



Adults may be used to alleviate weaning stress in domestic foals (*Equus caballus*)

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ABSTRACT

The present study aims to investigate whether the presence of unrelated adult horses at weaning would reduce the social stress of weaning and the emergence of undesirable behaviours. We tested this hypothesis in 32 domestic foals by comparing short and medium term behavioural and physiological responses to weaning in foals maintained in homogeneous groups of peers (PW) to those of foals grouped with both peers and unrelated adults (AW). In total, three trials were conducted, which each trial consisting of one AW group and one PW group. In all foals, weaning was followed by increased vocalization, increased locomotion and increased salivary cortisol concentration. However, signs of stress were less pronounced and shorter in duration in weanlings housed with unrelated adults (e.g. whinnies: $p < 0.05$; salivary cortisol: $p < 0.05$). Only foals without adults exhibited increased aggressiveness towards peers ($p < 0.05$) and abnormal behaviours ($p < 0.05$) such as excessive wood-chewing and redirected sucking towards peers. In conclusion, introducing adults to minimize weaning stress in foals and later on aggressiveness and abnormal behaviours appears as the most promising approach to date.

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1. Introduction

Mother–young relationships in mammals undergo different stages, amongst which weaning (i.e. no suckling anymore) is a progressive process, most often under the mother's "control" at its final stage, but resulting also in a gradual reduction in milk intake combined with increasing social independence from the mother and increasing intake of solid food (e.g. pigs: [1]; sheep: [2]; for a review: [3]). Weaning of young from maternal milk occurs at variable ages according mainly to the timing of arrival of the mother's next offspring. Mother–young relationships do not usually fade away completely after the end of the suckling period and may persist beyond the birth of subsequent offspring (e.g. cattle: [4]; horse: [5]). For instance, ewes are reported to maintain associations with their lambs for up to 2.5 years, long after weaning and birth of subsequent young [6].

In domesticated mammals, the young are generally separated abruptly and permanently from their mothers at much younger ages than in the wild. Therefore, artificial weaning involves both a nutritional and social change. The young is also faced with changes in social (e.g. isolation, mixing with unfamiliar peers) and physical (e.g. confinement, moving to an unfamiliar enclosure) environments.

In farmed animals, weaning under such conditions results in high levels of stress (for a review: [7]). The behavioural response (e.g. distress vocalizations, high activity) typically peaks within the first two post-weaning days, but other behavioural changes such as altered feeding and sleep patterns, aggressiveness and suspension of play, may be observed for much longer periods. Many animals also experience elevated glucocorticoid levels, changes in heart rate and core body temperature, as well as a decline in growth rates, often losing body weight for several days after weaning (e.g. rabbits: [8]; lambs: [9]; horses: [10]; for a review: [3]). Lastly, artificial weaning may result in the emergence of abnormal or stereotypic behaviours in young animals (e.g. belly-nosing in piglets: [11]; pacing and tail biting in farmed mink: [12]; cross-suckling in calves: [13]) stemming from frustration (e.g. frustrated motivations to suckle or to receive other forms of maternal care, to escape; [14]). Some of these abnormal behaviours may persist long after young animals have recovered [14]. These pronounced behavioural and physiological responses form an obvious welfare concern for these animals and over the past two decades, a considerable amount of research has been devoted to reducing the stress of weaning by altering management practices.

The present study focuses on weaning of foals, as in horses a selective mother–young bond is established soon after parturition and remains strong until pubertal stages. Foals are highly dependent on their dams at early developmental stages, but with increasing age, they behave more and more independently (for a review: [5]). After 3–4 weeks of age, foals progressively share their social activities between the dam

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and other social partners and start to spend more time at larger distances from their dams [15,16]; suckling also decreases from a rate of 4–7 per hour at 1 month of age to 1–2 per hour at the age of 6 months [17,18]. In natural conditions, weaning occurs around one year of age, shortly before the birth of the next foal. Even after weaning has occurred the mare and foal retain integral close social bond and the foal will often remain in the natal group until sexual maturity [15,19]. Under domestic conditions, weaning is often abrupt and tends to take place earlier, typically between 4 and 6 months of age (for a review: [10]) and feeding practices and housing may be drastically altered. Artificial weaning is therefore commonly recognized as a source of emotional, physical and physiological stress [20–26]. Such a stressful impact has been highlighted using behavioural indicators, such as the increase in whinnies and general motor activity [20,22,25]. Physiological measures in foals, taken 28 h after weaning, also showed an increase in plasma cortisol concentrations and a subsequent decrease in immune response [23]. In the days or weeks post-weaning, abnormal behaviours may develop [27,28].

Different approaches have been investigated in order to reduce undesirable effects of weaning in foals. Both feeding and housing conditions have been demonstrated to be important (e.g. [10,25–29]), as low foraging opportunities [27,28] and confinement [20,27,28] in a box promote the development of abnormal behaviours, amongst other disorders. Equally essential are social conditions and pair [20] or grouped housing [27] results in lower indicators of stress in weaned foals. However, when foals are grouped with peers they exhibit elevated levels of aggressive behaviour [25] or redirected sucking that may lead to wounds [25]. As foals develop in a rich and varied network of social relations in natural conditions [19], where adults play a major role in attenuating aggressive behaviours [30,31], one can hypothesize whether the presence of adults at weaning would not be more appropriate than weaning solely with same-age peers.

In the present study, we hypothesized that the presence of unrelated adult horses at weaning would reduce the social stress of weaning and help avoid the emergence of undesirable, abnormal behaviours. Two pilot studies have suggested that the progressive removal of dams in a group of mare–foal dyads minimizes the stress of weaning, maybe because of the presence of older conspecifics [26,32]. Here, we tested this idea by comparing short and medium term behavioural and physiological responses to weaning in foals maintained in homogeneous groups of peers to those of foals grouped with both peers and unrelated adults.

2. Materials and methods

Subjects were thirty-three foals (*Equus caballus*), including 12 colts and 20 fillies. All animals were observed prior to weaning and through one month post-weaning.

2.1. Study site and animals

This study was conducted in two sites which differed mainly in the breeds present and the age at which weaning was performed. All management practices followed farm standard operating procedures. All foals from the same stud farm were housed under the same conditions from birth to 2 weeks prior to weaning.

2.1.1. Farm 1

A pilot study was conducted at September to October 2004 at the “MSU Horse Teaching and Research Center” from the Michigan State University (USA) on ten Arabian foals, 5 colts and 5 fillies, all born on the study site (Table 1). Foals were kept with their dams in 3 m × 3 m box stalls. The stalls were bedded with wood shavings and contained a feeder and an automatic drinker. Animals were fed concentrate pellets and alfalfa hay according to National Research Council recommendations (1989). Foals and mares were turned out for a few hours per day in individual paddocks until the age of 3 months and afterwards on pasture with all the other mare–foal pairs until the beginning of the study. All foals were weaned at the age of 4.5 months, in agreement with USA farm standard operating procedures.

2.1.2. Farm 2

The “Station expérimentale de Chamberet”, managed by the National French Studs is located in Correze (France). Twenty-three foals, 8 colts and 15 fillies, all born and housed at the experimental station, were used from October to December 2006. They were all Anglo Arabs or French Saddlebreds (Table 1). Foals were housed with their mares in individual 4 m × 4 m boxes during their first three days of life and were kept afterwards until weaning in a large pasture (1–2 ha) as a group with all the other mare–foals dyads until the beginning of the study. Water and forage were provided ad libitum. All foals were weaned when they were 7 months old which is a common practice in France.

2.2. Description of treatment groups

At both sites and at least two weeks prior to weaning, foals were divided into experimental and control groups, balanced for gender, age and sire (Table 1): in the control groups, foals were maintained after weaning in same-age groups (PW: Peer Weaned), while in the experimental groups two unfamiliar adult horses were introduced within 15 min following the removal of all mares (AW: Adult Weaned). At farm 1, one PW group ($n_{PW1-1} = 5$) and one AW group ($n_{AW1-1} = 4$) were constituted. At farm 2, four balanced groups, 2 PW groups ($n_{PW2-1} = 6$, $n_{PW2-2} = 6$) and 2 AW groups ($n_{AW2-1} = 6$, $n_{AW2-2} = 5$),

Table 1
Description of animals and groups of both farms: number, sex and breeds.

Farm	Farm 1		Farm 2			
	Adult weaned	Peer weaned	Adult weaned	Peer weaned	Adult weaned	Peer weaned
Group code	AW1-1	PW1-1	AW2-1	PW2-1	AW2-2	PW2-2
Number of males	3	1	3	3	1	1
Number of females	2	3	3	3	4	4
Total	5	4	6	6	5	6
Breed (number of foals)	Ar (5)	Ar(4)	AA (5) SF (1)	AA(4) SF (2)	AA(4) SF (1)	AA(5) SF (1)
Birth date	04/09/04–05/29/04		03/17/06–04/12/06		04/13/06–05/05/06	
Age at weaning (days)	138.0 ± 6.6	132.2 ± 5.3	204.0 ± 4.3	204.3 ± 3.3	201.6 ± 4.9	203.2 ± 3.0
(months)	4.6 ± 0.2	4.4 ± 0.2	6.8 ± 0.1	6.8 ± 0.1	6.7 ± 0.2	6.8 ± 0.1
Adults (age in years)	2 mares (18, 21)	/	1 mare (13) and 1 gelding (11)	/	1 mare (13) and 1 gelding (11)	/

Legend: AA = AngloArab, Ar = Arab, SF = French Saddlebred; for the group code: AW = “Adult-weaned” group, PW = “Peer-weaned” group. The first number indicates the site (1 = farm 1, 2 = farm 2), the second the numeral of the group.

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