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The development and pilot evaluation of a 'serious game' to promote positive child-animal interactions

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1 **The Development and Pilot Evaluation of a ‘Serious Game’ to Promote**
2 **Positive Child-Animal Interactions**

3

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15

16

17 **Running head: SERIOUS GAME TO PROMOTE POSITIVE CHILD-ANIMAL**
18 **INTERACTIONS**

19

20

Abstract

21 Animal welfare education aims to nurture compassion, respect and kindness to animals but
22 there remains a need for more rigorous evaluations of such programmes to assess the most
23 effective approaches. Incorporating technology into animal welfare education is a relatively
24 novel field. This study examines the process of designing, developing, and evaluating the
25 effectiveness of a new theoretically-driven educational computer game intervention. Pet
26 Welfare was designed for children aged 7-12 years, to promote positive child-animal
27 interactions. A pre-test, post-test, test-control, quasi-experimental design was used using a
28 self-report questionnaire that children completed within class. Participants included 184

29 primary-school children from schools in Scotland, UK. The results indicated a positive
30 impact on knowledge about animal welfare needs, knowledge about appropriate and safe
31 behaviour towards pets and beliefs about pet minds. Children were also less accepting of
32 cruelty to pets. There was no impact on self-reported compassion. This study presents the
33 first evaluation of a digital animal welfare ‘serious game’ for children, demonstrating the
34 benefits of incorporating technology and game-based learning into animal cruelty prevention.
35 The results of this study will inform future education directions for those wishing to promote
36 positive and safe relationships between children and animals.

37

38 **Key words:** Animal Cruelty; Animal Welfare; Children; Education; Technology; Serious
39 games

40

41

Introduction

42 School-based animal welfare education aims to nurture compassion, respect and kindness to
43 animals, facilitate empathy, humane attitudes, prosocial skills and behaviour, and can play a
44 key role in violence prevention (Arbour, Signal & Taylor, 2009; Ascione & Weber, 1996;
45 Faver, 2010; Nicoll, Trifone & Samuels, 2008). Such programmes can be built into existing
46 curricula, follow school pedagogy and therefore meet educational standards by building on
47 specific subjects (‘curriculum-blended’; Ascione, 1997). Animal welfare education
48 programmes can also be built upon the framework of curriculum for excellence (Hawkins,
49 Williams & Scottish SPCA, 2017a). Even though many programmes that involve direct child-
50 animal interactions have proven to be successful (Nicoll, Samuels & Trifone, 2008; Tardif-
51 Williams & Bosacki, 2015), direct contact is neither always possible nor necessary (Ascione,
52 1993; Hawkins, Williams & Scottish SPCA, 2017a). Scientific evaluations of such
53 programmes are lacking, and evaluation studies that do exist, lack methodological rigour with
54 many not including control groups. This paves the way for new collaborations between
55 researchers, psychologists and animal welfare organisations to develop and evaluate the
56 effectiveness of such programmes and assess the best practices in promoting positive human-
57 animal interactions.

58 There is a lack of research into the development and evaluation of interventions which aim to
59 prevent animal cruelty and to promote positive child-animal interactions. Those interventions

60 that do exist, have focused on intervention once a child has been cruel to an animal, rather
61 than on prevention. Most research on childhood animal cruelty rarely considers cruelty within
62 the general population, instead focusing on narrow clinical or other special populations
63 (Ascione, 1993; Felthous & Kellert, 1987; Hawkins, Hawkins & Williams, 2017; Longobardi
64 & Badenes-Ribera, 2018), but ideally, prevention programmes should be universal. We know
65 from previous research (Hawkins, 2018; Hawkins, Hawkins & Williams, 2017) that most
66 cruelty towards animals in childhood is accidental, and that education is the key to preventing
67 unmotivated animal cruelty and promoting positive and safe child-animal interactions
68 (Hawkins, Williams & Scottish SPCA, 2017a). We also know that dogs, cats and rabbits are
69 not only the most common pets in the UK, but also the most common targets for pet cruelty
70 in childhood (Scottish SPCA, 2017; PDSA, 2011). The present study examines the
71 effectiveness of a new theoretically-driven digital educational intervention for children in the
72 general population, focusing on dogs, cats and rabbits. Pet Welfare was designed to enhance
73 compassion, understanding of animal sentience, animal welfare needs, appropriate and safe
74 behaviour towards animals, and prevent animal cruelty from an early age.

75 As mentioned, childhood animal cruelty is often unintentional and may have cognitive roots,
76 resulting from misinterpretation of animal behaviour and welfare needs, as well as a lack of
77 knowledge about appropriate and safe behaviour towards animals, and lack of ability to
78 recognise emotional signals in pets (Hawkins & Williams, 2016; Lakestani, Donaldson,
79 Verga & Waran, 2006; Meints & De Keuster, 2009). Reducing acceptance of animal cruelty
80 (indicative of cruelty behaviour) through education is a key goal, which could be achieved
81 through the inclusion of emotional material aimed to increase beliefs about animal minds,
82 how to accurately identify emotional signals (Hawkins & Williams 2016; Lakestani,
83 Donaldson & Waran, 2014; Meints, Racca & Hickey, 2010), and through examples of animal
84 cruelty and neglect (Hawkins, Williams & Scottish SPCA, 2017a). Educational materials
85 need to be child-friendly and ethically appropriate, without distressing images. This can be
86 tackled through focusing on accidental and intentional animal cruelty using common
87 everyday scenarios and behaviours (e.g., “Should you pull a cat’s whiskers?”).

88 Considering unmotivated animal cruelty and neglect, children also seem to lack detailed
89 animal welfare knowledge (Jamieson et al., 2012; Muldoon et al., 2009; Wells & Hepper,
90 1995), leading to inadequate animal care (Batson, 2008) and animal welfare issues such as
91 irresponsible pet ownership (Buckland, Corr, Abeyesinghe & Wathes, 2014). Research shows
92 that even adult pet owners lack knowledge about pet welfare and social needs, especially

93 concerning rabbits (Edgar & Mullan, 2011). Teaching children about the complex welfare
94 needs of animals, their natural behaviours and social needs, is important to promote positive
95 pet-owner relationships and prevent accidental cruelty and neglect (d'Ovidio, Pierantoni,
96 Noviello & Pirrone, 2016). Moreover, evidence-based educational interventions that target
97 these cognitive factors may have the potential for promoting responsible pet care, optimal pet
98 welfare, and for the prevention of cruelty and neglect (Buckland et al., 2014; Tardif-Williams
99 & Bosacki, 2015).

100 Computer games for educational purposes (i.e. 'game-based learning' or 'serious games'),
101 have been found to be more effective at increasing learning and retention, and cognitive
102 outcomes than traditional teaching methods (Vogel et al., 2006; Wouters, Van Nimwegen,
103 Van Oostendorp & Van Der Spek, 2013). Computer games can be built upon the science or
104 'pillars' of learning, ensuring high quality education, and can target both cognitive and
105 affective aspects of learning and have been shown to promote helping behaviour and reduce
106 aggressive cognitions (Ewoldsen et al., 2012; Schmierbach, 2010; Chi, 2009; Hirsh-Pasek et
107 al., 2015; Alfieri, Brooks, Aldrich & Tenenbaum, 2011; Darling-Hammond, 2008; Fisher et
108 al., 2011; James & Swain, 2011). Moreover, technology can be utilised to create emotionally
109 engaging experiences for children which fosters interest in animals, promotes a sense of
110 emotional connection to another species, and subsequently elicits cognitive and affective
111 empathy for animals (Webber, Carter, Smith & Vetere, 2017). The use of photos can
112 stimulate positive responses towards animals (Myers, Saunders & Bexell, 2009). There is
113 therefore exciting potential for new educational computer games to be developed and
114 evaluated which aim to promote positive child-animal interactions.

115

116 **The Present Study**

117 The aim of this study was to evaluate the effectiveness of a new 'serious game' named Pet
118 Welfare. This study aimed to answer the following research question: Does the Pet Welfare
119 game intervention have a significant impact on children's beliefs about pet minds, knowledge
120 about animal welfare needs, knowledge about appropriate and safe behaviour towards pets,
121 compassion towards animals and acceptance of cruelty to pets? It was hypothesised that there
122 would be a significant pre- to post-test change for all target outcomes for the intervention
123 group but not the control group.

124

125

Method

126

127 **Development of Pet Welfare**

128 Pet Welfare was developed using Articulate Storyline 2 (www.articulate.com), an e-learning
129 tool that allows interactive educational material to be developed for online or offline use. A
130 series of interactive levels were developed for the three types of pets (dogs, cats and rabbits)
131 incorporating text, images and sound. Three levels were developed per animal to provide
132 variety and different interactivity. Children received feedback throughout the game and
133 viewed their scores. All images were either provided by the Scottish SPCA or purchased
134 from photo stock websites. Once developed, the game was downloaded and played offline
135 through the Articulate Storyline Mobile App player on iPads in class (also available on other
136 devices).

137 Based on a literature review, key target outcomes were decided before the development of the
138 game, feeding into decisions made regarding content, and therefore were the focus of the
139 evaluation procedure. A logic model based on the Evidence Based Practice Unit (EBPU)
140 Logic Model (Wolpert et al., 2016) was created to inform the development of the game
141 (Figure 1). Based on the logic model, an evaluation questionnaire was developed. This
142 included measures to test the key target outcomes of the game (knowledge, beliefs about pet
143 minds, compassion and acceptance of cruelty to pets). All content and feedback were based
144 on current scientific research into animal sentience, behaviour and welfare and confirmed by
145 animal behaviour experts to ensure accuracy and to avoid misinformation. Images were also
146 sent to three animal behaviour experts for validation during the development phase to ensure
147 accuracy of the emotions displayed. All three behaviour experts had expertise in identifying
148 and recognising behaviour stills and agreed accuracy of all images.

149

150 [Figure 1 about here]

151

152 **Level 1: Sentience and Belief in Animals Minds**

153 Level 1 targeted children's beliefs about pet minds. The aim of this level was to teach
154 children that pet animals are sentient and to facilitate their beliefs about pet minds using the

155 most up-to-date research on animal emotion and cognition. The questions focused on the
156 items from the Children’s Beliefs about Animal Minds measure (Hawkins & Williams,
157 2016), happiness, sadness, fear, pain and intelligence. In this level, an image was presented
158 on the screen (e.g., a scared dog) with the question “how is this dog/cat/rabbit feeling?”.
159 Children had to choose a correct answer from four options (happy/sad/scared/in pain). One
160 image per emotion (happy/sad/scared) was provided per animal. Where no suitable image
161 was available, children were shown a neutral image of an animal and asked “can
162 dogs/cats/rabbits feel pain?” and “are dogs/cats/rabbits clever?” and subjects had to click yes
163 or no on the screen. Feedback was provided about information on animal behaviour relating
164 to those emotions (e.g., “This dog is frightened. A frightened dog might crouch down or
165 whimper”). The feedback was made short, simple and child-friendly. For correct answers,
166 children were congratulated and provided with feedback, for incorrect answers, “oops that
167 was incorrect” was displayed and children were given another chance. All emotion images
168 had a plain white background to prevent children from looking for visual cues in the
169 background of images.

170

171 **Level 2: Knowledge of Animal Welfare Needs**

172 The goal of level 2 was to tackle potential inaccurate knowledge and promote new knowledge
173 around the welfare needs of animals and highlight the five freedoms. This level focused on
174 what pet animals need to be ‘happy and healthy’ through a ‘drag and drop’ game. For each
175 animal, children had options of care items (e.g., water) and distractors (e.g., chocolate) to
176 move on the screen and were asked “what does a dog/cat/rabbit need to be happy and
177 healthy?”. Correct items had to be moved onto a target animal icon and incorrect items onto a
178 bin icon. Incorrect answers ‘bounced back’ and so children had to keep trying until all items
179 were on the correct location. Once finished, feedback was provided about the five freedoms
180 for each animal to reinforce learning and provide context to the items.

181

182 **Level 3: Appropriate Behaviour**

183 Level 3 focused on children’s interactions with pets, which is important for preventing
184 accidental animal cruelty (Buckland et al., 2014; Shen et al., 2016). This level involved a quiz
185 where children had to respond to questions by pressing ‘yes’ or ‘no’. The questions related to

186 animal welfare knowledge (e.g., “Should you give a dog chocolate?”), accidental animal
187 cruelty (e.g., “Should you hold a rabbit upside down like a baby?”), motivated animal cruelty
188 (e.g., “Should you kick a cat?”), animal neglect (e.g., “Should you leave a cat alone for a few
189 days without feeding it?”) and safe behaviour towards animals (e.g., “Should you approach a
190 dog you don’t know?”), two questions per theme and ten questions per animal. Feedback
191 reinforcing key messages was provided after each question (e.g., “Rabbits do not like this,
192 they become stressed. It slows their heartbeat and puts them in a trance like state which can
193 be harmful”).

194

195 **Evaluation Method**

196

197 **Participants**

198 Participants included 184 primary school children, 92 test and 92 control (53% boys, 47%
199 girls) from three schools in West Lothian, Scotland, UK. Randomisation was not possible for
200 this study and so a quasi-experimental design was used. Two schools made up the test group
201 and one school made up the control group. Children were aged between 7-years and 12-years
202 (M=10, SD=1) and from two age classes, 7-9-years (42%) and 10-12-years (58%). The
203 control group was from a separate school and age-matched to the test group. Most children
204 had pets (63%). The types of pets owned were: dogs (40%), cats (20%), rabbits (1%), other
205 small mammals (8%), horse/donkey/pony (2%), birds (4%), fish (11%), and
206 reptiles/amphibians (4%).

207

208 **Design**

209 A quasi-experimental, mixed factorial design was used to evaluate the intervention. One
210 variable was phase of testing (time), a repeated-measures variable with two conditions: pre-
211 tests (day before intervention) and post-tests (two days after intervention). The between-
212 subjects variable was the intervention condition (game intervention vs. control).

213

214 **Procedure**

215 The ethical guidelines of the British Psychological Society, specifically relating to research
216 with children, were adopted for this research, and ethical consent was granted from an
217 internal review board at the host university. Permission was granted from the local authority
218 before schools were contacted via email and telephone. Head teachers and class teachers were
219 provided with information regarding the study and participation was at their discretion.
220 Parents/guardians were provided with a covering letter and project information sheet at least
221 a week ahead of the study. Opt-out forms were provided to complete and return to the school
222 if a parent/guardian wished not to give their consent for their child to participate in the
223 research project. Only one parent opted their child out from the study. Child consent was also
224 obtained with child-friendly consent forms.

225 The pre-test, intervention, and post-test conditions were conducted over three school days.
226 Children completed the pre-test questionnaire on the first day (Monday), played the game
227 intervention on the second day (Tuesday) and then completed the post-test questionnaire two
228 days later (Thursday). The control group followed a similar pattern whereby they completed
229 the pre-test questionnaire on the first day (Monday), went about usual class activities on the
230 second day (Tuesday), and completed the post-test questionnaire two days later (Thursday).
231 The control group were able to play the game immediately following the completion of the
232 post-test questionnaire. On the intervention day, children took turns individually playing the
233 game at their school desk. The game took each child approximately 15 minutes to complete.

234

235 **Pre- and Post-test Questionnaire**

236 A self-report questionnaire was developed as the evaluation tool and administered during
237 class time. The questionnaire comprised of a range of validated child-animal measures
238 described below, each checked for reliability using Cronbachs Alpha. The questionnaire took
239 each child approximately 15 minutes to complete and they could ask the researcher or their
240 teacher for help if needed. The researcher and teachers could only help the children read or
241 understand a question and did not provide the child with any answers. Demographic
242 questions including gender, age and pet ownership (yes/no) were incorporated. Other
243 measures included: beliefs about pet minds, knowledge about the five freedoms, knowledge
244 about appropriate and safe behaviour, compassion, and acceptance of cruelty to animals.

245

246 **Children’s Beliefs about Pet Minds**

247 An adapted version of the Children’s Beliefs about Animal Minds measure (Hawkins &
248 Williams, 2016; Menor-Campos, Hawkins & Williams, 2018) was created for the purpose of
249 this evaluation, named Children’s Beliefs about Pet Minds. Each scale (e.g., “Do you think
250 the following animals are ...?”) relates to a specific sentence item
251 (clever/pain/happiness/sadness/fear). These questions were asked in relation to dogs, cats and
252 rabbits. Each item is scored on a 5-point Likert scale (“Strongly disagree” to “Strongly
253 agree”). Total scores were calculated for each species (score range 5-25) as well as an overall
254 Child-BAM score across all species (score range 15-75) where a high score indicates high
255 Child-BAM. The measure demonstrated high reliability within the current sample ($\alpha = 0.91$).

256

257 **Children’s Knowledge about the Five Freedoms for Pets**

258 This knowledge question asked, “What do dogs/cats/rabbits need to be happy and healthy?”.
259 An image of each animal was provided with space around the image for children to write
260 freely. Answers were coded according to the five animal freedoms. For example, mentioning
261 food, water and hay for rabbits would score the child three points for ‘freedom from thirst,
262 hunger and malnutrition’. Total scores for each species were calculated as well as a total
263 knowledge score across species. The measure demonstrated very good reliability within the
264 current sample ($\alpha = 0.76$). There was no maximum total score.

265

266 **Children’s Knowledge about Appropriate and Safe Behaviour towards Pets**

267 This measure was developed specifically for this study to test elements of the intervention
268 around appropriate and safe behaviour. The measure asked, “Should you do the following...?”
269 for 12 items. Four questions per species were included and the questions were taken directly
270 from those included in the game intervention. One question per species was asked for welfare
271 knowledge (e.g., “Give cats toys such as a scratching post?”), one question per animal for
272 cruelty (e.g., “Shout or scream at a dog?”), one question per species for neglect (e.g., “Leave
273 a cat for a few days without feeding it?”) and one question per species for safe behaviour
274 towards animals (e.g., “Touch a rabbit when it is showing its teeth or stomping its feet?”).
275 Total scores for each species were calculated (score range 4-20) as well as a total knowledge

276 score across all species (score range 12-60) where a high score indicated high knowledge.
277 The measure demonstrated very good reliability within the current sample ($\alpha= 0.74$).

278

279 **Children's Compassion towards Animals**

280 The Children's Compassion towards Animals measure (CCA; Hawkins, Williams & Scottish
281 SPCA, 2017b) was included for this evaluation. This measure uses a one 5-item scale asking
282 "What do you think about animals?" with five statements (e.g., "When I see an animal that is
283 hurt or upset I feel upset" and "When I see an animal that is hurt or upset I want to help it").
284 The measure was scored on a 5-point Likert scale ("Strongly disagree" to "Strongly agree").
285 Total scores were calculated (range 5-25). This measure demonstrated good reliability within
286 the current sample ($\alpha= 0.61$).

287

288 **Children's Acceptance of Cruelty towards Pets (CACP)**

289 A new measure was developed for the purpose of this study named Children's Acceptance of
290 Cruelty to Pets (CACP). This measure included three 9-item scales with the question "Do you
291 think it is alright to..?" with nine statements (e.g., "make a cat scared?"). The measure was
292 based on pet sentience (e.g., "make a dog sad?" and "injure a rabbit") and pet welfare needs
293 (e.g., "not give a rabbit food or water?"). The measure comprised of three separate scales, one
294 for each pet species (dogs/cats/rabbits). Each item was scored on a 5-point Likert scale
295 ("Strongly disagree" to "Strongly agree"). Total scores were calculated for each species
296 (score range 9-45) as well as an overall cruelty score across all species (score range 27-135)
297 where high scores indicate high acceptance of animal cruelty. This measure showed high
298 reliability within the current sample ($\alpha= 0.85$).

299

300 **Analysis**

301 Total scores were added for each key variable for each individual at each sample point and
302 data were analysed at the individual level using the Statistical package for the Social Sciences
303 Statistics 24 (SPSS Inc.), with a two-tailed significance of $p < .05$. Initially the data was
304 checked for outliers, normal distribution, homogeneity of variances and sphericity, and
305 outliers were removed from analysis. A two-way repeated measures ANOVA using time

306 (phase of testing: pre-test, post-test) as the within-subject variable and group (two conditions:
307 test, control) as the between-subject variable, tested main and interaction effects. The focus of
308 the results reported below are the interaction effects which show a difference in performance
309 for the intervention group but not the control. Significant interactions were analysed using
310 simple main effects analysis of time within the treatment condition, this indicated whether
311 there was a significant change from pre-test to post-test in the test group, but not in the
312 control group. Where there was no statistically significant interaction, main effects were
313 reported. ANCOVA was used to examine whether the interaction remained significant once
314 adjusting for pre-test scores, age, gender and pet ownership.

315

316

Results

317

318 **Beliefs about pet minds**

319 Pet Welfare significantly improved total beliefs about pet minds scores; there was a
320 statistically significant interaction between the intervention condition and time (Table 1, 2).
321 The intervention group significantly improved at post-test whereas the control group did not.
322 The difference between game intervention and control at post-test remained significant when
323 adjusting for pre-test scores and demographics using ANCOVA (Table 3). A significant
324 effect of the intervention was also found in the scores given to each species' minds, these
325 effects remained significant when adjusting for pre-test scores and demographics using
326 ANCOVA (Table 1, 2, 3).

327

328 **Children's knowledge about the Five Freedoms**

329 Pet Welfare significantly improved total knowledge about the five freedoms scores; there was
330 a statistically significant interaction between the intervention condition and time (Table 1, 2).
331 The intervention group significantly improved at post-test whereas the control group did not.
332 The difference between game intervention and control at post-test remained significant when
333 adjusting for pre-test scores and demographics using ANCOVA (Table 3). A significant
334 effect of the intervention was also found for dog, cat and rabbit welfare knowledge, these

335 effects remained significant when adjusting for pre-test scores and demographics using
336 ANCOVA (Table 1, 2, 3).

337

338 **Knowledge about Appropriate and Safe Behaviour towards Pets**

339 Pet Welfare significantly improved total knowledge about appropriate and safe behaviour
340 towards pets scores. There was a statistically significant interaction between the intervention
341 condition and time (Table 1, 2). The intervention group significantly improved at post-test
342 whereas the control group did not. The difference between game intervention and control at
343 post-test remained significant when adjusting for pre-test scores and demographics using
344 ANCOVA (Table 3). A significant effect of the intervention was also found for dog and
345 rabbit behaviour knowledge. These effects remained significant when adjusting for pre-test
346 scores and demographics using ANCOVA (Table 1, 2, 3). No significant effect of the
347 intervention was found for knowledge about appropriate and safe behaviour towards cats,
348 although a significant difference was found after adjusting for pre-test scores and
349 demographics using ANCOVA (Table 1, 2).

350

351 **Compassion towards Animals**

352 Pet Welfare did not significantly improve children's scores for compassion towards animals.
353 No statistically significant interaction between the intervention condition and time was found
354 (Table 1, 4). This result remained nonsignificant when adjusting for pre-test scores and
355 demographics using ANCOVA (Table 2).

356

357 **Children's acceptance of cruelty to pets**

358 Pet Welfare did not significantly improve scores for total attitudes towards cruelty to pets, no
359 statistically significant interaction between the intervention condition and time was found
360 (Table 1, 4). However, a significant difference was found when adjusting for pre-test scores
361 and demographics using ANCOVA (Table 2). No significant effect of Pet Welfare was found
362 for cruelty to dogs or cats, these results remained nonsignificant when adjusting for pre-test
363 scores and demographics using ANCOVA (Table 1, 2, 4). There was a significant effect of

364 Pet Welfare for cruelty to rabbits, this remained significant when adjusting for pre-test scores
365 and demographics using ANCOVA (Table 1, 2,).

366

367 [Tables 1-4 about here]

368

369

Discussion

370

371 The purpose of this study was to evaluate a novel animal welfare ‘serious game’ named Pet
372 Welfare. The game was designed to impact the cognitive and affective dimensions of child-
373 animal interactions, with the overarching goal of preventing unintentional animal cruelty and
374 neglect and to promote positive child-pet interactions. The aim was to modernise and
375 maximise the learning and teaching of animal welfare education by utilising technology,
376 thereby making animal welfare education more interactive and engaging. A key question was
377 whether the Pet Welfare game intervention would have a significant impact on children’s
378 beliefs about pet minds, knowledge about animal welfare needs, knowledge about appropriate
379 and safe behaviour towards pets, compassion towards animals and acceptance of cruelty
380 towards pets.

381 Firstly, it was promising that despite relatively high pre-test scores (average score 65.2 out of
382 75, 58% scored above the mean), Pet Welfare was successful at increasing children’s beliefs
383 about pet minds. Total scores as well as scores for each animal, increased at post-test. These
384 findings suggest that teaching children about pet sentience will increase their understanding
385 of animal minds. Anthropomorphic attributions of emotions and cognition to other species, or
386 holding a belief that animals are sentient, is arguably at the core of human-animal
387 relationships (Urquiza-haas & Kotrschal, 2015). Such abilities facilitate social interactions,
388 social bonds, but are also prerequisites for empathy development and moral concern (Baron-
389 Cohen, Tager-Flusberg & Lombardo, 2013; Eisenberg, Huerta & Edwards, 2012). Believing
390 that animals cannot feel emotions and lack sentience (low beliefs about animal minds) is
391 related to negative child-animal interactions (low compassion, low humane behaviour,
392 negative attitudes and higher acceptance of animal cruelty; (Hawkins & Williams, 2016) as
393 well as aggressive beliefs and behaviour (Randour & Gupta, 2013; Sprinkle, 2008)).

394 In recent years, there has been a movement towards focusing on positive welfare (increasing
395 well-being). This movement involves education about increasing animal's happiness such as
396 opportunities for enrichment and positive social interactions (Mellor & Beausoleil, 2015). In
397 Pet Welfare information was provided about what children can do to make their animals
398 'happy and healthy' in line with animal welfare needs (The Animal Welfare Act, 2006;
399 Animal Health and Welfare (Scotland) Act, 2006). Pet Welfare was successful at increasing
400 children's knowledge about animal welfare needs, this included total scores as well as scores
401 for each pet type. These results are promising when considering that teaching children how to
402 interpret animal welfare needs will facilitate positive child-animal interactions such as caring
403 behaviour, and lead to better care (Muldoon et al., 2009). Such caring behaviour may also
404 foster a child-pet attachment which, as known from previous studies, has developmental
405 benefits (Muldoon, Williams & Lawrence, 2016, Hawkins, Williams & Scottish SPCA,
406 2017b).

407 Pet Welfare aimed to encourage children to think about an animal's perspective and
408 encourage children to behave in ways that will not be harmful to an animal. Although
409 evidence is limited, recent findings demonstrate the potential of education at promoting such
410 beliefs and knowledge (Angantyr et al., 2016; Coleman, Hall & Hay, 2008; Fonseca et al.,
411 2011). In line with these previous findings, it was promising that Pet Welfare was successful
412 in increasing children's knowledge about appropriate and safe behaviour towards pets.
413 Children improved on total scores and for each pet type. Given the range of positive
414 psychological, emotional and physiological health outcomes of pets for children (Purewal et
415 al., 2017), facilitating positive and safe child-pet interactions has important implications that
416 are often overlooked in research. Increasing such knowledge, as demonstrated through Pet
417 Welfare, is also important for preventing injuries to children, as well as preventing distress to
418 pets (Shen et al., 2016), yet children lack this knowledge. One consequence of children's lack
419 of understanding, is dog bites which remains a public health problem. With better knowledge,
420 perhaps children would learn better ways to interact with dogs, reducing the likelihood of
421 being bitten (Lakestani & Donaldson, 2015; Westgarth, Brooke & Christley, 2018). Future
422 studies may wish to include other common 'high-risk' situations such as safe child-dog
423 interactions (Dixon, Mahabee-Gittens, Hart & Lindsell, 2012) including touching or
424 removing a food bowl when a dog is eating as resource guarding is a common cause of dog
425 bites (Reisner, Shofer & Nance, 2007). Also, safe handling of animals may be important for
426 preventing accidental injury to pets and injuries to children (Dickman, 2013). This study

427 supports previous research that found knowledge is the most susceptible to change through
428 intervention (Reisner, Shofer & Nance, 2007; Mariti et al., 2011; Vermeulen & Odendaal,
429 1993).

430 A key aim of animal welfare education is to prevent violence towards animals, and it was
431 anticipated that Pet Welfare would decrease children's acceptance of cruelty. However, a
432 significant reduction was found only for rabbits, a common target of cruelty and neglect. A
433 lack of change overall may be due to the measure itself, low acceptance of cruelty at baseline,
434 or that the intervention did not have a strong focus on animal cruelty. It is important to
435 prevent childhood cruelty to animals given the complex relationship between animal-directed
436 and human-directed violence, low cognitive empathy, behavioural problems and that cruelty
437 attitudes and behaviour are related (Monsalve, Ferreira & Garcia, 2017; Trentham, Hensley
438 & Policastro, 2017; Hartman et al., 2016; Hawkins et al., 2017). Further research is therefore
439 required to examine how to successfully address animal cruelty in childhood education, and
440 address how attitudes towards animal cruelty, translate to long-term behaviour. It was
441 positive though that children in our study were generally unaccepting of cruelty at baseline
442 (scoring an average of 31.2 out of 135, where a high score indicates high acceptance). This
443 was especially true for dogs and items relating to intentional cruelty. Future educational
444 programmes should be aimed at those children 'at risk' for violence.

445 Another key aim of animal welfare education is to promote compassion and kindness towards
446 animals. However, Pet Welfare was not successful at increasing children's self-reported
447 compassion towards animals. This suggests that it may not be possible to intervene at the
448 affective level through a short classroom-based digital educational intervention. Pet Welfare
449 was designed to prevent unmotivated, or accidental animal cruelty and neglect, and so it may
450 not be effective for children who lack compassion and empathy (Decety et al., 2016).

451 Children in the current study also demonstrated high compassion at baseline (average score
452 of 20.8 out of 25), leaving little room for improvement. It could be the measure used or it
453 could be argued that no change was observed due to Pet Welfare being a one-off, short
454 intervention. However, no impact on compassion was found in a longer-term (6 week)
455 follow-up of a short intervention (Hawkins, Williams & Scottish SPCA, 2017a). It may be
456 that compassion is resistant to change through interventions that do not include direct contact
457 with animals, given that caring behaviour towards pets promotes attachment and compassion
458 (Hawkins, Williams & Scottish SPCA, 2017b). However, we cannot make conclusions about
459 this given the lack of evidence. Previous research has shown that direct contact with animals

460 is important for developing compassion, moral concern, species-specific knowledge of
461 animal care, understanding of appropriate about pet care and needs, and promoting human-
462 animal bonds (Melson, 2003; Kurdek, 2008; Serpell, 2004). However, involving animals in
463 education raises welfare concerns and the impact on the animals themselves who are involved
464 in animal welfare education is very much an under researched (Fine & Huss, 2017). There is
465 no legislation in the UK to enforce these types of activities. The question of whether the
466 affective domains of child-animal interactions can be promoted through humane educational
467 remains.

468 Kellert (1985) recommended focusing educational efforts for 6-10-year-olds on
469 children's affective reactions to animals and building on children's positive orientations to
470 animals. This is due to this age range being characterised by a major increase in emotional
471 concern and affection for animals. A dramatic improvement in factual and cognitive
472 understanding of biology and animals is seen between 7-14 years (Binnie & Williams, 2002;
473 Myant & Williams, 2005). As Pet Welfare was aimed at children aged 7-12-years old, both
474 affective and cognitive domains were targeted, and potential age differences were considered,
475 as recommended by Arbour, Signal and Taylor (2009). Middle childhood is an important
476 time for educational intervention due to a peak in pet ownership (Paul & Serpell, 1993),
477 receptivity to animal welfare education (Melson, 2003), as well as important changes in
478 cognitive development including increases in prosocial moral reasoning and empathetic
479 moral concerns (Eisenberg-Berg, 1979; Flavell, 2004). Furthermore, childhood is a key time
480 for the development of attitudes and related behaviours, reinforcing the importance of
481 encouraging humane orientations to animals early on (Borgi & Cirulli, 2015).

482 Although this study displays promising findings, longer-term evaluation is required with a
483 larger population to test the reliability of findings and suitability of the intervention for other
484 cultural contexts. This research was conducted within three primary schools within West
485 Lothian in Scotland and so the results should be generalised with caution. Conclusions can
486 only be drawn about the short-term effects of the programme and it is not known how
487 knowledge gained through this programme will generalise to other animals and translate long
488 term. However, feedback from the children was extremely positive (scoring an average of
489 4.5/5), and the children reported that they wanted more animals and more levels to play. It is
490 recommended that a longer, more complex game with more animal types and varied levels is
491 developed.

492

493 **Conclusion**

494 This study highlights the potential of promoting positive child-animal interactions and
495 preventing accidental animal cruelty and neglect through the use of a fun, reward-based,
496 interactive child-friendly digital game. This study is the first evaluation of an animal welfare
497 education computer game for children and the results are promising with the game having a
498 significant impact on knowledge, attitudes and belief in animal minds. Future work in this
499 area may include the development of more varied and complex games, and different methods
500 of delivering games. Through education, children learn kindness, and how to become
501 responsible animal citizens in their communities, which will in turn have wider, long-term
502 implications for a humane society and the prevention of violence.

503

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507

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749 **Table 1**750 *Descriptive statistics.*

	Test				Control			
	Pre-test		Post-test		Pre-test		Post-test	
	M	SD	M	SD	M	SD	M	SD
Beliefs about pet minds								
Total beliefs about pet minds	65.56	8	72.31	7	64.77	10	66.28	11
Dog minds	22.27	2.9	24.37	1.8	21.83	3	22.65	3
Cat minds	21.78	3	24.04	2.7	21.43	4	21.98	4
Rabbit minds	21.53	3	23.87	3	21.42	4	21.49	4
Knowledge about animal welfare needs								
Total knowledge	24.03	8.5	25.55	10	19.04	6.7	17.23	7.9
Dog welfare	8.33	3	8.6	3.6	6.86	2.7	5.84	2.7
Cat welfare	7.32	2.8	8.16	3.4	5.85	2.5	5.56	2.8
Rabbit welfare	8.26	3.3	8.6	3.6	6.37	2.4	5.84	2.7
Knowledge about appropriate and safe behaviour towards pets								
Total knowledge	55.77	3	59.01	1.9	56	5.5	56.57	3.3
Dog knowledge	18.68	1.3	19.70	.81	18.71	2	18.81	1.3
Cat knowledge	18.99	1.4	19.80	.74	18.95	2	19.25	1.4
Rabbit knowledge	18.10	1.6	19.51	1.1	18.34	2.2	18.95	2
Compassion towards animals								
Total compassion	20.48	2.4	20.99	2.4	21.04	3.2	21.58	2.9
Acceptance of cruelty to pets								
Total acceptance of cruelty to pets	31.57	6.6	28.41	3.3	30.92	8.3	29.99	6
Cruelty to dogs	10.42	2.3	9.58	1.3	10.53	4	9.93	2
Cruelty to cats	10.68	3.3	9.46	1.3	10.22	3	9.91	2
Cruelty to rabbits	10.70	2.97	9.47	1.3	10.21	2.4	10.15	2.2

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762 **Table 2**763 *Results from two-way repeated measures ANOVA and ANCOVA.*

	Interaction effects from two-way repeated measures ANOVA	Controlling for demographics and baseline scores using ANCOVA
Beliefs about pet minds		
Total beliefs	F(1,166)=27.6, p=.0001, η^2 =.14	F(1,168)=33.84, p=.0001, η^2 =.17
Dog minds	F(1,170)=15.05, p=.0001, η^2 =.08	F(1,172)=24.8, p=.0001, η^2 =.13
Cat minds	F(1,168)=18.43, p=.0001, η^2 =.10	F(1,170)=22.5, p=.0001, η^2 =.12
Rabbit minds	F(1,168)=26.5, p=.0001, η^2 =.14	F(1,170)=31.2, p=.0001, η^2 =.16
Knowledge about welfare needs		
Total knowledge	F(1,167)=15.2, p=.0001, η^2 =.084	F(1,169)=23, p=.0001, η^2 =.123
Dog welfare	F(1,169)=15.2, p=.0001, η^2 =.08	F(1,171)=25.4, p=.0001, η^2 =.13
Cat welfare	F(1,167)=11.8, p=.001, η^2 =.07	F(1,169)=24, p=.0001, η^2 =.13
Rabbit welfare	F(1,169)=7.72, p=.006, η^2 =.044	F(1,171)=18.5, p=.0001, η^2 =.1
Knowledge about appropriate and safe behaviour towards pets		
Total knowledge	F(1,165)=12.7, p=.0001, η^2 =.072	F(1,167)=36.3, p=.0001, η^2 =.18
Dog knowledge	F(1,165)=11.06, p=.001, η^2 =.06	F(1,167)=28.2, p=.0001, η^2 =.15
Cat knowledge	F(1,166)=3.9, p=.05, η^2 =.023	F(1,168)=11.6, p=.001, η^2 =.07
Rabbit knowledge	F(1,165)=11.06, p=.001, η^2 =.06	F(1,167)=22.4, p=.0001, η^2 =.12
Compassion towards animals		
Total compassion	F(1,171)=.09, p=.77, η^2 =.001	F(1,173)=2.2, p=.14, η^2 =.013
Acceptance of cruelty to pets		
Total acceptance of cruelty to pets	F(1,166)=3.12, p=.079, η^2 =.02	F(1,168)=33.84, p=.0001, η^2 =.17
Cruelty to dogs	F(1,169)=.09, p=.077, η^2 =.001	F(1,171)=1.21, p=.27, η^2 =.01
Cruelty to cats	F(1,168)=1.9, p=.174, η^2 =.011	F(1,170)=2.1, p=.058, η^2 =.022
Cruelty to rabbits	F(1,167)=8.8, p=.004, η^2 =.05	F(1,169)=9.5, p=.002, η^2 =.001

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775 **Table 3**776 *Results for main simple effects following significant interactions.*

Test x Control at Pre-test				Test x Control at Post-test			
df	F	p	η^2	df	F	p	η^2
Beliefs about pet minds							
Total beliefs about pet minds							
1,180	.331	.57	.002	1,171	20.2	.0001	.11
Dog minds							
1,182	.893	.346	.005	1,173	18.2	.0001	.096
Cat minds							
1,182	.52	.472	.003	1,172	16.6	.0001	.09
Rabbit minds							
1,182	.042	.837	.0001	1,172	20.1	.0001	.11
Knowledge about animal welfare needs							
Total knowledge about animal welfare needs							
1,181	19.2	.0001	.097	1,170	35.7	.0001	.18
Dog welfare							
1,181	11.8	.001	.061	1,172	32.2	.0001	.16
Cat welfare							
1,181	13.9	.0001	.072	1,170	29.6	.0001	.15
Rabbit welfare							
1,183	20.2	.0001	.1	1,172	32.2	.0001	.16
Knowledge about appropriate and safe behaviour towards pets							
Total knowledge about appropriate and safe behaviour							
1,181	.12	.73	.001	1,167	36.04	.0001	.18
Dog knowledge							
1,181	.021	.89	.0001	1,167	28.9	.0001	.15
Rabbit knowledge							
1,181	.691	.407	.004	1,167	20.1	.0001	.11

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786 **Table 4.**

787 *Results from main effects analysis for each intervention following insignificant interactions.*

Main effect of time				Main effect of group			
<i>df</i>	<i>F</i>	<i>p</i>	η^2	<i>df</i>	<i>F</i>	<i>p</i>	η^2
Compassion towards animals							
1,171	9.99	.002	.06	1,171	2.7	.15	.012
Total attitudes towards cruelty to pets							
1,166	16.32	.0001	.09	1,166	.322	.57	.002
Attitudes towards cruelty to dogs							
1,169	11.31	.001	.063	1,169	.632	.428	.004
Attitudes towards cruelty to cats							
1,168	13.61	.0001	.08	1,168	.015	.904	.000
Knowledge about appropriate and safe behaviour towards cats							
1,166	13.1	.0001	.073	1,166	2.2	.145	.013

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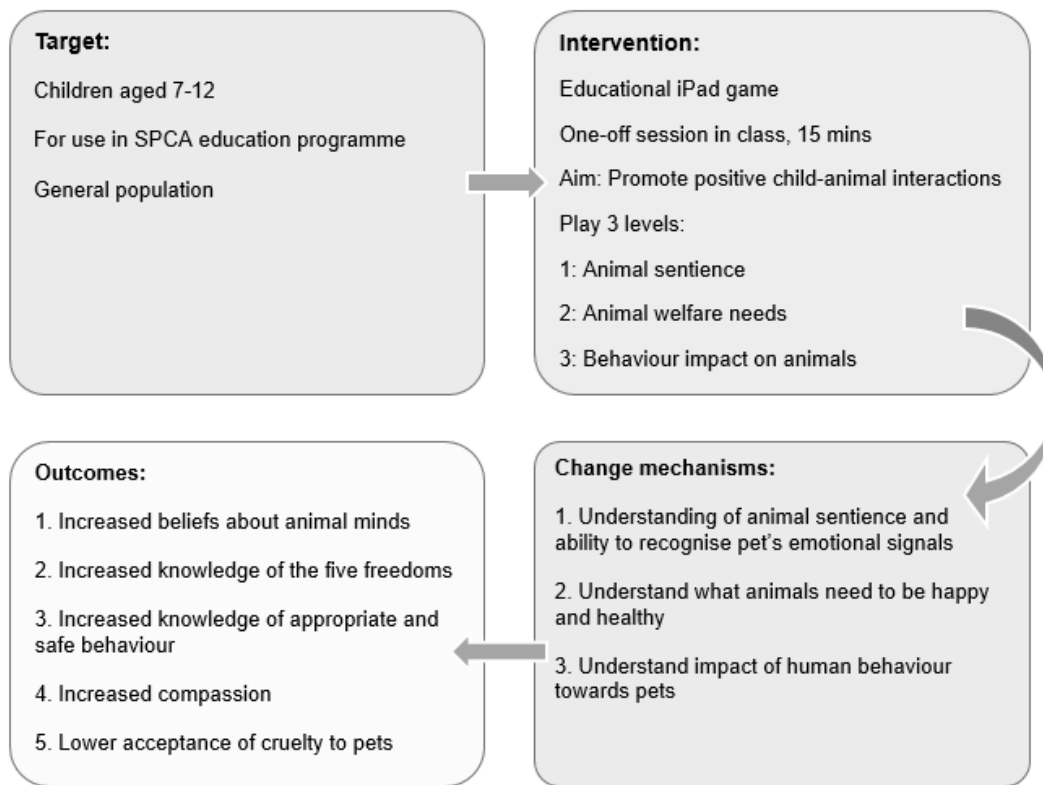
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806 **Figure 1.** Logic model for Pet Welfare.

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