

The effects of audiobooks on the behaviour of dogs at a rehoming kennels

Brayley, Clarissa; Montrose, V. Tamara

Published in:
Applied Animal Behaviour Science

Publication date:
2015

The re-use license for this item is:
CC BY-NC-ND

This document version is the:
Peer reviewed version

The final published version is available direct from the publisher website at:
[10.1016/j.applanim.2015.11.008](https://doi.org/10.1016/j.applanim.2015.11.008)

[Find this output at Hartpury Pure](#)

Citation for published version (APA):
Brayley, C., & Montrose, V. T. (2015). The effects of audiobooks on the behaviour of dogs at a rehoming kennels. *Applied Animal Behaviour Science*, 174, 111-115. <https://doi.org/10.1016/j.applanim.2015.11.008>

Accepted Manuscript

Title: The effects of audiobooks on the behaviour of dogs at a rehoming kennels

Author: Clarissa Brayley V. Tamara Montrose

PII: S0168-1591(15)00312-3

DOI: <http://dx.doi.org/doi:10.1016/j.applanim.2015.11.008>

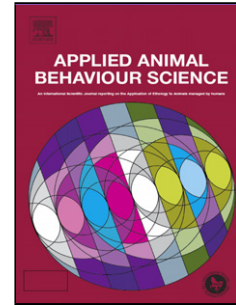
Reference: APPLAN 4157

To appear in: *APPLAN*

Received date: 21-5-2015

Revised date: 9-11-2015

Accepted date: 15-11-2015



Please cite this article as: Brayley, C., Montrose, V.T., The effects of audiobooks on the behaviour of dogs at a rehoming kennels., *Applied Animal Behaviour Science* (2015), <http://dx.doi.org/10.1016/j.applanim.2015.11.008>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

1 The effects of audiobooks on the behaviour of dogs at a rehoming kennels.

2
3 Clarissa Brayley, V. Tamara Montrose* Tamara.montrose@hartpury.ac.uk

4
5 Hartpury University Centre, Department of Animal and Land Sciences, Hartpury College,
6 Hartpury, Gloucestershire, United Kingdom GL19 3BE

7
8 Tel.: +441452702464, fax: +441452700629

9
10 *Abstract*

11 Domestic dogs are often kept in kennelled environments. These may be stressful, and impact
12 negatively upon welfare, due to unpredictable variations in space, social interaction and
13 noise. Auditory stimulation such as music has been demonstrated to enhance animal welfare
14 in a range of species, however despite suggested benefits in humans the potential of
15 audiobooks as auditory enrichment for animals has not been investigated. The present study
16 aimed to investigate the effects of audiobooks upon the behaviour of 31 dogs housed in a
17 rescue shelter. The dogs were exposed to five auditory conditions (audiobook, classical
18 music, pop music, psychoacoustically designed dog music and no auditory control) for 2
19 hours with an intervening period of 2 days between conditions. The dogs' behaviour were
20 recorded every 5 minutes throughout the 2 hour auditory conditions using instantaneous scan-
21 sampling. The findings from the present study indicate that exposure to audiobooks
22 significantly influences the behaviour of kennelled dogs. Audiobooks resulted in dogs
23 spending more of their time resting than when exposed to any of the other auditory conditions
24 (Control: $Z = -4.807$, $P < 0.001$; Pop: $Z = -4.791$, $P < 0.001$; Classical: $Z = -4.732$, $P < 0.001$;
25 Psychoacoustically designed dog music: $Z = -3.911$, $P < 0.001$). Dogs also spent less time
26 displaying sitting or standing vigilant behaviour when the audiobook was played compared to
27 all other conditions (Control: $Z = -4.579$, $P < 0.001$; Pop: $Z = -4.504$, $P < 0.001$; Classical: Z
28 $= -3.450$, $P = 0.001$; Psychoacoustically designed dog music: $Z = -3.514$, $P < 0.001$). This
29 study suggests that exposure to audiobooks can enhance the welfare of kennelled dogs due to
30 their calming influence on dog behaviour. Use of audiobooks provides a simple yet practical
31 tool that can be readily used in many kennel environments to enhance dog welfare and
32 potentially increase the likelihood of successful rehoming of dogs.

33
34 *Keywords*

35 Audiobooks, Auditory stimulation, Animal Welfare, Dogs, Environmental enrichment.

36
37 *1. Introduction*

38 Audiobooks increase resting behaviour in kennelled dogs.

39 Audiobooks decrease sitting/standing behaviour in kennelled dogs.

40 Audiobooks have potential as auditory enrichment for kennelled dogs.

41
42
43 Domestic dogs are kept in kennel environments for a range of reasons with rescue, boarding,
44 quarantine and laboratory kennels being commonplace (Hubrecht, 1995; Taylor and Mills,
45 2007). Kennels are often stressful environments due to the associated spatial and social
46 restrictions (Beerda et al., 1999a; Hiby et al., 2006; Taylor and Mills, 2007). Limited social
47 interactions, restricted space, high noise levels and lack of control occurring within kennels
48 are all potential sources of stress for dogs (Hubrecht and Turner, 1998; Sales et al., 1997;
49 Taylor and Mills, 2007). Continued exposure to these factors can result in chronic stress and
50 compromised welfare (Beerda et al., 1999ab; Beerda et al., 2000). They can also lead to

51 behavioural problems (Serpell and Jagoe, 1995; Tuber et al., 1999; Wells and Hepper, 2000)
52 which can impact upon successful re-homing of shelter dogs (Mondelli et al., 2004;
53 Normando et al., 2006).

54

55 Auditory stimulation is a form of sensory enrichment that can include sounds of conspecifics,
56 natural habitat sounds and music (Wells, 2009). A number of studies have demonstrated the
57 potential for the use of music to enhance animal welfare. Listening to music can result in
58 physiological and psychological benefits in humans (McCraty et al., 1998; Särkämö and
59 Soto, 2012; Sousou, 1997; Wall and Duffy, 2010). Classical music has also been shown to be
60 beneficial in reducing abnormal behaviour in Asian elephants, *Elephas maximus* (Wells and
61 Irwin, 2008) and gorillas, *Gorilla gorilla* (Wells et al., 2006, But cf, Robbins and Margulis,
62 2014). Domestic cats have not been found to benefit from musical stimulation (Stephens and
63 Montrose, 2014) however have recently been shown to exhibit a preference for specially
64 designed species-appropriate music (Snowdon et al., 2015). Few studies currently exist into
65 the effects of auditory stimulation on kennelled dogs. Wells et al. (2002) investigated effects
66 of exposure to human conversation, classical, pop and heavy metal music on behaviours of
67 dogs in rescue kennels. They found that exposure to classical music resulted in dogs spending
68 more time resting and less time standing and barking when compared to the other auditory or
69 control conditions. Kogan et al. (2012) furthered this investigation, identifying behavioural
70 changes in kennelled dogs upon exposure to classical, heavy metal and psychoacoustically
71 designed dog music. They found dogs spent more time sleeping and less time vocalising
72 when exposed to classical music than the other auditory treatments. Recently Bowman et al.
73 (2015) found classical music to induce more resting behaviour and less time standing and
74 barking in kennelled dogs compared to a silent control condition. Excessive barking and
75 activity are indicators of stress in dogs (Beerda et al., 2000; Hetts et al., 1992; Stephen and
76 Ledger, 2010). Classical music is seemingly efficacious as environmental enrichment for
77 kennelled dogs, however other forms of potentially beneficial auditory stimulation have not
78 yet been investigated in a kennel environment.

79

80 An audiobook is a recording of a book read by the author, an actor, a celebrity or an amateur
81 (Colbjørnsen, 2015). Audiobooks are widely utilised as a form of human entertainment (APA
82 2014). Audiobooks have been suggested to provide company and comfort to listeners and
83 enable control over the emotional state of their physical environment (Pedersen and Have,
84 2012). The use of audiobooks has also been found to aid neurological rehabilitation in stroke
85 patients (Särkämö et al. 2010), and to have beneficial emotional effects in dyslexic children
86 (Milani et al., 2010). However, to date, the potential of audiobooks as auditory enrichment
87 for animals, including kennelled dogs, has not been investigated. The present study aimed to
88 investigate the effects of audiobooks upon the behaviour of kennelled dogs. In order to
89 determine how these effects compared to other forms of auditory stimulation we also
90 examined the effects of classical, pop and psychoacoustically designed dog music upon the
91 behaviour of the kennelled dogs.

92

93

94 2. Material and methods

95 2.1. Subjects

96 Thirty one dogs (twenty four males; seven females) aged between 9 months and 13 years and
97 2 months (mean age: 5 years and 4 months) were used in this study. All dogs were neutered
98 or spayed and in good general health including possessing good hearing. The dogs' had
99 varying origins such that eighteen were owner relinquished, five removed from their owners
100 due to welfare concerns and eight were strays. All of the dogs were housed at Burford Blue

101 Cross rehoming centre, Burford, Oxfordshire, UK. The centre is divided into four blocks each
102 of which has the capacity to house six dogs. Within each block each dog was singly housed in
103 individual kennels. The kennel blocks are not open to the public with only Blue Cross staff
104 and volunteers having access to the kennels. The potential confounding factors of visiting
105 hours and the impact of visitors upon the dogs' behaviour were thus negated. The length of
106 time that the dogs had been housed in the kennels varied from 7 days to 330 days (mean
107 length of time in kennels: 51.4 days). Dogs soon to be rehomed were excluded from data
108 collection ensuring that every dog studied was exposed to all auditory conditions. Kennels
109 were made of concrete with wire doors and were rectangular in shape, varying in size from
110 3m by 2m to 4m by 4m. All kennels contained a bed, toys, food and water bowls. Kennels
111 were cleaned daily at 8:30 h. Dogs were taken into individual outside runs twice daily for
112 approximately an hour in the morning whilst cleaning occurred and a second hour in the
113 afternoon. Dogs were walked at least once a day. Dogs were fed two or three times daily. The
114 feed times varied depending on the dogs' condition with underweight dogs being fed three
115 times a day. All dogs were fed at 9:30 h and 15:30 h, and underweight dogs were fed again at
116 12:00 h. Of the thirty-one dogs in the study only seven dogs were fed three times a day.
117 These dogs received the three feeds consistently throughout all conditions in the study.

118
119

120 2.2. Auditory treatments

121 The dogs experienced five different auditory treatments: audiobook, classical music, pop
122 music, psychoacoustically designed dog music and no auditory control. For the audiobook
123 condition 'The Lion, the Witch and the Wardrobe' (C.S.Lewis; performed by Michael York,
124 Harper Collins publisher) was used. In the classical condition, dogs were exposed to 'The
125 best of Beethoven' album (Naxos). In the pop condition, a randomly chosen mixture of tracks
126 from a pop album 'Now 88' (EMI Virgin Records) were used. In the dog specific music
127 condition, dogs experienced the psychoacoustically designed dog music album "Through a
128 dogs' ear" (Leeds and Wagner, 2008). All auditory treatments were played at 60 decibels, the
129 same volume as normal conversation (NIH, 2011), to ensure that it would not be harmful to
130 dogs or staff. In all auditory conditions dogs were also exposed to normal kennel sounds such
131 as barking and staff talking. The audiobook used was selected as it is popular amongst
132 humans and appropriate for all ages, therefore is suitable for a range of environments (Good
133 Reads, 2015). The other auditory conditions were used to enable comparison of the
134 audiobook treatment with auditory conditions used in previous enrichment studies (e.g.
135 Bowman et al., 2015; Kogan et al., 2012; Wells et al., 2002).

136
137

138 2.3. Procedure

139 The experimental design used was based on that previously utilised to investigate the effects
140 of auditory stimulation on kennelled dogs (Wells et al., 2002). A CD player (Lenco SD-24,
141 UK) was placed in the central empty kennel of each block, between 4m and 12m away from
142 each individual. Dogs experienced each auditory condition for two hours from 10:00 h to
143 12:00 h, with an intervening period of two days between treatments to avoid over stimulation.
144 The control condition was applied first followed by pop music, classical music, audiobook,
145 and psychoacoustically designed dog music. This order was randomly determined. The dogs'
146 behaviour was recorded every 5 minutes using an instantaneous scan-sampling technique
147 resulting in twenty-four behaviour points being recorded for every condition. The behaviour
148 of each dogs at each of these points was recorded using an ethogram (based on Hubrecht et
149 al., 1992; Stephen and Ledger, 2005; Wells et al., 2002; Table 1). Video cameras (Vivitar
150 DVR508, UK) set up to view the entirety of each dog kennel were used to record dog

151 behaviour and avoid observer effects (Martin and Bateson, 2007). The authors have read and
152 can confirm that this study complies with the ISAE policy relating to animal ethics.
153

154

155

155 2.4. Data Analysis

156 For each auditory treatment the total number of times each dog was recorded exhibiting each
157 behaviour was summed. A total frequency count for each dog for each behaviour was thus
158 generated. Where behaviours were exhibited at very low levels (mean occurrence <1) they
159 were omitted from analysis as statistical analyses are not robust at such low levels. Otherwise
160 Wilcoxon Signed-Rank Tests were conducted for each behaviour to evaluate differences
161 between audiobooks versus each of the other auditory treatments. The statistical significance
162 level was accepted at $P < 0.05$. All analyses were carried out in SPSS (version 22.0, SPSS
163 Inc. 2013).
164

165

166

166 3. Results

167 3.1. Walking

168 In a comparison of the efficacy of the audiobook and other auditory conditions, significant
169 differences between walking behaviour were found between the audiobook and the control
170 condition ($Z = -3.181$, $P = 0.001$), pop condition ($Z = -3.224$, $P = 0.001$) and
171 psychoacoustically designed dog music condition ($Z = -4.171$, $P < 0.001$). For all these
172 conditions, lower levels of walking behaviour occurred in the audiobook condition (Table 2).
173 No difference in walking behaviour was found between the audiobook and classical music
174 conditions ($Z = -1.198$, $P = 0.231$).
175

176

177

177 3.2. Sitting/Standing

178 The levels of sitting/standing behaviour differed between the audiobook and all other
179 auditory conditions (Control: $Z = -4.579$, $P < 0.001$; Pop: $Z = -4.504$, $P < 0.001$; Classical: Z
180 $= -3.450$, $P = 0.001$; Psychoacoustically designed dog music: $Z = -3.514$, $P < 0.001$). For all
181 these comparisons, lower levels of sitting/standing behaviour were displayed in the
182 audiobook condition (Table 2).
183

184

185

185 3.3. Inactive (resting/sleeping)

186 Significant differences between inactive behaviour were found between the audiobook and all
187 other auditory conditions (Control: $Z = -4.807$, $P < 0.001$; Pop: $Z = -4.791$, $P < 0.001$;
188 Classical: $Z = -4.732$, $P < 0.001$; Psychoacoustically designed dog music: $Z = -3.911$, $P <$
189 0.001). Higher levels of resting/sleeping behaviour were displayed in the audiobook
190 condition (Table 2).
191

192

193

193 3.4. Barking

194 Barking behaviour differed between the audiobook condition and the pop music condition (Z
195 $= -3.229$, $P = 0.001$), classical condition ($Z = -2.018$, $P = 0.044$), and psychoacoustically
196 designed dog music condition ($Z = -2.832$, $P = 0.005$). For all these comparisons, lower
197 levels of barking were exhibited in the audiobook condition (Table 2). No difference in
198 barking behaviour was found between the audiobook and control condition ($Z = -1.753$, $P =$
199 0.080).
200

200

201

202 *3.5. Other vocalisations (howling/growling/whining)*

203 The levels of other vocalisations displayed differed between the audiobook and control
204 condition ($Z = -3.639, P < 0.001$) and audiobook and pop condition ($Z = -3.519, P < 0.001$).
205 Lower levels of vocalisations occurred in the audiobook condition (Table 2). Levels of
206 vocalisations did not significantly differ between the audiobook and classical condition ($Z = -$
207 $1.157, P = 0.247$) or the audiobook and psychoacoustically designed dog music condition (Z
208 $= -0.922, P = 0.357$).

209

210

211 *3.6. Other Behaviours*

212 All other behaviours were performed at very low levels and were omitted from the statistical
213 analyses.

214

215

216 *4. Discussion*

217 The findings from the present study indicate that exposure to audiobooks significantly
218 influences the behaviour of kennelled dogs. Audiobooks resulted in dogs spending more of
219 their time resting or sleeping than any of the other auditory conditions. Dogs also spent less
220 time sitting or standing when exposed to audiobooks compared to all other conditions. Lower
221 levels of barking were also displayed when exposed to audiobooks compared to all other
222 conditions bar the control. Audiobooks also decreased walking behaviour in dogs compared
223 to all auditory treatments bar classical music where in both conditions similarly low levels of
224 walking behaviour were displayed. Lower levels of vocalisations such as howling, growling
225 and whining were displayed in the audiobook condition compared to the control and pop
226 conditions.

227

228

229 A number of these behaviours such as increased activity and vocalising act as indicators of
230 stress in dogs (Beerda et al., 2000; Hetts et al., 1992; Stephen and Ledger, 2000). Sitting and
231 standing behaviour, which tended to be performed by subjects at the front of kennels
232 alongside vigilance behaviours, has also been suggested to be indicative of anxiety or distress
233 (Beerda et al., 2000; Hiby et al., 2006; Taylor and Mills, 2007). Exposure to audiobooks
234 resulted in reduced vocalising and sitting or standing vigilant behaviour as well as increased
235 resting behaviour, all of which are indicative of lower levels of stress in dogs (Beerda et al.,
236 2000; Hetts et al., 1992; Hiby et al., 2006; Stephen and Ledger, 2000). The changes in
237 behaviour induced by audiobooks are therefore suggestive of enhanced welfare in dogs.

238

239

240 Whilst exposure to classical music was equally effective in terms of reducing behaviours
241 such as walking, a finding which is perhaps unsurprising considering the beneficial effects
242 that classical music has been shown to produce in kennelled dogs (e.g. Bowman et al., 2015;
243 Kogan et al., 2012; Wells et al., 2002), exposure to audiobooks was more effective than all
244 other auditory conditions, including classical music, in enhancing resting behaviours.
245 Activity is often used as an indicator of canine stress (e.g. Beerda et al., 2000; Hetts et al.,
246 1992; Stephen and Ledger, 2010), with enhanced resting behaviour being viewed as
247 indicative of relaxation and improved welfare in kennelled dogs (Kogan et al., 2012; Wells et
248 al., 2002). Excessive barking is another indicator of canine stress (e.g. Hetts et al., 1992;
249 Stephen and Ledger, 2010). Whilst lower levels of barking were also displayed under the
250 control condition, the audiobook treatment was the most effective of the auditory stimulation

251 conditions in reducing barking. This study therefore suggests that audiobooks may be a more
252 beneficial form of auditory enrichment for kennelled dogs than classical music. This result is
253 somewhat surprising considering the enriching effects of classical music that have been
254 documented in a range of species (e.g. Chickens, *Gallus gallus domesticus*: Gvaryahu et al.
255 1989; Carp, *Cyprinus carpio L*: Papoutsoglou et al., 2007; Gorillas: Wells et al., 2006; Dogs:
256 Wells et al. 2002; Asian Elephants: Wells and Irwin, 2008), however audiobooks have also
257 been demonstrated to benefit humans via providing company, comfort and other positive
258 emotional effects (Milani et al., 2010; Pedersen and Have, 2012). Dogs are highly social
259 animals whose welfare is enhanced by human interactions (Taylor and Mills, 2007; Tuber et
260 al, 1996; Wells, 2004). Audiobooks may approximate this human interaction for dogs and
261 thus provide the illusion of company and comfort in a kennel environment.
262

263

264 These beneficial effects of audiobooks are also interesting considered that a previous study
265 has found that human conversation had no effect on dog behaviour (Wells et al., 2002). This
266 difference could be due to the fact that whilst dogs may habituate to conversation due to this
267 being heard on a regular basis, audiobooks are likely to be a novel form of auditory
268 stimulation due to being rarely played within kennel environments. Another factor to
269 consider is the presentation of audiobooks as opposed to overheard conversation. Audiobooks
270 are characterised by clear and strong enunciation, a steady pace and tempo, and non-
271 monotonous or stilted delivery (NLS, 1995). The focused delivery of the audiobook
272 (Pedersen and Have, 2012) may also make the narration of more relevance to the dog. These
273 aspects may help ensure that the dog retains interest in the audiobooks, as opposed to regular
274 human conversation.
275

276

277 This study indicates that exposure to audiobooks can have beneficial effects on the welfare of
278 dogs in a kennel environment. Kennels are frequently stressful environments due to the
279 restricted space and social interactions and high noise levels (Hubrecht and Turner, 1998;
280 Sales et al., 1997; Taylor and Mills, 2007) so any amelioration of this stress is beneficial for
281 dog wellbeing. It is also important to consider indirect effects on dog welfare. By reducing
282 the stress of kennelled dogs this may not only reduce behaviours such as excessive barking or
283 activity (Serpell and Jagoe, 1995; Stephen and Ledger, 2010), but also potential behavioural
284 problems (Tuber et al., 1999; Wells and Hepper, 2000), both of which can impact upon
285 rehoming potential and successful rehoming of shelter dogs (Mondelli et al., 2004; Normando
286 et al., 2006; Wells and Hepper, 2000).
287

288

289 5. Conclusions

290 Overall, the findings from this study indicate that audiobooks have beneficial effects upon the
291 behaviour of kennelled dogs. The audiobook condition influenced the dogs' behaviour in a
292 manner suggestive of improved welfare, displaying positive effects upon dog behaviour even
293 compared to classical music, which has previously proven the most efficacious in kennel
294 environments. Due to their calming influence on dog behaviour, audiobooks are suggested to
295 display strong potential for use as auditory enrichment. Audiobooks provide a simple, cost-
296 effective and practical tool that can be readily used in many kennel environments to enhance
297 dog welfare and potentially increase the likelihood of successful rehoming of dogs.

298 Limitations to the current study include the sample size which was relatively small compared
299 to previous studies in the field (e.g. Bowman et al., 2015; Kogan et al., 2012; Wells et al.,
300 2002) and the limited duration of exposure to auditory stimulation. A further limitation is that

301 the researcher was not blind to the auditory conditions during behavioural analysis providing
302 a potential source of bias. Investigation of the effects of daily exposure to audiobooks over a
303 longer time frame would be useful to determine whether audiobooks are effective at reducing
304 stress experienced by kennelled dogs in the long term. In addition further research should
305 occur to determine what aspects of audiobooks are important in reducing canine stress.
306 Investigating dog behaviours in response to such factors as the narrator's gender, age, accent,
307 voice pitch and speed of narration would be of interest in determining which audiobooks to
308 play to best enhance the welfare of kennelled dogs.

309
310

311 *Acknowledgements*

312 The authors wish to thank Sienna Jones and Chris Browne and two anonymous reviewers for
313 their helpful comments.

314
315

316 *References*

317 Audio Publishers Association (APA), 2014. Audio Publishers Association Annual Survey of
318 Members 2014. Accessed on 17/05/15:
319 <http://www.audiopub.org/PDFs/APASalesSurvey2014.pdf>

320

321

322 **Beerda**, B., Schilder, M. B., Van Hooff, J. A., De Vries, H. W., Mol, J. A., 1999a.
323 Chronic stress in dogs subjected to social and spatial restriction. I. Behavioral responses.
324 *Physiology and Behavior*, 66(2), 233-242.

325
326

327 Beerda, B., Schilder, M. B., Bernadina, W., Van Hooff, J. A., De Vries, H. W., Mol, J. A.,
328 1999b. Chronic stress in dogs subjected to social and spatial restriction. II. Hormonal and
329 immunological responses. *Physiology and Behavior*, 66(2), 243-254.

330
331

332 Beerda, B., Schilder, M. B., Van Hooff, J. A., De Vries, H. W., Mol, J. A. 2000. Behavioural
333 and hormonal indicators of enduring environmental stress in dogs. *Animal Welfare*, 9(1), 49-
334 62.

335
336

337 Bowman, A., Scottish, S., Dowell, F. J., and Evans, N. P., 2015. 'Four Seasons' in an animal
338 rescue centre; classical music reduces environmental stress in kennelled dogs. *Physiology and
339 behavior*, 143, 70-82.

340
341

342 Colbjørnsen, T. (2015). The accidental avant-garde: Audiobook technologies and publishing
343 strategies from cassette tapes to online streaming services. *Northern Lights: Film & Media
344 Studies Yearbook*, 13(1), 83-103.

345
346

347 Good Reads, 2015. *The Best of the chronicles of Narnia*. Accessed on 18/05/15. Available
348 from: http://www.goodreads.com/list/show/2236.The_Best_of_the_Chronicles_of_Narnia
349

350

351 **Gvaryahu**, G., Cunningham, D. L., Van Tienhoven, A., 1989. Filial imprinting,
352 environmental enrichment, and music application effects on behavior and performance of
353 meat strain chicks. *Poultry Science*, 68(2), 211-217.
354

355

356 Hetts, S., Clark, J. D., Calpin, J. P., Arnold, C. E., Mateo, J. M., 1992. Influence of housing
357 conditions on beagle behaviour. *Applied Animal Behaviour Science*, 34(1), 137-155.
358

359

360 Hiby, E. F., Rooney, N. J., Bradshaw, J. W., 2006. Behavioural and physiological responses
361 of dogs entering re-homing kennels. *Physiology and behavior*, 89(3), 385-391.
362

363

364

365 Hubrecht, R.C., 1995. The welfare of dogs in human care. In: Serpell, J. (Ed.), *The Domestic*
366 *Dog*. Cambridge University Press, Cambridge, pp. 180–198.
367

368

369

370 Hubrecht, R. C., Serpell, J. A., Poole, T. B., 1992. Correlates of pen size and housing
371 conditions on the behavior of kenneled dogs. *Applied Animal Behavior Science*, 34, 365–383.
372

373

374

375 Hubrecht, R.H., Turner, D.C., 1998. Companion animal welfare in private and institutional
376 settings. In: Turner, D., Wilson, C.C. (Eds.), *Companion Animal in Human Health*. Sage
377 Publications, Thousand Oaks, CA, pp. 267-289.
378

379

380

381 Kogan, L. R., Schoenfeld-Tacher, R., Simon, A. A., 2012. Behavioral effects of auditory
382 stimulation on kenneled dogs. *Journal of Veterinary Behavior: Clinical Applications and*
383 *Research*, 7(5), 268-275.
384

385

386

387 Leeds, J., Wagner, S., 2008. *Through a dog's ear: using sound to improve the health and*
388 *behavior of your canine companion*. Sounds True, Boulder, CO.
389

390

391

392 Martin, P., Bateson, P., 2007. *Measuring Behaviour*. Cambridge University Press,
393 Cambridge.
394

395

396

397 McCraty, R., Barrios-Choplin, B., Atkinson, M., Tomasino, D., 1998. The effects of different
398 types of music on mood, tension, and mental clarity. *Alternative therapies in health and*
399 *medicine*, 4(1), 75-84.
400

401

- 394
395 Milani, A., Lorusso, M. L., Molteni, M., 2010. The effects of audiobooks on the psychosocial
396 adjustment of pre-adolescents and adolescents with dyslexia. *Dyslexia*, 16(1), 87-97.
397
398
399 Mondelli, F., Prato Previde, E., Verga, M., Levi, D., Magistrelli, S., Valsecchi, P., 2004. The
400 bond that never developed: adoption and relinquishment of dogs in a rescue shelter. *Journal*
401 *of Applied Animal Welfare Science*, 7(4), 253-266.
402
403
404 National Institute of Health (NIH), 2011. How Loud Is Too Loud? Accessed on 18/05/15.
405 Available at: <http://www.nidcd.nih.gov/health/hearing/pages/ruler.aspx>
406

407

408 **National** Library Service for the Blind and Physically Handicapped (NLS),
409 1995. The Art and Science of Audio Book Production. Accessed on 18/05/15. Available at:
410 <http://www.loc.gov/nls/other/audioart/allinone.html>
411
412
413 Normando, S., Stefanini, C., Meers, L., Adamelli, S., Coultis, D., Bono, G., 2006. Some
414 factors influencing adoption of sheltered dogs. *Anthrozoos: A Multidisciplinary Journal of*
415 *the Interactions of People and Animals*, 19(3), 211-224.
416
417
418 Papoutsoglou, S.E., Karakatsouli, N., Louizos, E., Chadio, S., Kalogiannis, D., Dalla, C.,
419 Polissidis, A., Papadopoulou-Daifoti, Z., 2007. Effect of Mozart's music (Romanze-Andante
420 of 'Eine Kleine Nacht Musik', sol major, K525) stimulus on common carp (*Cyprinus carpio*
421 L.) physiology under different light conditions. *Aquacultural engineering*, 36(1), 61-72
422
423
424 Pedersen, B. S., Have, I., 2012. Conceptualising the audiobook experience. *Sound Effects*,
425 2(2), 79-95.
426
427
428 Robbins, L., Margulis, S.W., 2014. The effects of auditory enrichment on Gorillas. *Zoo*
429 *Biology*, 33(3), 197-203.
430
431
432 Sales, G., Hubrecht, R., Peyvandi, A., Milligan, S., Shield, B. 1997. Noise in dog kennelling:
433 is barking a welfare problem for dogs?. *Applied Animal Behaviour Science*, 52(3), 321-329.
434
435
436 Särkämö, T., Pihko, E., Laitinen, S., Forsblom, A., Soynila, S., Mikkonen, M., ... Tervaniemi,
437 M., 2010. Music and speech listening enhance the recovery of early sensory processing after
438 stroke. *Journal of Cognitive Neuroscience*, 22(12), 2716-2727.
439
440

- 441 Särkämö, T., Soto, D. 2012. Music listening after stroke: beneficial effects and potential
442 neural mechanisms. *Annals of the New York Academy of Sciences*, 1252(1), 266-281.
443
444
- 445 Serpell, J., Jagoe, J. A. 1995. Early experience and the development of behaviour. In: Serpell,
446 J.A. (Ed.), *The Domestic Dog: Its Evolution, Behaviour and Interactions with People*,
447 Cambridge University Press, Cambridge, pp. 79–102
448
449
- 450 Snowdon, C. T., Teie, D., Savage, M., 2015. Cats prefer species-appropriate music. *Applied*
451 *Animal Behaviour Science*, 166, 106-111.
452
453
- 454 Sousou, S. D., 1997. Effects of melody and lyrics on mood and memory. *Perceptual and*
455 *motor skills*, 85(1), 31-40.
456
457
- 458 Stephen, J.M; Ledger, R.A., 2005. An audit of behavioural indicators of poor welfare in
459 kennelled dogs in the United Kingdom. *Journal of Applied Animal Welfare Science*, 2, 79-95
460
461
- 462 Stephens, G., Montrose, V.T. 2014. Soothing the Savage Beast: The Effect of Auditory
463 Enrichment on Domestic Cats. *The Shape of Enrichment*, 23 (1-2), 9.
464
465
- 466 Taylor, K. D., Mills, D. S., 2007. The effect of the kennel environment on canine welfare: a
467 critical review of experimental studies. *Animal welfare*, 16(4), 435-447.
468
469
- 470 Tuber, D. S., Miller, D. D., Caris, K. A., Halter, R., Linden, F., Hennessy, M. B., 1999. Dogs
471 in animal shelters: Problems, suggestions, and needed expertise. *Psychological Science*,
472 10(5), 379-386.
473
474
- 475 Wall, M., Duffy, A. 2010. The effects of music therapy for older people with dementia.
476 *British Journal of Nursing*, 19(2), 108-113.
477
478
- 479 Wells, D. L., 2004. A review of environmental enrichment for kennelled dogs, *Canis*
480 *familiaris*. *Applied Animal Behaviour Science*, 85(3), 307-317.
481
482
- 483 Wells, D. L., 2009. Sensory stimulation as environmental enrichment for captive animals: a
484 review. *Applied Animal Behaviour Science*, 118(1), 1-11.
485
486
- 487 Wells, D. L., Coleman, D., Challis, M. G., 2006. A note on the effect of auditory stimulation
488 on the behaviour and welfare of zoo-housed gorillas. *Applied Animal Behaviour Science*,
489 100(3), 327-332.
490

- 491
 492 Wells, D. L., Graham, L., Hepper, P. G., 2002. The influence of auditory stimulation on the
 493 behaviour of dogs housed in a rescue shelter. *Animal Welfare*, 11(4), 385-393.
 494
 495
 496 Wells, D. L., Hepper, P. G., 2000. Prevalence of behaviour problems reported by owners of
 497 dogs purchased from an animal rescue shelter. *Applied animal behaviour science*, 69(1), 55-
 498 65.
 499
 500
 501 Wells, D. L., Irwin, R. M., 2008. Auditory stimulation as enrichment for zoo-housed Asian
 502 elephants (*Elephas maximus*). *Animal Welfare*, 17, 335–340.
 503
 504
 505
 506

Table 1 Description of dog behaviours sampled.

Behaviour	Definition
Walking	Dog engages in ambulatory gait around kennel.
Sitting/Standing	Dog sits on hind legs/Dog stands on four legs.
Inactive (resting/sleeping)	Dog reclines in ventral or lateral position, eyes open or closed.
Barking	Staccato vocalisation; varying in duration.
Other vocalisations	Includes howling, growling or whining.
Playing	Dog engages in solitary playing with toys; or displays play bow.
Panting	Dog pants for reasons other than physical exertion or a warm ambient temperature.
Drinking	Dog ingests water.
Eating	Dog ingests food.
Repetitive pacing	Dog repeatedly paces around kennel in a fixed route.
Wall bouncing	Dog repeatedly jumps up kennel wall from side to side.
Circling	Dog walks around in small circle repeatedly.
Self-mutilation	Dog chews or bites own body.
Chewing bedding	Dog chews its own bedding.
Digging	Dog digs into the corner of kennel or in bedding with forepaws.

- 507
 508
 509 Table 2 The mean (\pm S.D.) number of times each behaviour was displayed by the dogs in the
 510 five auditory conditions.

Behaviour	Control	Classical	Pop	Dog music	Audiobook
-----------	---------	-----------	-----	-----------	-----------

Walking	2.97	1.97	2.84	3.10	1.74
	(2.105)	(1.560)	(2.115)	(1.399)	(1.437)
Sitting/ Standing	12.03	10.00	13.68	10.45 (4.523)	8.19
	(5.930)	(4.967)	(5.659)		(4.963)
Inactive	9.61	11.16	7.71	10.35	15.00
	(7.753)	(6.293)	(6.394)	(5.625)	(8.095)
Barking	5.06	4.84	5.90	5.23	3.90
	(0.359)	(5.080)	(5.160)	(5.371)	(4.134)
Other vocalisations	4.10	1.81	2.71	1.84	1.52
	(5.455)	(4.199)	(4.762)	(4.591)	(3.345)
Playing	0.29	0.19	0.13	0.19	0.23
	(0.739)	(0.654)	(0.428)	(0.543)	(0.669)
Panting	0.23	0.16	0.19	0.16	0.16
	(0.956)	(0.735)	(0.792)	(0.735)	(0.735)

Drinking	0.03	0.13	0.06	0.06	0.06
	(0.180)	(0.428)	(0.250)	(0.250)	(0.250)
Eating	0.03	0.03	0.00	0.06	0.13
	(0.180)	(0.180)	(0.000)	(0.250)	(0.341)
Repetitive Pacing	0.84	0.29	0.52	0.58	0.23
	(1.675)	(1.039)	(1.092)	(1.311)	(0.956)
Wall Bouncing	0.45	0.10	0.35	0.13	0.00
	(1.060)	(0.396)	(0.755)	(0.428)	(0.000)
Circling	0.39	0.00	0.13	0.03	0.00
	(1.086)	(0.000)	(0.499)	(0.180)	(0.000)
Chewing Bedding	0.26	0.26	0.10	0.13	0.13
	(0.815)	(0.815)	(0.396)	(0.428)	(0.562)
Digging	0.10	0.06	0.00	0.00	0.00
	(0.539)	(0.359)	(0.000)	(0.000)	(0.000)

512
513
514
515
516

Accepted Manuscript