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Rein sensor leash tension measurements in owner-dog dyads navigating a course with distractions

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Abstract

Consistent owner-dog interaction patterns such as dog-directed parenting styles could reflect in the leash tension applied when walking a dog. Rein sensors are commonly used to measure tension applied to a horse's bit and our research aim was to evaluate the performance of this methodology for measuring leash tension. We evaluated the consistency of leash tension measurements in owner-dog dyads walking a food-distraction course and a more complex zigzag object-distraction course to confirm our prediction that the more challenging course would trigger increased leash tension. Leash tension sample points were averaged per owner-dog dyad per course and we used Restricted Maximum Likelihood (REML) to analyze leash tensions for effects of course difficulty and dog body weight. In 24 participating owner-dog dyads leash tension was an average (±standard deviation) 18.29±14.03 newtons. Leash tensions were 1.6 times higher ($P<0.001$) during the more challenging second course than during the easier first one and variation between owner-dog dyads was consistent across the two courses (rank correlation of 0.63, $P=0.001$, $N=24$). Our findings support the usefulness of rein sensors for measuring leash tension, with potential applications in studies on the owner-dog relationship such as how leash exerted levels of control relate to dog-directed parenting styles.

Short communication

Leashed dogs seemingly habituate to wearing harnesses as well as head and neck collars, even after wearing them for only 20 minutes (Ogburn et al., 1998, Haug et al., 2002, Grainger et al., 2016). However, the restraint imposed by leashes does affect a dog's gait and behavior. Leash tension and the way it is applied translates into specific pressure distributions on a dog's body, as measured earlier with pressure strips placed underneath three different harnesses in eight guide dogs (Peham et al., 2013). Pressure mat measurements revealed that the forelimb weight shifted away from the leash in dogs weighing less than twelve kilos (Keebaugh et al., 2015) and such leash-related gait asymmetry was found also in a study group of 66 dogs of various breed sizes (Fahie at al., 2018). Next to affecting a dog's gait, leash-restraint affects a dog's behavior. Leash-restrained walking was associated with less sniffing of other dogs in a data set of 1,870 recorded spontaneous dog-dog interactions (Řezáč et al., 2011). More importantly, leash-restrained dogs displayed threats twice asoften towards other dogs, for instance through baring teeth, growling or snarling (Řezáč et al., 2011). Finally, the restricted freedom of movement causes some dogs to leash pull, which was reported by 69% of 192 dog owners (Blackwell et al., 2008) and is a common annoyance to dog owners. Clearly, leash tension matters, both to dogs and their owners. We searched for a tool to validly measure leash tension during everyday life situations of owners walking their dog, for use in future owner-dog relationship studies. Leash tension measurements could provide information on the mutual relationship between owner and dog, reflecting consistent owner-dog interaction patterns such as dog-directed parenting styles. So far, rein sensors have been used to measure applied weight on a horse's bit during horse training (Dumbell et al., 2018). We aimed to evaluate the performance of IPOS Technology© rein sensor methodology to measure leash tension.

The performance of the rein sensor was assessed by identifying suitable read-out parameters and by testing if walking a more difficult object-distraction course would indeed trigger increased leash tension as compared to a more easily navigated food-distraction course. Both courses were set out in the same indoor location, a dog training hall. On site the IPOS Technology© rein sensor was calibrated using weights of 820 to 4260 grams. Participating dog owners (N=24) filled out an intake survey answering questions on for instance the dog's breed, age, gender and obedience class attendance. Thereafter, the dog's body weight was measured by one of the experimenters. The owner-dog dyad then entered the indoor training hall. The first ('food-distraction') course was a twelve-meter straight path with pieces of dried chicken as distractions placed at fixed positions at either side of the path. The second more tricky ('object-distraction') course was a zigzag path of twelve meters along objects such as balls, fake dogs, food bowls and odd-shaped objects. The dog owners were instructed to guide their dogs through the course without the dog touching food or objects, but in their own time and way of handling the dog. In line with this, the garment and leash were used that the dogs were walked with normally. Garments were either a flat collar around the dog's neck or a standard harness around the dog's torso. Leashes were leather or canvas leashes between 1.5 and 2.0 meters in length. The rein sensor, a device of 45 millimeters by 100 millimeters by 16 millimeters and weighing 68 grams, was attached between the dog's garment and leash. The top part of the rein sensor was attached to the D-ring of the collar or harness with a pin and screw system. Onto the bottom part of the rein sensor the spring hook of the leash was clipped, which normally would be clipped directly onto the D-ring of the collar or harness. Attachment of the device was done for all dogs by the same person and the recordings were started at the same time the owner started the first course by starting the device via a tablet application. The recordings were streamed wireless from the rein sensor to a tablet on which the data was stored per dog. Leash tensions in grams were stored at rates over 10 times per second, expressed as newtons by multiplying recordings in kilograms by 9.8, and we averaged these recorded tensions per dog per course. Coefficients of variation were calculated based on averages per dog per course. Restricted Maximum Likelihood (REML) was used to test for interaction effects of a dog's body weight and course on leash tension. The REML-data set included 48 records of average leash tensions for each of the 24 dogs for each of the two courses. Body weight and course were fitted as a co-variate and owner-dog dyads made up the random component. With a Spearman rank correlation we tested how average leash tension associated between courses and consistently characterized owner-dog dyads. Statistical analyses were done using GenStat (18^{th} edition) software.

The intake survey revealed that all owner-dog dyads had previously attended dog obedience classes. Dogs varied widely in breed and were aged half a year to ten years old. The dogs' average body weight was 22.5±10.7 (5.5-39.4) kilograms. Eighteen dogs were male, six were female. The times to complete the two courses was an average (±standard deviation, range) of 224±53 (125-344) seconds. Especially at the start some owners walked their dog more quickly than others. The average leash tension (±standard deviation, range) across dogs and courses was 18.29±14.03 (1.16-60.16) newtons. The average coefficient of variation for within-dog leash tension was 1.33 (0.65-2.84), as based on an average number of 4,321±2,312 (2,011-18,204) samples. The REML-predicted means (±standard errors) for leash tensions were 1.6-fold higher ($F_{1,22}=17.4$, $P<0.001$) for the second course (22.40±2.61) than the first course (14.17±2.61 newtons), as based on an average number (±standard deviation) of 5,253±2,886 second course samples and 3,388±885 first course samples. REML-effects for the dog's body weight (P=0.06) or an interaction between course and body weight (P=0.1) were not significant. Owner-dog dyads differed in a consistent way, as evident from a Spearman rank correlation of $r_s=0.63$ ($P<0.001$, $N=24$) between leash tensions during the first and second course, explaining 40% of variance.

In our owner-dog study with dogs of several breeds and sizes, rein sensor leash tension measurements detected consistent variation between owner-dog dyads. We conclude that the rein sensor is a useful tool for gathering quantitative leash tension information as our findings support its reliability and validity. Respectively, the two leash tension measurements per owner-dog dyad correlated and in line with expectations the tensions were higher when dyads had to navigate the more difficult of two courses. This allows for future studies to use rein sensors in determining how leash tensions characterize owner-dog interactions. Specifically, further development and validation of rein sensor methodology to measure leash tension can identify how dog-directed parenting styles reflect in owner-exerted leash control or, alternatively, a dog's leash-pulling. Discriminating between parts of leash tension that are attributable to the owner versus the dog is a challenging issue to address in future studies.

Key words: rein sensor; leash pressure; dog; dog-owner relationship

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