielding specific information.
4. Development of cognitive skills necessary for behavioral adaptability.
5. Acquiring behavioral tactics used in intraspecific competition.
6. Establishing or strengthening social bonds in a pair or the social cohesion of the group.

Foals likely utilize play as a means of exercise, muscle development, social bonding, establishing hierarchies, exploration, and gaining combat experience for future situations where dominance may be tested. Houpt (1997) describes play as accounting for 75% of a foal's daily locomotion, and the most common reason that a young horse will travel more than five meters from its dam's side. Sex differences among foal play behavior include a greater propensity for colts to mount and fight and for fillies to chase

and mutually groom. Nipping of the head and mane, including gripping of the crest, accounted for the greatest number of play sequences (see Figure 14).

Play behavior can be broadly broken into two categories: solitary and social. Solitary play includes circling, galloping, jumping, and manipulating objects. These behaviors are most common in young foals and likely serve the development of physical coordination and object exploration. Social play typically involves combat, chase, and mounting. These mock battles and sexual encounters likely allow an individual animal to develop skills that will eventually assist it in the social hierarchy (Waring, 1983) (see Figure 15).

Brownlee (1984) suggests that the non-serious nature of social play insures that real injury is minimized. The quick engagement that characterizes foal play suggests that not only is the majority of a foal's social time dominated by play, but it could very well be their first reaction to threats, frustrations, or startles. Although foals are born with a range of abilities, their dam initially provides many of their necessities. It would be unrealistic to expect foals to have the ability to have well-developed responses for hostility, confusion, or fear. It is possible that when confronted with a frustrating, uncertain, or ambiguous situation, foals will respond with a modified play behavior in the form of snapping.

### *1.5 Snapping Behavior*

It has been demonstrated that foals are born into a hierarchical social group that is governed by visual cues that communicate rank, intention, and social affiliation. Although foals exhibit a well-developed behavioral skill set within the first hours of



Fig. 11: (a) and (b) present the level of head movement that occurs with snapping. (Crowell-Davis, Houpt, and Burnham, 1985)



Fig. 12: Close up view of teeth baring in snapping. (Waring, 1983)

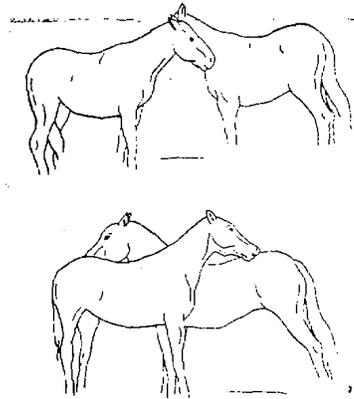


Fig. 13: Two allogrooming postures. (Feist and McCullough, 1976)



Fig 14: Playful nipping. (Fraser, 1992)

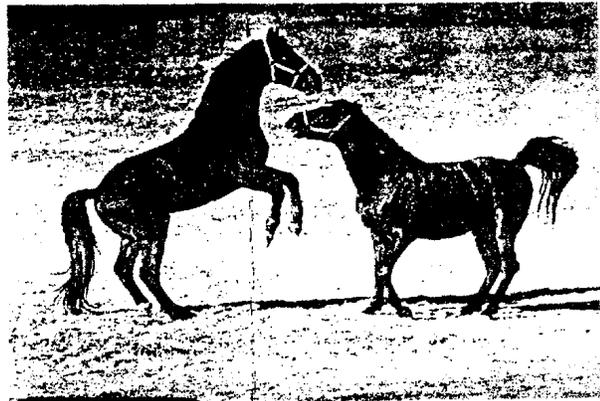


Fig 15: Playful combat. (Waring, 1983)

life, young horses also learn through exploration, play, and social status testing. In this light, one behavior that has been particularly enigmatic is snapping. As discussed earlier, snapping has inspired two theories in regard to its origin: submission and displacement.

Waring (1983) defined snapping as a fearful response exhibited by young horses when approaching or being approached by another horse, large animal, or unfamiliar object. He cited Williams (1974), who noticed that foals reared on milk dispensing machines and isolated from other horses showed snapping at the approach of strange humans but not toward familiar ones. The frequency of snapping directed toward humans was noticeably higher in such foals than foals reared from birth with their dam or with other foals. However, Feist and McCullough (1976) noted a case where an immature male exhibited snapping behavior to a dominant stallion before being attacked. The stallion clamped onto the neck of the juvenile and held him for over a minute. This action seriously questions the notion of the submissive nature of snapping as the stallion was neither appeased nor avoided.

Houpt (1997) also discussed snapping in terms of submission, citing a behavior known as yawning in zebras and donkeys. Yawning occurs in similar approach-avoidance circumstances as snapping, however, estrous donkey and zebra mares are the only animals to exhibit the behavior. Houpt suggests that the same desire to approach but fear of reprisal drives both yawning and snapping as submissive gestures. However, this interpretation has several deficiencies. Foals will snap in situations where they have been standing in the proximity of a horse for some time, as well as on approaches, departures, and even in the absence of another animal. Further, the motor patterns associated with

yawing and snapping are different. Yawing is more physically similar to a flehmen response or yawning action pattern. Finally, there is a temporal difference, in that snapping disappears by three years of age, and yawing does not typically occur until a mare enters estrous at approximately one to two years of age.

Feist and McCullough (1976) utilized six bands of feral horses in Wyoming to conduct behavioral observations focused on social structure and communication patterns both within and between horse herds. The authors found that the most common submissive behavior was for the non-dominant horse to simply move away. However, they also recorded 20 instances of snapping by immature males to dominant stallions and one act of snapping by a yearling male towards a yearling female. Feist and McCullough dismissed the aberrant snapping by a male to female as confusion on the part of the colt due to his age. The study narrated several interactions that led up to and followed the snapping incidents, and came to the conclusion that yearlings would exhibit the behavior as a method of making amends for previously exhibited dominant behavior by the younger horse. This does not fit the definition of submissive behavior, as it was not elicited by an aggressive act directed toward the non-dominant horse (Mills, 1998). It is important to note that the observers attempted to avoid the possible bias of their presence by recording behaviors from a long distance, often aided by the use of binoculars. It is very likely that there were more incidents of snapping that went unnoticed because of the observational limitations of the study.

Wolski, et al.'s (1980) study of mare foal recognition found that foals exhibited snapping during their approach to a choice of two dams on 66.7% of their trials. When

this behavior was directed toward their dam, the reaction from the mare was nosing and acceptance (see Figures 16a, 16b, and 17). However, when snapping was directed toward alien females, the mares exhibited aggressive behavior, with ears pinned back and bite threats. Again, although the behavior was referred to as submissive in the study, the reactions of the non-maternal mares suggest the need for another explanation.

### *1.51 Displacement Theory*

Crowell-Davis, Houpt, and Burnham (1985) offered another characterization of foal snapping behavior. In their study, foals were monitored for the occurrence of snapping behavior and the environmental factors that surround it. As a means of better understanding the purpose of snapping, notes were taken on the foals' age, sex, proximity, spatial orientation, movement pattern, and social interactions. Additionally, observations concerning the animal being snapped to were also recorded. These categories included the participant's age, sex, vocalizations, movement and social interactions before and after a snapping incident, and if there was a presence of agonistic behavior. Snapping was found to occur in a wide variety of circumstances. Six social instances seemed to most commonly elicit snapping: (a) another horse's approach, (b) foal initiated interaction with another horse (often times unsolicited), (c) following aggression toward the subject foal, however not all instances of aggression elicited snapping, (d) courtship of the foal's mother, (e) aggression between horses other than the foal, and (f) during migration.

The researchers came to the conclusion that snapping was not a submissive behavior. Instead, they proposed that snapping is a ritualized nursing behavior that occurs

as a displacement activity in circumstances of conflicting drives or excess excitation. The authors theorized that teeth clapping's similarities with nursing behavior (extended neck, lowered head, and the chomping of the mouth) demonstrated a feeding behavior (see Figures 18,19, and 20). In many species, feeding acts, comfort movements, and resting postures are often utilized when exhibiting displacement activities (Houpt, 1997). This is further corroborated by the fact that nursing declines with age at a similar rate to snapping, while true submissive gestures persist throughout the lifetime (Arnold & Grassia, 1982).

The 'submissive' explanation of snapping was held without question until Crowell-Davis, et al. published their displacement theory of snapping in 1985. This study specifically targeted snapping by foals up to 24 weeks old, and as mentioned, described a range of situations during which snapping occurred. Field descriptions totaled 484 snapping incidents observed through focal samples and ad-lib recordings. Foals snapped to foals 43 times, 14 of which followed an aggressive act by the other foal. On four occasions, the chomping foal was attacked only after the snapping occurred, and there was one incident of two foals snapping to each other at the same time.

In about half (54%) of the total snappings, the foal and other horse were already next to each other (resting, grazing, playing) when teeth clapping occurred. The other half of the snapping incidents consisted of either approaches by the foal (21%) or approaches by the horse being snapped to (24%). In 62% of the cases, when observed for operationally defined signals of agonistic behavior, no aggression was directed toward the foal before, during, or immediately after chomping occurred. In 31% of the cases,

snapping was begun after an aggressive act, while 7% of the snapping incidents elicited agonistic behavior.

Crowell-Davis, et al. reported foals to snap at their own mother on 33 occasions, and ambiguously champed toward their dam and a courting stallion eight times. Of the 443 remaining teeth clapping incidents, 15 were followed by distinct protective aggression by the dam towards whatever horse was being snapped to. Foal behavior after champing was highly variable. The most common post-snapping reaction was for a foal to return to what it was doing (feeding, exploring, playing, etc.) before the snapping incident. However, on 46 occasions, the foal moved away from the targeted horse after tooth clapping. These data provide further evidence that snapping is an important form of communication for foals, but questions the usefulness of characterizing it as a submissive one.

There are, however, some questions that are not effectively addressed with the displacement hypothesis. To begin, Rashek (1976) recorded instances where udder sensitivity led maternal mares to deny foals milk through aggressive behavior toward the offspring. The reaction of the foals was to paw the ground or to paw and kick at their dams. If snapping is indeed a nursing displacement, would this not be the most likely time to observe it? Also, if it is a displacement behavior that affects both genders equally, why do colts snap more often to stallions, while fillies snap equally to both sexes (Crowell-Davis, et al. 1985)? Another unresolved question that arises is why does snapping often occur sporadically when there is no obvious stimulus to elicit any response? And finally, considering the fact that foals are the lowest level in the social



Fig 16: Foal snapping (a) followed by nosing (b) between dam and foal. (Waring, 1983)



Fig 17: Nosing between dam and foal. (Fraser, 1992)

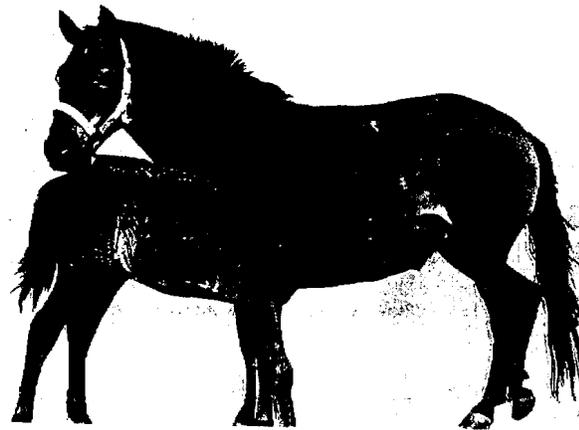


Fig 18: Foal nursing posture. (Fraser, 1992)

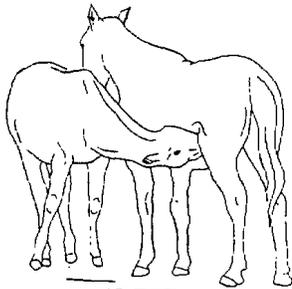


Fig 19: Outline of foal nursing posture. (Feist and McCullough, 1976)

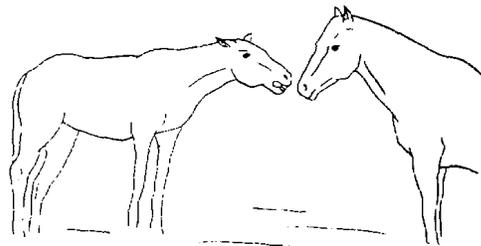


Fig 20: Outline of foal snapping posture. (Feist and McCullough, 1976)

hierarchy, why do foals snap to some non-threatening adults both before and after initial nosing, but often do not snap when presented with stressful conditions? Given these various questions and issues, the notion of displacement seems inadequate in providing a satisfactory explanation of snapping behavior in foals.

### *1.6 A New Hypothesis for Snapping*

This study proposed a new hypothesis regarding a seemingly misunderstood behavior pattern. This proposal suggested that snapping is a response rooted in play behavior and is elicited when foals are presented with an uncertain or ambiguous situation. This view differs from the displacement theory of snapping by including a much wider set of contexts. Displacement occurs when there is over-stimulation and an individual cannot decide which action to take due to a conflict between established opposing drives. However, as stated earlier, snapping often occurs when there is no overt stimulation or environmental factors that would induce such a state.

This hypothesis attempted to account for the multitude of situations in which snapping can occur. A foal that is playing alone can be frustrated by a wide variety of environmental factors or objects and display a snapping response (Tyler, 1969). Foals that are confused by social interactions between their dam and a stallion would snap at both horses, as was seen in Crowell-Davis, et al.'s (1985) observations. Unprovoked aggression from an older horse would also cause snapping (Houpt, 1997). Rather than attempting to limit snapping behavior to submission or displacement, this study proposed that snapping may be a confused communicative behavior that is expressed when a foal is faced with a novel, uncertain, or ambiguous social situation. This would explain why

snapping is most often noted in young foals, and then progressively declines through age. Two-month-old horses snap more often than six-month-old horses because they may have less knowledge of appropriate social responses to the variety of contexts and events present in their social group.

Foals develop in a social environment that is largely dependent on visual communication. As has been discussed, even the most minor posture change can actually serve as a threat of agonistic behavior. As with all social species, learning to maneuver within this complex environment takes a large amount of trial and error experience. Foals spend a great deal of their early life close to their mother, not only for nourishment, but also for protection from hostile conspecifics. Most mammals have a high degree of tolerance for young offspring that exhibit irregular behavior. While this tolerance declines with the age of the young, it also drastically declines when interactions occur between non-related conspecifics.

This proposed view of snapping suggests that foals may experience high arousal when encountering situations and communicative signals that are novel or ambiguous. Snapping would then accomplish two objectives. First, it would release tension through a modified play response and thereby elicit reduced arousal in the presence of conflict (Brownlee, 1984). Second, the foal would get practice at exhibiting a visual communication in response to social cues.

As was stated earlier, play takes up the majority of active time in a foal's life and is a primary method of learning the social rules that horses live by. Foals will often surprise one another with mock attacks, chases, and even hide and seek behavior. It

would then seem plausible that foals encountering confusing or uncertain situations could first exhibit an altered play behavior, as play is their initial source for social education. This is not to say that the foals are attempting to play, if that were the case, then snapping would occur most often between foals. Instead, snapping may be a signal that the foal does not know how to react, and is attempting to respond with a gesture that is familiar.

This study had two goals. The first goal was to examine the validity of the previously held theories defining snapping behavior as either a submissive gesture or a displacement activity. The second goal of the study was to determine if there is a pattern of social situations that show a relationship with snapping displays. These goals were achieved through a testing regime that utilized a combination of demographic information, behavioral observations anchored in operationally defined terms, and forced interaction between conspecifics. The use of staged interactions between foals and conspecifics provided an opportunity to compare the nature and frequency of snapping displays across types of social companions.

## **2.0 METHODS SECTION**

### *2.1 Subject Pool*

The study utilized thirty domestic foals (*Equus caballus*) that included a variety of lineages. Foal breeds included: thoroughbreds, standardbreds, quarter horses, warmbloods, and unknown mixes. The ages of the foals varied from a minimum of two days of age to a maximum of twelve months old. All foals resided on professionally operated horse ranches in Virginia that specialized in breeding, riding instruction, or training. Foal living conditions were dependent on the breed and business focus of the

ranch that owned them. For example, as a means of avoiding any damage to the animal that could decrease its value for sale, thoroughbred foals had limited access to other horses and grazing. In contrast, many quarter horses that were utilized for breeding and recreation were allowed to socially graze freely in pastures. Many of the foals tested spent the majority of their time stabled inside the confines of a barn. Foals kept in this situation had access to auditory communication by conspecifics, but a limited ability to encounter visual signaling. A particular focus of the study was to determine if snapping occurred more frequently in foals that had less social experience.

Social experience was broken down into two independent variables: 'age' and 'out-time'. Age was simply calculated in weeks and divided into three groups: 'low' - (0 to 17 weeks), 'medium' - (18 to 34 weeks), and 'high' (35 to 52 weeks). 'Out-time' was also a variable that was broken down into low, medium, and high levels of social experience. 'Out-time' was established through an internal comparison of the average number of hours per day that each foal had the ability to make visual contact with a conspecific. The measures for 'out-time' included: 'low' - (0 to 8 hours), 'medium' - (9 to 16 hours), and 'high' (17 to 24 hours). The reliability of this measure was supported by the scheduled daily exercise that each farm provided the foals. Foals that were stabled the majority of the day were given set exercise periods that are established through the preference of the stable manager. It was predicted that foals with less social experience ('age' and 'out-time') would perceive social encounters as more novel, uncertain, or ambiguous and thereby show higher levels of snapping intensity.

Greeter horses served as stimulus animals to which subjects were exposed. Greeters encompassed most possible horse types including: colts, fillies, male yearlings, female yearlings, non-related mares, dams, and stallions. As was mentioned earlier, the limitations of what horse types reside on a particular ranch prevented the study from exposing each subject to every type of greeter. However, every foal was tested with a minimum of three horses, and many encountered as many as eight to ten during the course of the study.

## *2.2 Testing Environment*

All testing was conducted in barns composed of multiple stalls and housing a minimum of four horses. While barn size varied, the stall environment between testing sites was relatively uniform. All horses resided in approximately 2.5 m x 3.5 m stalls filled with hay and access to drinking water. Given the business environment of a typical horse farm, every foal and greeter had been habituated to handling and the presence of strange humans. In addition, the observer spent 30 minutes with each foal before the beginning of the overall study as an attempt to familiarize the subject with the observer's presence. Based on this socialization, it was assumed that the presence of an observer would not significantly influence the occurrence of snapping behavior. Snapping was never exhibited toward either the handler or observer.

Stall doors were also relatively uniform between sites. The average stall door was approximately 2.2 m x 1.2 m and split into two doors at roughly 1.1 m from ground level along the horizontal axis. The top door was utilized as a window that the horses could look through. Testing was conducted through the stall window as a means of avoiding

any injury to the foal if the greeter exhibited an agonistic response. Tactile contact such as nosing was allowed, but any bite attempts resulted in interference by the handler. In this case, the trial continued and notes were taken as to the events that transpired.

### *2.21 Pilot Study*

The methods employed in this study were originally developed during a pilot study conducted on a single horse farm in southwest Virginia. The pilot study utilized three foals exposed to three greeters each. The ages of the foals were 9 weeks, 37 weeks, and 48 weeks. The out-times of the foals were 6 hours, 16 hours, and 24 hours respectively. Using a similar testing procedure to the one outlined in this paper, all three subjects snapped during every interaction. The youngest horse averaged 47.9 seconds of snapping per interaction. Correspondingly, the 37 week-old and 48 week-old averaged 20.3 and 18.9 seconds of snapping per interaction. This data suggested that the amount of snapping time reduced with both age and conspecific access. However, due to the fact that there were only 9 interactions, no statistical analysis was employed.

The pilot study proved to be an excellent method of noting difficulties before the collection of analyzable data. For example, it was found that a ‘cool-down’ period of 5 minutes between every interaction was necessary to lower arousal levels and try to keep an effective baseline. Also, the pilot study was essential for discovering the most effective camera positioning for recording the event while still minimizing the influence of the observer’s presence. Finally, the pilot study created the impression that snapping was indeed easily observable and a common occurrence during manipulated interactions between foals and greeters.

### *2.3 Testing Procedure*

Testing began with the handler entering the foal's stall and tethering the animal with a harness and lead. The handler was the individual who spent the most time with the foal and was chiefly responsible for the horse's care and maintenance. The harness consisted of leather or fabric straps that ran around the foal's nose and head, but did not impede vision, audition, or mouth movements. All foals had been habituated to the presence of a head-harness prior to the study. After removal from its stall, the foal was brought to an isolated area of the barn for a minimum of five minutes to allow the foal's arousal level to lower and habituate the subject to the new environment. The foal was judged to be habituated to the presence of the observer after the subject had spent at least 60 continuous seconds (within the initial five minute isolation time) without focusing its attention on the observer. The foal was then led to the entrance of a stall where a conspecific was located.

A hand held video camera recorded all interactions to ensure the accuracy of the data. During the trial, the observer stood two meters away from the interaction and remained still to avoid distracting both the foal and the greeter. Movement of the observer was permitted if it was necessary to get a clear view of the interaction. A trial time of two minutes (as measured by a digital timer) was begun as soon as the foal arrived at the stall window. Although the greeter was not coaxed into an interaction, a combination of the small stall size and the unique situation presented by the experiment elicited the attention of all but one of the greeter horses.

The experimental data were recorded after close review of the videotaped interactions. Observations noted information about the foal, the greeter, and the interaction between the two (see Appendix 1). Relevant data concerning the foal included age, sex, and prior social experience. Information recorded concerning the greeter included sex, age, and relationship to the foal. Snapping was defined as the full or partial retraction of the lips combined with the movement of the mandible in an up and down gesture. The total number of snapping bouts within the two-minute trial time was noted, in addition to the total time spent snapping per trial as measured with a digital stopwatch. Annotations were taken concerning the greeter's reaction both before and after snapping incidents, utilizing operationally defined terms (see Tables 1 and 2) specifying the stereotypes that composed different behaviors. The reaction of the foal after each snapping bout was also recorded using operationally defined terms. If no snapping occurred, the trial was still recorded and behavioral interactions described using the same terms.

After each two-minute trial, the foal was led back to the isolated area of the barn where no interaction with conspecifics was possible for five minutes. This 'cool down' period allowed the foal to relax and engage in feeding, drinking, or play behavior. The purpose of this break was to allow the foal's arousal level to return to base in the case of agonistic or play behavior exhibited by the greeter. Given the subject pool size, each foal encountered as many greeters as possible, but was limited to only one trial per greeter. Foals were tested with each greeter only one time; however, a greeter would encounter more than one foal.

## 2.4 Descriptive Behavioral Observations

Operationally defined behaviors were utilized to record ‘descriptive behavioral observations’ of greeter and foal reactions. These definitions were drawn from a literature review of previous studies of horse social and communicative behavior. To ensure reliability, both the primary observer and a secondary observer (a stable manager) viewed 60 minutes of video taped, non-experimental, foal behavioral interactions. Utilizing a Cronbach  $\alpha$  analysis (Kachigan, 1991), descriptions had to maintain a 90% agreement between the observers in order to be included in the study. Below is a list of behavior descriptions that were used for foal and greeter reactions:

<b>Table 1: FOAL BEHAVIORS</b>	
<i>Snapping (Sn)</i>	Extension of the neck; with retraction of the lips with partial exposure of the teeth; with rapid up and down movement of the mandible.
<i>Aggression (A)</i>	Pinning back of the ears; with bite attempt or front kick attempt.
<i>Submission (Sb)</i>	Attempt to quickly turn away or move away from greeter in a manner consistent with an escape posture.
<i>Withdrawal (W)</i>	Attempt to turn away or move away to conclude interaction with greeter not in a manner consistent with submission.
<i>Play Behavior (P)</i>	Ears in an upright position; with head shaking, rearing, jumping, or mock aggression.
<i>Vocalizations (V)</i>	Snorts, whinnies, grunts, or squeals.
<i>Nosing (N)</i>	Extension of the nose so that nostrils touch and mutual smelling can occur.
<i>Licking (L)</i>	Extension of the nose; with quick licks of the greeter’s mouth, nose and face.
<i>No Interaction (NI)</i>	Foal focuses on other aspects of the situation including the handler, the observer, other horses, or undirected.

<b>Table 2: GREETER BEHAVIORS</b>	
<i>Aggression (A)</i>	Pinning back of the ears; with bite attempt, front kick attempt, rearing, turning to threaten rear kick, or rear kick.
<i>Play Behavior (PB)</i>	Ears in an upright position; with head shaking, rearing, jumping, or mock aggression.
<i>Vocalizations (V)</i>	Snorts, whinnies, grunts, or squeals.
<i>Nosing (N)</i>	Extension of the nose so that nostrils touch and mutual smelling can occur.
<i>Licking (L)</i>	Extension of the nose; with quick licks of the foal's mouth, nose and face.
<i>Flehmen (F)</i>	Rearing of head; with curling of upper lip; with rapid nasal inhalation.
<i>No Interaction (NI)</i>	Greeter focuses on other aspects of the situation including the handler, the observer, other horses, or undirected.
<i>Ignore (I)</i>	Greeter views the presence of the foal, but withdraws and focuses on other aspects of the environment.

### *2.5 Data Analysis*

The data of primary interest in this study were calculated measures of ‘snapping intensity’ (dependent variable) compared to two predictors of social experience (age and conspecific access). ‘Snapping intensity’ was comprised of the total amount of time spent snapping by the subject foal (in seconds) during a single two-minute trial. Snapping does not progress through increasingly intensified stages, so time (in seconds) was utilized to gauge snapping intensity. Measures of ‘snapping intensity’ were compared to the foal’s rating on a social experience scale. Social experience was evaluated through measurements of the average daily time the foal has access to visual communication with conspecifics and the age of the foal.

The initial parametric data analysis utilized continuous data for the ‘age’ and ‘out-time’ measures, but failed to produce any significant results. Due to difficulties with regards to subject availability, wide gaps between the various ‘ages’ and ‘out-times’ showed a non-parametric, categorical perspective to be more effective. Given the lack of background information on the subject of snapping, there was no previous research to establish a proven continuum for either ‘out-time’ or ‘age’. With regards to ‘out-time’, this measure had never been suggested before and it was determined that a simple break down of the 24-hour day into thirds would be the most unbiased method of separating groups. As to ‘age’, the literature review cited a progressive declination in snapping intensity over the first year. However, no previous studies had provided numerical support to establish a rate of snapping reduction over that first year. Again, it was determined that the most effective method of analyzing the data without ‘creating’ results was to break down the year into thirds. While slightly arbitrary, the primary goal of this categorization was to create a timeline that was uninfluenced by the current study’s results. To change the parameters of the categories after the data had been collected would have damaged the integrity of the study.

Access to visual communication or ‘out-time’ was calculated through the average daily time spent outside its stable pen and in view of conspecifics: ‘Low’- (0 to 8 hours), ‘Medium’- (9 to 16 hours), and ‘High’ (17 to 24 hours). ‘Out-time’ was evaluated through a numerical measure (nominal data) employing the following values: High = 3, Medium = 2, and Low = 1. The age of the foal in weeks was used as the second measure of social experience. Age was calculated in weeks and divided into three groups: ‘Low’-

(0 to 17 weeks), 'Medium' – (18 to 34 weeks), and 'High' (35 to 52 weeks). The same numerical measure utilized for 'out-time' was also employed for 'age'. It was assumed that increases in 'age' or 'out-time' would quantify an increase in social experience. A 3x3 (age x out-time) ANOVA was utilized to determine if there was a relationship between snapping intensity and foal 'age', snapping intensity and 'out-time', and any interactions effects between the predictors.

The recorded data outlining 'descriptive behavioral interactions' during the trial were kept as a means of interpreting the statistically analyzed results of 'snapping intensity' and to determine patterns within the context of the social interaction. This behavioral analysis took particular note of interactions that support or refute the theory that snapping is submissive (i.e. presence of aggression, presence of submission, reaction by greeter after snapping has occurred, etc.).

### **3.0 RESULTS SECTION**

#### *3.1 Summary of Results*

This study hypothesized that the level of 'snapping intensity' (dependent variable) would show an inverse relationship with the two chosen predictors of 'social experience' (independent variable) listed as 'age' and 'out-time'. A 3x3 ANOVA was utilized to determine any effects. In addition, descriptive behavioral observations were utilized to gain a more accurate picture of the interactions. These observations were based on the previously described categories and were simply marked as occurring when the behavior presented itself during the two-minute trial.

The study utilized 30 *Equus caballus* foals under the age of 1 year to record 150 interactions. The ages and care-taking regimes of the foals used in the study were determined by subject availability at Virginia horse ranches. This fact created some

**Table 3.**

***NUMBER OF INTERACTIONS PER GROUP***

		Value Label	N
AGE	1	LOW	63
	2	MEDIUM	29
	3	HIGH	58
OUT-TIME	1	LOW	15
	2	MEDIUM	61
	3	HIGH	74

**Table 4.**

***DESCRIPTIVE STATISTICS***

(Mean Snapping Intensity in Seconds, N in Number of Interactions.)

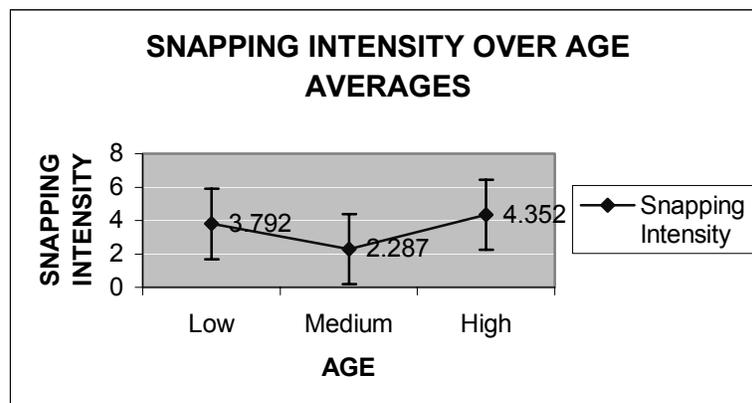
Age	Out-Time	Mean	Std. Deviation	N
LOW	LOW	0.43	1.13	7
	MEDIUM	3.61	7.37	32
	HIGH	0.33	6.72	24
	TOTAL	4.68	7.03	63
MEDIUM	LOW	3.57	6.18	3
	MEDIUM	0	0	9
	HIGH	3.29	5.52	17
	TOTAL	2.30	4.76	29
HIGH	LOW	0.5	1.12	5
	MEDIUM	5.80	8.70	20
	HIGH	6.76	8.61	33
	TOTAL	5.89	8.36	58
TOTAL	LOW	1.08	2.83	15
	MEDIUM	3.80	7.45	61
	HIGH	6.15	7.48	74
	TOTAL	4.69	7.30	150

difficulties with the ‘medium age group’ (17 to 34 weeks) being in shortest supply (29 interactions). ‘Out-time’ (daily availability to conspecifics) was a factor determined by the operational conditions of each individual farm. ‘Low out-time’ (0 to 8 hours per day) was found to have the fewest occurrences, with only 15 interactions falling into this group (Table 3). These constraints resulted in the groups ‘low out-time’/ ‘low age’, ‘low out-time’/ ‘medium age’, and ‘low out-time’/ ‘high age’ being under-represented (Table 4).

### 3.2 Effects of Age on Snapping Intensity

Over the course of the 150 observations, snapping occurred less frequently than would have been expected for interactions between adult horses and foals. Snapping incidents were only witnessed in 71 of the 150 interactions (47%). Using the previously described method for obtaining measures of the dependent variable ‘snapping intensity’, a 3x3 ANOVA (criterion of  $p < .05$ ) was run comparing the effects of the independent variables ‘age of foal’ and ‘out-time’. ‘Age’ (Fig. 21 and Table 5) was found to have no significant effect on ‘snapping intensity’.

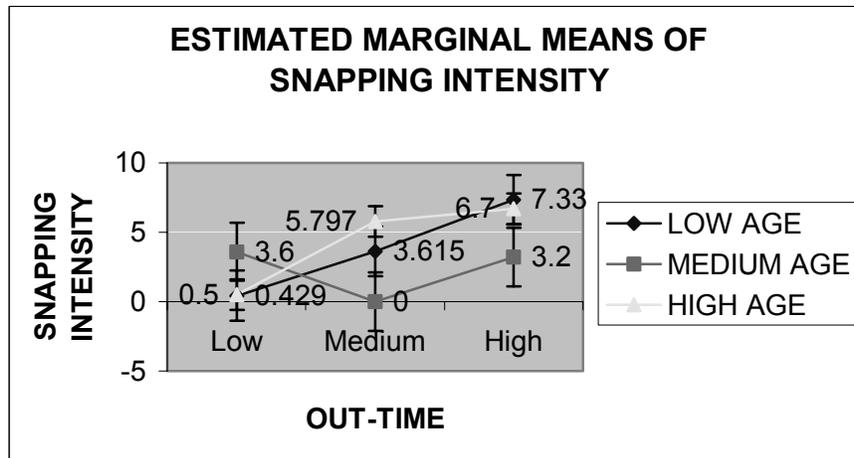
**Figure 21.**



### 3.3 Interaction Effects (Age \* Out-Time)

In addition, the analysis showed no significant interaction effect for ‘age’ \* ‘out-time’ (Table 5). However, inspection of the interaction plot comparing ‘snapping intensity’ over ‘out-time’ (Fig. 22) showed a trend between ‘medium’ and ‘high out-time’ subjects. Table 5 summarizes the results of the 3x3 ANOVA. The most important data center around the independent analysis of ‘out-time’.

**Figure 22.**



**Table 5.**

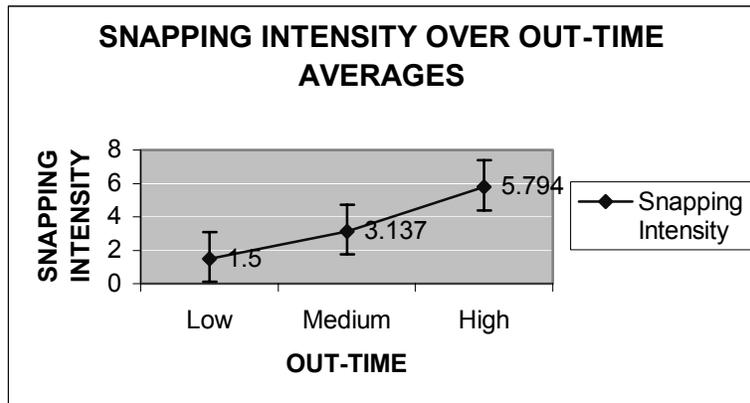
**3x3 ANOVA TABLE**

	Type III Sum of Squares	df	Mean Square	F	Sig.
<b>Model</b>	4113.67	9	457.08	9.06	0
<b>AGE</b>	49.74	2	24.87	0.49	0.61
<b>OUT-TIME</b>	320.35	2	160.18	3.18	0.045
<b>AGE * OUT-TIME</b>	160.86	4	40.22	0.80	0.53
<b>Error</b>	7113.51	141	50.45		
<b>Total</b>	11227.18	150			

### 3.4 Effects of Out-time on Snapping Intensity

Table 5 displays that the 3x3 ANOVA did show a significant effect with the variable ‘out-time’. Figure 23 charts the effects of ‘out-time’ on ‘snapping intensity’. Interestingly, these numbers displayed a positive (not a negative) relationship between the level of ‘snapping intensity’ and the amount of ‘out-time’.

**Figure 23.**



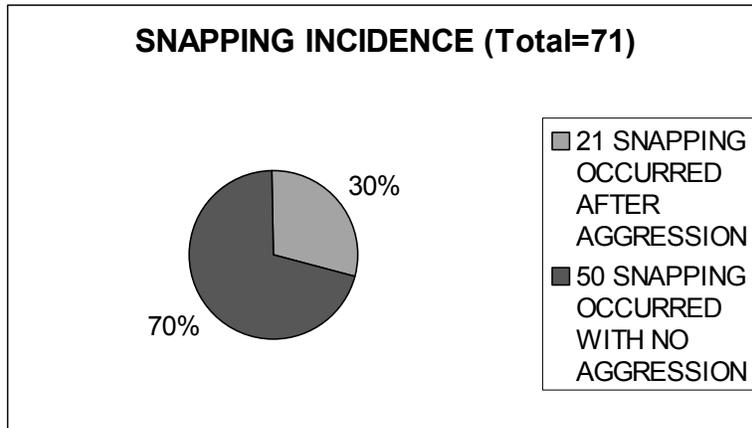
## 3.5 DESCRIPTIVE BEHAVIORAL OBSERVATIONS

### 3.51 Effectiveness of Snapping

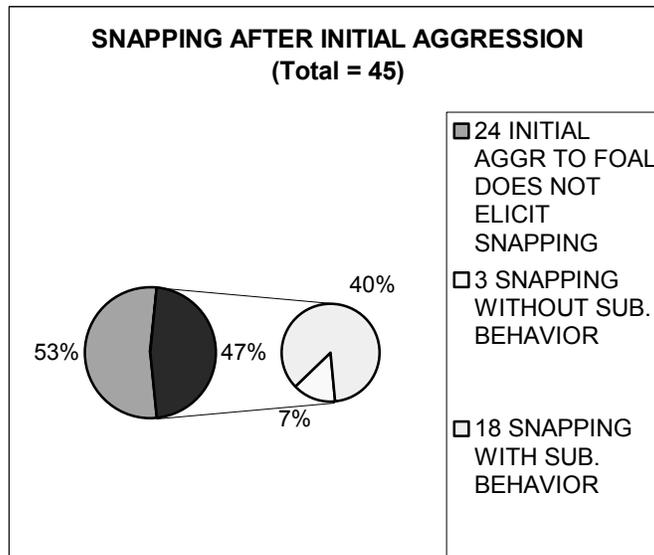
The descriptive behavioral observations provided far more interesting data. As was mentioned earlier, only 65% of the interactions produced snapping behavior. Figure 24 shows that only 30% of these snapping incidents occurred after an aggressive act by the greeter. This same trend is continued from the opposite side when examining the total number of aggressive acts initiated by the greeter. Figure 25 shows that of the 45 initial aggressive acts towards the foals, 47% elicited snapping. However, of these 21 snapping incidents, 18 co-occurred with typical submissive behaviors. Figure 26 further breaks down the ‘initial aggressive acts’ into ‘solely aggressive acts’. ‘Solely aggressive acts’

constituted two-minute interactions during which strictly aggression, and no other behaviors were displayed by the greeter. Of these 19 incidents, snapping occurred 42% of the time.

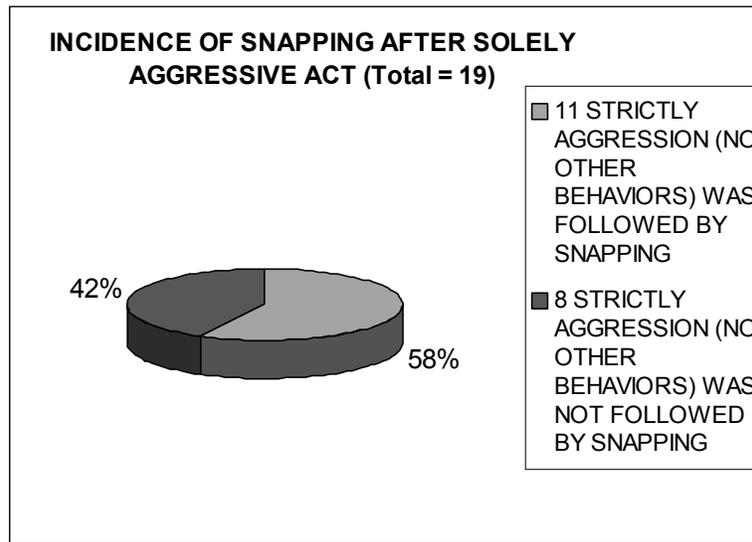
**Figure 24.**



**Figure 25.**



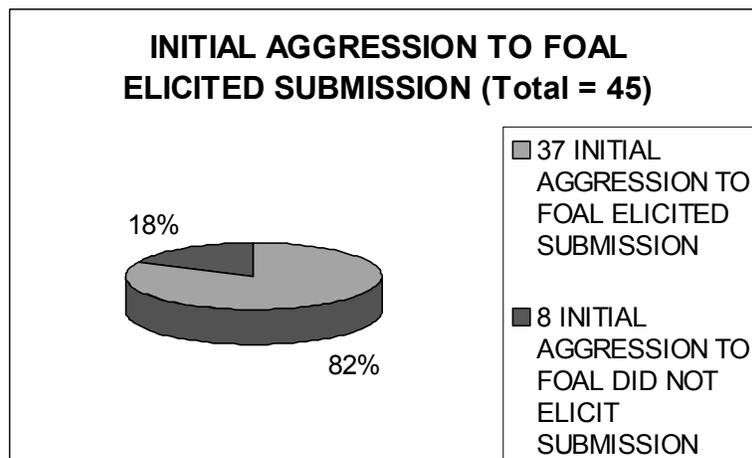
**Figure 26.**



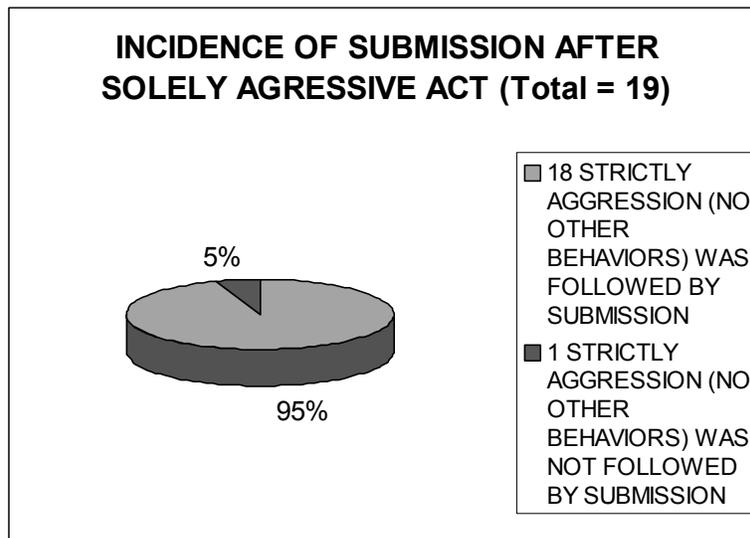
*3.52 Effectiveness of Submissive Behavior*

Conversely, Figure 27 displays that of the 45 initial aggressive acts, 82% elicited submissive behavior (Table 1) in foals. Additionally, 95% of the solely aggressive acts by greeters caused a submissive gesture by foals (Fig. 28).

**Figure 27.**



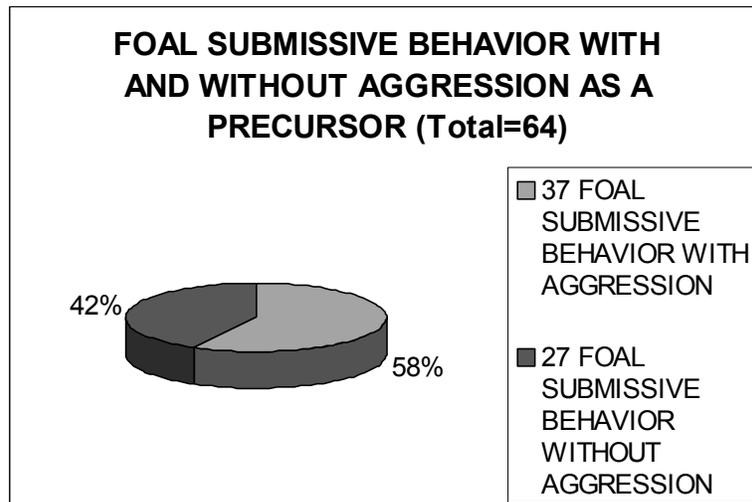
**Figure 28.**



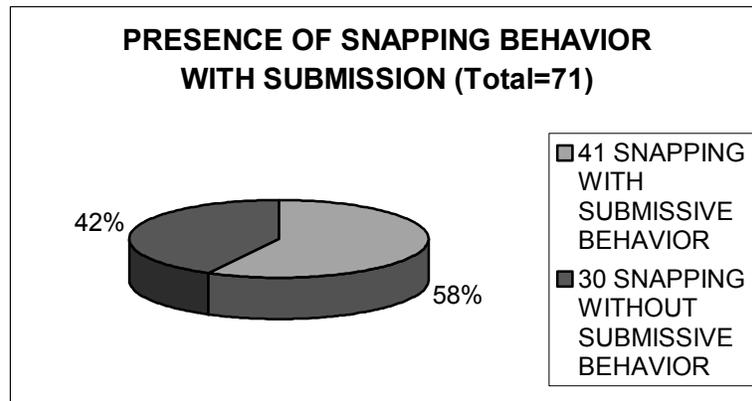
### *3.53 Similarities between Snapping and Submission*

Figure 29 shows that foals displayed submission 64 times and 58% of the submissive acts were in response to aggression. When compared with Figure 24, we see that submission occurred less frequently than snapping overall (snapping comprised 71 incidents), but more often in response to aggression (30% of snapping incidents responded to aggression). Similarly, Figure 30 demonstrates that snapping and submission were paired for 58% of the 71 snapping incidents that occurred over the study.

**Figure 29.**



**Figure 30.**



*3.54 Differences Between Snapping and Submission*

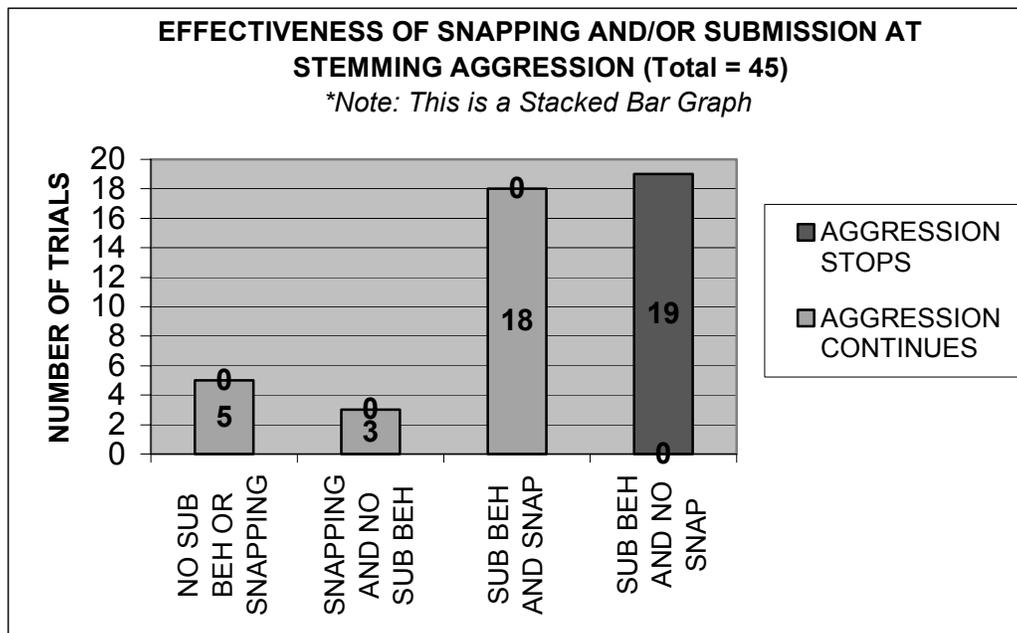
Despite the many similarities between snapping and submissive behavior, the most important data of the study come from the differences. Figure 31 shows the effectiveness of submissive behavior, and the apparently counterproductive effects of snapping to stem attacks. To begin, the graph demonstrates that the subjects who utilized neither snapping nor submissive acts as a means of avoiding attack were never successful

in stopping a greeter's aggression. Additionally, when foals displayed snapping and no typical submissive postures, the greeters' aggression also continued through all 3 trials. Furthermore, when foals utilized both snapping and submissive actions, aggression was still never stymied during any of the 18 two-minute observation periods. However, if only submissive acts were utilized (no snapping), aggression was stopped in all 19 instances.

### 3.55 Other Behavioral Notes

As was mentioned in the methods section, it was important to draw a distinction between 'submission' and 'foal withdrawal'. Figure 32 shows the incidence of withdrawal over the 150 trials (34.7%) and the number of times foal withdrawals

**Figure 31.**

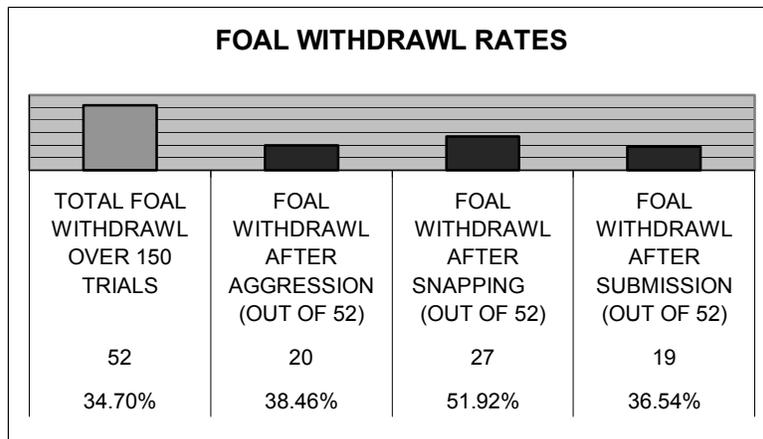


occurred in conjunction with greeter aggression, snapping, and submission. Withdrawal was found to be easy to distinguish from submission. Overall, the withdrawals often

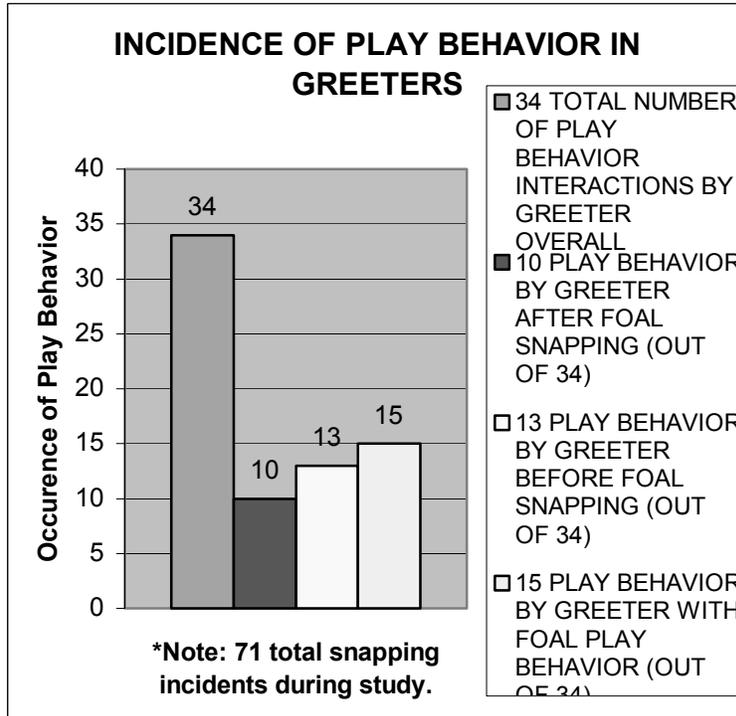
occurred after a period of inactivity and an obvious lack of attention between both the greeter and the foal. This was somewhat common, even after bouts of snapping and aggression. Withdrawal was characterized by either the foal, the greeter, or both animals turning attention to other aspects of the environment and slowly moving away from the stall window.

Figure 33 displays the incidence of play behavior by greeters. It is important to note that play behavior was a response to 24% of the 71 foal snapping incidences. However, play behavior was not observed often in greeters and was most often responded to with play behavior by the foal test subject. Figure 34 displays the incident rate of foal play behavior. Again, play behavior by foals was rarely observed and in the majority of cases it was a response to play signals displayed by the greeter (15 of 29 observations).

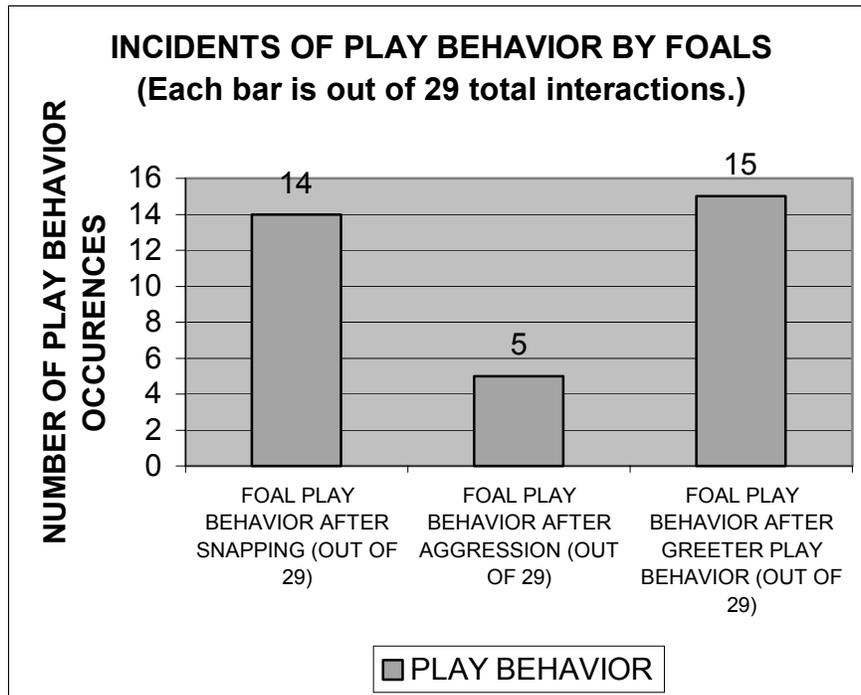
**Figure 32.**



**Figure 33.**



**FIGURE 34.**



## **4.0 DISCUSSION SECTION**

### *4.01 Discussion Summary*

This study attempted to examine three aspects of foal snapping behavior. First, it suggested that the previous theoretical explanation for snapping established by behavioral researchers was incorrect. As was discussed earlier, Zeeb (1959, as cited in Crowell-Davis et al., 1985) set the standard explanation for snapping by suggesting that “Unterlegenheitsgebarde” was a submissive posture rooted in the imitation of allogrooming. This theory was cited often in subsequent studies including Feist and McCullugh (1976), Wolski (1980), Waring (1983), and Houpt (1997). Utilizing videotaped behavioral observation, this project attempted to question the established premise that snapping behavior was a submissive gesture. Behaviors by both the greeter and the foal were catalogued during each two-minute interaction. These behavioral observations were used to describe any behavioral trends, establish the rate and effectiveness of submissive strategies, and catalogue the incidence of play behavior.

Second, as a means of suggesting an alternative hypothesis, this study proposed that snapping behavior could be a modified play response that was elicited when foals were confused by the complex social signals displayed by conspecifics. It was suggested that the incidence of snapping would be inversely correlated to the amount of social experience a foal had encountered. Support for this hypothesis came from the widely accepted theory that play behavior is an essential component in the development of cognitive skills, acquisition of behavioral tactics, and the establishment of social bonds. (Fagen, 1981)

Finally, this project tested the aforementioned hypothesis by recording interactions between foals and conspecifics and analyzing the snapping intensity with each subject's previous level of social experience. There were two indicators utilized to establish social experience. First, the 'age' of the foal was employed as a measure of overall life experience and development. Second, the number of hours per day the foal was exposed to conspecifics gave an effective measure of the amount of time the subject had an opportunity to learn the complex *Equine* visual communication (referred to as 'out-time').

#### **4.1 DESCRIPTIVE BEHAVIORAL DATA**

##### *4.11 Typical Submissive Gestures Versus Snapping*

As was previously cited in the literature review (Tyler, 1972, Boyd, 1980, Mills, 1998), the physical components of snapping do not fit the normal pattern of a submissive behavior. Mills (1998) cited numerous examples of appeasement signals from several species and found that submissive gestures are most often the opposite of a threatening movement. In addition, both Boyd (1980) and Tyler (1972) observed many instances of snapping in feral horses, but failed to see it work effectively as a means of stemming attack.

This study also found a similar effect when looking at the descriptive behavioral observations. Figure 31 compared the four strategies foals utilized to stem attacks from dominant greeters. (See Table 1 for definitions of foal snapping and submission.) The first strategy, utilizing neither submissive behavior nor snapping occurred 5 times (11%) and never stopped the aggression from the greeter. The second strategy, utilizing only

snapping, occurred 3 times (7%) and was never successful. The third method, utilizing both typical submissive behavior and snapping as means of submission, occurred 18 times (40%) and also never worked as an effective means of stemming attacks. However, the final category, the utilization of solely submissive behavior, occurred 19 times (42%) and always stopped the greeters' aggression. These observations suggest that the presence of snapping is not only ineffective as a submissive gesture, but also works to negate the effectiveness of typical submissive behaviors.

Typical submissive behavior was witnessed during 64 (43%) of the 150-recorded interactions. The descriptive data revealed that 37 (58%) of the 64 submissive gestures followed initial aggressive behavior by the greeter (Figure 29). The suggestion that snapping is infrequent as a means of defense can be supported by Figures 25 and 27, which demonstrate that of the 45 acts of initial aggression by greeters, 37 (82%) elicited a submissive behavior while only 21 (47%) elicited snapping. Additionally, Figure 31 shows that 18 (85%) of the 21 snapping incidents after initial aggression coincided with the subjects also displaying submissive gestures. Overall, 41 (58%) of the 71 snapping incidents in this study occurred with the additional presence of submissive behaviors (Figure 30). These data demonstrate that foals were far more likely to display the typical submissive posture than to snap in the presence of aggression. In addition, when foals did snap as a response to aggression, it was very likely that the submissive posture also occurred.

As a means of providing a more precise picture, Figures 26 and 28 display the presence of submission and snapping after the occurrence of solely aggressive acts by the greeter. In most interactions, both animals displayed a variety of behaviors during the

trial time. However, during 19 (12.7%) of the 150 interactions, the greeter displayed no other behavior than aggression towards the foal. These displays, called solely aggressive acts, included attempted kicks, bites, and vocalizations. Figure 28 displays that of these 19 incidents, 18 (95%) resulted in typical submissive gestures by the foals being tested. On the other hand, Figure 26 shows that snapping only occurred 11 times (58%) after solely aggressive acts from greeters.

Figure 24 shows that snapping occurred during 71 (47%) of the 150 trials. Of these 71 incidents, only 21 (30%) occurred after the presence of an initial aggressive act by a greeter. This demonstrates that 70% of the snapping incidents were elicited by something other than a need to stave off an attack. Additionally, Figure 25 shows that these 21 acts of snapping only occurred during 47% of the total number of aggressive incidents demonstrated by greeters. Taken together, these numbers suggest that not only were a minority of the snapping incidents directed towards aggressive conspecifics, but it was used less than half the time as a “submissive strategy” when the foal was in peril.

#### **4.2 PLAY BEHAVIOR AS AN ALTERNATE HYPOTHESIS**

This study has suggested that a possible alternative explanation for snapping was rooted in play behavior. The suggestion of a modified play response seemed plausible when paired with the facts that much social education is rooted in play behavior and that, similar to snapping, play behavior incidents decline with age (Waring, 1983). However, the descriptive data showed no numbers to support these conclusions. Figure 34 outlines the incidence of foal play behavior with greeters. Only 29 (19%) of the 150 observed interactions included a sighting of play behavior by the foal. Within these 29 occurrences,

half were exhibited with snapping and only 5 (17%) occurred in response to aggression. In addition, half of the play behavior incidents were seen in response to play instigated by the greeter. Figure 33 demonstrates that play behavior was observed more often in greeters than foals. Of the 34 incidents, 13 (38%) occurred before foal snapping, 10 (29%) occurred after foal snapping, and 15 (44%) occurred in the presence of foal play behavior.

These numbers suggest that play behavior had virtually no tie to snapping or aggression. The few times that play did occur between greeter and foal, it was usually in response to greeter instigation. When viewed from the stance that snapping occurred in 71 interactions, we see that play behavior only co-occurred 19% of the time. As a result, it is difficult to suggest any support for snapping to be a modified play response besides the inferences outlined in the literature review.

#### **4.3 SOCIAL EXPERIENCE (AGE and OUT-TIME) AND SNAPPING**

Table 3 shows a breakdown of the ‘ages’ and ‘out-times’ (exposure to conspecifics) of the 150 interactions utilized for this study. One of the primary difficulties with this study was the lack of consistency between subjects due to the utilization of foals volunteered by private farms. Only 15 of the interactions utilized foals in the category of ‘low out-time’ and only 29 fell into the ‘medium age’ group. This was unfortunately unavoidable, as the care taking practices and birth dates were outside research control. Table 4 further demonstrates this difficulty when both ‘age’ and ‘out-time’ were compared. The previously mentioned groups (‘low out-time’ and ‘medium age’) were further depleted with additional sub-categorizations. The most extreme example was the

combination of the two. Only 3 interactions involved foals that were both ‘low out-time’ and ‘medium age’. These numbers are reflected in some of the results, but did not skew the entire study.

Figure 21 and Table 5 show the effects of ‘age’ on ‘snapping intensity’. The graph shows that there was no decrease in ‘snapping intensity’ with increased ‘age’. In fact, the highest levels of ‘snapping intensity’ occurred with the oldest ‘age’ group. This does not support the hypothesis that increased social experience would lead to decreased snapping as the foals gained knowledge and experience with intraspecific communication. This is further corroborated by the 3x3 ANOVA results that displayed no significant effects when utilizing the variable ‘age’.

This trend was continued when 3x3 ANOVA interaction effects (Table 5) were computed using both ‘age’ and ‘out-time’. Levels were far outside the ( $p < .05$ ) level set at the beginning of the study. However, Figure 22 did show interesting patterns, demonstrating that the group with the lowest number of interactions proved to go against the overlying pattern. The ‘medium age group’ had far fewer interactions than either the ‘low’ or ‘high age groups’ (Table 3). As Figure 22 shows, there was a trend showing increased ‘snapping intensity’ with ‘out-time’ in both the ‘low’ and ‘high age groups’. However, the ‘medium age group’ showed very different results and nullified any significant effects. Given the fact that there were so few ‘medium age’ interactions (Table 3), it would be interesting to see if the pattern exhibited would continue with more interactions. Overall, these results showed the opposite effects as was hypothesized in the introduction. Instead of an inverse relationship, increased social experience showed a higher score in ‘snapping intensity’.

The only significant findings in this study were related to ‘out-time’. Figure 23 shows that ‘snapping intensity’ clearly increased with increased daily access to conspecifics. The 3x3 ANOVA found a significance level of .045 for ‘out-time’ (Table 5). It is important to note that this study showed a positive relationship for ‘out-time’ and ‘snapping intensity’. Although this was significant, it went counter to the originally suggested hypothesis that there would be a negative correlation between ‘snapping intensity’ and both ‘age’ and ‘out-time’.

## **5.0 CONCLUSION**

On the whole, the study was successful in one aim, but proved inconclusive in the other two. The descriptive behavioral data clearly showed that snapping was not an effective submissive behavior. It was rarely used as a defense against aggressive behavior and actually nullified the effectiveness of typical submissive postures when displayed in tandem. Combined with the evidence of previous studies and the behavioral literature review, this study casts some doubt on the currently accepted explanations for foal snapping behavior. However, the suggestion that snapping is a modified play response to confusing communicative displays was not supported by the behavioral descriptions or the statistical analysis presented in this study. Instead only more questions were uncovered. First, if snapping is not an effective method of submission, why does it ever occur (even rarely) during acts of aggression by higher-ranking conspecifics? Second, why would the behavior actually increase with longer hours of daily conspecific contact? Finally, what purpose does snapping serve foals, individuals that fall on the lowest rung of the *Equus caballus* social hierarchy, but not to

horses over the age of two years? Future research in field of Equid behavior will likely shed more light on snapping behavior and the questions that surround it.



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