

Literature Review Assignment 3: Annotated Bibliographies

Stress behaviours of kennelled dogs (*Canis lupus familiaris*) and using olfactory stimulation and enrichment to reduce these stress behaviours

My annotated bibliographies on articles regarding behavioural and physiological manifestations of stress in dogs are ordered from oldest to newest and are presented first to introduce the reader to ways stress is showcased by dogs. Following those, annotated bibliographies for articles regarding the effects of olfactory enrichment on physiological parameters and/or behavioural tendencies are listed in chronological order after a review article that summarizes previous work done concerning environmental enrichment in kennelled dogs.

Beerda, B., Schilder, M. B. H., van Hooff, J. A. R. A. M., & de Vries, H. W. (1997). Manifestations of chronic and acute stress in dogs. *Applied Animal Behaviour Science*, 52(3–4), 307-319.
[https://doi.org/10.1016/S0168-1591\(96\)01131-8](https://doi.org/10.1016/S0168-1591(96)01131-8)

Summary

Long-term environmental stressors can be correlated with poor welfare in canines. Previous studies have found that specific behaviours, like particular tail movements and characteristic vocalizations may be indicative of stress in dogs. The aim of this study was to dissect which behaviours, physiological parameters, and immune system factors change invariably upon exposure to experimental and naturally-occurring stressors using previous literature and a current study. The researchers also attempted to determine which internal and external indicators were diagnostic for dogs experiencing poor welfare. They analyzed studies done testing behavioural responses of dogs in response to experimental stress-inducers such as electric shocks and loud noises. These studies found that dogs often answered through thermoregulatory responses such as piloerection, panting, and antidiuresis, particularly when they were anticipating the aversive stimulus.

In this current study, researchers presented intermittent noise blasts that were loud but not damaging to beagles. Three trials lasting 30 mins were done, with blasts at 70, 78, and 87 dB (loudness), where 18 blasts of sound were played for five, ten, or fifteen second periods in three-minute intervals. Behaviours were observed continuously from 30 minutes before trials started to 60 minutes after the trials began. Additionally, heart rate and saliva cortisol concentrations were taken before and after stimulus exposure. The most notable results were observed in one dog unintentionally exposed to a 95 dB blast. In this dog, increases in frequencies of paw-lifting, body-shaking, tongue-out behaviours and a lower posture following the aversive stimulus, were positively correlated with increases in heart rate and saliva cortisol concentrations, suggesting these parameters are associated with increased stress levels. Similar trends were seen in dogs exposed to the quieter stimuli, but the correlation was weaker. Future studies should aim to determine hormonal influences on displays of both acute and chronic stress.

Contribution

This article is important for my literature review as it provides a solid baseline of possible physiological and behavioural markers of stress. Although it uses aversive stimuli to generate significant results, the information can be used when comparing the findings found in more modern experiments regarding behavioural and physiological parameters in kennelled dogs. These early findings of dogs facing negative stimulus presentations can be compared to the measured parameters of dogs in short-term kennelling situations to find out which physiological systems may be differentially activated according to the distinct stressor.

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. *Animal Welfare*, 9(1), 49-62.

**Digital Object Identifier is not available for this article. I have checked with the UCalgary Library.

Summary

Chronic stress of dogs is a serious problem resulting from long-term kennelling. Previously, cortisol levels and manifestations of certain behaviours in dogs exposed to different levels of stressful conditions had been found to vary accordingly. This study aims to form grounds for using measurements of behaviour and physiological parameters in assessing the chronic stress of dogs housed in different conditions. These researchers compared behavioural and hormonal parameters between dogs that were housed appropriately and those housed badly to study the behavioural and physiological indicators of welfare problems.

72 dogs were grouped into categories: GI - privately-owned and walked and fed twice a day, GII - housed in kennels with indoor and outdoor access, and were fed and walked once a day, GIII - housed in pairs inside but had access to an outside kennel for six hours a day and GIV - individually kept in smaller inside kennels (compared to GII) with access to smaller outdoor kennels for six hours per day. Video recordings of each dog were taken for ten minutes when uninterrupted and five minutes following the slamming of a door, and behaviours were recorded either by frequency or duration. Urinary cortisol and catecholamine concentrations were also obtained.

The researchers found that adrenaline and cortisol concentrations increased as living conditions worsened and thus were labeled as indicators of chronic stress. Behaviours displayed by dogs of the 'worst-living' condition included increased general movements, paw-lifting, nosing, urinating, and decreased frequencies of high-posture position displays. The authors associated these behaviours with high stress and poor welfare. Following door slamming, behaviours previously associated with acute stress including yawning, oral actions, and body shaking were observed, suggesting that these are acute, rather than chronic stress indicators. Future studies could better identify the particular living conditions that induce greater amounts of stress in dogs.

Contribution

This article provides a great source of identifying both behavioural manifestations of stress and possible corresponding physiological parameter changes that might trigger stress-indicating behaviours. Elevated cortisol and adrenaline levels were present in dogs facing enduring stressful conditions, suggesting they might trigger behaviours associated with chronic stress. The researchers also used the data they found to contrast the behavioural representations of acute versus chronic stress, and I can use this information in my topic summary to differentiate the two. Given the results of this study, future lines of research could include better controlling for the severity of conditions causing chronic stress.

Part, C. E., Kiddie, J. L., Hayes, W. A., Mills, D. S., Neville, R. F., Morton, D. B., & Collins, L. M. (2014). Physiological, physical and behavioural changes in dogs (*Canis familiaris*) when kennelled: Testing the validity of stress parameters. *Physiology and Behavior*. 133, 260-271.
<https://doi.org/10.1016/j.physbeh.2014.05.018>

Summary

Kennelling dogs can induce stress in dogs as they are deprived from adequate socialization and located in a confined space. Previous studies suggest that temporary kennelling can lead to acute stress while longer-term kennelling can cause chronic stress. This study wanted to validate tests, which measured behavioural and physiological parameters, as being representative of acute stress in kennelled dogs and to find normal values for physiological parameters using dogs found in private homes.

14 male and 15 female dogs were studied using a within-subject design whereby their physiological and behavioural parameters were recorded in their private home and in boarding kennels. A 30-minute video recording segment was randomly selected to be analyzed for each dog in both of the different environments. Both frequency and duration of 38 different behaviours were recorded using a continuous-sampling technique. Saliva and urine samples were collected from each dog before and after enrichment.

Dogs showed significantly more time being alert, panting, sitting, travelling, and doing other locomotory activities when in the kennel versus at home, however only five dogs exhibited panting. Cortisol to creatinine ratios and vanillylmandelic acid (VMA) to creatinine ratios were significantly higher for dogs when kennelled compared to at home. However, these physiological parameters were not significantly correlated to travelling behaviour or locomotor activity. Increases in both ratios are associated with increased activation of both major stress-response systems, the hypothalamic-pituitary-adrenal axis and the sympathetic-adrenal-medullary system. The authors also mentioned that elevated cortisol and VMA could result from increased arousal upon exposure to a new environment, rather than kennel-induced stressors.

Authors suggest that future studies should further test the linkage between physiological measures and their association with acute and chronic stress, given that conditions in the current study didn't have any significant impacts on stress and therefore couldn't be well analyzed.

Contribution

This article contributes well to my literature review as it identifies the stress response systems and the elevated physiological parameters that are associated with onset of stress and corresponding behaviours. This study found similar results to previously done studies, such as elevated cortisol levels following exposure to stress-inducing conditions. However, the authors discuss that novel environments can also contribute to elevated cortisol and thus separate, diagnostic changes to baseline parameters must be used in combination with elevated cortisol to accurately assess stress in kennelled dogs. Future lines of study should identify physiological parameters that are more accurately indicative of stress.

Wells, D. L. (2004). A review of environmental enrichment for kennelled dogs, *Canis familiaris*. *Applied Animal Behaviour Science*, 81(3-4), 307-317. <https://doi.org/10.1016/j.applanim.2003.11.005>

Summary

This article summarizes the various methods of environmental enrichment, collected from previous literature, tested on kennelled dogs both in rescue shelter and laboratory environments. The author sought out to provide a rundown of ways to increase the welfare and decrease the stress (and the corresponding behaviours) of canines in kennels through both human/dog socialization as well as inanimate enrichment, including exposure to scents, sounds, toys, and furniture. The review was conducted in aims to spread the knowledge of methods that improve the welfare of dogs living in kennelled environments.

The presence of other dogs and humans to dogs is incredibly important to their welfare as deprivation of conspecific and human contact in canines has been associated with behaviour deficits. However, the presence of other dogs (via scent, sound, or sight) reduces chances of under-stimulation in a captive environment. Grooming and handling of dogs by humans generally reduces physiological and behavioural indicators of stress (lower cortisol levels and heart rate), while training may decrease 'bad behaviours'. The review mentions that toys have shown to be more beneficial to laboratory-housed dogs than to shelter dogs, possibly due to the hyper-stimulatory environment of rescue shelters. Cage furniture has not been shown to have beneficial effects on the behaviour of kennelled dogs, however both auditory and olfactory enrichment have been shown to have positive effects. Classical music has previously spawned behaviours indicative of relaxation and rock music has had stimulatory effects on kennelled dog behaviour. For olfaction, lavender and peppermint have been demonstrated to have calming and stimulatory effects, respectively.

The author hopes that these methods will be applied more commonly in shelters in order to increase the welfare of kennelled dogs. Furthermore, as new and successful enrichment methods are discovered, Wells hopes they are used globally to alleviate the stress of caged canines.

Contribution

This review lays out various methods derived from previous studies that can be used to increase the wellbeing of dogs housed in kennels. Environmental enrichment, using both animate and inanimate methods, is described and the effects of these methods on stress-indicating behaviours has been explained.

This review is important to my literature review as it combines enrichment methods from multiple studies and discusses how each has impacted the stress-indicating behaviours of kennelled dogs. Moreover, it mentioned previous research done on olfactory enrichment and provides references for future discussion on methods of enrichment associated with my topic.

Graham, L., Wells, D. L., & Hepper, P. G. (2005). The influence of olfactory stimulation on the behaviour of dogs housed in a rescue shelter. *Applied Animal Behaviour Science*, 91(1-2), 143-153. <https://doi.org/10.1016/j.applanim.2004.08.024>

Summary

As the sense of smell is particularly strong in canines, the chemosensory system is a strong target for reducing the stress associated with kennelling for dogs. Previous research has explored the effects of essential oils, spices, and body scent on the behaviours of humans, pigs, cats, and mice. However, research previously done on effects of olfactory enrichment on behaviours of captive dogs had been quite limited. This study aims to investigate the influence of different scent conditions on behaviours of kennelled dogs.

In this study, 29 male and 26 female dogs were exposed to five diffused scent conditions, in the order: control (no scent), lavender, peppermint, chamomile, and rosemary. Each dog was exposed to one treatment at a time for four hours for five consecutive days. A scan-sampling technique was used on days one, three, and five where scans were taken every ten minutes during the treatment period. In each scan, the behaviours observed could include: position, standing, sitting, moving, resting, sleeping, and vocalizing, and only one behaviour was recorded per scan.

Peppermint caused dogs to spend significantly more time standing and moving and less time resting than when they were exposed to the other conditions. Rosemary led dogs to spend significantly more time vocalizing compared to the other conditions. Dogs with lavender diffused spent significantly more time resting and less time vocalizing than those in other treatments, suggesting increased relaxation. Both lavender and chamomile were associated with dogs spending significantly less time moving than other dogs. The results indicate that various olfactory stimuli differentially affect the behaviour of kennelled dogs and therefore some can be used to decrease the stress of kennelled canines. Authors suggest that in future experiments, using another control condition following the treatment conditions may account for habituation and order of treatments affecting the results.

Contribution

This article contributes well to my literature review as it provides an elaborate comparison of the effects that multiple common scents have on the behaviour of kennelled dogs. The method of using diffusers for olfactory enrichment was also verified to be effective in this study. The results confirm that the effects of lavender, chamomile, rosemary, and peppermint on canines are similar to those found previously in other animals studied in that rosemary and peppermint are more stimulating, and lavender and chamomile have more relaxing properties. Future lines of research could investigate positive effects that stimulating scents have on dog behaviour.

Binks, J., Taylor, S., Wills, A., & Montrose, V. T. (2018). The behavioural effects of olfactory stimulation on dogs at a rescue shelter. *Applied Animal Behaviour Science*, 202, 69-76.
<https://doi.org/10.1016/j.applanim.2018.01.009>

Summary

Olfaction is the strongest sensory mechanism in canines and their welfare in kennelled environments can be improved by using olfactory-related enrichment. Previous studies have explored the use of essential oils (EOs) in canines as well the effects on vanilla, coconut and ginger in wombats, sea lions, and gibbons, respectively to determine the effect these had on the animals' behaviour. Vanilla and coconut have increased investigative behaviour, vanilla has decreased repetitive behaviours, and ginger has increased foraging and physical activity. Researchers here wanted to explore the differential effects of vanilla, ginger, coconut and valerian on the behaviour of kennelled dogs.

15 dogs participated in each of six experimental conditions. In five of the conditions, cloths were placed inside the kennel with the particular EO applied. The order of treatments was: no cloth, coconut, vanilla, valerian, ginger, unscented cloth. Observations for each trial took place for two hours per day for three consecutive days. In each hour of the trial, there were scans taken every ten minutes and a behaviour was identified for each. Vocalization observations were taken simultaneously with the others.

Dogs in the treatment conditions had a significantly lower vocalization frequency than either of the controls. Moving frequency was higher in the unscented cloth control than the treatment cloths, but there was no significant difference between this control and the vanilla treatment. Frequency of resting was significantly higher in the treatment cloths than the no cloth present control. These results suggest that the presence of different scents does affect the behaviour of shelter dogs given that frequency and occurrence of multiple stress-indicating behaviours significantly varied between the control and treatment conditions. In the future, doing a similar study where sample sizes are bigger and treatment groups can be separated would be beneficial to allow randomization of the odour conditions.

Contribution

This article contributes well to my literature review as it presents an effective method of providing olfactory enrichment that is different from other articles. Using cloths may be problematic in some kennelled canines, but for others it may prove to be successful in reducing the effects of possible stressors. The results are similar to previous studies as the presence of a scent reduces stress-indicative behaviours such as excessive moving and vocalizations. The results additionally exemplify that multiple different scents can be used for enrichment purposes, which can help eliminate habituation effects when these methods are used in practice.

Haverbeke, A., Uccheddu, S., Arnouts, H., & Sannen, A. (2019). A pilot study on behavioural responses of shelter dogs to olfactory enrichment. *Veterinary Science Research*, 1(1). <https://doi.org/10.30564/vsr.v1i1.1147>

Summary

Essential oils (EOs) have formerly been studied on their influence on frequencies of certain behaviours. Previous research has studied the effects of various individual EOs with stimulating and relaxing properties on the behaviour of kennelled dogs. Researchers here wanted to determine the effects of a diffused essential oil (EO) blend on the posture of kennelled dogs, with posture being indicative of alertness and stress-levels. 23 dogs were divided into two groups with G1 being dogs with a diffuser and G2 dogs in kennels at ten meters away from their diffuser. The oils were diffused for 21 hours per day for 53 consecutive days (Day 3-56). There was a three-day control period first to observe the posture of the dogs before the EOs were diffused. Video footage was taken for 20 minutes each day in the control period (Day 1-3), Week 1 (Day 4-10), and Week 8 (Day 57-63). Postures were recorded using a description chart, with five different postures and their descriptions, taken from previous studies. The 'highest' posture has previously been associated with aggressive behaviours.

In both the G1 and G2 groups, there was a significant decrease in percentage of high posture observed when comparing the control period postures to the Week 8 postures, but no significant difference in the percentage of high postures observed between the control and Week 1 periods.

These findings may suggest that EO blend has a longer-term effect on the stress in kennelled dogs, given that the average time spent in a higher posture decreases over time. However, due to the length of the experiment, the changes in posture observed may have been due to longer time at the shelter and habituation effects. The authors suggest future experiments should look at the different effects of variable concentrations and distances for diffusion of EOs studied.

Contribution

This article contributes well to my topic summary as it analyzes the effects that diffuser distance may have on canine behaviour and the method of diffusing a blend of EOs was used as opposed to the diffusion of single scents, and thus is different from the methods used in my other articles. Therefore, this article presents alternate methods that can be used for reducing stress in kennelled dogs. Future lines of research might involve evaluating the effects the EOs have on stress using changes in behaviour, and perhaps test with shorter treatment times to better mimic typical shelter stay lengths.

Murtagh, K., Farnworth, M. J., & Brilot, B. O. (2020). The scent of enrichment: Exploring the effect of odour and biological salience on behaviour during enrichment of kennelled dogs. *Applied Animal Behaviour Science*, 223, 104917. <https://doi.org/10.1016/j.applanim.2019.104917>

Summary

Diffusion of a variety of essential oils has been shown to be correlated with reduction in stress-indicating behaviours such as decreased moving and barking and increased resting and sleeping. This study investigated the effect of adding calming and biologically-relevant (prey) scents to toys on the behaviour of kennelled dogs and the authors aimed to link how this enrichment is associated with increased canine welfare.

26 male and 18 female dogs participated in each of the experimental conditions for 20 minutes each: NT- No toys provided, T- unscented toys present, T+ - scented toys. The toys in the T+ condition had lavender oil, no scent applied, or rabbit gland and pelt scent applied. The dog' behaviour was video recorded for each trial period and vocalization data was noted simultaneously.

Presence of scented toys significantly increased the interaction with the toys provided (both scented and unscented). They found that the stress-related behaviours, including snout/lip licking, body shaking, paw lifting, yawning, and crouching observed were significantly less in the T and T+ conditions than in the NT condition.

There were no major differences between the conditions for vocalization frequency, however dogs in the T+ condition was significantly more likely to display exploratory behaviours. The authors label the reduced rate of stress-indicating behaviours, associated with toy presentation, as a marker for increased welfare in the dogs, however they mentioned that the olfactory stimuli may be effective simply due to novelty. Because the dogs showed no preference for the rabbit scent over the lavender, the authors suggest that a variety of scents could be effective as prey-scented items were not comparatively successful. The authors recommend that future studies could use a wider variety of scents or aim to better understand how the toy and scent stimulation work together to decrease stress in dogs.

Contribution

This article is highly important to my literature review because it looks at both toy and olfactory enrichment and how they together affect the behavior of kennelled dogs. The results support previous findings that lavender and other scents presented reduce the frequency or duration of stress-indicating behaviours. However, the effects of lavender alone were not measured in this study. This study has important implications in shelters as it bears evidence that applied scents can bring attention to toys that are normally ignored and these methods combined can help to reduce stress that the animals may be facing.

a. Amaya, V., Paterson, M. B. A., & Phillips, C. J. C. (2020). Effects of olfactory and auditory enrichment on the behaviour of shelter dogs. *Animals*, 10(4), 581. <https://doi.org/10.3390/ani10040581>

Summary

This article investigated how different types of enrichment affected the behaviour of shelter dogs. In previous studies, olfactory and auditory stimulation were studied individually, but a study had not yet been conducted that compared the two. Authors here looked at how lavender, dog appeasing pheromone

(DAP), and music differentially decreased stress-indicating behaviours. It had been found previously that all three of the treatments had results showing decreased behavioural responses indicative of stress (i.e. panting, excessive vocalizations and alertness) compared to control groups. In the study, 60 dogs were split into four groups: lavender diffuser (n=15), DAP on worn bandana (n=16), music played through speaker (n=14), control (n=15). Treatment groups were separated by walls where required.

The dogs were exposed to their given stimulus for three hours straight for five consecutive days. Video footage was observed in increments for the three-hour exposure period (five minutes/15 minutes recorded), the four-hour post-treatment period (five minutes/30 minutes recorded) and the night period (five minutes/hour recorded). During the treatment-exposure period, it was found that the dogs in the DAP group spent significantly more time than the control in percent-time lying down with head up and that music group differed significantly from the control in percent-time lying down with head down. Dogs in the treatment groups spent significantly less time than the control in root percent of time spent vocalizing. As lying down and less time vocalizing can be representative of relaxation, these results indicate that the treatments do reduce stress. In future studies, the authors suggest increasing the amount of lavender diffused, which may increase the magnitude of response. Moreover, further comparisons between olfaction and auditory stimulation would allow for broader understanding of the difference in the effects between the two on stress-indicating behaviour.

Contribution

The findings of this study support previous literature regarding the effects of olfactory and auditory enrichment on decreasing stress-indicating behaviours in kennelled dogs. However, the decrease in stress-indicating behaviours in the lavender treatment is less than what was expected in comparison to previous studies. This article contributes sufficiently to my literature review as it bridges the gap between the effects of auditory and olfactory enrichment in the shelter environment and provides a good comparison in the effects of the two. It also provides references to multiple articles on my topic of interest.

b. Amaya, V., Paterson, M. B. A., Descovich, K., & Phillips, C. J. C. (2020). Effects of olfactory and auditory enrichment on heart rate variability in shelter dogs. *Animals: An Open Access Journal from MDPI*, 10(8), 1385. <https://doi.org/10.3390/ani10081385>

** Major findings primarily focus on lavender treatment effects as the olfactory condition is more relevant to my topic**

Summary

Environmental enrichment has become wide-spread in canines in both private homes and shelter environments to decrease stress. Previous studies have looked at heart rate (HR) variability parameters in dogs, cows, and horses and how these measures relate to autonomic nervous system (NS) activation. HR parameters have been measured during presentations of good and aversive stimuli and associations were made between HR variability responses and physiological and emotional stress.

This study explored how auditory and olfactory enrichment affected HR variability in kennelled dogs. 35 male and 25 female dogs were split into four different enrichment conditions: control (nothing

added, n=15), lavender (diffusion of essential oil, n=15), music (301 song playlist, n=14), and dog appeasing pheromone (DAP) (applied to bandana worn by the dog n=16). Behaviours were observed through video recordings; five minutes per 15 minutes during the treatment period, five/30 minutes during post-treatment period (four hours), and five minutes/hour during the night (16 hours). On the fifth day, HR variability measures were taken and heart rate (HR) was measured before, during, and after the treatment period.

It was found that dogs exposed to lavender spent significantly less time root-percent time standing at the door and percent time vocalizing than dogs in the control. Mean HR was less in the dogs exposed to lavender than to the control, although not significantly. The mean time duration between successive RR intervals was higher in the lavender condition dogs as opposed to the control and this suggests that lavender increases parasympathetic activity (Rietmann et al. 2004). These findings confirm results of previous studies that lavender exposure decreases stress-related behaviours. However, the music condition had more noticeable effects on both physiological and behavioural indicators. Authors suggest future experiments could explore different methods of exposing canines to lavender.

Rietmann, T. R., Stuart, A. E. A., Bernasconi, P., Stauffacher, M., Auer, J. A., & Weishaupt, M. A. (2004). Assessment of mental stress in warmblood horses: Heart rate variability in comparison to heart rate and selected behavioural parameters. *Applied Animal Behaviour Science*, 88(1-2), 121-136. <https://doi.org/10.1016/j.applanim.2004.02.016>

Contribution

This article contributes well to my literature review as it touches on how changes in the activity of major stress systems in the canine body are associated with the onset of stress-inducing behaviours. The results of this study are consistent with that of others, in that both lavender and music decrease stress-indicative behaviours. However, this study specifically found that upon exposure to lavender, the parasympathetic nervous system may be activated. Therefore, this article provides relevant information regarding the physiological mechanisms triggered by the olfactory condition. Future lines of research could focus on which parasympathetic parameters are influenced by various scents.
