Effect of neck injection and handler visibility on behavioral reactivity of beef steers

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ABSTRACT: The use of the neck region as an injection site in cattle is becoming routine. Use of a blind may reduce aversive behavior caused by the presence of the person administering the injection. To evaluate whether cattle react to the proximity of the stockperson or to the actual injection, one hundred twenty 10-mo-old Angus steers (298 ± 28 kg of BW; mean ± SD) were assigned to 1 of 4 treatment groups using a partial crossover design (neck/sham injection × blind/no blind) replicated over 2 d (3 d apart). Steers were restrained for a total of 60 s in a squeeze chute, with treatment being administered 20 s after entry. Animal reactivity was rated using 2 scoring methods, including a visual and an electronic score, for three 20-s intervals (pretreatment, treatment, and posttreatment intervals). Flight speed (m/s) was used as a measure of aversion to the treatments and was taken upon release from the chute. No interactions (P > 0.10) were observed between the blind and injection treatments for any of the measurements taken. No treatment or day effect on flight speed (2.7 vs. 2.6 m/s; P > 0.03) was observed; however, the correlation between days (r = 0.74; P < 0.001) was significant. Visual scores indicated that injected steers were more agitated during the treatment interval than were the sham injected steers (1.9 vs. 1.6, respectively; P = 0.01). However, no differences (P > 0.10) were found between injection and sham injection treatments for any of the electronic scores. Steers exposed to the blind had lower electronic reactivity scores (P < 0.05) than those not exposed to the blind, which was in contrast to the results obtained for the visual scores (P < 0.05). Discrepancies between reactivity scores may be due to the difficulty of accurately assessing minor animal responses using the visual method. The presence of a handler during an injection procedure could be a contributor to the aversion response observed in cattle undergoing routine neck injections, and use of a blind helped to reduce the reactivity of the steers.

Key words: blind, cattle, flight speed, injection, reactivity score

INTRODUCTION

North American beef producers have been encouraged to switch injection sites from the hip to the neck region to reduce losses associated with reduced meat quality (Van Donkersgoed et al., 2000). However, neck injections may increase aversion to squeeze chute procedures due to the increased proximity and visibility of the handler (Grandin, 1993b) and the increased duration and level of restraint required to complete a procedure (Van Donkersgoed et al., 1999).

An animal’s response to an injection is dependent on numerous factors. For example, venipunctures increased plasma cortisol concentrations in inexperienced dairy heifers (Hopster et al., 1999). Further, pain associated with insertion of the needle has been attributed to the mechanical pressure on tissues from undiluted drugs (Brazeau et al., 1998) and tissue damage in muscles postinjection (George et al., 1995).

Any experience by cattle linked with human contact can affect fearfulness (Hemsworth, 2003). For example, repeated nonaversive handling of beef cattle has been linked to increased aversion to enter a chute (Schwartzkopf-Genswein et al., 1997). Furthermore, fear increased in animals that learned to associate humans or places with a negative experience (de Passillé et al., 1996; Pajor et al., 2000). In addition, Ewbank (1961) observed that the majority of cattle restrained in a headgate became agitated when stimuli were applied to their neck.

Eyesight, in particular the lateral field (Rehkämper and Görlach, 1997), is important for identifying an aver-
sive situation in cattle (Munksgaard et al., 1997; Rushen et al., 1999). Consequently, installing a solid barrier on the outside of the chute has been recommended to prevent visual contact between the animal and the handler (Grandin, 1993c).

The objectives of this study were to evaluate the aver-siveness of 1) the visibility of the stockperson, and 2) a neck injection in beef cattle using different behavioral reactivity measurement techniques.

**MATERIALS AND METHODS**

*Animals and Housing Conditions*

All animals were cared for according to the guidelines set out by the Canadian Council on Animal Care (Olfert et al., 1993).

This study was conducted in January 2005 at the Agriculture and Agri-Food Canada Research Centre (Lethbridge, Alberta, Canada) with 120 Red Angus beef steers (approximately 10 mo of age and 298 ± 2.6 kg of BW). The steers came from a single herd at a local ranch, where they had been previously castrated and vaccinated as calves before they arrived at the research feedlot. Steers were sourced from a single herd to reduce the potential confounding effect of previous experience. Once at the feedlot, they were not administered any other injections, and they had not been exposed to a blind. Steers were randomly assigned to 1 of 12 outdoor pens (14 × 20 m), with a loafing area bedded with straw situated in the middle of the pen. Groups remained stable throughout the experiment. Steers were fed a total mixed ration consisting of 35% barley, 58% barley silage, 5% supplement, 2% premix (DM basis) once daily at 0900 h and received ad libitum access to water. All steers were previously ear-tagged for individual identification.

*Experimental Design*

A partial crossover design was used to access treatment effects. Before the experiment, steers were randomly assigned to 1 of 4 treatments according to a 2 × 2 factorial arrangement of treatments, with exposure to a blind and administration of an injection yielding: blind/injection (n = 24), blind/sham injection (n = 24), no blind/injection (n = 30), and no blind/sham injection (n = 42) treatment groups that were replicated over 2 d (3 d apart; Table 1).

**Blind**

A hydraulic squeeze chute (Cattlелас Handling System, Red Deer, Alberta, Canada), which included a headgate and a weigh scale, was fitted with a curtain (1.8 × 1.9 m) made of a dark blue, opaque fabric that served as the blind in the experiment. The blind was placed such that when drawn closed it prevented steers restrained in the squeeze chute from seeing the stock-person approach and administer a neck injection (or sham injection). In contrast, when the curtain was drawn open, the steer was able to visually observe the stockperson approaching the squeeze chute immediately before and during the injection procedure. All steers had been previously subjected to the squeeze chute, including capture in the head gate and the application of light lateral pressure to ensure immobility a total of 4 times to habituate them to the presence of the closed blind. Stock personnel involved in this study were familiar to the steers and remained constant throughout the study, including the habituation period.

On the day of the experiment, each pen of steers was moved to a holding pen. From the holding pen, the group of steers was moved via a solid-sided, semi-circular chute system (Hi-Hog Parallel Axis Squeeze Chute, Hi-Hog Farm and Ranch Equipment Ltd., Calgary, Alberta, Canada) to the squeeze chute. In the squeeze chute, steers were identified from their unique ear tag, their treatments were applied, and measurements of behavioral reactivity were taken. Steers were managed calmly over the course of the study, which included slow careful handling, no use of electric prods, and minimal noise.

**Injection Procedure**

The experiment was conducted between 0800 and 1200 h on each of the experimental days. Steers were lightly restrained in the squeeze chute for 20 s (pretreatment interval), after which the injection or sham injection treatment was applied (treatment interval; lasting 20 s). The steers remained in the chute for another 20 s (posttreatment interval) after the conclusion of the treatment interval, which completed the 60-s testing period, before being released.

A multiple dose syringe (Allflex Canada, St-Hyacinthe, Quebec, Canada) fitted with a 0.41 × 25.4-mm needle was used for the injection. Steers were injected by placing the needle sideways under the skin and delivering 5 mL of sterilized phosphate buffered (pH = 7.5) physiological saline solution subcutaneously. A new needle was used for each injection. For the sham injection, the same procedure was carried out, with the ex-

<table>
<thead>
<tr>
<th>Table 1. Treatment schedule for each experimental group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

1Blind treatment refers to steers exposed to an opaque blind fixed onto the squeeze chute that when drawn closed (yes) removed visual contact between the steers and the handler when drawn open (no) allowed for visual contact.

2Injection treatment refers to the administration of saline solution via a needle and syringe applied on the neck of a steer; the sham injection involved holding the syringe (without the needle) against a steer.
ception that the syringe did not have a needle attached and did not contain saline solution. All stock personnel, including those that gave the injections, operated the headgate, and handled the steers remained the same and maintained the same positions on both days of the experiment.

**Visual Reactivity Score**

The behavioral reactivity of the steers in the squeeze chute was scored in three 20-s intervals (pretreatment, treatment, and posttreatment intervals) over the 60-s measurement period using a numerical scale (Grandin, 1993a): (1) calm, no movement; (2) slightly restless; (3) squirming, occasionally shaking the squeeze chute; (4) continuous, very vigorous movement and shaking of the squeeze chute; (5) rearing, twisting of the body, and struggling violently. The person who scored the steers in the squeeze chute stood approximately 1.5 m away from the squeeze chute on the side opposite of the blind. This ensured that the person doing the visual scores could not see if the blind was drawn open or closed; however, they could clearly see the steer’s behavioral response.

**Electronic Reactivity Score**

Movements of the steers in the chute were quantified with a strain gauge system similar to the system described by Schwartzkopf-Genswein et al. (1998, 1997). The strain gauges were mounted on the headgate (one on each side) at approximately the height of the steer’s neck, making it possible to measure the pressure exerted when a steer moved forward or backward in the chute. Output signals from each strain gauge were measured in mV and were amplified by a signal conditioner (Model 2310 signal amplifier, Vishay Measurement Group, Raleigh, NC). A multichannel analog input board (Model CIO-DAS08, Measurement Computing, Middleboro, MA) was used to retrieve and digitize data from the strain gauges. All digitized signals were captured onto a personal computer at a rate of 20 samples s$^{-1}$. This sampling rate produced an accurate representation of the analog signal without providing an overwhelming number of data points. The DAS Wizard software (ComputerBoards, Middleboro, MA) was used to collect and export the data into a Microsoft Excel spreadsheet (Microsoft, Redmond, WA).

The exported data were summarized using a computer program written in Visual Basic (Microsoft) and run in SAS (SAS Inst. Inc., Cary, NC). Data from each strain gauge were collected, reported, and summarized in 1 of 2 ways: the first included the entire 60-s period while the steers were in the squeeze chute, and the second was for the three 20-s intervals as described previously for the visual reactivity scores. To account for individual variation in steer movement while restrained in the squeeze chute, a baseline value was calculated for each steer on each test day using the mean number of peaks within the pretreatment interval while the steers were held without being disturbed. The variables calculated included the number of peaks (defined as a change in direction of the digitized signal value) above or below and the total number of peaks above and below the baseline (pretreatment) mean. The number of peaks is an indication of how much an animal is moving in the chute; the more the animal moves, the greater the number of peaks generated. The maximum millivolt reading or exertion force above the baseline mean as well as the duration of time (s) the exertion force stayed above or below the baseline and the total time the exertion forces stayed above and below the baseline mean were also calculated. The exertion force measurements are an indication of how much pressure the steers are applying on the head gate as they move forward or backward in the chute; the greater the exertion force, the more forceful the escape response by the steers. The electronic system measures whole body movement and not just movement specific to the neck region.

**Flight Speed Test**

Flight speed was measured using an electronic system described previously by Müller and von Keyserlingk (2006). The flight speed measuring device consisted of 2 light-beam generators and reflectors that were positioned on stands, a timer, and a laptop computer. The first stand was positioned 1.55 m from the exit of the squeeze chute, and the second stand was 2.22 m beyond the first stand. The stands were 0.9 m above ground to record flight speed of the steer at head level. Upon release from the chute, the steer proceeded down a grooved concrete alley (8.2 × 2.1 m) at its own pace and broke the first light beam, starting the timer. When the steer broke the second beam, the timer stopped. The time it took for the steer to move the 2.22 m between the 2 light-beams was used to calculate flight speed (m/s). The subject could not see other steers while proceeding down the flight speed alley. Once a steer had moved along the alley, it was returned to its pen. Flight speed measurements were missed for 39 steers on the first day, as follows: blind/injection (n = 7); blind/sham injection (n = 6); no blind/injection (n = 12); and no blind/sham injection (n = 12); and from 2 steers on the second day, as follows: blind/injection (n = 1); and blind/sham injection (n = 1), due to problems encountered with the data capture software.

**Statistics**

Analyses were performed using SAS. Data collected over the 2-d study were combined due to the partial crossover design and lack of day effect ($P > 0.05$). The MIXED procedure was used with injection, blind, and their interactions as fixed effects and steer as the random effect, for flight speed, visual, and electronic reactivity scores. The experimental unit was steer. Treat-
ment comparisons were made between steers as well as within steers by day for comparison of pretreatment and postinterval behavior for the reactivity scores. Injection × blind interactions were not significant \( (P > 0.05) \) for flight speed, visual, or electronic reactivity scores, and therefore only the main effects were discussed. A Kruskal-Wallis Test was used to make treatment group comparisons for the visual reactivity score data due to the ordinal nature of the data. Spearman’s rank correlation was used to calculate the relationship between individual steer scores at different time intervals while the steer was confined in the squeeze chute. Differences were considered significant at \( P < 0.05 \), and trends were reported at \( P < 0.10 \).

## RESULTS

### Flight Speed Test

Neither the blind nor the injection or their interactions affected \( (P > 0.40) \) the flight speed of the steers overall (Table 2) or on d 1 or 2 of testing. Furthermore, flight speed was consistent between the repeated measurements taken from the same steers across both days \( (r = 0.77; P < 0.001; n = 80) \).

### Visual Reactivity Score

No blind × injection interaction effects were observed \( (P > 0.10) \) over the 60-s test or for any of the intervals within that period. The average visual reactivity score over the 60-s test (mean score) was greater \( (P < 0.01) \); Table 2) for both those steers exposed to the blind and given the actual injection treatments compared with the sham procedures. During the pre- and posttreatment intervals, steers had greater \( (P < 0.005) \) scores when the blind was used than when it was not (Table 2). However, there was no difference \( (P = 0.20) \) in the reactivity scores between the blind and no blind groups during the treatment interval. In contrast, steers receiving an actual injection had greater \( (P = 0.002) \) reactivity scores than those subjected to the sham injection during the treatment interval and tended \( (P = 0.07) \) to have a greater reactivity score during the posttreatment interval. No difference \( (P = 0.40) \) in reactivity score of injected and sham-treated steers was observed in the pretreatment interval (Table 2).

When visual reactivity scores were compared between intervals the posttreatment interval was greater \( (P < 0.04; \) Table 3) than the treatment intervals. Neither the treatment nor the posttreatment intervals were different from the pretreatment interval.

Subjects having greater visual reactivity scores in the pretreatment interval also had greater scores in the treatment-interval regardless of the injection or blind effect. This relationship was strongest for those steers receiving an injection regardless of whether the stockperson was visible \( (r = 0.44; P < 0.001) \) or not \( (r = 0.62; P < 0.001) \) when compared with the sham treatment \( (r = 0.29; P < 0.05; r = 0.27; P < 0.05; \text{respectively}) \). Similarly, steers receiving an injection also displayed more agitated behavior during the posttreatment interval regardless of whether the stockperson was present \( \text{(without blind: } r = 0.37; P < 0.01) \) or not \( \text{(with blind: } r = 0.55; P < 0.001) \). Interestingly, a relationship was also observed between the visual reactivity scores obtained in the treatment and the posttreatment interval in those steers receiving a sham injection \( (r = 0.27; P < 0.05; r = 0.37; P < 0.01; \text{respectively}) \).

### Electronic Reactivity Score

No blind × injection interaction effects were observed \( (P > 0.10) \) over the 60-s test or for any of the intervals within that period (Table 2). Treatment effects on steer reactivity, as measured by the strain gauge system over the 60-s test, were in contrast to the visual score results made over the same period. The number of peaks above the baseline mean and total number of peaks (above and below); the total duration of exertion force (above and below) as well as the duration of force above the baseline mean were all greater \( (P < 0.05; \) Table 2) in the absence of the blind. No differences \( (P > 0.10) \) were observed in any electronic reactivity score parameter between the injection and sham injection treatments over the 60-s test period.

Within the pretreatment interval the maximum exertion force was greater \( (P = 0.04; \) Table 2) for the group not exposed to the blind. No treatment (blind or injection) differences \( (P > 0.10; \) Table 2) were observed in any of the other electronic score parameters.

During the treatment interval, steers not exposed to the blind were more reactive than those exposed to the blind. This was supported by the fact that the no blind group had greater \( (P < 0.05; \) Table 2) scores than the blind group for the following parameters: number of peaks above the baseline mean, total duration of force, and the duration of force above the baseline mean. No electronic reactivity score differences were observed between the injection and sham injection treatments \( (P < 0.10; \) Table 2).

Contradictory results were obtained within the posttreatment interval. The maximum exertion force was greater \( (P = 0.02; \) Table 2) for steers exposed to the blind than those that were not. However, there was a tendency \( (P = 0.07; \) Table 2) for the no blind group to have a greater score for total number of peaks above and below the baseline mean. Consistent with the other intervals was the absence of a treatment difference \( (P > 0.10; \) Table 2) associated with the injection and sham injection procedures.

Differences \( (P < 0.01) \) in the electronic scores were found between the pretreatment, treatment, and posttreatment intervals (Table 3). All parameters with the exception of maximum exertion force were greater \( (P < 0.001) \) during the posttreatment interval than the pretreatment interval. Maximum exertion force during the treatment interval was greater \( (P < 0.001) \) than
### Table 2. Effect of blind and injection treatments on flight speed, visual, and electronic reactivity scores over a 60-s period while steers were restrained in a squeeze chute (n = 120)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Blind&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Injection&lt;sup&gt;2&lt;/sup&gt;</th>
<th>P-value&lt;sup&gt;3&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>0</td>
<td>1&lt;sup&gt;4&lt;/sup&gt;</td>
<td>SE</td>
</tr>
<tr>
<td>Flight speed, m/s</td>
<td>2.7</td>
<td>2.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Visual reactivity score&lt;sup&gt;5&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment (20 s)</td>
<td>1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.07</td>
</tr>
<tr>
<td>Treatment (20 s)</td>
<td>1.7</td>
<td>1.8</td>
<td>0.06</td>
</tr>
<tr>
<td>Posttreatment (20 s)</td>
<td>1.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.07</td>
</tr>
<tr>
<td>Average score (60 s)</td>
<td>1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.03</td>
</tr>
<tr>
<td>Electronic reactivity score&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretreatment (20 s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of peaks</td>
<td>7.7</td>
<td>7.9</td>
<td>0.32</td>
</tr>
<tr>
<td>Number of peaks above mean</td>
<td>3.3</td>
<td>3.4</td>
<td>0.29</td>
</tr>
<tr>
<td>Number of peaks below mean</td>
<td>4.3</td>
<td>4.5</td>
<td>0.28</td>
</tr>
<tr>
<td>Maximum force, V</td>
<td>3.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.02</td>
</tr>
<tr>
<td>Total duration of force, s</td>
<td>1.1</td>
<td>1.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Duration of force above mean, s</td>
<td>0.5</td>
<td>0.5</td>
<td>0.04</td>
</tr>
<tr>
<td>Duration of force below mean, s</td>
<td>0.6</td>
<td>0.6</td>
<td>0.04</td>
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<tr>
<td>Treatment (20 s)</td>
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<tr>
<td>Total number of peaks</td>
<td>33.2</td>
<td>25.3</td>
<td>3.49</td>
</tr>
<tr>
<td>Number of peaks above mean</td>
<td>15.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.12</td>
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<td>Number of peaks below mean</td>
<td>17.8</td>
<td>16.8</td>
<td>2.59</td>
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<td>Maximum force, V</td>
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<td>3.8</td>
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<tr>
<td>Total duration of force, s</td>
<td>4.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>1.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.21</td>
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<td>Duration of force below mean, s</td>
<td>2.2</td>
<td>1.9</td>
<td>0.27</td>
</tr>
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<td>Posttreatment (20 s)</td>
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<td></td>
<td></td>
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<tr>
<td>Total number of peaks</td>
<td>44.6</td>
<td>32.5</td>
<td>4.52</td>
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<tr>
<td>Number of peaks above mean</td>
<td>17.1</td>
<td>11.1</td>
<td>2.83</td>
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<tr>
<td>Number of peaks below mean</td>
<td>27.4</td>
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<td>3.58</td>
</tr>
<tr>
<td>Maximum force, V</td>
<td>3.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.02</td>
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<tr>
<td>Total duration of force, s</td>
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<td>3.7</td>
<td>0.43</td>
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<tr>
<td>Duration of force above mean, s</td>
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<td>1.3</td>
<td>0.27</td>
</tr>
<tr>
<td>Duration of force below mean, s</td>
<td>2.9</td>
<td>2.4</td>
<td>0.34</td>
</tr>
<tr>
<td>Average score (60 s)</td>
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</tr>
<tr>
<td>Total number of peaks</td>
<td>28.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.86</td>
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<td>7.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.17</td>
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<td>Number of peaks below mean</td>
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<tr>
<td>Total duration of force, s</td>
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<tr>
<td>Duration of force above mean, s</td>
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<td>0.12</td>
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<tr>
<td>Duration of force below mean, s</td>
<td>1.9</td>
<td>1.7</td>
<td>0.15</td>
</tr>
</tbody>
</table>

<sup>a,b</sup>MMeans in a row with different superscripts differ (P < 0.05).

1Blind treatment refers to steers exposed to an opaque blind fixed onto the squeeze chute that when drawn closed removed visual contact between the steers and the handler and when drawn open allowed for visual contact.

2Injection treatment refers to the administration of saline solution via a needle and syringe applied on the neck of a steer.

3Blind × Injection interactions were not significant (P > 0.15).

4For Blind and Injection treatments, 0 refers to the sham procedure and 1 refers to the actual procedure.

5Visual reactivity score were described previously by Grandin (1993a).

6For all electronic scores, values were calculated from above or below the baseline (pretreatment) mean.

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Both pre- and posttreatment scores. Posttreatment scores were also greater (P < 0.001) than the treatment scores for the number of peaks above, below, and total from the baseline mean. Scores were not different between the posttreatment and treatment scores for any of the duration of force parameters. All pretreatment values were always less (P < 0.001) than treatment values.

**DISCUSSION**

**Flight Speed Test**

Flight speed values in our study agree with Petherick et al. (2003) who reported mean values of 2.3 m/s for 2- to 3-yr-old *Bos indicus* steers. No differences were observed in flight speed as a result of using a blind with
or without administration of the injection in the present study. These findings are also consistent with those of Petherick et al. (2003) who reported flight speed was not affected by a moderately aversive treatment such as repeated blood sampling via venipuncture of the coccygeal vein. However, this is in contrast to results obtained from both the visual and electronic behavioral reactivity scores indicating that cattle exhibited some aversive behavior to the blind and the injection treatments. Similar findings have been observed in some recent studies looking at the relationship between flight speed and visual scores. In these studies greater visual scores during restraint did not necessarily mean a faster chute exit speed when assessing cattle temperament (K. S. Schwartzkopf-Genswein, unpublished data). However, our flight speed results are in contrast to Grandin (2003) who reported faster chute exit speeds were correlated with more struggling during restraint and slower exit velocities with less struggling. Similarly, Kilgour et al. (2006) reported a correlation of r = 0.44 (P < 0.05) between flight speed and visual scores during restraint for Angus calves. One reason for these discrepancies is that the studies by Grandin (2003) and Kilgour et al. (2006) were not designed to assess effects of aversive procedures during restraint as in our study. Previous work has suggested that increased flight speed upon exit from a squeeze chute can be used to predict fearfulness in beef cattle (Müller and von Keyserlingk, 2006).

The consistency of flight speed measures taken over the 2-d period in our study were similar to the findings of Müller and von Keyserlingk (2006), who reported a high individual within-day consistency of flight speed in beef cattle. Although flight speed in beef cattle appears to be an individually consistent measure over a short period of time, it appears to be an insensitive measure of minimally aversive experimental treatments.

### Visual and Electronic Reactivity Scores

The visual reactivity scores obtained in the present study were similar to those of Red Angus cattle (mean behavioral reactivity score = 1.77 ± 0.07) assessed in a nonrestraining scale crate (Voisinet et al., 1997). However, they were less than those recorded by Müller and von Keyserlingk (2006) who reported a mean score of 2.62 for Aberdeen-Angus cattle of similar age but without the application of an aversive treatment such as the neck injection used in this study. Differences between studies may be attributed to several factors including different handling procedures and previous handling experience of the animals (Hemsworth, 2003). In addition, high interanimal variability in behavioral reactivity is common (Stookey et al., 1994) and is one reason why the use of within animal comparisons be made when testing for changes in reactivity over time or in relationship to specific treatments.

The electronic scores obtained in our study were similar to those reported by Mitchell et al. (2004; ranging from 0.80 to 3 V for maximum force) in British cross beef heifers used in a study to document the effect of a blindfold on reactivity to handlers. Mitchell et al. (2004) study only used the average force and the maximal force to assess reactivity however; our study used several other relevant parameters calculated from the electronic system that may also be useful in assessing behavioral responses in restrained cattle. Because this was the first time some of these parameters have been used, no relevant literature comparisons could be made. All electronic parameters used in this study identified differences in animal reactivity between the pre-, test, and posttest intervals. However, of the same parame-

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**Table 3. Mean visual and electronic reactivity scores made on steers during pretreatment and posttesting intervals while restrained in a squeeze chute.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Pretreatment</th>
<th>Treatment</th>
<th>Posttreatment</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactivity score type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual score</td>
<td>1.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Electronic score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of peaks</td>
<td>7.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>38.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.61</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number of peaks above mean</td>
<td>3.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.56</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number of peaks below mean</td>
<td>4.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>24.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.95</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Maximum force, V</td>
<td>3.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total duration of force</td>
<td>1.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.28</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Duration of force above mean</td>
<td>0.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.18</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Duration of force below mean</td>
<td>0.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.21</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<sup>a–c</sup>Means in a row with different superscripts differ (P < 0.05).

<sup>1</sup>Treatments included use of a blind and or neck injection (n = 120). Blind treatment refers to steers exposed to an opaque blind fixed onto the squeeze chute that when drawn closed removed visual contact between the steers and the handler and when drawn open allowed for visual contact. Injection treatment refers to the administration of saline solution via a needle and syringe applied on the neck of a steer.

<sup>2</sup>Visual reactivity score were described previously by Grandin (1993a).

<sup>3</sup>For all electronic scores values were calculated from above or below the baseline (pretreatment) mean.
ers used to assess within test interval differences, only
the number of peaks above the baseline mean, the maxi-
mum force, total duration of force, and total duration of
force above the mean identified treatment differences.
This suggests that some of the parameters may be more
useful and appropriate to assess the effects of minimally
invasive treatment than others.
Visual reactivity scores indicated that cattle were
more reactive when the blind (regardless of whether
they received an injection or not) was used than when
it was not in the pre- and posttreatment intervals but
not during the treatment interval. This result is in con-
trast to the electronic reactivity scores in this study
that indicated the cattle were as or more reactive when
the blind was not in use during the treatment and post-
treatment intervals where effects on behavior would
most likely be seen. No treatment differences were ob-
erved in the pretreatment interval for electronic
scores, which may be explained by the fact that a han-
dler did not approach the animal in this interval. The
visual score finding was also contrary to work done by
Mitchell et al. (2004) who found that blindfolded an-
mals were less responsive (had lower exertion forces on
the chute and lower heart rates) than nonblindfolded
controls when they were approached and touched on
the neck. The electronic reactivity scores indicated that
the presence of the blind did, as previously recom-
mended by Grandin (1993a) and reported by Mitchell
et al. (2004), mediate the negative behavioral reactions
that can occur when visual and physical contact is made
on the neck region.
The contrasting results obtained from the visual and
electronic scores are most likely due in part to the fact
that visual scoring methods may not be sensitive
enough to identify treatment differences when mini-
mally invasive treatments, like the use of a blind or
injection, are applied. These findings are supported by
an earlier study assessing beef cattle responses to dif-
ferent branding techniques. Schwartzkopf-Genswein et
al. (1997) found that by using visual observations (100
animals/treatment) they could not differentiate re-
ponses of cattle to freeze and sham branding; however,
using electronic measures, they could detect differences
in the responses to the same treatments. In addition,
it is possible that a 20-s interval may be too short a
period to accurately visually assess an animal’s re-
sponse to a procedure. Although Mitchell et al. (2004)
did not use visual scores, they came to the same conclu-
sions, using a similar scoring method to the one used
in this study, regarding the effect of a blindfold.
Visual scores also showed that actual injection, re-
gardless of blind use, resulted in more movement, sug-
igesting it was more aversive than the sham procedure.
Again, these results were in contrast to the electronic
scores where no differences were found between the
injection/sham injection treatments. The discrepancies
between visual and electronic reactivity scores are dif-
ficult to explain particularly in light of the fact that
electronic scores have been shown to be more sensitive
than visual scores (Schwartzkopf-Genswein et al.,
1997). One reason for these discrepancies, as stated
previously, may be that the treatments were minimally
invasive and therefore animal responses are minor and
more difficult to access accurately using the visual
method. Both scoring methods were sensitive to
changes in animal reactivity across the pretreatment,
treatment, and posttreatment intervals. Results of the
electronic scores suggest that the animals reacted to
the injection treatments (sham and actual) from the
time of their application until at least 40 s after injec-
tion. In addition, as predicted the pretreatment interval
was always characterized by the lowest score as no
handler was in the vicinity of the animal’s neck during
this period. These results are also different from those
obtained using visual reactivity scores as pretreatment
and posttreatment intervals were not different from the
treatment interval, suggesting that the visual scores
be interpreted carefully when assessing the effects of
minimally invasive treatment.
Our study revealed that under the conditions de-
scribed in this experiment the subcutaneous neck injec-
tion was not consistently aversive in comparison to a
sham injection procedure depending on the assessment
method used. Electronic scores indicated that the blind
led to a reduction in the animal’s reaction to a handler
regardless of whether a needle was inserted into the
animal during the injection procedure. This reduced
level of agitation may be explained by the loss of the
visual field such that the handler administering the
injection was not invisible to the animal during the
approach or during the injection itself. Similar findings
have been reported by many other researchers looking
at the effect of a blindfold on cattle (Mitchell et al.
2004), elk (Thierman et al., 1999), and white-tailed deer
(Haigh and Friesen, 1995). However, to our knowledge
this is the first study to assess effects of a blind on
reducing handler aversion during a routine manage-
ment procedure.
The bovine eye has a streak of high cell density ex-
tending along a straight horizontal line in the retina
(Hebel, 1976) running in parallel to the pupillary cleft.
This morphology has been suggested to improve the
horizontal view in cattle (Rehkämper et al., 2000). This
highly developed lateral visual field is also evident in
other prey species and allows them to flee for protection
(Rehkämper and Görlich, 1997). Therefore, blocking
this visual field with a blind or blindfold results in a
calming effect because the cattle cannot see handlers
approaching them or other visual cues that have been
reported to cause fear in cattle such as bright lights,
shadows, or novel objects (Grandin, 1993c).
In summary, use of a blind may help improve han-
dling ease particularly with cattle having to undergo
repeated aversive procedures and in cattle having little
previous experience with humans. This is not surpris-
ing considering the evolution of cattle as a species in
which use of visual cue is vital in launching appropriate
escape responses to perceived and or real aversive or
dangerous situations. A blind may have more practical application than a blindfold for use in reducing aversion in cattle to handling as it requires no further potentially dangerous and time consuming handling of the animals and is easy and inexpensive to install.

LITERATURE CITED


