LOCOMOTOR, VOCAL AND OTHER BEHAVIORAL RESPONSES TO VARYING METHODS OF WEANING FOALS

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ABSTRACT


Behavioral responses to weaning were studied in 21 foals assigned to one of five treatments: (1) abrupt, total separation of mare and foal, no pre-weaning creep feed (TSNC); (2) total separation but with creep feed (TSC); (3) partial separation of mare and foal allowing fence-line contact, no pre-weaning creep feed (PSNC); (4) partial separation but with creep feed (PSC); (5) control (CON), no separation of mare and foal with creep feed. Foals were observed for 5 h immediately after weaning. Vocalization frequency and times of the following behaviors were recorded: lying down; standing still; walking; trotting; cantering. The TSNC foals spent more time walking than PSNC, PSC or CON foals, and spent less time standing still than foals on all other treatments. The TSC, PSNC, PSC and CON foals spent more time standing still than walking. There were no significant treatment effects on times spent lying down or cantering, but TSNC foals tended (P < 0.06) to spend more time trotting than other foals. The PSC and CON foals were not different in locomotor patterns, indicating that during weaning PSC foals utilized the same patterns of activity behavior as unweaned foals, and weaning stress was apparently minimal. Data from the weaned foals (CON excluded) indicated partial separation resulted in less post-weaning activity in foals than total separation, and access to pre-weaning creep feed resulted in less activity than no pre-weaning creep feed. Treatments were not significantly different in mean times spent lying down, trotting or cantering. Total vocalizations ranged from 0 to 722. Foals on PSNC, PSC and CON treatments vocalized less (P < 0.05) than TSNC or TSC foals. Foals weaned by total separation treatments vocalized more (P < 0.001) than those weaned by partial separation. Pre-weaning feeding management did not affect (P > 0.05) vocalization frequency during weaning. All weaned foals exhibited aggression toward other foals, pawing and non-nutritional sucking of other foals. Non-nutritional sucking started within 2 h post-weaning and was observed up to 2 weeks post-weaning. Results of this study showed that foals weaned by means of a partial separation management system exhibited fewer signs of stress than those weaned by abrupt separation.

INTRODUCTION

Several systems of artificially weaning foals are practical in the horse industry and most suggest abrupt separation of mare and foal. In many
conventional weaning management systems, foals are vaccinated, de-wormed and halter-broken during weaning, which multiplies potentially stressful situations. Some management systems do not allow foals access to creep feed prior to weaning and following weaning, foals do not readily consume enough feed to meet their nutrient requirements. These situations are potentially very stressful and may lead to sickness, injury and economic loss.

This study was conducted to examine behavioral responses of foals weaned by varying management systems as a potential indication of stress incurred by foals at weaning time.

EXPERIMENTAL PROCEDURE

Twenty-one Quarter Horse foals were used in this study. All foals were handled prior to weaning to facilitate data collection and to ensure data collection itself would not be an extraneous source of stress. Handling began at birth and continued twice weekly until the foal was 2 months of age. Each handling session lasted approximately 15 min and consisted of catching and rubbing the foal while it was stalled with its dam. All foals were vaccinated and de-wormed 1 month prior to weaning.

Foals were blocked by sex and birth-date and randomly assigned to one of five different weaning management regimes in a randomized, blocked design with two main effects; separation method and pre-weaning feeding management. Weaning management regimes (treatments) were as follows:

- **TSNC** — Abrupt complete separation of mare and foal; no pre-weaning creep feed ($n = 5$)
- **TSC** — Abrupt complete separation of mare and foal; foals with pre-weaning creep feed ($n = 4$)
- **PSNC** — Partial separation of mare and foal allowing visual, auditory and olfactory contact; no pre-weaning creep feed ($n = 5$)
- **PSC** — Partial separation of mare and foal allowing visual, auditory and olfactory contact; foals with pre-weaning creep feed ($n = 4$)
- **CON** — Controls; no separation of mare and foal; foals with pre-weaning creep feed ($n = 3$)

All foals were weaned at 4 months of age. Mares and foals were maintained on pasture prior to weaning. In TSNC and PSNC treatments, mares were fed their concentrate ration from buckets situated 1.5 m high on posts to prevent foals from eating their dams’ feed. In TSC, PSC and CON treatments, mares were fed their concentrate ration from feeders on the ground. Foals on these treatments could eat their dam’s feed and also had access to additional feed provided free choice in a 4 m x 4 m creep feeder (16% crude protein commercially available diet$^1$).

During weaning, all foals were placed in mesh wire pens approximately 15 m x 15 m with 1.2-m high fences. After placing the foal in the weaning

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$^1$Cargill-Nutrena Feeds, Giddings, TX, U.S.A.
pen, dams in TSNC and TSC treatments were moved so that their foals could not see, hear or smell them. Dams in PSNC and PSC treatments were put in pens adjoining the foals' weaning pens. Fence-line contact between these mares and foals was permitted for 7 days following weaning, then dams were moved where their foals could not see, hear or smell them. In CON treatments, both foal and dam were placed in the same pen. All foals were kept in the weaning pens for 14 days following weaning, then were turned out to pasture. Mares and foals from the CON treatment were also kept in the weaning pens for 14 days before being turned back to pasture. This ensured that CON foals were exposed to the same surroundings and experiences, except actual weaning, as weaned foals. Foals were always weaned in pairs or triplets to ensure any observed behavioral changes resulted from weaning rather than from isolation. Weaning always started between 07.00 and 10.00 h.

Each foal was observed for 5 h immediately following weaning. This 5-h time-span was determined by watching the first 2 groups of weaned foals for 18 and 14 h, respectively. Five hours was determined to be sufficient time to detect behavioral differences among foals on various treatments.

Time spent in the various patterns of activity behavior (lying down, standing still, walking, trotting and cantering) was recorded during the observation period. Number and type of vocalizations were counted for each foal. Occurrences of other behaviors such as aggression, pawing, non-nutritional sucking and playing were also noted. Behavioral data were analyzed for each hour of observation to investigate hourly differences after weaning. Analysis of variance in a randomized blocked design with treatment and sex as sources of variation were used in data examination from weaned and non-weaned (CON) foals. Least squares means of behavioral characteristics were compared using Duncan's new multiple range test (Steel and Torrie, 1980) only if the treatment F statistic was significant ($P < 0.05$). When the $F$ statistic for weaning treatment was significant, effects of separation method and creep feed on post-weaning performance of weaned foals (CON treatment excluded) were examined by analyses of variance in a $2 \times 2$ factorial analysis. Relationships among behavioral characteristics were studied using simple correlation analyses.

RESULTS AND DISCUSSION

**Locomotor patterns**

The amount of time foals on each treatment spent standing still or walking are shown in Table I. Foals on TSNC treatment spent less time ($P < 0.05$) standing still than foals on other treatments. The TSC and PSNC treatments did not differ ($P > 0.05$) in mean time standing still, and these foals stood still significantly longer than TSNC foals. The lower activity levels of TSC and PSNC foals indicates they were less upset during weaning than TSNC foals, and suggests that provision of pre-weaning creep feed or partial
contact with the dam may off-set some stress involved in separation of mare and foal. The PSC and CON foals stood still significantly longer than foals on other treatments. The CON foals were assumed to exhibit locomotor patterns typical of unweaned and non-stressed foals, and they spent the majority of their time standing by their dams. The PSC foals also spent the majority of their time standing within 4 m of their dams in the adjoining pen. The PSC foals did not differ ($P > 0.05$) from CON foals in their locomotor patterns, indicating the PSC weaning method allowed foals to maintain locomotor patterns they utilized prior to weaning.

**TABLE I**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Standing still</th>
<th>Walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSNC</td>
<td>93.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>182.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>TSC</td>
<td>162.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>118.8&lt;sup&gt;a,b&lt;/sup&gt;</td>
</tr>
<tr>
<td>PSNC</td>
<td>175.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>108.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>PSC</td>
<td>272.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>27.5&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>CON</td>
<td>283.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.8&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>S.E.</td>
<td>9.0</td>
<td>9.1</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup>Column means with different superscripts differ ($P < 0.05$).

Mean walking times (Table I) for the TSNC and TSC foals were not significantly different. Walking in these treatments seemingly contained an et-epimeletic component. These foals often vocalized while walking around the perimeter of the weaning pen and then turned quickly around and walked or trotted in the opposite direction while vocalizing. Answering vocalizations or visible movements of unrelated adult horses caused an immediate orientation in these foals to the direction of the sound or movement. This orientation movement was not observed in other treatments. The TSC treatment did not differ from the PSNC treatment, again suggesting that pre-weaning creep feed or partial contact with the dam may off-set some stress involved in weaning. The PSC and CON foals did not differ in mean walking times and spent significantly less time walking than those from the other treatments.

Table II shows mean times foals on each treatment spent lying down, trotting and cantering. Treatment did not significantly affect times foals spent lying down and cantering, but differences in mean trotting time approached significance. Although time spent lying down was not significantly affected by treatment, treatment differences in lying postures were observed. The PSNC, PSC and CON foals spent much of their lying time in lateral recumbency. In contrast, TSNC and TSC foals would lie in sternal recumbency but were not observed for any length of time in lateral recumbency. Their lying bouts usually consisted of lying down, rolling and then
TABLE II

Least squares means of times (min) foals spent lying down, trotting and cantering

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Lying down</th>
<th>Trotting</th>
<th>Cantering</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSNC</td>
<td>0.0</td>
<td>22.9</td>
<td>1.3</td>
</tr>
<tr>
<td>TSC</td>
<td>2.5</td>
<td>16.3</td>
<td>0.0</td>
</tr>
<tr>
<td>PSNC</td>
<td>8.3</td>
<td>6.3</td>
<td>1.3</td>
</tr>
<tr>
<td>PSC</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>CON</td>
<td>12.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>S.E.</td>
<td>3.1</td>
<td>3.9</td>
<td>0.3</td>
</tr>
</tbody>
</table>

1Effect of treatment on trotting time approaches significance ($P < 0.06$).

TABLE III

Least squares means of times (min) foals of each sex spent in the various locomotor modes

<table>
<thead>
<tr>
<th>Locomotor mode</th>
<th>Colt</th>
<th>Filly</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying down</td>
<td>9.3</td>
<td>0.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Standing still1</td>
<td>216.4</td>
<td>179.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Walking2</td>
<td>68.7</td>
<td>107.5</td>
<td>9.1</td>
</tr>
<tr>
<td>Trotting</td>
<td>5.6</td>
<td>12.5</td>
<td>3.9</td>
</tr>
<tr>
<td>Cantering</td>
<td>0.1</td>
<td>1.0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

1Effect of sex of foal on time spent standing still approaches significance ($P < 0.07$).
2Effect of sex of foal on time spent walking approaches significance ($P < 0.06$).

spending 1–4 min in sternal recumbency before standing. These differences in lying posture may reflect levels of relaxation or anxiety in the foals. Houpt (1980) suggests paradoxical sleep occurs only during lateral recumbency in the horse. A calm, secure environment is apparently required before a horse will lie in lateral recumbency. Lack of paradoxical sleep could be an important factor involved in weaning stress, since foals sleep more frequently than adult horses (Houpt, 1980) and since hormone releases (notably growth hormone) and cell division are intricately related to the sleep cycle (Tepperman, 1980).

Table III shows mean times foals of each sex spent in the various patterns of activity behaviors. Sex of foal did not significantly affect any locomotion mode, but did influence times foals spent standing still ($P < 0.07$) and walking ($P < 0.06$). Colts tended to stand still longer and walk less than fillies. This tendency may reflect variations in stress perception, emotionality, maturation rate or mobility between the sexes (Critchlow et al., 1963; Gray, 1971; Brain, 1972).

Times the weaned foals (CON excluded) spent standing still or walking were significantly affected by both separation method (Table IV) and access
TABLE IV

Influence of separation method on times (min) weaned foals spent standing still and walking

<table>
<thead>
<tr>
<th>Separation method</th>
<th>Standing still</th>
<th>Walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>128.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>149.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Partial</td>
<td>230.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>61.8&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>S.E.</td>
<td>13.6</td>
<td>13.4</td>
</tr>
</tbody>
</table>

*Values are least squares means.
<sup>b,c</sup>Column means with different superscripts differ (P < 0.01).

TABLE V

Influence of pre-weaning feeding management on times (min) weaned foals spent standing still and walking

<table>
<thead>
<tr>
<th>Feeding management</th>
<th>Standing still</th>
<th>Walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>No creep</td>
<td>141.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>138.5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Creep</td>
<td>217.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>73.1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>S.E.</td>
<td>13.6</td>
<td>13.4</td>
</tr>
</tbody>
</table>

*Values are least squares means.
<sup>b,c</sup>Column means with different superscripts differ (P < 0.01).

to creep feed (Table V). Foals on total separation weaning methods spent more time walking and less time standing still (P < 0.01) than foals on partial separation weaning methods. Foals without access to pre-weaning creep feed also spent more time walking and less time standing still (P < 0.01) than foals with pre-weaning creep feed.

**Vocalizations**

Total vocalizations for each foal ranged from 0 to 722 during the 5-h observation period. Mean vocalizations for each treatment during each hour of observation are shown in Table VI. During the first, second and fifth hour post-weaning, TSNC and TSC treatments elicited higher vocalizations (P < 0.05) than other treatments. During the third and fourth hour post-weaning, TSNC treatment caused more vocalizations than any other treatment. During each hour of observation, PSNC and PSC treatments did not differ significantly from the CON treatment, indicating that foals on these treatments had vocalization frequencies similar to unweaned foals.

Vocalizations of the weaned foals (CON excluded) were affected (P < 0.001) by separation method, with total-separation foals vocalizing more frequently than partial-separation foals (Fig. 1). Foals on the partial separation weaning method vocalized most often during the first hour post-wean-
TABLE VI

Least squares means of vocalizations of foals during each hour

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSN C</td>
<td>97.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>123.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>97.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>85.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>TSC</td>
<td>93.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>128.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>66.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>53.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>P8NC</td>
<td>3.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.7&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>PSC</td>
<td>16.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>CON</td>
<td>1.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>S.E.</td>
<td>7.8</td>
<td>9.5</td>
<td>4.1</td>
<td>3.9</td>
<td>2.8</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup>Column means with different superscripts differ ($P < 0.05$).

ing (87 vocalizations) and their vocalizations decreased steadily during the observation period, with only 22 vocalizations occurring during the fifth hour post-weaning. Total-separation foals vocalized most during the second hour after weaning. After the second hour post-weaning, vocalizations of total-separation foals decreased steadily but remained substantially higher

![Fig. 1. Total vocalizations during each hour post-weaning for weaned foals on each separation method.](image-url)
than those of partial-separation foals through the 5 h of post-weaning ob-
observation.

Access to pre-weaning creep feed did not affect ($P > 0.05$) number of
vocalizations during any hour of observation.

All vocalizations recorded were whinnies, which are considered to be
distress calls (Tyler, 1972; Feist and McCullough, 1976). As with locomotor
patterns, vocalizations were related to et-epimeletic behavior. Visible move-
ments of unrelated adult horses generated vocalizations in foals, and vocali-
zations of one foal were usually accompanied or followed by vocalizations
of other foals.

Simple correlation coefficients between total vocalizations over the 5-h
observation period and time spent in the various locomotion modes show
that vocalizations were negatively related to time spent standing still ($r =
-0.67, P < 0.001$) and positively related to time spent walking ($r = 0.66,$
$P < 0.001$) and trotting ($r = 0.48, P < 0.05$). These relationships suggest that
foals upset enough to vocalize frequently also exhibited increased locomotor
activity.

Other behaviors

Foals on all treatments except CON exhibited aggression to other foals
during the observation period. Most aggressive acts were threats to kick other
foals, as described by Houpt et al. (1978). Aggression began during the first
hour post-weaning. Sex of foal did not influence the incidence of aggression;
6 colts and 5 fillies exhibited agonistic behavior during weaning. Pawing was
also observed in all treatments except CON and began within the first hour
after weaning. Play behavior was seen only in CON foals during the observa-
tion period, but was observed in all treatments by 2 weeks post-weaning.

Non-nutritional sucking of other foals was observed in all treatments
except CON. Non-nutritional sucking started within 2 h post-weaning and
was observed up to 2 weeks post-weaning. Foals are opportunistic suckers
(Waring et al., 1975) which suck every 1–2 h at 4 months of age (Tyler,
1972); therefore, some non-nutritional sucking episodes seem inevitable
during artificial weaning. Tyler (1972) stated that non-nutritional sucking
acts as a comforting stimulus in unweaned foals, and it may be indicative of
weaning stress (Wood-Gush et al., 1975).

These data on locomotor patterns, vocalization frequencies and other
behaviors indicate that different management regimes can cause behavioral
differences in foals during weaning. When subjected to total-separation wean-
ing management, foals which did not have access to pre-weaning creep feed
exhibited more behavioral signs of stress than foals which had been creep-fed
before weaning. Provision of creep feed prior to weaning decreased the
activity levels of foals weaned by total separation but did not affect their
vocalization frequency. Foals on partial separation weaning treatments had
lower activity levels and vocalization numbers than foals on total separation
treatments. Also, partially separated foals with access to pre-weaning creep feed did not exhibit behaviors significantly different from unweaned foals.

Further research is being summarized which measures physiological responses of these foals to the varying weaning management systems. Those data will be reported at a later date. In any event, behavioral responses of foals as measured in this study indicate that foals should be adjusted to creep feed prior to weaning and weaned in a partial-separation management system that minimizes the stressful effects of weaning.

REFERENCES