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Systematic training of shelter dogs improves their cooperation with new handlers

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■ Summary

It has been shown that training may increase the resilience of shelter dogs against developing more problem behaviour, supporting their welfare and adoptability. We investigated whether and in what way the behaviour of dogs towards new handlers is affected by positive reinforcement training. Twenty shelter dogs received six sessions with positive reinforcement training (PRT) over two weeks, with nine control dogs receiving the normal shelter procedures including occasional leash walks with volunteers. Before and after the two-week training/control period, the dogs were submitted to a simple temperament test and a standardized leash walk, which included two obedience exercises. To simulate interactions with a new owner, the dog handlers in all tests were not known to the dog. Dogs in the training group established eye contact with the dog handler less often than did dogs in the control group, perhaps because trained dogs were more confident, reducing the need for checking with the handler. Training reduced the likelihood that dogs showed a startle

■ Zusammenfassung

Systematisches Training von Tierheimhunden verbessert deren Kooperation mit unbekannten Hundeführern

Einleitung

Es konnte gezeigt werden, dass Training bei Tierheimhunden die Entwicklung von Verhaltensproblemen eindämmen kann. Das wiederum fördert das Wohlbefinden und die Vermittlungsrate. Mit dieser Studie wollten wir herausfinden, ob und in wie weit das Verhalten von Tierheimhunden gegenüber neuen Hundehaltern via Training mittels positiver Bestärkung (PRT) beeinflusst werden kann.

Material und Methoden

Zwanzig Tierheimhunde wurden in sechs Trainingseinheiten über zwei Wochen via PRT trainiert. Neun Kontroll-Hunde durchliefen lediglich das normale Tierheim-Verfahren inkl. gelegentlicher Spaziergänge mit Freiwilligen ohne Training. Vor und nach der Trainings- bzw. Kontrollperiode wurden die Hunde einem einfachen Temperamenttest und einem

Standardspaziergang, der zwei Unterordnungsübungen beinhaltete, unterzogen. Um eine Interaktion mit einem neuen Hundehalter zu simulieren, war der Hundeführer in den Tests immer eine für den Hund unbekannte Person. Aufmerksamkeits-, Stress-, agonistisches Verhalten, Vokalisation, Schreckreaktion, Leinenstatus (gestrafft, locker), sowie Übungsleistungen (Sitz, Platz) und Übungsdauer wurde codiert und mittels SPSS analysiert. Um herauszufinden, ob es einen Verhaltensunterschied im Pre- und Post-Test gibt, wurde der Wilcoxon signed-rank Test, für „Leineziehen“ seitens des Hundeführers der one-sample Wilcoxon signed-rank Test verwendet.

Ergebnisse

Im Gegensatz zu Hunden aus der Kontrollgruppe suchten Hunde aus der Trainingsgruppe weniger Blickkontakt zum Hundeführer. Ebenfalls reduzierte das Training die Schreckreaktion bei Hunden in der Regenschirm-Testsituation. Trainierte Tierheimhunde zeigten außerdem eine bessere Leistung in den Übungen „Sitz“ und „Platz“,

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response in the umbrella test. Trained shelter dogs performed better than controls in the exercises “sit” and “lie”, indicating that training made them more controllable and cooperative, even with an unknown human handler. We conclude that shelter dogs benefit from PRT by improved stress management and by becoming more confident and cooperative with potential adopters. This may increase their odds of being adopted and reduce the risk of their being returned to the shelter.

Abbreviations: DH = dog handler; PRT = positive reinforcement training; WHWT = West Highland White Terrier

■ Introduction

Approximately 5 % of the estimated 80 million dogs in the USA enter shelters every year and half of them are euthanized (PATRONEK and GLICKMAN, 1994; PATRONEK et al., 1995; BARTLETT et al., 2005). The situation is similar in many other Western countries. In Austria, the number of dogs euthanized is much lower, largely because euthanasia is only legal for serious medical reasons (SCHLAGER, 2003). This legal provision contributes to crowded shelters and high operating costs, potentially limiting dog welfare (NORMANDO et al., 2009). To maintain high standards of welfare at shelters, reasonable adoption rates are needed.

Shelter dogs often are exposed to stressors, such as high levels of noise and novelty, insufficient contact with human partners and conspecifics and restricted housing conditions. All of them could result in frequent arousal and increased levels of cortisol. Human–animal interactions can decrease cortisol levels and generally seem to have positive effects on behaviour and welfare of shelter dogs (HENNESSY et al., 1997; HENNESSY et al., 2002; BERGAMASCO et al., 2010). Regular interactions with humans, particularly training, may thus benefit adoption rates. For example, regular leash walking substantially decreased the number of dogs remaining in a shelter for more than four years (BRAUN, 2011) and trained dogs have been shown to be adopted 1.4 times more often than untrained ones (LUESCHER and MEDLOCK, 2009). When training shelter dogs was combined with advertising these dogs in social media and with pre- and post-adoption services for new owners, adoption rates increased by 27.5 % over control conditions (MENCHETTI et al., 2015). However, it is often unclear whether the studies were biased against including difficult/aggressive dogs, which would affect their outcomes. We aimed to control for such a bias by focussing on the potential behavioural effects of a training programme. We were confident that training would improve the interaction patterns of the dogs with humans, potentially also improving adoptability, because we have shown that the interaction of dogs with people can be significantly modulated by the personality and interaction styles of the human

selbst wenn der Hundeführer eine für den Hund unbekannte Person ist.

Schlussfolgerung

Training mittels positiver Verstärkung führte zu verbesserten Leistungen der Hunde in den Unterordnungsübungen mit ihnen unbekannt Personen. Die Hunde wurden kooperativer, kontrollierbarer und potentiell selbstsicherer. Dies könnte die Vermittelbarkeit von trainierten Hunden verbessern und das Risiko einer erneuten Rückgabe ins Tierheim senken.

partners (KOTRSCHAL et al., 2009; SCHÖBERL et al., 2009), although the “personality” and “temperament” of individual dogs remains relatively stable over time (SVARTBERG and FORKMAN, 2002; SVARTBERG et al., 2005). Based on what we know about the nature of the human-dog bond (KAMINSKI and MARSHALL-PESCINI, 2014; KOTRSCHAL, 2016) and on previous results (above), we expected that anxious and potentially aggressive interaction styles would decrease, while interaction quality and cooperation would improve even towards handlers unknown to the dogs. No such changes would be expected in the control group.

■ Material and methods

Subjects

We used 20 test dogs (eight males, twelve females; nine neutered/spayed, eleven intact) and nine control dogs (five males, four females; five neutered/spayed, four intact). Table 1 provides information on the dogs. Their minimum age was 15 months, as suggested, for example, by the *Niedersächsischer Wesenstest* (Niedersächsisches Ministerium für den ländlichen Raum, Ernährung, Landwirtschaft und Verbraucherschutz, 2003).

Housing

We worked with dogs of the “Landestierschutzverein für Steiermark” in Graz/Styria, a small shelter for approximately 20 dogs with a rapid turnover (average of 1.5–3 months). We worked with the dogs as they became available and for practical reasons related to shelter procedures, we processed the experimental group first and the control group subsequently. Dogs are kept alone (except for puppies) in 4–6 m² inside kennels during the night and in groups of up to three in 60–90 m² outdoor kennels during the day. If a volunteer wants to walk a dog, the dog is collared/harnessed, put on a leash and brought outside the kennels by the shelter staff. Each dog is normally walked by several volunteers two or three times a week. Dogs are fed at 7:00 a.m. Further feedings are adapted to the dogs’ condition, with skinny dogs and puppies fed more often than others. Upon arrival, dogs are microchipped, treated against parasites and vaccinated, if necessary, before entering the quarantine station. Dogs found as strays remain in quarantine for 30–40 days; healthy dogs with complete vaccination records leave quarantine immediately. Depending on their health and vaccination status, the dogs are made available for adoption. “Listed dogs” (according to

Tab. 1: Shelter dogs participating in the study. An asterisk after the age indicates “estimated”. Duration of stay was measured until beginning of study. / Übersicht über die teilnehmenden Hunde aus dem Tierheim. Ein Stern hinter dem Alter bedeutet „geschätzt“. Die Aufenthaltsdauer berechnet sich bis zum Start der Studie.

Group	Name	Age [years]	Sex	Breed	Length of stay [days]
Test	Aika	9	Female	German Shepherd-Mix	339
	Jenny	11	Female	German Shepherd	870
	Ginny	1.5*	Female	Greenland Dog	22
	Bellatrix	3*	Female	Greenland Dog	14
	Hera	9	Female	German Shorthaired Pointer-Mix	36
	Wonder	14*	Female	German Shepherd	14
	Molly	2*	Female	Spitz-Mix	19
	Timon	1.5*	Male	Greenland Dog	14
	Aikon	3.5	Male	Husky	16
	Elli	4	Female spayed	Dachshund-WHWT-Mix	19
	Sue Ellen	9	Female spayed	Dalmatian-Mix	17
	Shadow	9	Male castrated	American Staffordshire Terrier-Mix	399
	Chip	3	Male castrated	Labrador	378
	Blacky	7	Male castrated	Cocker Spaniel	30
	Bero	8	Male castrated	Rottweiler-Mix	13
	Bella	1.5*	Female spayed	Border Collie-Mix	14
	Lucky	1.5	Male	Jack Russell-Mix	17
	Inja	3.5	Female spayed	Labrador	15
	Rocky	8	Male	Yorkshire Terrier	13
	Control	Nicki	8	Female spayed	German Shepherd-Mix
Dexter		1.5	Male	Czechoslovakian Wolfdog	14
Scarecrow		3*	Male castrated	American Staffordshire Terrier	29
Joker		3*	Male castrated	American Staffordshire Terrier	29
Xena		3	Female	Cane Corso-Mix	14
Lucy		1.5	Female spayed	American Staffordshire Terrier-Mix	18
Sally		6	Female spayed	German Shepherd	14
Jimmy		10	Male castrated	German Shepherd-Mix	16
Elisabeth		4*	Female	American Staffordshire Terrier	15
Tyson		2.5	Male	American Staffordshire Terrier	14

the law, NÖ HUNDEHALTERGESETZ, 2018; VO WIEN, 2018; VO VORARLBERG, 2018) i.e. American Staffordshire Terrier, Dogo Argentino, Fila Brasileiro etc., are neutered/spayed upon arrival at the shelter; other breeds are thus treated only if there is a veterinary indication. Listed dogs need to wear a muzzle when walked, while other dogs only do so when indicated by their behaviour. Dogs are trained via positive reinforcement by the shelter staff to wear the muzzle. Enclosures are regularly enriched with toys or via hidden treats. During the study, the shelter staff was asked to stop enrichment and staff and walkers were asked not to train the dogs in any way while they were participating in the study.

Training

Participating dogs received positive-reinforcement training units (PRT) from volunteer dog handlers, supervised by the first author (RP). Each dog in the training group completed six training sessions within two weeks; dogs in the control group were not trained. Training sessions were conducted at a dog obedience school close

to the shelter. Each session took approximately one hour including a few breaks, depending on the dog's progress and motivation. Each of the ten dog handlers trained one to four dogs, with every handler training the same dog in all six sessions and leash-walking the dog from and to the shelter before and after training. The leash walk from the shelter to the training facility took approximately twelve minutes. The training featured seven tricks, suitable for all dogs: Slalom (dog walks slalom through the legs of the handler), Give Paw (dog puts paw into the handler's hand), Turn (dog turns around its own axis), Around (dog walks around the handler), Tip Tap (dog puts its paws on the handler's feet, alternating left and right), Bow (dog stands on its back legs and lies on its front legs in a bow-like pose) and Peng (dog quickly lies down on its side). Because of their different personalities and progress, each dog had a training programme specifically adapted to it, although the tricks were generally trained in the given order. For “listed dogs” (see above), the shelter management allowed the test team to remove the muzzle during the training. Treats such as cheese, liver pate, pork sausage or conventional dog food were used as motivating rewards. After every training session, the

Tab. 2: Ethogram to analyse the behaviour of shelter dogs / Ethogramm zur Auswertung des Verhaltens von Tierheimhunden

Behaviour	Description	Type
Behaviour Class 1: Agonistic behaviour. According to FEDDERSEN-PETERSEN (2013a), modified from ZIMEN (1971).		
Offensive threat	Baring front teeth, fixation, raising hackles, growling	Duration
Defensive threat	Baring all teeth, raising hackles, looking away, defence snapping, chattering of teeth, “play”-bow, turning toward bottom, playful defence	Duration
Behaviour Class 2: Calming signals and stress behaviour. According to RUGAAS (2001) and FEDDERSEN-PETERSEN (2013b).		
Lifting one paw		Event
Yawning		Event
Licking intention	The dog licks its nose	Event
Turning the head and/or looking away	The dog turns his head or looks away from the disturbing factor	Event
Turn away	The dog turns away. Cowered position, avoiding eye contact, tucked tail and ears are possible	
Sniffing	The dog sniffs intensively on the ground or on bushes. Fast walking with sunken head is not coded.	Duration
Soft eye blinks		Event
Shaking		Event
Scratching		Duration
Behaviour Class 3: Startle response. According to BUBLAK (2013).		
Startle response	Fast orientation reaction (sudden looking)	Event
Behaviour Class 4: Vocalizations. According to FEDDERSEN-PETERSEN (2013c).		
Whimper	Intermittent and plaintive sound like “hihihiiii”	Duration
Wuffing	Barking with closed snout. Every “wuff” is counted as one event	Event
Barking	Every bark is counted as one event	Event
Growling	Sometimes with showing the teeth, sounds like “grrrrrrr”	Duration
Behaviour Class 5: Dog’s attention.		
Gaze directed to dog handler	Dog looks at the handler’s face	
Duration		
Gaze directed to lure	Dog looks in the lure’s direction	Duration
Gaze not directed to dog handler	Dog looks neither to lure nor to dog handler	Duration
Behaviour Class 6: Leash.		
Leash strained to the front or side	Dog pulls forward or to the side	Duration
Leash strained to the back	Dog pulls backward	Duration
Leash loose	No-one is pulling	Duration
Dog handler is pulling	The dog handler pulls	Duration
Time-out during the exercise	No leash-behaviour during the exercises	Duration
Behaviour Class 7: Exercises.		
Sit/Lie	Food rewarding, verbal and hand assistance are allowed and do not influence the grade. Rating from 1 (good) to 5 (bad): 1: Exercise is performed with little help from the dog handler. “Lie” is also valid when the dog has to perform a “sit” before 2: The exercise is performed after the second attempt 3: The exercise is performed after several attempts 4: The dog performs the exercise with a great deal of effort 5: The dog does not pass the exercise	Event

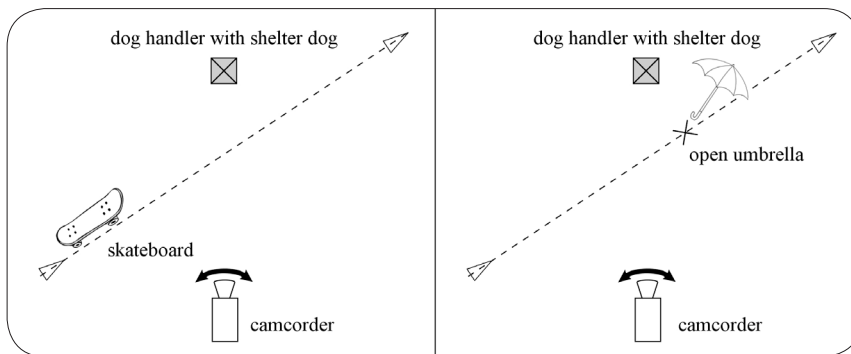


Fig. 1: Layout of the temperament test for shelter dogs / Aufbau des Temperamenttests für Tierheimhunde

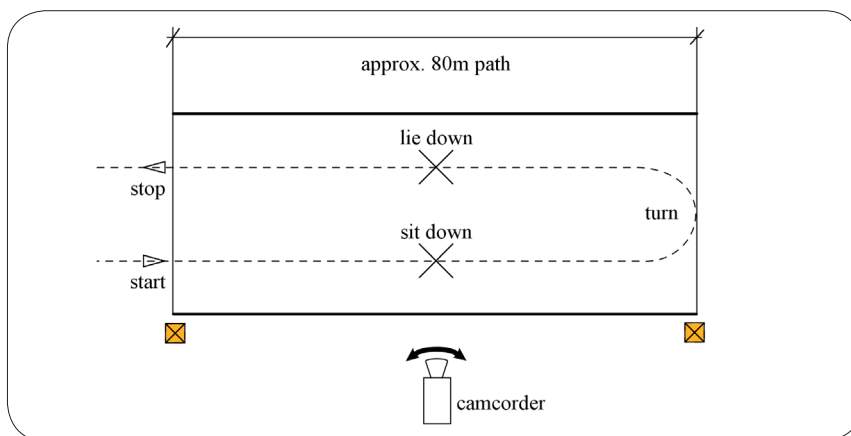


Fig. 2: Layout of the standardized leash walk. The orange markings represent the pylons and show where the walk starts, turns and stops. Approximately in the middle of the path, on the way towards the turning point, the pair had to perform the exercise “sit”, and on its way back, the exercise “lie”. / Aufbau des standardisierten Leinenspazierganges. Die orangen Markierungen repräsentieren die Pylonen und zeigen an, wo der Spaziergang startet, wendet und stoppt. Ungefähr auf der Mitte des Weges, am Weg hin zum Wendepunkt, musste die Dyade die Übung „Sitz“ ausüben und am Weg zurück die Übung „Platz“.

dog handler recorded the date, time, name of dog, name of handler, tricks trained, the dogs' motivation, training success, problems during the training etc.

Temperament testing

The same temperament tests were staged before and after the training period. To remain compatible with the trained group, the control dogs were subjected to the temperament tests twice with two weeks between tests. We used two everyday-life situations and a standardized leash walk. The tests were staged in a public park near the shelter, at a leash-walk distance of approximately 5 min. All tests were videotaped with a Samsung SMX-F30 Hand-held Camcorder by RP. During the two tests, a total of ten persons, unknown to the dogs, handled each dog. The first and second test sessions were always performed by different handlers and lure persons, all unknown to the dog, to ensure that the dogs always experienced an unknown person. The test team was permitted to remove the muzzle from “listed dogs” (above) during the tests. First, a lure person was skateboarding near the leashed dog; later, the same person opened an automatic umbrella near the dog (see Fig. 1; *Niedersächsischer Wesenstest*). Different umbrellas were used in the pre- and post-training tests to avoid habituation.

Standardized leash walk

A standardized leash walk was carried out in the park where the temperament tests were performed, also with a person unknown to the dog. A route of approximately 80 metres was marked with orange pylons. In the middle of the walk, the handler/dog team had to practise a command. The standardized walk started at the orange pylon. When the pair reached a particular bench, they performed the obedience exercise “sit”. They continued walking until they reached the second orange pylon, where they turned around. At the marked park bench, they performed the exercise “lie”, then continued to walk towards the first orange pylon (Fig. 2). As not all shelter dogs knew how to “sit” and/or “lie”, the handlers were allowed to use food and verbal and gentle hand assistance to help the dog complete the exercise. During the leash walk the handlers would not hand out treats to the dog (except during the obedience exercises) and were requested to “walk as usual” and not to aim at a perfect performance. The time was not limited.

Observation and ethogram

Data were collected from March 2015 until February 2016 and the behaviour coding with the *Solomon Coder*[®] was completed by June 2016. The configuration was based on an ethogram (see Tab. 2). Inter-observer reliability was tested before starting behaviour coding; three persons not included in the study coded seven videos (five standardized leash walks of approximately 2.5 minutes and two temperament tests of approximately 30 seconds). The index of concordance was 88.5 % (\pm SD 11.8). For the temperament tests, the coding started when the lure person started to walk or ride the skateboard and lasted until the scene ended (15–30 sec). In the leash walk, the coding started when the pair passed the first pylon and ended when they passed the first pylon again. Leash walks took approximately 2–4 min.

As the standardized leash walk and the umbrella situation in the personality test were not initially part of the data acquisition, only 22 dogs took all test situations (skateboard, umbrella and walk; see Tab. 3). Seven dogs (one control and six in the training group) took the first test but could not take the final test because they were adopted in the meantime (not mentioned in Tab. 3). In total, 146 videos were encoded.

Statistical analysis and measures of outcome

The data set was prepared with MS Excel 2016. Absolute durations were taken for variables based on durations independent of the total duration of a test (only “time out while exercise” = “duration of the exercises”; only available on standardized leash walks). Variables based on duration were normalized by the total duration of the test. Events (frequencies) were also relativized with the duration of the entire test (rate per minute, e.g. “licking intention”). The behaviour patterns were pooled over the three test situations (skateboard, umbrella, walk). For example: “sum of licking intention in all three

tests” divided by the “sum of total time in all three tests” = “pooled frequency of licking intention”.

Data were analysed according to the ethogram (see Tab. 2). Stress-related behaviour (ethogram, class 2) and vocalizations (ethogram, class 4) were pooled, without mixing data on durations and data on events. The following behaviour patterns were analysed; agonistic behaviour, attention (gaze to dog handler, gaze not to dog handler, gaze to lure), startle response, leash status (strained, loose) and exercises (sit down, lie down, exercise duration).

IBM SPSS 20.0 for Windows was used for statistical analysis. The Wilcoxon signed-rank test was used to test for a difference in behaviour between pre- and post-test. The one-sample Wilcoxon signed-rank test was used for leash-pulling behaviour by the dog handler. The significance level was set at $p=0.05$. A trend towards significance was considered if $p<0.09$.

Results

Stress-related behaviour

To compare stress-related behaviour in the tests before and after the training session, all behaviour indicative of stress in the ethogram (see Tab. 2) was pooled over all tests and standardized for observation time. No differences were found between pre- and post-test (see Tab. 4). A statistical trend toward significance ($p<0.09$) could be found for the test group (Wilcoxon signed-rank test $Z = -1.792$, $p = 0.073$). When the two test situations (skateboard, umbrella) were analysed separately, dogs in the training group but not in the control

Tab. 3: Number of dogs for the personality/temperament tests and leash walks. All 29 dogs ran through the skateboard test situation; 22 of them completed the umbrella situation and the standardized leash walk. / Anzahl der Hunde für die Persönlichkeits-/ Temperamenttests und Leinenspaziergänge. Alle 29 Hunde der Studie durchliefen den Skateboard-Test, 22 von ihnen schlossen zusätzlich den Schirm-Test und den standardisierten Leinenspaziergang ab.

Test characteristics		Group		Total
		Training	Control	
Personality test	Skateboard	20	9	29
	Umbrella	14	8	22
Leash walk		14	8	22

group showed significantly less stress-related behaviour in the umbrella test post-training than pre-training (Wilcoxon signed-rank test $Z = -2.417$, $p = 0.016$). The startle responses in the umbrella test decreased in the training group but not in the control group (Wilcoxon signed-rank test $Z = -2.023$, $p = 0.043$).

Attention

The dogs in the training group, but not in the control group, looked less often at the dog handler during the tests after training (test group: Wilcoxon signed-rank test $Z = -2.069$, $p = 0.039$; Fig. 4; control group: Wilcoxon signed-rank test $Z = -1.007$, $p = 0.314$). No significant differences between pre- and post-test were found for the behaviour “gaze to lure”, either in the training group (Wilcoxon signed-rank test $Z = -0.747$, $p = 0.455$) or in the control group (Wilcoxon signed-rank test $Z = -0.770$, $p = 0.441$) (see also Tab. 4).

Leash walking

The behaviour of the different walkers was relatively homogenous, as there was no difference in how different dog handlers (DH) pulled the leash (one-sample Wilcoxon signed-rank test with median of 0.022 in relation to the total observed duration DH 1: $p = 0.655$, DH 2: $p = 0.494$, DH 3: $p = 1.000$, DH 4: $p = 0.574$, DH 5: $p = 0.180$, DH 6: $p = 0.109$, DH 7: $p = 0.180$, DH 8: $p = 1.000$, DH 9: $p = 0.713$).

Leash strain was evidently not affected by training, as there were no differences in leash walks pre- and post-training, nor were any differences seen in the control group. However, the dogs in the training group performed significantly better (observer-rated) in the post-training leash walks than pre-training in the obedience commands “sit” (Wilcoxon signed-rank test $Z = -2.264$, $p = 0.024$) and “lie” (Wilcoxon signed-rank test $Z = -2.265$, $p = 0.024$); no such change was seen in the control group (“sit”, Wilcoxon signed-rank test $Z = -1.134$, $p = 0.257$,

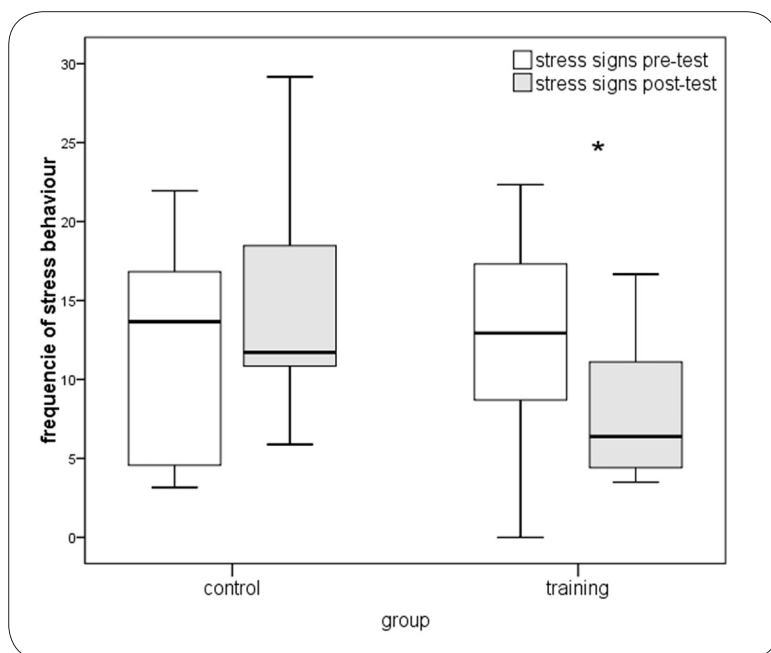


Fig. 3: Frequency of stress behaviour in the umbrella situation pre- and post-test in the control group and the training group [min^{-1}]. / Frequenz des Auftretens von Stressverhalten im Schirm-Test vor (weiß) und nach (grau) der Testsituation in der Trainings- und in der Kontrollgruppe [min^{-1}].

Tab. 4: Statistical analysis of behaviour patterns of shelter dogs before and after training (Wilcoxon signed–rank Test). Group: T=Test, C=Control; Type: D=Duration, E=Event. Numbers in “Test” 1=skateboard Test situation, 2=umbrella Test situation, 3=leash walk. More numbers mean pooled across mentioned Tests. Significances ($p<0.05$) and statistical trends toward significance ($p<0.09$) are highlighted in grey. Variables based on durations are given in percent. Variables based on events are given in rate per minute. Exercise Duration is given in seconds. Exercise performances are given in Grades (see also Tab. 2). Startle response only occurred in umbrella Test situation. Defensive threat never occurred, offensive threat only occurred in skateboard Test situation. / Ergebnisse der statistischen Auswertung der Verhaltensweisen von Tierheimhunden vor und nach Training (Wilcoxon signed–rank Test). Gruppe: T=Test, C=Kontrolle; Typ: D=Dauer, E=Event. Zahlen in „Test“ bedeuten 1= Skateboard Testsituation, 2=Schirm Testsituation, 3=Leinenspaziergang. Mehrere Zahlen bedeuten, dass die Ergebnisse über die angegebenen Test gepoolt wurden. Signifikanzen ($p<0,05$) und Tendenzen ($p<0,09$) sind grau unterlegt. Variablen, die auf Dauer basieren, sind in Prozent angegeben. Variablen, die auf Events basieren, sind in Anzahl pro Minute angeben. Die Übungsdauer ist in Sekunden angegeben. Die Übungsleistung ist in Noten angegeben (siehe auch Tab. 2). Schreckreaktion trat nur in der Schirm-Testsituation auf. Defensives Drohen trat nie auf, offensives Drohen nur in der Skateboard-Testsituation.

Behaviour	Group	Pre-Test		Post-Test		p-value	Z-value	Type	Test	r-value	
		Mean	SD	Mean	SD						
Agonistic behaviour (offensive threat)	T	0.1989	0.0867	0.0383	0.1800	0.180	-1.342	D	1	0.217	
	C	0.0000	0.0000	0.0000	0.0000	1.000	0.000	D	1	0.236	
Stress behaviour	T	11.76	8.02	6.52	5.58	0.062	-1.867	E	1	0.295	
	C	17.52	6.31	17.41	8.37	0.767	-0.296	E	1	0.070	
	T	0.0036	0.0161	0.0089	0.0398	0.655	-0.447	D	1	0.070	
	C	0.0120	0.0220	0.0000	0.0000	0.180	-1.342	D	1	0.316	
	T	12.61	5.93	8.24	4.55	0.016	-2.417	E	2	0.457	
	C	11.90	6.55	14.64	6.90	0.484	-0.700	E	2	0.175	
	T	0.0279	0.0923	0.0000	0.0000	0.180	-1.342	D	2	0.254	
	C	0.0440	0.0952	0.0031	0.0088	0.285	-1.069	D	2	0.267	
	T	3.16	2.17	2.67	1.74	0.650	-0.454	E	3	0.086	
	C	3.76	2.11	4.02	3.09	0.889	-0.140	E	3	0.035	
	T	0.0764	0.0557	0.1214	0.1153	0.096	-1.664	D	3	0.314	
	C	0.2858	0.1690	0.2730	0.1520	0.779	-0.280	D	3	0.070	
	T	6.74	6.06	4.29	2.19	0.073	-1.792	E	1,2,3	0.283	
	C	7.85	6.93	6.50	2.65	0.678	-0.415	E	1,2,3	0.098	
	T	0.0465	0.0497	0.0698	0.8940	0.124	-1.538	D	1,2,3	0.243	
	C	0.2161	0.1584	0.1998	0.1406	1.000	0.000	D	1,2,3	0.236	
	Startle response	T	1.86	2.67	0.57	1.45	0.043	-2.023	E	2	0.382
		C	0.53	1.49	0.52	1.47	0.655	-0.447	E	2	0.494
Vocalization	T	0.00	0.00	8.12	17.16	0.109	-1.604	E	1	0.303	
	C	0.00	0.00	0.00	0.00	1.000	0.000	E	1	0.000	
	T	0.2081	0.4419	0.3517	0.7522	0.285	-1.069	D	1	0.202	
	C	0.1533	0.0434	0.0167	0.0471	0.655	-0.447	D	1	0.111	
	T	2.68	10.02	3.10	11.61	0.655	-0.447	E	2	0.090	
	C	0.00	0.00	0.00	0.00	1.000	0.000	E	2	0.000	
	T	0.0414	0.1457	0.3173	0.0880	0.715	-0.365	D	2	0.069	
	C	0.0000	0.0000	0.0134	0.0379	0.317	-1.000	D	2	0.250	
	T	0.00	0.00	0.00	0.00	1.000	0.000	E	3	0.000	
	C	0.00	0.00	0.00	0.00	1.000	0.000	E	3	0.000	
	T	0.0084	0.3015	0.0000	0.0000	0.180	-1.342	D	3	0.254	
	C	0.0017	0.0389	0.0037	0.0104	0.655	-0.447	D	3	0.112	
	T	2.68	10.02	11.22	26.12	0.285	-1.069	E	1,2,3	0.202	
	C	0.00	0.00	0.00	0.00	1.000	0.000	E	1,2,3	0.000	

	T	0.0706	0.1944	0.6689	0.1506	0.917	-0.105	D	1,2,3	0.020
	C	0.1701	0.0428	0.3375	0.0954	1.00	0.000	D	1,2,3	0.000
Gaze not to DH	T	0.64	0.25	0.68	0.25	0.067	-1.829	D	1,2,3	0.290
	C	0.75	0.15	0.75	0.11	0.953	-0.059	D	1,2,3	0.014
Gaze to DH	T	0.08	0.05	0.06	0.04	0.039	-2.069	D	1,2,3	0.327
	C	0.09	0.04	0.10	0.03	0.314	-1.007	D	1,2,3	0.237
Gaze to lure	T	0.5698	0.1901	0.5191	0.2340	0.455	-0.747	D	1,2	0.118
	C	0.5027	0.1550	0.4707	0.0974	0.441	-0.770	D	1,2	0.181
Leash strained (front/ side)	T	0.2763	0.1321	0.2699	0.2073	0.551	-0.596	D	3	0.189
	C	0.3800	0.1427	0.3919	0.1540	0.889	-0.140	D	3	0.035
Leash strained (back)	T	0.0164	0.0224	0.0146	0.0145	0.594	-0.533	D	3	0.101
	C	0.0227	0.0335	0.0043	0.0095	0.225	-1.214	D	3	0.304
Leash loose	T	0.3699	0.1739	0.3674	0.1872	0.826	-0.220	D	3	0.042
	C	0.2841	0.1334	0.2994	0.1255	0.779	-0.280	D	3	0.070
Sit down	T	2.21	1.42	1.5	1.24	0.024	-2.264	Grade	3	0.428
	C	1.88	1.27	1.25	0.66	0.257	-1.134	Grade	3	0.284
Lie down	T	3.57	1.67	2.36	1.54	0.024	-2.265	Grade	3	0.428
	C	2.63	1.87	2.38	1.41	0.865	-0.171	Grade	3	0.043
Exercise duration	T	54.20	31.81	66.84	65.35	0.397	-0.847	D	3	0.160
	C	39.58	12.07	40.18	21.77	0.889	-0.140	D	3	0.035

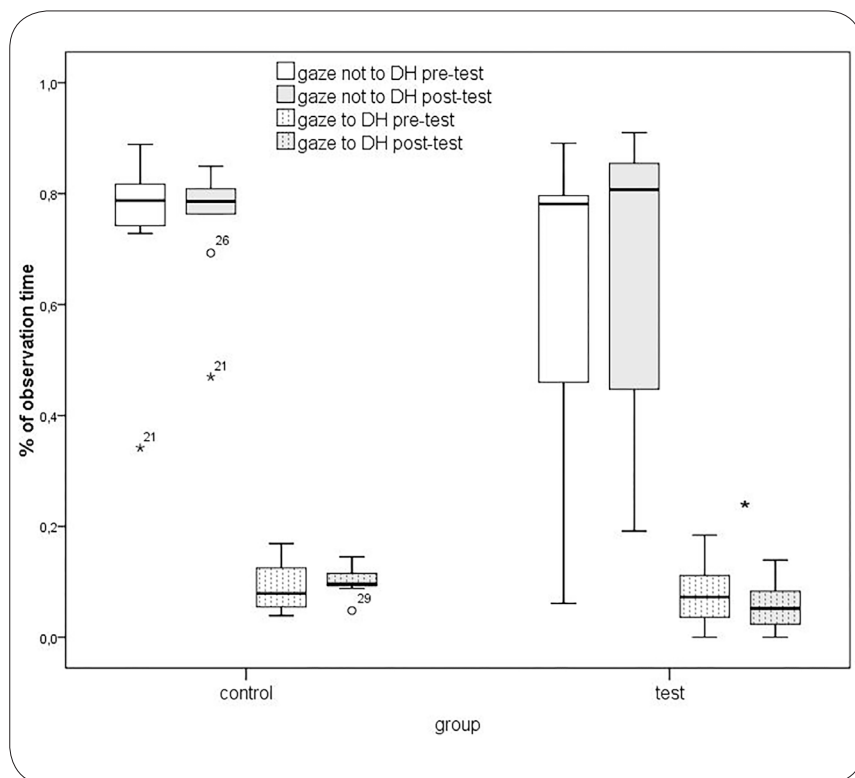


Fig. 4: Relative duration of the attention behaviour “gaze not to dog handler (DH)” and “gaze to DH” pre- and post-test in the control group and the training group / Relative Dauer des Aufmerksamkeitsverhaltens „Blick nicht zum Hundeführer (DH)“ (ungepunktet) und „Blick zum Hundeführer (DH)“ (gepunktet) vor (weiß) und nach (grau) der Testphase in der Trainings- und in der Kontrollgruppe.

“lie”: Wilcoxon signed-rank test $Z = -0.171$, $p = 0.865$) (Fig. 5 and Fig. 6, see also Tab. 4).

Discussion

Some decrease in the startle response to an unfolding umbrella, a decrease in eye contact to the handler and an improvement in executing the commands “sit” and “lie” were found only in trained dogs; no such differences were found in the control group. We suggest that this slight but significant improvement in the dogs’ behaviour, even with unfamiliar handlers, was an effect of training. During PRT, the shelter dogs learned seven tricks, several of which included sitting or lying down. If a dog did not know the commands “sit” or “lie”, it was taught to obey to be able to continue with the training. It was thus not surprising that trained dogs performed better in these exercises than untrained dogs. A current study shows that dogs perform better with a familiar dog handler

(JAMIESON et al., 2018), so it is remarkable that shelter dogs performed well even when working with an unknown dog handler, as was the case in our tests.

Our findings are in line with previous results that cooperative interactions with humans could reduce stress, as reflected by physiological parameters such as the level of the stress hormone cortisol (HENNESSY et al., 1997, 2002; BERGAMASCO et al., 2010; DA SILVA VASCONCELLOS et al., 2016) and a decreased heart rate (McGOWAN et al., 2018) as well as by behavioural parameters such as stress-related behaviour patterns (FECHNER, 2017; McGOWAN et al., 2018). Our findings also agree with studies showing that trained shelter dogs establish eye contact with the dog handler less often (MIKLÓSI et al., 2000, 2003; GAUNET, 2008, 2009) and became more self-assured. In general, dogs spontaneously gaze at human faces when confronted with a novel situation or stimulus (DURANTON et al., 2016; MIKLÓSI et al., 2003) to look for human reassurance, to gain information (DURANTON et al., 2016) or to ask for help (GAUNET, 2008, 2009; MIKLÓSI et al., 2000, 2003). Previous studies found that pet dogs and shelter dogs gaze at people for the same total time (BARRERA et al., 2011, 2015; JAKOVCEVIC et al., 2012; UDELL, 2015), for example, in solvable tasks (UDELL, 2015). A comparison of pet dogs and shelter dogs in a non-social problem-solving task showed

that shelter dogs looked significantly longer at the experimenter than pet dogs during an extinction phase (BARRERA et al., 2015). However, pet dogs spent more time with the apparatus, even when no experimenter was present. Normally, pet dogs are more frequently exposed to partial reinforcement processes in their everyday life than shelter dogs, which may have increased resistance to extinction (AMSEL, 1962). In addition, BARRERA et al. (2015) suggest that the shelter dogs' longer gazing at the experimenter indicates that the person was more attractive to shelter dogs than to the average pet dog, due to their relative deprivation of social contact. They might have experienced some empowerment, supporting their confidence and thereby reducing their feelings of helplessness and dependence, as indicated by the decreased eye contact (GAUNET, 2008, 2009; MIKLÓSI et al., 2000, 2003; DA SILVA VASCONCELLOS et al., 2016).

Shelter staff reported that several of the trained dogs were more predictable after training sessions, as well as being more easily controlled and calmer than usual. Dogs seemed mentally challenged by training in a positive way and so they were tired: many of them slept after the training session and returning to their kennel. We also suggest that PRT in our shelter dogs may compensate for the partial deprivation in their interaction with humans.

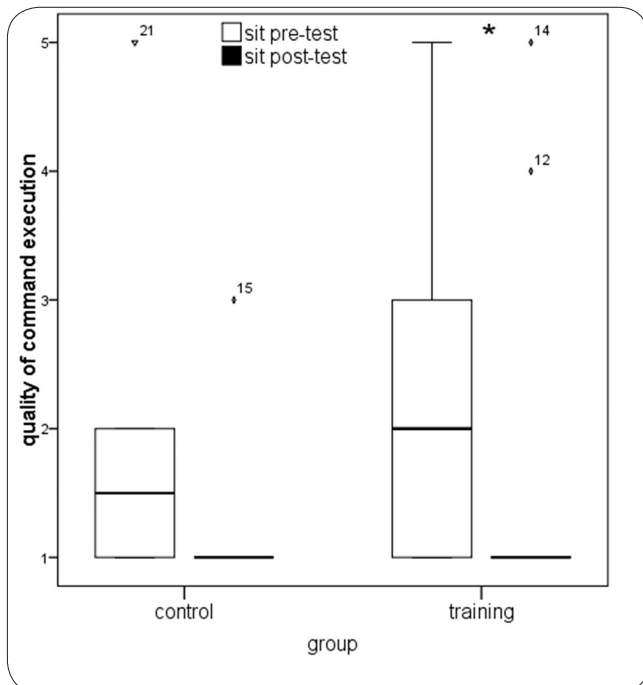


Fig. 5: Quality of command execution for the exercise “sit” pre- and post-test in the control group and in the training group (from 1 = “exercise is performed with little help from the dog handler” to 5 = “not passed”, see Tab. 2) / Bewertung der Ausübung für die Übung „Sitz“ in Schulnoten (von 1 = „Übung wird mit geringer Hilfe des Hundeführers ausgeführt“ bis zu 5 = „Übung wird nicht ausgeführt“, siehe Tab. 2) vor (weiß) und nach (schwarz) der Testphase in der Trainings- und in der Kontrollgruppe.

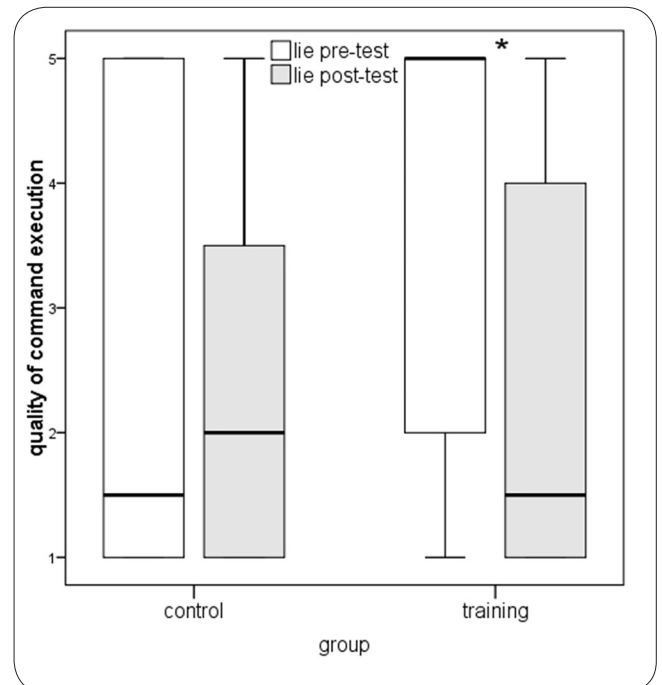


Fig. 6: Quality of command execution for the exercise “lie” pre- and post-test in the control group and the training group (from 1 = “exercise is performed with little help from the dog handler” to 5 = “not passed”, see Tab. 2) / Bewertung der Ausübung für die Übung „Platz“ in Schulnoten (von 1 = „Übung wird mit geringer Hilfe des Hundeführers ausgeführt“ bis zu 5 = „Übung wird nicht ausgeführt“, siehe Tab. 2) vor (weiß) und nach (grau) der Testphase in der Trainings- und in der Kontrollgruppe.

Our study is in agreement with previous work (LUESCHER and MEDLOCK, 2009; MENCHETTI et al., 2015; HENNESSY et al., 1997; 2002; BERGAMASCO et al., 2010) as well as with anecdotal reports from shelter staff, suggesting that training interactions may represent substantial behavioural enrichment for shelter dogs, potentially improving adoptability. The two remarkable features of our results are that dogs in both the experimental and control group received leash walks in parallel to our programme but the additional training still evidently had positive effects. Secondly, the effects – a somewhat decreased readiness to startle and enhanced compliance and cooperation – were found although the handlers in the test situations were previously unknown to the dog.

We are aware of the limitations of our study. Mainly due to the necessity to adjust to the turnover of dogs at the local shelter, and to the conditions and procedures, our sample size is comparatively low. The order of training and testing sessions in the experimental and control group was constrained and our influence on the breeds included was limited. Nevertheless, the weaknesses in our design were at least partially balanced by the “internal control” design: we compared the performance of individual dogs pre- and post-training. Doing so might also have minimized the effects

of potential differences between breeds. Nevertheless, our results should be interpreted with caution.

We conclude that, at least in our population of shelter dogs, regular training significantly improves self-confidence and cooperativeness even with handlers previously unknown to the dogs. We therefore suggest that regular positive reinforcement training may improve the adoptability of shelter dogs and may contribute to reducing their time of residence in the shelter.

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We should like to thank Mag. Margit Auer, who first took RP to the shelter for training with the dogs; she helped with the proposal for this study, shared her scientific experience and was always pleased to provide help and advice. We should also like to thank court counsellor DDR. Fritz Lichtenegger, Susanne Bräuer and the entire team of the animal shelter, as well as Helmut Weber for the cooperation. The study would not have been possible without the help of so many volunteers, whom the authors thank for their participation.

Fazit für die Praxis:

Tierheimhunde in dieser Studie zeigten nach dem Training weniger Schreckreaktionen, hielten weniger Blickkontakt zum Hundeführer, was auf eine Zunahme der Selbstsicherheit schließen lässt, und zeigten, trotz unbekanntem Hundeführer, bessere Leistungen in den Unterordnungsübungen, was für eine erhöhte Kontrollierbarkeit spricht. Regelmäßig abgehaltene, auf positiver Verstärkung basierende Trainingseinheiten seitens des Tierheimpersonales und/oder eingeschulter, ehrenamtlicher Spaziergänger können demzufolge positive Auswirkungen auf das Verhalten der Hunde haben. Es wäre somit überlegenswert, kleinere Trainingseinheiten standardmäßig in den täglichen Tierheimalltag einfließen zu lassen.

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