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Factors associated with long-term success in working police dogs

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ABSTRACT

With increasing threats of terrorism, police and military detection dogs are of growing importance for protecting servicemen/women and society. However, a relatively high proportion of potential working dogs fail to make full operational status, or are later withdrawn from service. To date, research has focused primarily on factors which are associated with a dog's short term success, such as passing/failing certification after training. Rather than the more important outcome of working life expectancy. In this study, we used two validated instruments of temperament (Positive and Negative Affect Scale (PANAS) and Dog Impulsivity Assessment Scale (DIAS)) to identify factors associated with long-term working dog success. Active working UK police dogs (n = 63) scored significantly higher on the trait "energy and interest" within PANAS and "responsiveness" within DIAS in comparison to a general population of those withdrawn from service (n = 16), and those included for a matched pairs analysis (n = 11pairs), and the wider pet dog population (PANAS n = 343; DIAS n = 571). This suggests that the combination of these traits may be important for a long-term working life. There was no significant difference between active UK police dogs and active military dogs (n = 20) on these factors, suggesting this trait may also be important across different service fields. Comparison with a non-UK police dog sample (active Dutch police dogs n = 28) revealed no significant differences in energy and interest, but higher responsiveness scores in active UK police dogs, further highlighting the importance of these traits in working dog populations. Future research should assess the cause-effect relationship between these traits and success / withdrawal from work in the field.

1. Introduction

Working dogs provide a vital contribution to numerous industries worldwide, yet the selection process is notably inefficient, with many dogs failing to retain full operational status (Cobb et al., 2015). There is a lack of objective information about the specific aspects of temperament that make a successful working dog, specifically in terms of factors which relate to long-term performance. This knowledge gap limits the efficiency of operations, particularly with respect to reliably selecting dogs who will have long careers in their field.

Temperament can be defined as the individual difference in behavioural responses, consistent across time and context that are grounded in affective state and its regulatory processes and which are evident from an early age (Deidrich and Giffroy, 2006). Despite the fact that working dogs have often been bred and reared with a specific job in mind, there are extensive individual behavioural variations between these dogs (Graham and Gosling, 2009; Willis, 1995), as there is in the general dog population (Diederich and Giffroy, 2006; Jones and Gosling, 2005). Those employing working dogs operationally need methods to detect behavioural tendencies that could potentially be problematic or beneficial and these need to be suitable for use early on in the selection process to avoid recruiting or investing heavily in dogs that will be unable to work efficiently. However, the ability of a dog to perform a task in the test environment often does not predict performance in the field as it fails to consider how the working environment may impact upon performance. Variation in performance in the field is thought to be, at least in part, due to individual differences in emotional responding and thus aspects of temperament are clearly implicated, but it is unclear which temperament traits are most strongly related to working dog success (Sinn et al., 2010).

Previous research has examined factors which relate to potential working dogs passing certification or completing training (e.g. Asher et al., 2013; Batt et al., 2008; Foyer et al., 2016; Sinn et al., 2010; Svartberg, 2002). However, there is a notable lack of published research on factors relating to dogs being withdrawn after entering into service, or factors which relate to long-term successful performance (typically 7–8 years of service). Additionally, there is a lack of consensus regarding the definition of a successful working dog (Foyer et al.,

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2016). The lack of research as well as the confusion in this area likely contributes to the high failure rates of working dogs (~50-70%), which has been reported across countries (Foyer et al., 2016; Maejima et al., 2007; Slabbert and Odendaal, 1999).

In addition, current approaches appear to be predominantly based around subjective notions of what makes a good working dog, rather than being based on any sound underlying biological construct of temperament that can be directly related to performance in the field or reasons for withdrawal (Slabbert and Odendaal, 1999). Such a biological approach is likely to strengthen the potential to make good long-term predictions of field dog success, or failure, since biologically valid traits should be less subject to random or systematic error across time and situations than more notional characteristics (Goldsmith et al., 1987).

Distractibility is a well-recognised influence on both scent detection dog certification (Maejima et al., 2007) and guide dog performance (Arata et al., 2010); but it is not a unitary phenomenon and does not appear to be well characterised in dogs. At a theoretical level, distractibility may be determined, at least in part, by sensitivity to both emotionally positive stimuli (how salient positive environmental stimuli are to the dog) and emotionally negative stimuli (how salient aversive qualities within the environment are to the dog). This sensitivity to rewards and punishers in the environment can be characterised within a general biological construct (core effect), and can be assessed in the dog using a specific 21 item psychometric instrument known as the **P**ositive **A**nd **N**egative **A**ffect **S**cale (PANAS - Sheppard and Mills, 2002). The PANAS (Sheppard and Mills, 2002), is a 21-item, owner (or handler) completed scale, which measures negative (i.e. frequency of fearful and relaxed states, responses to changing and unfamiliar environments, habituation and the startle response; 11 items e.g. “your dog is easily startled by noises and/or movements”) and positive (i.e. energy, interest, persistence and excitement; 10 items e.g. “your dog is very boisterous”) activations influencing dog behaviour. Each item is rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The scale demonstrates good test-retest reliability and internal validity (Sheppard and Mills, 2002). However, positive and negative emotional sensitivity is unlikely to be the sole determinant of distractibility. It also seems theoretically reasonable to suggest that impulsivity may interact with this affective sensitivity to predict distractibility, since impulsivity has been shown to relate to an individual’s sensitivity to differences in environmental reinforcement opportunity (Brucks et al., 2017). Impulsivity may also be important to success in many working contexts in other ways, such as those that require the dog to respond rapidly or make quick decisions. In the dog, trait impulsivity is well characterised and can be reliably assessed using the Dog Impulsivity Assessment Scale (DIAS; Wright et al., 2011, 2012). The DIAS is an 18-item owner (or handler) completed scale, which measures impulsivity in dogs. The scale is comprised of three factors: Behavioural regulation (sample item “your dog appears to have a lot of control over how it responds”), Aggression and response to novelty (sample item: “your dog is not keen to go into new situations”), Responsiveness (sample item: “your dog reacts very quickly”). Each item is scored on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The scale has been shown to have good reliability and validity (Wright et al., 2011) and temporal stability from a young age into early adulthood (Brady et al., 2018), and across adulthood (Riemer et al., 2014).

We thus have two psychometric instruments available in PANAS and DIAS which characterise biologically based traits that appear to be directly relevant to working dog success in the field. Both Positive Activation and Impulsivity are further characterised within these scales into a number of underlying factors on the basis of their principal component structure.

Another critical quality for long-term successful performance in stressful environments is resilience (Rutter, 1987). This is defined by both the capacity to cope with potential stressors and the ability to return to normal after a stressful event as well as the processes which reduce the risk of harm in relation to a stressful event. Although the concept of resilience has received little attention in working dog literature, it seems reasonable to suggest that temperament traits related to sensitivity to rewards or punishers may also play an important role in this and thus potentially the longevity of the working life of service dogs operating in stressful environments. Not only are there the obvious associations with sensitivity to negative stimuli (stressors) associated with resilience, but also potential relationships with sensitivity to positive stimuli, as these may provide an important foundation to confidence, and this is often sought in these animals (Slabbert and Odendaal, 1999).

Therefore, the aim of this study was to use the psychometric instruments of PANAS and DIAS to assess whether active working police dogs were different to withdrawn police dogs, and other working and pet dogs, in components of core affect (based on PANAS scores) or impulsivity (based on DIAS scores).

2. Methods

Written Informed consent was obtained from each participant, all procedures complied with British Psychological Society “Code of Ethics and Conduct”, and with the World Medical Association Helsinki Declaration as revised in October 2008. The ethical committee in the School of Life Sciences, University of Lincoln approved the study (Ref: CoSREC124).

2.1. Participants

Police dog data were provided with the support of managers and dog handlers within the dog unit at the Greater Manchester Police and the British Transport Police, Military dog handlers were recruited via contacts within the Defence Science and Technology Laboratory (DSTL). To increase cross-country generalisability, we also recruited participants from a Netherlands specialist canine unit.

Participants were sent a secure survey link that contained an introduction to the study and the questionnaires that extracted the information that we were interested in studying as well as a means of recording whether the dogs reported on were active or withdrawn from service. All responses were anonymous. Since the researchers did not always make direct contact with handlers, and because some handlers needed authorisation to take part, it is not known how many handlers received the survey link. Participants received no reimbursement for taking part in the study, but were offered the opportunity to be entered into a prize draw of dog toys. Participants were asked to complete the survey with reference to all service dogs under their care who were currently in active service and any who had been withdrawn from service, for non-medical or age-related conditions, within the past 12 months.

The pet dog population for comparison was drawn from the data sets resulting from previous research at the University of Lincoln. For the DIAS, this consisted of 560 pet dogs reported on by Wright et al. (2011): Age range: 3 months-16.5 years. Sex: male neutered n = 199, (34.9%), female neutered n = 187, (32.7%), male entire n = 103, (18.0%), female entire n = 82, (14.4%), pedigrees n = 435, (76.2%) from 107 different breeds; the remainder n = 136, (23.8%) were crossbreeds. For the PANAS this consisted of 343 pet dogs reported on by Sheppard and Mills, (2002): Age range, 3 months – 17 years. Sex: male neutered n = 71 (20.7%), male entire n = 113 (32.94%), female neutered n = 89 (25.95%), female entire n = 67 (19.53%). The data from these studies (Wright et al., 2011; Sheppard and Mills, 2002) were collected using online and postal survey completion methods, and recruited through a range of sources including university press, dog shows, retail outlets and dog training clinics.

2.2. Survey

A secure online website was created to host the PANAS (Sheppard and Mills, 2002), DIAS (Wright et al., 2011) and a brief demographic survey assessing whether or not the dog had been retired from service due to behavioural concerns in the past year. The survey link and password were distributed to dog handlers (see participants section) through established contacts. The survey link was accessible from March 2014-October 2015.

2.3. Data analysis

After checking data for normality, using Kolmogorov-Smirnoff and Levene's tests, data were analysed to compare active and withdrawn dogs in terms of their temperament profiles. Given that effect sizes are potentially more valuable than tests of statistical significance in this type of exploration (Sullivan and Feinn, 2012) we calculated Cohen's d effect sizes (small = 0.2, medium = 0.5, large = 0.8; Cohen, 1988) along with unrelated, between subjects t-tests to compare means across populations. There were sufficient data for the following comparisons to be made with confidence: (1) active versus withdrawn police dogs in the UK; (2) matched pair analysis of active versus withdrawn police dogs in the UK; (3) active UK police dogs versus active UK military dogs; (4) active UK police dogs versus active Dutch police dogs; (5) active UK police dogs versus the pet population; (6) withdrawn UK police dogs versus the pet population. Descriptive statistics (means and standard deviations) and effect sizes (Cohen's d) are reported in Table 1a and b.

3. Results

Eighty-seven UK police dog handlers responded to the survey. After excluding UK police dogs who had a medical condition (n = 2; withdrawn) and those with incomplete questionnaires (active: n = 5; withdrawn: n = 1) data were collected and analysed from 79 dogs (active: n = 63; withdrawn: n = 16). Of these dogs 63 were currently in active service (*Breed:* Working collie: 5 (7.9%), German shepherd: 31 (49.2%), Labrador retriever: 6 (9.5%), English springer spaniel: 15 (23.8%), Belgian Malinois: 2 (3.2%), Cross breed: 4 (6.3%); *Sex:* Male entire: 33 (52.4%), Male neutered: 16 (25.4%), Female entire: 7 (11.1%), Female neutered: 7 (11.1%); *Age:* 4.81 years ± 2.34; Mean ± SD) and 16 were withdrawn from service (*Breed:* German shepherd: 6 (37.5%), Labrador retriever: 1 (6.3%), English springer spaniel: 5 (31.3%), Belgian Malinois: 1 (6.3%), Cross breed: 3 (18.8%); *Sex:* Male entire: 8 (50%), Male neutered: 3 (18.8%), Female entire: 3 (18.8%), Female neutered: 2 (12.5%); *Age:* 4.53 years ± 2.53).

Twenty military dog handlers responded to the survey. All of the completed questionnaires for military dogs made reference to animals in active work, no exclusions were made (*Breed:* German shepherd: 6 (30%), Labrador retriever: 2 (10%), English springer spaniel 1 (5%), Belgian Malinois: 9 (45%), Cross breed: 2 (10%), (5%); *Sex:* Male entire: 11 (55%), Male neutered: 2 (10%), Female entire: 3 (15%), Female neutered: 4 (20%); *Age:* 5.00 years ± 1.97).

Twenty-eight police dog handlers in the Netherlands responded to the survey, no exclusions were made, all of the completed questionnaires made reference to dogs in active work (*Breed:* Dutch herder: 28 (100%); *Sex:* Male entire: 11 (55%), Male neutered: 2 (10%), Female entire: 3 (15%), Female neutered: 4 (20%); *Age:* 4.32 years ± 1.92).

3.1. Active versus withdrawn police dogs in the UK

Dogs who were currently active in the UK police scored significantly higher on the PANAS positive activation factor of 'energy and interest' compared to withdrawn dogs ($t(77) = 2.57$, $p = 0.02$), with a large effect size Table 1a). No significant differences were found between the other positive activation factors; persistence ($t(77) = 0.28$, $p = 0.78$),

Table 1
Means, standard deviations and effect sizes for comparisons between the working and non-working dog groups.

a

PANAS	Active UK Police (AUKP) Mean ± SD	Withdrawn UK Police (WUKP)	AUKP v WUKP d[1]	AUKP matched pairs Mean ± SD	WUKP matched pairs	AUKP v WUKP matched pairs d
Energy & interest	0.92 ± 0.09	0.78 ± 0.22	0.8	0.90 ± 0.08	0.73 ± 0.23	0.9
Persistence	0.52 ± 0.14	0.54 ± 0.15	0.1	0.45 ± 0.09	0.49 ± 0.15	0.3
Excitement	0.80 ± 0.15	0.77 ± 0.21	0.2	0.85 ± 0.11	0.72 ± 0.21	0.8
Total positive activation	0.74 ± 0.09	0.68 ± 0.16	0.5	0.71 ± 0.05	0.63 ± 0.16	0.7
Negative activation	0.38 ± 0.12	0.45 ± 0.19	0.4	0.39 ± 0.13	0.45 ± 0.17	0.4
DIAS						
Responsiveness	0.76 ± 0.1	0.67 ± 0.14	0.7	0.77 ± 0.09	0.65 ± 0.14	0.9
Behavioural regulation	0.52 ± 0.15	0.56 ± 0.17	0.2	0.46 ± 0.07	0.52 ± 0.14	0.5
Aggression/response to novelty	0.37 ± 0.12	0.40 ± 0.15	0.2	0.37 ± 0.15	0.38 ± 0.11	0.1
Overall questionnaire score	0.55 ± 0.09	0.56 ± 0.11	0.1	0.50 ± 0.05	0.53 ± 0.09	0

b

PANAS	Active UK Military (AUKM) Mean ± SD	AUKP v AUKM d[1]	Active Dutch Police (ADP) Mean ± SD	ADP v AUKP d	Pet Population (PP) Mean ± SD	PP v AUKP d	PP v WUKP d
Energy & interest	0.93 ± 0.09	0.1	0.92 ± 0.08	0	0.85 ± 0.15	0.6	0.4
Persistence	0.52 ± 0.15	0	0.52 ± 0.17	0	0.55 ± 0.18	0.2	0.1
Excitement	0.80 ± 0.16	0	0.80 ± 0.19	0	0.79 ± 0.17	0.1	0.1
Positive activation	0.74 ± 0.08	0	0.74 ± 0.10	0	0.72 ± 0.15	0.2	0.3
Negative activation	0.39 ± 0.09	0.1	0.38 ± 0.10	0	0.48 ± 0.15	0.7	0.2
DIAS							
Responsiveness	0.75 ± 0.15	0.1	0.69 ± 0.09	0.7	0.69 ± 0.13	0.6	0.1
Behavioural regulation	0.49 ± 0.15	0.2	0.52 ± 0.14	0	0.47 ± 0.16	0.3	0.5
Aggression/response to novelty	0.34 ± 0.1	0.3	0.40 ± 0.15	0.2	0.37 ± 0.15	0	0.2
Overall questionnaire score	0.54 ± 0.15	0.1	0.57 ± 0.10	0.2	0.52 ± 0.1	0.3	0.4

[1] = Cohen's d effect sizes (small = 0.2, medium = 0.5, large = 0.8).

excitement ($t(77) = 0.56$, $p = 0.58$) or total positive activation ($t(77) = 1.34$, $p = 0.20$), or for the negative activation factor ($t(77) = -1.378$, $p = 0.19$).

Dogs who were currently active in the UK police service also scored significantly higher than dogs who had been withdrawn from service during the past year, on the DIAS factor 'responsiveness' ($t(77) = 2.74$, $p < 0.01$) with a medium-large effect size (Table 1a). There was no significant difference between active and withdrawn dogs on the other DIAS factors; behavioural regulation ($t(77) = -0.597$, $p = 0.34$) or aggression and response to novelty ($t(77) = -0.956$, $p = 0.34$) and the overall questionnaire score ($t(77) = -0.28$, $p = 0.78$).

3.2. Matched pair analysis of active versus withdrawn police dogs in the UK

To help control for the effects of individual variation within this small sample study, dogs who were currently active in the UK police service were matched against those who had been withdrawn from service within the past year. Dogs were matched based on breed, sex, neuter status and age (*Breed:* Labrador retriever: 1 (9.1%), German shepherd: 5 (45.5%), English springer spaniel: 5 (45.5%); *Sex:* Male entire: 6 (54.5%), Male neutered: 3 (27.3%), Female entire: 1 (9.1%), Female neutered: 1 (9.1%), *Age:* 5.09 years ± 2.46). Based on these criteria it was possible to make 11 matched pairs (total n = 22). Similarly to that observed with the total sample, dogs who were currently active in the UK police service scored significantly higher than their matched counterpart, who had been withdrawn from service, on the PANAS factor 'energy and interest' ($t(10) = -2.24$, $p = 0.04$) with a large effect size. No statistically significant differences were found between any of the other PANAS factors including total positive activation ($t(10) = -1.43$, $p = 0.18$), and its facets; persistence ($t(10) = 0.77$, $p = 0.46$) and excitement ($t(10) = -1.70$, $p = 0.12$), or negative activation ($t(10) = 0.86$, $p = 0.41$). However, differences were large, or approaching large for comparisons on positive activation and excitement, with higher scores on these factors observed in the active compared to the withdrawn group.

Comparable to the full sample, dogs who were currently active in the UK police service scored significantly higher than their matched counterpart, who had been withdrawn from service, on the DIAS factor 'responsiveness' ($t(10) = -2.405$, $p < 0.04$) with a large effect size (Table 1a). There was no significant difference and comparable effect sizes between active and withdrawn dogs on the other DIAS factors: behavioural regulation ($t(10) = 1.075$, $p = 0.31$) or aggression and response to novelty ($t(10) = 0.165$, $p = 0.87$) and the overall questionnaire score ($t(10) = 0.940$, $p = 0.37$).

3.3. Active police dogs versus active military dogs in the UK

To assess whether active police dogs showed significantly different traits to active military dogs, scores on the PANAS and DIAS were compared between the two groups. Data from withdrawn dogs could not be compared due to an absence of data on withdrawn military dogs. There was no significant difference between active police dogs and active military dogs on the PANAS: Total positive activation ($t(81) = -0.291$, $p = 0.77$), including its facets: energy and interest ($t(81) = -0.369$, $p = 0.71$), persistence ($t(81) = 0.201$, $p = 0.84$), excitement ($t(81) = 0.125$, $p = 0.90$), or for negative activation ($t(81) = -0.380$, $p = 0.71$). No significant differences were observed for scores on the DIAS: overall questionnaire score ($t(81) = 0.742$, $p = 0.46$), behavioural regulation ($t(81) = 0.641$, $p = 0.52$), aggression/response to novelty ($t(81) = 0.863$, $p = 0.39$), responsiveness ($t(81) = 0.148$, $p = 0.88$). Effect sizes for these comparisons were small (Table 1b).

3.4. Active UK police dogs versus active Dutch police dogs

To examine the generalisability of traits associated with performance in police dogs PANAS and DIAS scores were compared between UK and Dutch police dogs; although there was a lack of data on Dutch police dogs who had failed service within the past year, comparisons were possible between active police dogs. There was no significant difference between the two groups on the PANAS: Total positive activation ($t(89) = 0.212$, $p = 0.66$), energy and interest ($t(89) = 0.367$, $p = 0.81$), persistence ($t(89) = 0.786$, $p = 0.87$), excitement ($t(89) = 0.492$, $p = 0.11$), or negative activation ($t(89) = 0.156$, $p = 0.29$), with small effect sizes (Table 1b).

Active UK police dogs scored significantly higher than active Dutch police dog on the DIAS factor 'responsiveness' ($t(89) = 0.51$, $p < 0.01$), with a medium-large effect size. There was no significant difference between the groups for overall questionnaire score ($t(89) = 0.506$, $p = 0.53$), behavioural regulation ($t(89) = 0.212$, $p = 0.99$), or aggression/response to novelty ($t(89) = 0.126$, $p = 0.24$).

3.5. UK police dogs versus the pet population

Comparisons were made between both active and withdrawn UK police dogs and the pet dog population to assess whether success or failure were associated with levels of traits which were typical within the general dog population. Active UK police dogs scored significantly lower on the PANAS negative activation factor ($t(623) = 3.76$, $p < 0.01$), and significantly higher on the energy and interest facet ($t(623) = 2.97$, $p < 0.01$) compared to the UK pet dog population, with medium-large effect sizes. There was no significant difference between the two groups on scores of total positive activation, ($t(623) = 0.85$, $p = 0.39$), persistence ($t(623) = 0.95$, $p = 0.34$), or excitement ($t(623) = 0.31$, $p = 0.75$), with small potential differences noted.

In relation to impulsivity, active UK police dog scored significantly higher than the pet dog population on the DIAS factor 'responsiveness' ($t(623) = 2.69$, $p < 0.01$) and behavioural regulation ($t(623) = 2.65$, $p < 0.01$), with a medium effect size and small effect size respectively. There was no significant difference between the groups for overall questionnaire score ($t(623) = 1.59$, $p = 0.11$), or aggression/response to novelty ($t(623) = 0.01$, $p = 0.99$).

Withdrawn UK police dogs were similar to the pet dog population in all aspects of PANAS and DIAS: PANAS: Total positive activation ($t(576) = 0.89$, $p = 0.38$), energy and interest ($t(576) = 0.18$, $p = 0.17$), persistence ($t(576) = 0.19$, $p = 0.84$), excitement ($t(576) = 0.37$, $p = 0.71$), or negative activation ($t(576) = 0.63$, $p = 0.53$), DIAS: overall questionnaire score ($t(576) = 1.59$, $p = 0.11$), behavioural regulation ($t(576) = 1.59$, $p = 0.11$), aggression/response to novelty ($t(576) = 1.10$, $p = 0.27$), responsiveness ($t(576) = 0.80$, $p = 0.42$). Effect sizes were small for all comparisons.

4. Discussion

Although causal relationships cannot be determined by this type of study, the results indicate some traits which may be associated with long-term successful police dog working, and how these differ to those found in the general dog population. It seems that energy and interest (positive activation) and responsiveness (related to impulsivity) are of particular importance.

Active working UK police dogs scored significantly higher on energy and interest than their withdrawn counterparts and the pet population. Energy and interest within PANAS (Sheppard and Mills, 2002) is measured via items such as 'your dog is full of energy' and 'your dog shows little interest in its surroundings' (reverse scored). Behaviours such as these have been used as a measure of positive affect in humans (Watson et al., 1988) and are frequently associated with motivational systems in humans and animals (Depue and Collins, 1999; Panksepp, 1998), indicating that dogs who show high energy and interest are more motivated to work (a term often referred to as "drive" among handlers). There was no significant difference between active UK police dogs, active Dutch police dogs and active military dogs on this trait, which suggests convergent validity and the potential general

importance of this trait in working dog success across fields. It cannot be determined from this study whether dogs who were withdrawn from service were lower than optimal in this trait from the outset (perhaps because it was not assessed reliably at selection) or if they showed a gradual decline perhaps due to persistent failure to perform or a failure to cope with the environment; or possibly that their management post-withdrawal induced these changes in perception. This could easily be investigated via longitudinal assessments, and deserves future attention, given its likely relationship with resilience. Related factors, referred to variously as "engagement" and "desire for work" have previously been associated with successful working dog performance (Foyer et al., 2016; Maejima et al., 2007) and this provides concurrent validation of the importance of this trait for working success. Compared to non-working dogs, working animals have also been shown to exhibit significantly more extravert behaviours, which are similar to the behavioural tendencies assessed in the energy and interest facet (Ley et al., 2009).

Active working UK police dogs scored higher on the factor "responsiveness" within impulsivity compared to both their withdrawn-from-service counterparts and the wider pet population. Dogs that score highly on responsiveness, as assessed through the DIAS (Wright et al., 2011) are easy to train, remain interested in new stimuli for longer and react more quickly. These behaviours appear very complementary to those associated with energy and interest, for the type of work that these dogs are required to undertake (protection or detection work). There was no significant difference in scores of responsiveness between active UK police and military dogs, supporting the general importance of this trait in these types of working dog in the UK. However, in comparison to the Dutch sample of active police dogs, the UK police dogs scored higher on responsiveness. It is not possible to assess why this difference occurred but it is possible that cultural differences in answering and interpreting the items, breed related factors (all the Dutch dogs were of a single breed) or the working environment might be important, especially given the relatively small sample size involved. Another possible explanation could lie within training differences, since this factor focuses partly on how easy the dogs are perceived to be to train; differences in training techniques might affect responsiveness or affect selection for responsiveness given the otherwise similar phenotype in temperament, but the sample size is too small to explore this statistically. This raises potentially important questions about the interaction between training style, working environment and temperament in dogs.

Although no other comparisons between active and withdrawn UK police dogs were statistically significant, it is perhaps worth noting, given the relatively small sample size, that the active group scored higher on total positive activation and excitement (PANAS) with medium to large effect sizes. Given that this comparison was not significant in this study we do not consider this result in detail, but highlight its potential importance for future investigation.

Two additional key differences were observed, these were between the pet population and active UK police dogs. Firstly, working dogs scored lower on negative activation (PANAS; Sheppard and Mills, 2002) compared to pet dogs. The negative activation factor assesses observations of startle behaviour, fear and phobias and whether or not the dog is unsettled by changes in routine; all of which are clearly undesirable in a working dog. This result may indicate an important temperamental aspect in active working dogs (i.e. a need to cope with stressful environments) that may not be selected for in pet dogs. It is worth noting that withdrawn police dogs did not show significantly different scores to pet dogs for this trait and this might indicate a potential reason for withdrawal, i.e. that the working dogs were more like pet dogs with regard to this trait and thus unable to sustain a full working life. However the similarity in score between these two populations would suggest that working dogs were not particularly traumatised or phobic, and thus withdrawn due to their fearfulness. Working dogs also scored higher on behavioural regulation than pet dogs (DIAS; Wright et al., 2011). Dogs scoring higher on behavioural regulation are rated as being more impulsive and not thinking before they act. It could be that these traits reflect an eager working dog (i.e. keen to get on and do something) which gets on with the job in hand (e.g. doesn't think about distracting influences). The behavioural regulation factor also includes items relating to high arousal, which may be a way of sustaining action in challenging environments. Whilst in the pet dog population this may be perceived as a negative trait, potentially causing behavioural problems (Mills et al., 2014), channelling arousal appropriately in the working dog could prevent dogs from being distracted by external stimuli and increase motivation to work.

This project represents the first research, known to the authors, which compares traits in active working dogs with those withdrawn from service and the pet population in order to identify those which may be of most importance for a full working life. If we are to improve the time and costs associated with the high failure rate of working dogs, it is essential that we look at their behavioural characteristics across their lifespan, as opposed to focusing solely on certification. The results are consistent with several aspects of a resilient temperament likely to be of importance in working dogs. This biologically grounded approach provides a more solid basis for identifying traits which are inherently stable across time and context, as opposed to more arbitrary behaviour profiles, which are likely to provide a less useful index of overall and enduring working dog success. Indeed, a strength of using validated questionnaires, as in this study, is the ability to rapidly ascertain a general overview of the dog's behaviour (assuming those completing the questionnaire are completed honestly), as opposed to relying on time consuming and more context dependent behavioural test observations. However, it must be acknowledged that it is not always possible to source individuals who will have sufficient reliable knowledge about the dog to accurately complete questionnaire-based approaches in the early stages of the dog's working life or even pre-acquisition. There is therefore a need to develop simple and quick behavioural tests associated with those traits found to be of most importance in longitudinal studies.

The provision of effect sizes mitigates against some of the concerns that may arise from the relatively small sample size, and gives an important resource to those interested in continuing the development of this work in this field. Having identified traits that may be associated with long-term success / withdrawal (i.e. energy and interest and responsiveness), the next logical step is to assess these in longitudinal studies to determine the cause-effect relationships.

In conclusion, responsiveness, in terms of impulsivity from the DIAS, and energy and interest, in terms of positive activation from the PANAS, appear to differentiate dogs in active service from those withdrawn from service; the latter appear to have traits relating to core affect and impulsivity which are more typical of the general pet population. If these differences between successful and unsuccessful animals are causal, not only may it be possible to potentially predict which dogs are at risk of being withdrawn in the field using PANAS and DIAS before they are placed into this form of work, but also it may be possible to develop remedial interventions aimed at helping individuals showing these predispositions to sustain an active working life.

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