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Assessing efficiency of a Human Familiarisation and Training Programme on fearfulness and aggressiveness of military dogs

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ABSTRACT

It has been shown that Belgian military working dogs exhibit fearful and aggressive behaviour towards human and unknown environment. This study aims to assess the effects of a Human Familiarisation and Training Programme (HFTP: based on positive and frequent dog–handler interactions and training) on fearfulness and aggressiveness of military working dogs. Authors predicted that an Experimental Group of dogs submitted to this HFTP (=EG dogs) would be less fearful and aggressive during a standardised aggression test than a Control Group of dogs (CG dogs). Higher posture, less yawning and less aggressive behaviours were observed among EG dogs. Authors interpreted those differences in fearfulness and aggressive behaviour as a positive effect of this HFTP on dog's welfare and concluded that this HFTP induced a better working dog–handler relationship.

1. Introduction

Different behavioural problems among Belgian military working dogs (or patrol dogs) have been revealed: high level of bite accidents (Haverbeke et al., 2005; Lefebvre et al., 2007), fearful behaviour (Lefebvre et al., 2007) and low performance during obedience exercises (Haverbeke et al., 2008a). These behavioural problems (i.e., biting, fearfulness, low obedience) affected the efficiency of the dog–handler's (DH) teams, the security of the military staff and caused dog's welfare problems.

These behavioural problems have also been reported among shelter and laboratory dogs living in an impoverished environment (Van der Borg et al., 1991; Wells and Hepper, 2000). Specific programmes can be effective in improving behaviours among others by reducing the level of stress. For instance, shelter dogs remaining almost 3 weeks constantly with their handlers demonstrated less behaviours reflecting excitation in a novel environment than control (Hennessy et al., 2006). Providing contacts with conspecifics (Hetts et al., 1992; Hubrecht et al., 1992; Mertens and Unshelm, 1996) and with humans (Hennessy et al., 2006; Seksel et al., 1999; Tuber et al., 1999) increased obedience and decreased vocalisations (Hennessy et al., 2006) and stereotypies (Hubrecht, 1993).

A HFTP, based on animal friendly training methods and resulting in positive dog–handler interactions, has been applied to a group of MWD. The effects on this HFTP have been studied for dog–handler team's efficiency during patrol work (Haverbeke et al., 2008a) and in dog's welfare (Haverbeke et al., 2008b). At the Belgian Defence, MWD are

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bought between 1 and 3 years old and 58.82% of the fearful dogs (11.22%) have been roughly handled before arriving at the Army (Lefebvre et al., 2007). Most dogs did not receive enough positive interactions with humans, as preconceived ideas say that military patrol dogs do not have to be 'too social' towards people. Moreover, once purchased by the Belgian Defence, it occurred that dogs were left in their kennel for five consecutive days without any human interaction (except for food distribution and kennel cleaning) or a daily walk (Lefebvre et al., 2009). The effect of this HFTP on MWD's behaviour has been evaluated with a standardised aggression test highlighting also fearfulness, as shown by Haverbeke et al. (2009). Authors predicted that dogs undergoing of this HFTP would be less fearful and aggressive than the dogs that have not followed it.

2. Methods

2.1. Subjects and programme

The Control Group (CG) has been characterised in a previous study (Haverbeke et al., 2009). It was composed of 31 dogs (24 males, 7 females; 26 Belgian shepherds, 5 German shepherds; 11 dogs housed in a shelter at the military kennel and 20 dogs housed at the handler's home). They arrived at the Belgian Defence at least 3 months before the study and were between 1 and 5 years old (3.30 ± 1.24 years (SEM)).

The Experimental Group (EG) was composed of 36 dogs, representative of the Military canine population as regards (1) sex (5 females, 31 males); (2) breed (30 Belgian shepherds, 5 German shepherds, 1 Rottweiler) and (3) ages (3.47 ± 0.15 years); except for the housing conditions as only 2 dogs were housed in the Military Kennels and all the other dogs at the handler's home.

Both groups passed a clinical examination, were declared in good health and admitted to take part of the evaluation.

CG dogs did not receive any socialization or training instruction and trained minimum 1 h per week prior to the evaluations. Handlers were allowed to train their dog however they wanted; no particular method was offered but the most often implemented was an aversive one (Haverbeke et al., 2008a). It should be noted that the CG teams were considered operational immediately after 2 weeks of familiarisation following purchase. This assessment and immediate deployment of the CG dogs reflects the actual training method and training system used in by Belgian Defence.

EG dogs followed a HFTP and trained minimum 6 h per week (i.e., daily training) prior to the standardised evaluation. This HFTP is based on a complete training programme using mainly positive training methods, more dog–human interactions, purchase of more sociable, playful dogs that showed little fear of humans, a theoretical course for handlers on dog training techniques, a manual of dog training, and a period of familiarisation with the dog (see Addendums A–C for a description of the complete HFTP). The EG DH teams had to pass assessments for three different certificates before being deployed and operational (average duration of training to becoming operational: 3 months). The additional certificates were tools aiming to stimulate training performance in the human partner of the DH teams. The exercises for each certificate and the performance needed to attain the next certificate were of growing 'exigency' and difficulty. The certificates were internal, indirect tools to oblige teams to train regularly and improve up to the final evaluation.

2.2. Behavioural assessment: the aggression test

As described in the previous study (Haverbeke et al., 2009), a standardised aggression test was used. It consisted of 16 subtests (see below for the description of the subtests). All subtest lasted 20 s and the time between two subtests was kept as short as possible. The test was performed in an unknown outdoor field of the dogs (Fig. 1) by 6 people: 3 testers and 1 cameraman (all not familiar to the dog) and 2 supervisors (both familiar to the dog). Dogs were given a leather collar, a harness and a leash before testing. An extra rope was added to secure the dogs. The leashes and the rope were attached to a very strong hook.

The subtests were performed as follows: subtests (ST) 1 through 7 were performed in the presence of the handler.

(1) A tester pets the dog using an artificial hand; (2) a sheet is pulled up and down; (3) a cat on a sledge is pulled from behind a screen; (4) a horn is activated; (5) cans, falling on a metal plate, are pulled up and down; (6) the three testers approach the dog slowly step by step and surround the dog. The owner is standing next to the dog; (7) in the same situation as in subtest 6, the three testers approach and surround the dog very rapidly.

Then, the owner left the dog and ST 8 through 16 were performed in his absence.

(8) A tester with a dog on the leash approaches the dog, stopping at a distance of 2 m from the tested dog. The gender of the stimulus dog is the same as the gender of the tested dog; (9) a tester pets the dog with the artificial hand; (10) a tester rings a bell in front of the dog; (11) a tester repeatedly opens an umbrella with a manual opening device in front of the dog; (12) a life-sized doll (65 cm tall), standing on a board mounted on small wheels, is pulled at walking speed towards the dog by a tester who is out of the dog's sight; (13) a tester holds the doll and tries to touch the dog with the doll's hand (if the dog does not retreat); (14) a tester surrounds and approaches the dog quickly, while staring at it; (15) the same tester pets the dog with the artificial hand; and (16) the handler pets the dog with a doll while talking to the dog.

2.3. Data collection, behaviour categories and analysis

An ethogram for aggression (aggressive biting behaviour and aggressive threatening behaviour, Netto and Planta, 1997, Table 1) and the dog's posture (from −3: very low to +2: high, Beerda et al., 1998, Table 2) were used. Only the highest level of aggression (Netto and Planta, 1997) and the dog's lowest posture (Schilder and Van der Borg, 2004) observed during each ST were scored. Two additional stress-related behaviours (Beerda et al., 1998) were scored in number of occurrences: (1) oral behaviour (i.e., non-directed licking) (tongue out: the tip of the

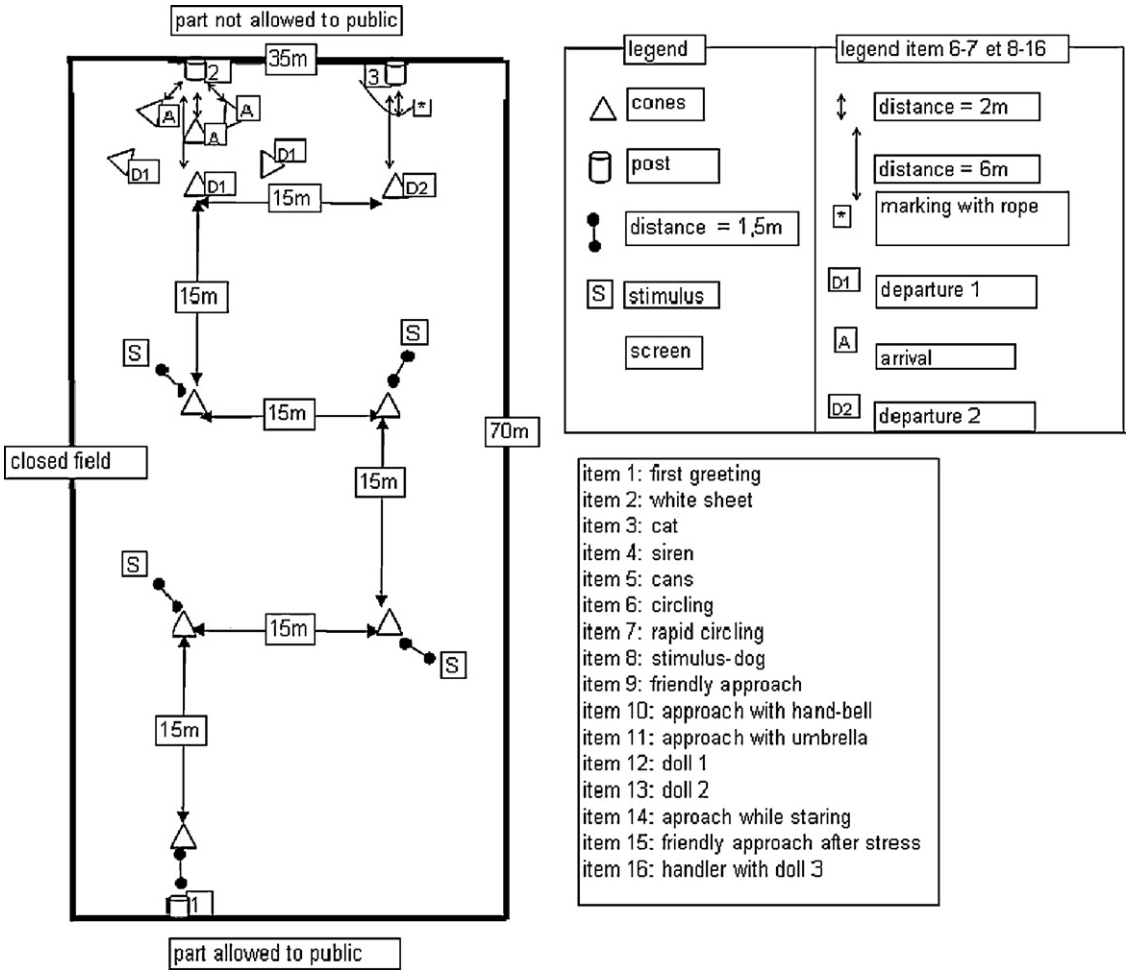

Fig. 1. Schematic view of the test area, adapted from Planta (2001). Only one part of the outdoor closed field (35 m × 70 m) was open to the public.

Table 1
Ethogram of aggressive dog behaviour (based on Netto and Planta, 1997).

Aggressive biting behaviour	
Snapping	A snapping movement (mouth opens and closes, possibly accompanied by showing the teeth and/or growling and/or barking) associated with a short lunge forward (not maximally) or a quick head movement
Attacking	The dog quickly moves forward maximally and makes a snapping movement or actually bites (this may be impossible because of the subtest safety design), possibly accompanied by showing the teeth and/or growling and/or barking
Aggressive threatening behaviour	
Growling	Low buzzing sound
Barking	Short barking sound
Baring the teeth	The dog pulls up its upper lip, so that its teeth are visible

tongue is briefly extended) and snout licking (part of the tongue is shown and moved along the upper lip) and (2) yawning (mouth open to apparent fullest extent while eyes are closed).

All tests were recorded on videotape (Digital Video Camera Recorder, DCR-TRV27E, Sony®) and subsequently analysed.

Data were analysed by an analysis of variance (one way ANOVA). The comparisons between the frequencies of aggressive behaviours of the two groups (CG and EG) were investigated using the Pearson χ^2 test. The level of significance was set at $p < 0.05$. The analyses were done by PROC SAS GLM (SAS, 2002–2005).

2.4. Ethical note

It was mentioned before the beginning of the evaluation that the standardised aggression test could be aborted if the handler considered it as too stressful for his dog. In this study, the test has never been interrupted.

Table 2
Ethogram of dog posture.

High	The breed-specific posture as shown by dogs under neutral conditions, but, in addition, the tail is positioned higher or the position of the head is elevated and the ears are pointed forward, or the animal is standing extremely erect
Half high	Two of the following features are exhibited: a higher position of the tail, an elevation of the head and/or ears pointed forwards (or also: tail higher than neutral, ears backwards)
Neutral	The breed posture shown by dogs under neutral conditions
Half low	Two of the following features are exhibited: a lowered position of the tail (compared to the neutral posture), a backward position of the ears and/or bent legs (or also: tail lower than neutral or neutral + ears backwards)
Low	The position of the tail is lowered, the ears are positioned backwards and the legs are bent
Very low	Low posture, but now the tail is curled forward between the hind legs

3. Results

Different factors influenced the standardised aggression test results: the increasingly threatening character of the subtests, the time effect (that is the duration of the test) and absence of the handler during the second part of the test. Therefore, and in accordance with Haverbeke et al. (2009) we decided arbitrarily to categorize the test as a Mild Stress (MS) (ST 1–7) and a Strong Stress (SS) (ST 8–16). During MS, the handler was present and the types of stimulations were not highly stressful. During SS, the handler was absent, the types of stimulations were judged to be more stressful and the effect of time was supposed to have an influence.

4. Identification of aggressive behaviour

4.1. Aggressive biting, aggressive threatening and no aggression

The number of EG dogs expressing at least one aggressive behaviour (aggressive biting or aggressive threatening behaviour) was significantly lower than in the CG dogs (respectively 58.33%, $n = 21$ and 83.87%, $n = 26$) ($\chi^2 = 5.188$, df = 1, $p < 0.05$). In parallel, the percentage of dogs without any aggression during the whole test increased significantly from 16.13% in CG ($n = 5$) to 41.67% ($n = 15$) in EG ($\chi^2 = 5.188$, df = 1, $p < 0.05$) (Table 3).

4.2. Percentages of events of aggressive behaviour

EG dogs expressed significantly less events of aggressive biting than dogs of CG in MS ($F(467) = 4.82$, df = 1, $p < 0.05$). Moreover, dogs of EG demonstrated significantly more events of aggressive threatening during MS ($F(1, 574) = 4.11$, df = 1, $p < 0.05$), than during SS, and significantly more aggressive biting during SS than during MS ($F(1, 574) = 6.11$, df = 1, $p < 0.05$) (Fig. 2).

Table 3
Percentages of dogs demonstrating aggression during the standardised aggression test. Behaviours that were collected were either to express no aggression or at least one aggression (including Aggressive threatening and/or Aggressive biting) during the whole test.

	No aggression	At least one aggression	
		Aggressive threatening	Aggressive biting
CG	16.13 ($n = 5$)	83.87 ($n = 26$)	
		45.16 ($n = 14$)	67.54 ($n = 21$)
EG	41.67 ($n = 15$)	58.33 ($n = 21$)	
		22.22 ($n = 8$)	47.22 ($n = 17$)
Differences in aggression expressed between groups			
χ^{2*}	5.188	5.188	
		NS	NS

* Statistical test and results. When significant, df = 1, $p < 0.05$.

4.3. Aggression according to the housing conditions

EG dogs housed at the handlers home showed less aggression than dogs of CG ($F(1, 1068) = 5.39$, $p < 0.01$), especially less aggressive threatening ($F(1, 1067) = 6.87$, $p < 0.001$).

4.4. Identification of dog's posture

The posture of EG dogs was significantly higher than the posture of CG dogs individually for MS ($F(1, 467) = 9.63$, df = 1, $p < 0.01$) and for SS ($F(1, 601) = 7.36$, df = 1, $p < 0.01$). For both groups, the posture was always lower than neutral except for subtest 8 in which CG had a posture higher than neutral (Table 4). For both groups, the posture was significantly lower during SS than during MS: for CG ($F(1, 494) = 23.40$, df = 1, $p < 0.0001$) and for EG ($F(1, 574) = 34.78$, df = 1, $p < 0.0001$) (Fig. 3). EG dogs exhibited no higher posture during aggressive biting, aggressive threatening or none aggression than CG dogs.

4.4.1. Posture according to the housing conditions.

Dogs of EG which lived at home adopted a posture higher than one of the CG dogs ($F(1, 1068) = 9.01$, $p = <0.0001$).

4.5. Identification of oral behaviour

There were no statistical differences in the total number of oral behaviours between both groups (1.41 ± 0.0929 for CG and 1.62 ± 0.09 for EG). For both groups, dogs presented significantly more oral behaviours during SS than during MS (CG: $F(1, 494) = 20.02$, df = 1, $p < 0.001$; EG: $F(1, 574) = 6.30$, df = 1, $p < 0.05$). Though EG dogs exhibited significantly more oral behaviours during MS than CG ($F(1, 467) = 6.51$, df = 1, $p < 0.05$), this difference was not significant anymore during SS (Fig. 4).

4.6. Identification of yawning

EG dogs demonstrated significantly less yawning in the total number than CG dogs ($F(1, 1069) = 13.73$, df = 1, $p < 0.001$). Although there was no difference between MS for both groups, EG dogs showed significantly less yawning during SS than CG dogs ($F(1, 601) = 14.54$, df = 1, $p < 0.001$) (Fig. 5).

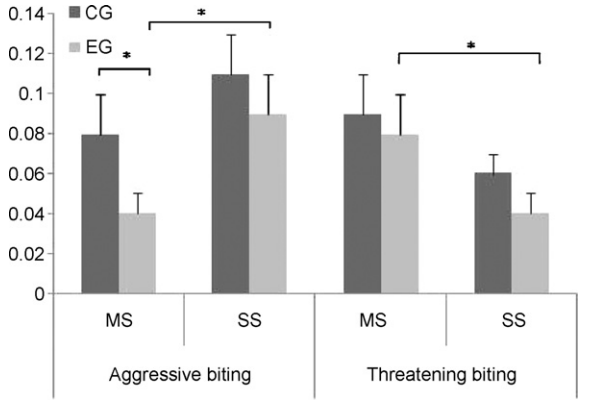

Fig. 2. Means values (±SE) of the number (events) of aggressive biting and threatening biting among CG (Control Group – black bars, $n = 31$) and EG (Experimental Group – light bars, $n = 36$) during Mild Stress (MS) and Strong Stress (SS) ($^{*}p < 0.05$).

4.6.1. Yawning according to the housing conditions

Dogs of EG demonstrated significantly less yawning in total than the ones on the CG dogs ($F(1, 1067) = 6.08$, $p < 0.001$).

5. Discussion

The dogs having followed this HFTP (=EG dogs) exhibited significantly less aggressive behaviour and fearfulness (measured through dog's posture, oral behaviours and yawning) in comparison to CG dogs. These results are encouraging and indicate that this HFTP did not only influence DH-team's efficiency (Haverbeke et al., 2010), but also dog's welfare.

EG dogs expressed less aggressive biting during Mild Stress (MS). Dogs of both groups demonstrated during MS mainly threatening aggression, and during Strong Stress (SS) mainly biting aggression. This can be explained by the fact that during SS, the handler is absent and the influence of the intensity of the stimulations and the time effect are heavier. For CG and EG dogs, no aggression has been observed during ST 3, 4, 5, 6, 8. Moreover for EG dogs, during two additional ST no aggression was observed: ST 10 (approaching with a bell) and 14 (approaching while staring at the dog), both belonging to SS.

In a previous study, authors highlighted that CG dogs showed fear-related aggression (Haverbeke et al., 2009). Even if EG dogs received more human interactions and training, it was still impossible for these dogs to escape in front of the threatening situation. The only way to react was to lower their posture with or without an aggressive behaviour.

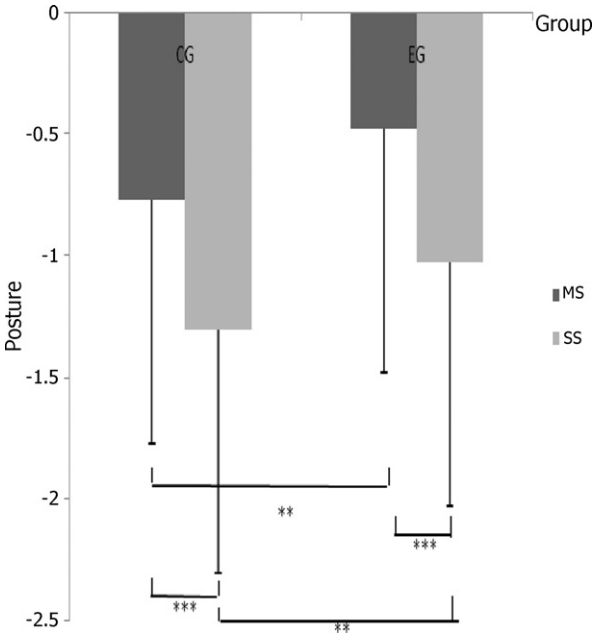

Fig. 3. Means values (±SE) of the posture among CG (Control Group, $n = 31$) and EG (Experimental Group, $n = 36$) during Mild Stress (MS, black bars) and Strong Stress (SS, light bars) ($^{**}p < 0.01$, $^{***}p < 0.001$) (0: neutral posture; −1: half low posture; −2: low posture; −3: very low posture).

Authors also observed that the EG dogs expressed more oral behaviours than CG dogs. Previous authors have defined these behaviours as stress-related behaviours (Beerda et al., 1998). As these dogs also adopted a higher body posture and exhibited less yawning, those behaviours were far less likely to represent canine stress-related behaviours (Beerda et al., 1998). It confirms the conclusion of Haverbeke et al. (2008a) in favor of positive stimulation or arousal of the dogs.

In accordance with the structure of the test, both groups exhibited more oral behaviour, yawning, and a lower posture during SS, when the handler was absent. This result may seem contradictory with previous findings of Beerda et al. (1998) who found that oral behaviour appears in a social context (human presence) and in a Mild Stress situation. If it was the case in the present study, dogs would have demonstrated more oral behaviour in the presence of the handler (=MS).

As already mentioned, there was an increase of yawning during SS. This result is consistent with earlier

Table 4
The dog's postures in percentage observed during the aggression test.

	HP*	HHP	NP	HLP	LP	VLP
CG	1.41	11.09	18.15	30.85	25.2	13.31
EG	0	17.88	13.19	51.73	6.60	10.59
Results	χ^2 (df = 1)					
	8.182	9.787	4.991	47.72	71.54	NS
	$p < 0.01$	$p < 0.01$	$p < 0.05$	$p < 0.001$	$p < 0.001$	

HP*: high posture; HHP: half high posture, NP: neutral posture, HLP: half low posture, LP: low posture, VLP: very low posture.

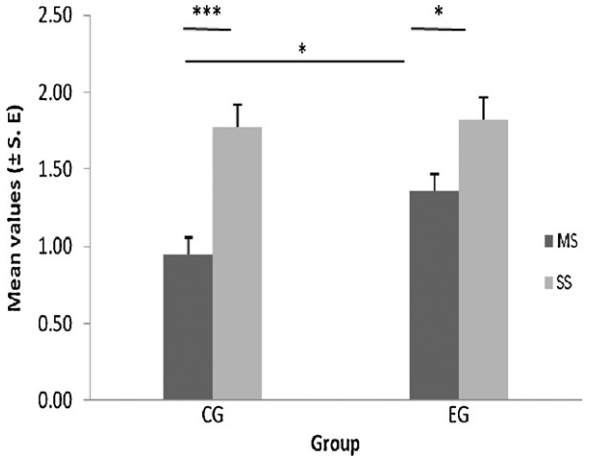

Fig. 4. Means values (±SE) of the number (events) of oral behaviour among CG (Control Group, $n = 31$) and EG (Experimental Group, $n = 36$) during Mild Stress (MS, black bars) and Strong Stress (SS, light bars) ($^{*}p < 0.05$, $^{***}p < 0.001$).

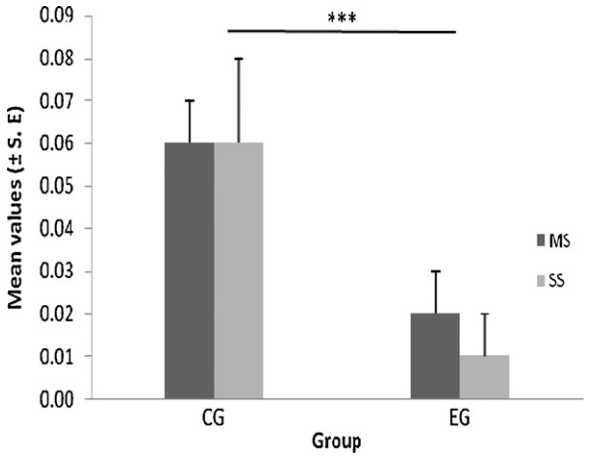

Fig. 5. Means values (± SE) of the number (events) of yawning among CG (Control Group, $n = 31$) and EG (Experimental Group, $n = 36$) during Mild Stress (MS, black bars) and Strong Stress (SS, light bars) ($^{***}p < 0.001$).

findings (Beerda et al., 1998, 2000; Hennessy et al., 1998, 2002, 2006) which found an increase of yawning in threatening situations. So yawning on dogs seems to indicate an acute (Beerda et al., 1998) or an intermittent stress (Tufik et al., 1995), which is exactly the case in this present aggression test.

Different parameters of this HFTP can explain the decrease of aggressiveness and fearfulness observed in EG dogs.

(1) The handlers were asked to abolish or at least to reduce punishment dramatically, as studies have shown that punishment, in particular with shock collars, compromised welfare of pet dogs (Hiby et al., 2004) and of working dogs (Schilder and Van der Borg, 2004) without benefits in obedience (Hiby et al., 2004).
(2) This HFTP proposed courses on Canine Ethology and on the theory of learning and training principles. This might have helped the handlers to acquire better knowledge about their dog, the complexity of canine training and indirectly to improve the bond with their dogs (Coppinger, 1998).
(3) The handlers were asked to use more appetitive stimuli during this HFTP (caresses, toy, food). The accent was put on the reinforcement through playing which increased dog's motivation in work (Rooney and Bradshaw, 2004) and may have had an indirect effect on dog's welfare.
(4) The fact that this HFTP included certificates to get the next level may have increased the handler's motivation and had indirect effects on the dog.
(5) This HFTP was preceded by a familiarisation period which allowed the handler and the dog to establish a bond through playing and walking.
(6) This HFTP aimed to develop environmental and social enrichments which can have contributed to the dog's welfare (Hennessy et al., 2006; Wells, 2004; Hetts et al., 1992).

The environmental enrichment in kennels included a toy which could encourage play, reduce boredom and abnormal behaviours (Hubrecht, 1993; Loveridge, 1998; Adams et al., 2004) and thus, increase animal's welfare.

The social enrichment was suggested to handlers and included inter-specific enrichment (positive contacts between the handler and his dog: walking, playing, obedience exercise, grooming, etc.) and intra-specific enrichment (contacts between dogs, outdoors, in the same kennel or at least a visual contact). Moreover some training sessions have been organized in group providing both social intra- and inter-specific enrichment. Finally, it was recommended that the handlers would house their dogs at their homes. All, but two, have followed these suggestions.

The number of differences between CG and EG should be mentioned. The groups differed in three major ways: kenneling (CG: 11 kennel housed, 20 housed at home; EG: 2 kennel housed, 34 housed at home); purchase selection criteria (EG more sociable, playful, less fear of humans) and training (CG: min. 1 h per week; EG: min. 6 h per week – daily training). This makes it impossible to know which factor(s) from this HFTP induced the improvements. These are constraints of the 'real world' environment: this HFTP had to satisfy numerous imperatives (i.e., time, money) and therefore affected several parameters at once.

In conclusion, this HFTP brought several improvements on the aggressiveness and fearfulness of the military dog, via the better quality of the environment, an improved dog–handler's relationship, and the application of more positive training methods. Authors are convinced that with a greater control on the implementation and with a follow-up of this HFTP, results would still improve. The origin of the dogs was unknown and the dogs were purchased as adult dogs. Nevertheless, this study has shown that improvements can be brought via an adequate programme of human familiarisation and training.

This study must be considered a preliminary investigation of the comparison of two training methods. However, the scope of the project and the already robust research

foundation on which the study is based are well beyond what most critics would consider "pilot" work.

Acknowledgments

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.applanim.2009.12.014.

References

Adams, K., Navarro, A., Hutchinson, E., Weed, J., 2004. A canine socialization and training program at the national Institutes of health. Lab Animal 33, 1.

Beerda, B., Schilder, M.B.H., Van Hooff, J.A.R.A.M., de Vries, H.W., Mol, J.A., 1998. Behavioural, saliva cortisol and heart rate responses to different types of stimuli in dogs. Appl. Anim. Behav. Sci. 58, 365–381.

Beerda, B., Schilder, M.B.H., Van Hooff, J.A.R.A.M., De Vries, H.W., Mol, J.A., 2000. Behavioural and hormonal indicators of enduring environmental stress in dogs. Anim. Welfare 9, 49–62.

Coppinger, R., 1998. Observations on assistance dog training and use. J. Appl. Anim. Welf. Sc. 1 (2), 133–144.

Haverbeke, A., Diederich, C., Stevens, M., Giffroy, J.M., 2005. Analysis of accident reports of canine bites, in the Belgian Defence. Int. Rev. Armed Forces Med. Serv. 78 (1), 26–30.

Haverbeke, A., Laporte, B., Depiereux, E., Giffroy, J.M., Diederich, C., 2008a. Training methods of military dog handlers and their effect on the team's performances. Appl. Anim. Behav. Sci. 113, 110–122.

Haverbeke, A., Messaoudi, F., Depiereux, E., Stevens M., Giffroy, J.M., Diederich, C., 2010. Efficiency of working dogs undergoing a new Human Familiarization and Training Program. J. Vet. Behav., doi:10.1016/j.jveb.2009.08.008.

Haverbeke, A., Diederich, C., Depiereux, E., Giffroy, J.M., 2008b. Cortisol and behavioral responses of working dogs to environmental challenges. Physiol. Behav. 93, 59–67.

Haverbeke, A., de Smet, A., Depiereux, E., Giffroy, J.M., Diederich, C., 2009. Assessing undesirable aggression among military working dogs. Appl. Anim. Behav. Sci. 117 (1–2), 55–62.

Hennessy, M.B., Williams, M.T., Miller, D.D., Douglas, C.W., Voith, V.L., 1998. Influence of male and female petters on plasma cortisol and behaviour: can human interaction reduce the stress of dogs in a public animal shelter? Appl. Anim. Behav. Sci. 61, 63–77.

Hennessy, M.B., Voith, V.L., Young, T., Hawke, J., Centrone, J., Mc-Dowell, A., Linden, F., Davenport, G.M., 2002. Exploring human interaction and diet effects on the behaviour of dogs in a public animal shelter. J. Appl. Anim. Welf. Sci. 5, 253–273.

Hennessy, M., Morris, A., Linden, F., 2006. Evaluation of the effects of a socialization program in a prison on behavior and pituitary–adrenal hormone levels of shelter dogs. Appl. Anim. Behav. Sci. 99, 157–171.

Hetts, S., Clark, J.D., Calpin, J.P., Arnold, C.E., Mateo, J.M., 1992. Influence of housing conditions on beagle behaviour. Appl. Anim. Behav. Sci. 34, 137–155.

Hiby, E.F., Rooney, N.J., Bradshaw, J.W.S., 2004. Dog training methods: their use, effectiveness and interaction with behaviour and welfare. Anim. Welfare 13, 63–69.

Hubrecht, R.C., Serpell, J.A., Poole, T.B., 1992. Correlates of pen size and housing conditions on the behaviour of kennelled dogs. Appl. Anim. Behav. Sci. 34, 365–383.

Hubrecht, R.C., 1993. A comparison of social and laboratory environmental enrichment methods for laboratory housed dogs. Appl. Anim. Behav. Sci. 37, 345–361.

Lefebvre, D., Diederich, C., Delcourt, M., Giffroy, J.M., 2007. The quality of the relation between handler and military dogs influences efficiency and welfare of dogs. Appl. Anim. Behav. Sci. 104, 49–60.

Lefebvre, D., Giffroy, J.M., Diederich, C., 2009. Cortisol and behavioural responses to enrichment in military working dogs. J. Ethol. 27 (2), 255–265.

Loveridge, G.G., 1998. Environmentally enriched dog housing. Appl. Anim. Behav. Sci. 59, 101–113.

Mertens, P.A., Unshelm, J., 1996. Effects of group and individual housing on the behaviour of kennelled dogs in animal shelters. Anthrozoös 9, 40–51.

Netto, W.J., Planta, D.J.U., 1997. Behavioural testing for aggression in the domestic dog. Appl. Anim. Behav. Sci. 52, 243–265.

Planta, D.J.U., 2001. Testing dogs for aggressive biting behaviour: the MAG-test (sociable acceptable behaviour test) as an alternative for the aggression-test. In: Overall, K.L., Mills, D.S., Heath, S.E., Horwitz, D. (Eds.), Proceedings of the Third International Congress on Animal Behaviour Medicine, Vancouver, UFAW Herts, UK, pp. 142–144.

Rooney, N.J., Bradshaw, W.S., 2004. Breed and sex differences in the behavioural attributes of specialist search dogs—a questionnaire survey of trainers and handlers. Appl. Anim. Behav. Sci. 86, 123–135.

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Schilder, M.B.H., Van der Borg, J.A.M., 2004. Training dogs with help of the shock collar: short and long term behavioural effects. Appl. Anim. Behav. Sci. 85, 319–334.

Seksel, K., Mazurski, E.J., Taylor, A., 1999. Puppy socialisation programs: short and long term behavioural effects. Appl. Anim. Behav. Sci. 62, 335–349.

Tuber, D.S., Miller, D.D., Caris, K.A., Halter, R., Linden, F., Hennessy, M.B., 1999. Dogs in animal shelters: problems suggestions and needed expertise. Psychol. Sci. 10, 379–386.

Tufik, S., De Luca, Nathan, C., Neumann, B., Hipolide, D.C., Lobo, L.L., De Medeiros, R., Troncone, L.R.P., Braz, S., Suchecki, D., 1995. Effects of stress on drug-induced yawning: constant vs. intermittent stress. Physiol. Behav. 58, 181–184.

Van der Borg, J.A.M., Netto, W.J., Planta, D.J.U., 1991. Behavioural testing of dogs in animal shelters to predict problem behaviour. Appl. Anim. Behav. Sci. 32, 237–251.

Wells, D.L., Hepper, P.G., 2000. Prevalence of behaviour problems reported by owners of dogs purchased from an animal rescue shelter. Appl. Anim. Behav. Sci. 69, 55–65.

Wells, D., 2004. A review of environmental enrichment for kennelled dogs, *Canis familiaris*. Appl. Anim. Behav. Sci. 85, 307–317.