Assessment of Detection of Potential Dog-Bite Risks in the Home Using a Real-Time Hazard Perception Test

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Assessment of detection of potential bite risks in the home using a real-time hazard perception test

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Abstract

Dog bites are a serious public health concern internationally and children are often at particular risk of dog bites. Because bites to children often occur during apparently benign interactions with a parent present, the need for dog-bite prevention approaches to address adult's awareness of, and supervision of, child-dog interactions has been highlighted. The aim of this study was to evaluate a hazard perception test of potential dog bite hazards within a home setting. Six hazards were incorporated in a 2 minute 41 second video, which was embedded into a web-based interface that enabled respondents to identify hazards by clicking the mouse button or tapping the screen of a tablet computer as the video played. The 268 volunteer respondents also completed a short questionnaire. These respondents were predominantly female and appeared more likely to have undertaken higher education and have greater experience with dogs than the general population. Almost one-third (31.8%) of respondents identified all six hazards and a further quarter (24.5%) missed only one; a quarter (25.2%) identified 3 or less, 43.8% identified 4 or less hazards. No one scored zero, and 5.5% and 6.9% identified 1 and 2 hazards, respectively. A range of factors were found to be associated with identification of specific hazards. Participants with professional, or long-term, experience with dogs, and those with higher educational attainment, were more likely to detect some hazards. Older respondents were less likely to identify several of the hazards, and those living with children were less likely to identify cuddling a dog as a hazard. We find that hazard perception testing could be a useful tool for assessment of knowledge regarding dog bite risk situations, and potentially an educational tool for increasing knowledge and changing practices around dogs.

Keywords: dog, bite, hazard perception video

Introduction

Dog bites are a serious public health concern internationally (Cameron et al., 2017; De Keuster et al., 2006; Dixon et al., 2013; Gilchrist et al., 2008; Health and Social Care Information Centre (HSCIC), 2014; Rajshekar et al., 2017) and their frequency is believed to be increasing in some countries (Overall & Love, 2001; Rajshekar et al., 2017; Súilleabháin, 2015; Winter, 2015), though this may not be the case in other countries (Gilchrist et al., 2008; Holzer et al., 2019). Dog bites may result in severe injury (Abraham & Czerwinski, 2019; Fein et al., 2019; Golinko et al., 2017; Maksymowicz et al., 2016; Mannion et al., 2015; Morzycki et al., 2019; Rajshekar et al., 2017) and/or long term disability and psychological impacts (De Keuster et al., 2006; Peters et al., 2004) (for reviews see Dhillon et al., 2018; Westgarth & Watkins, 2017). Many bites occur indoors and involve familiar dogs, most frequently the household dog (Abraham & Czerwinski, 2019; Fein et al., 2019; Reisner et al., 2011).

Children are often at particular risk of dogs bites (Cameron et al., 2017; De Keuster et al., 2006) and it is unsurprising that many bite prevention programmes focus on education of children and parents regarding behaviour of, and around, dogs (Chapman et al., 2000; Meints et al., 2018; Meints & De Keuster, 2009). While these have demonstrated enhanced knowledge (Meints & De Keuster, 2009) and safer behaviours (Chapman et al., 2000) following education, research in this area is very limited with systematic reviews of dog bite interventions finding no high quality studies of the link between dog bite education and dog bite rates (Duperrex et al., 2010; Shen et al., 2017). This may be due to some interventions having limited effectiveness and/or because of difficulties in measuring dog bite rates, particularly less severe bites. Nevertheless, it is likely education programmes may need

tailored approaches to different populations groups. For example, people with higher education levels are better able to define stress than those with lower attainment, women are more likely than men to consider their dogs as more stress (Mariti et al., 2012), and the ability to recognise dog emotions is primarily gained through experience with dogs and, in adults, is associated with attitudes to dogs (Amici et al., 2019). Furthermore, bites to very young children (2 years old and younger) occur while the child is too young to learn (Fein et al., 2019). Because of this, and because bites to children often occur with a parent present and during benign interactions (Reisner et al., 2011), the need for dog-bite prevention approaches to address adults' awareness of and supervision of child-dog interactions has been highlighted (Arhant et al., 2016, 2017; Meints et al., 2018; Meints & De Keuster, 2009).

These findings underline the need for methods to evaluate people's ability to detect potentially hazardous situations with dogs. Previous approaches have used reported responses to specific circumstances of interactions with dogs, including using: descriptions (Dixon et al., 2012; Spiegel, 2000), photos (Dixon et al., 2012; Schwebel et al., 2012; Wilson et al., 2003) and videos (Demirbas et al., 2016) of dogs, animated cartoons (Meints & De Keuster, 2009), role playing with dolls (Schwebel et al., 2012); and live dogs (Chapman et al., 2000; Morrongiello et al., 2013; Schwebel et al., 2012). Other studies have assessed via interpretation of emotions of dogs shown in photos (Aldridge & Rose, 2019) and videos (Aldridge & Rose, 2019; Meints et al., 2018). Regardless of the technique used, each of these methods entails respondents responding to individual stimuli involving dogs one at a time, which ensures the focus of the stimulus is prominent and allows time for consideration. In contrast, situation awareness testing aims to test individuals' ability to identify risky behaviours and conditions or events, while accounting for the contexts in

96 which events are occurring (Endsley, 1995). It requires respondents to anticipate and
97 identify potential hazards as they emerge during the real-time action shown in a video
98 (Mckenna & Crick, 1994). The most frequently used example is the driving hazard
99 perception test (Mckenna & Crick, 1994), which has been widely validated (Horswill &
100 McKenna, 2004). Hazard perception tests have now been used in diverse arenas, such as air
101 traffic control (Endsley & Rodgers, 1994), sport (James & Patrick, 2004), anaesthesia
102 (Endsley & Rodgers, 1994), food hygiene (Millman et al., 2015) and farm biosecurity
103 (Millman et al., 2017).

104 This study evaluated a hazard perception test of potential dog bite hazards within the home.
105 We investigated the ability of respondents to identify each of six potential hazards and
106 obtained feedback on the approach. We also evaluated the association between detection
107 of each of these hazards with factors hypothesised to play a part awareness of dog
108 behaviour and emotion and risks of unintentional injury, including gender (e.g. Mariti et al.,
109 2012), age (e.g. Bishai et al., 2008 and Mannion et al., 2015), experience with dogs (e.g.
110 Amici et al., 2019), presence of children in the household (e.g. Reisner et al., 2011), work
111 status (e.g. Laffoy, 1997 and Gordon et al., 2007) and educational attainment (e.g. Mariti et
112 al., 2012).

113 **Methods**

114 **Ethics**

115 This study was approved by the Veterinary Research Ethics Committee of the University of
116 Liverpool (VREC539a). The welfare of the dogs was monitored throughout the filming; one
117 author is a veterinary surgeon (RC) and another a Full Member of the Association of Pet

Behaviour Counsellors (CW - who also deemed the dogs suitable to take part and monitored the dogs throughout). Prior to the commencement of the questionnaire and data collection, potential respondents were informed of the purpose and nature of the research. Respondents were also informed that participation was voluntary, that data would be recorded anonymously and that no personal or identifying information would be collected, and that taking part was assumed to indicate consent for their data to be used in the research.

Participants

A self-selected group of respondents was recruited via advertisements on social media, including Facebook and Twitter. Participation was open to UK residents aged 18 years and older. Advertisements provided a link to the online tool together with information about the purpose and nature of the research. Recruitment began on 17th November 2017 and the survey was closed on 21st January 2018.

In all, 1003 people opened the first page of the survey website. Just over half of these (n = 532, 53.0%) fit the eligibility criteria: of those not fitting the eligibility criteria 444 (44.2%) did not complete the questionnaire and/or watch the hazard video, 23 (2.3%) were < 18 years and 6 (0.6%) were not based in the UK (several people met >1 of these criteria). Of those that completed the questionnaire and watched the hazard video (n = 532), 280 (50.2%) clicked at least once, whereas the other half did not click. Feedback from respondents on social media posts identified that screen taps consistently were not recorded on some types of mobile phones. Hence, we could not determine if this the group for which no clicks were registered did not click or if the clicks were not recorded. Therefore, data from these respondents were not included in the analyses of hazard

detection. Thus, at least one click registered during the video was made a requirement for inclusion for the hazard perception analysis. Furthermore, examination of respondents who made 40 or more clicks during the video (i.e. on average clicked every 3.5 seconds) revealed respondents (n = 12) who appeared to click extremely frequently and regularly and without clear pattern throughout the video; results from the hazard video for these individuals were deemed to be unreliable and they were removed from the hazard detection analysis. Thus, the final sample for analysis utilised 268 responses.

From the limited data available, it was evident that the respondents included in this study were not representative of the general population. Most notably, almost 90% of total respondents were female and around two-thirds had completed higher education (defined here as a university diploma or above and included teaching qualifications; Table 1). Additionally, many respondents had experience with dogs; almost all currently owned at least one dog, two-thirds reported they had attended dog training, about a quarter had a professional role with dogs and half had been bitten by a dog. The percent in each variable category was very similar between the those respondents that only completed the questionnaire (n = 264; Table 1) and those that also completed the hazard video (n = 268); the only exception was for 'role with dogs', with a greater proportion of those with a professional role with dogs completing the hazard video compared to participants without a professional role (χ^2= 3.9, df= 1, p = 0.047). However, as multiple statistical comparisons between respondents that only completed the questionnaire and those that also completed the hazard video have been made, the risk that this is a false significant result is high (Holm-Bonferroni corrected p value = 0.6)

Questionnaire

A questionnaire was used to gather information about: past experience with dogs (ever owned dogs, and if yes, at what ages and number of dogs); current dog ownership; whether or not ever bitten by a dog and, if so, whether the bite had occurred in the past 12 months; whether or not they had participated in any form of dog training; their age and gender; whether or not they lived with children under 16 years; whether or not they work with dogs professionally; where in the UK they lived; their employment status; highest educational level attained; and total gross household income. Respondents were asked to complete the questionnaire prior to undertaking the hazard perception test. Only the questions on age and location in the UK were compulsory, as these were inclusion criteria for the study.

Hazard selection and video production

A list of potential hazards for inclusion in the hazard video was developed through discussions among the authors, with other expert colleagues and through review of the literature. The six hazards included in the video (Table 2) were selected in order that they fulfilled the following criteria: a common everyday activity in the home, could be developed into a coherent storyline, could be safely acted without the need for speaking, and would not negatively impact the welfare of the dogs and people involved (editing and cutting was used to assist with this so that actions would appear more hazardous than they were in practice, for example, filming the crate hazard, the crate contained a stuffed toy dog during scenes involving ‘’interaction’ by a child and this film was spliced into sequences showing a dog entering and leaving the crate; see Table 1). The child actors were trained prior to filming and debriefed following filming to ensure they were aware of safety and animal welfare issues; the latter involved discussions among the children, parents and researchers regarding the nature of each hazard and the need to avoid such situations. Both dogs were

trained to Gold Canine Good Citizen level, were well socialised and attended weekly training classes. The dog owner/trainer, who was a full member of the Association of Pet Behaviour Counsellors, observed and praised the dogs during filming and rewarded the dogs between shots. Regular breaks were taken to enable actors and dogs to relax, and dogs were not made to participate whenever they showed reluctance to do so. Consent was obtained from the children's parents and assent from the children themselves. The children did not receive remuneration or reward for participating.

Filming took place on one day with the assistance of a professional videographer and director. All scenes were filmed multiple times and edited to produce the final video. The final set of six hazards was developed into a story and additional components added to assist the flow of the story and to provide periods of video without obvious hazards. The final video lasted for 2 minutes 41 seconds, including an introductory sequence which included a countdown to the start of the action. The hazards were shown in a fixed order within the storyline of the film. Hazard windows were identified around each hazard by carefully selecting the time point in the video at which each hazard visibly commenced and ended (See Table 2).

Online tool

The video was incorporated in to a real-time online hazard perception test by embedding the video into a web-based interface that enables respondents to identify hazards by clicking the mouse button or tapping the screen of a tablet computer as the video plays, whenever they perceived a hazard on the screen (http://www.clicklearner.co.uk/). Respondents received the following instructions prior to undertaking the hazard perception

test, including that they should click the left mouse button whenever they identify a hazard that may lead to a dog bite, even if the hazard has just left the screen.

The timing of each click was recorded relative to the video. The time of every click was recorded for each respondent, enabling calculation of the total number of clicks, and of clicks within and outside the six hazard windows. Respondents were recorded as having identified a hazard when the clicked at least once within the relevant hazard window. Following completion of the hazard perception test, respondents were provided with feedback on all the hazards, including information on why the action represented a hazard and whether or not they correctly identified it. A free text box was provided to enable respondents to comment on the hazard perception tool and to identify other hazards they may have observed.

Analysis

The total number of clicks made by each respondent was examined. The number of hazards each identified and the number of respondents correctly identifying each hazard was calculated. Logistic regression analysis, using backward-step variable selection, was used to explore risk factors for detection of each hazard. Variables considered within the multivariable models included: Respondents' age and gender; whether they lived with children; their educational attainment; the UK country in which they lived; whether or not they had previously been bitten by a dog; whether they worked with dogs professionally; how long they had owned dogs; their employment status; and their household salary was used to assess independence between explanatory variables. For all pairs of variables, Cramér's V was low or medium (Cohen, 1988) and were hence considered sufficiently independent for inclusions in the multivariable models. Only significant variables ($P < 0.05$)

were included in the final multivariable models. The Hosmer-Lemeshow statistic was calculated for each model to assess evidence of poor model fit. Influential responses were identified using by calculating delta-beta values; the influence of responses with high delta-beta values (0.5) was assessed by re-running models with these data removed (Christley & Diggle, 2018). All analyses were conducted using R v3.6.0 (R Core Team, 2019).

Results

Hazard identification

Among the 268 participants who clicked at least once during the hazard perception video, the mean number of clicks was 10.9 (median 9), the minimum was 1 and the maximum 36 (Figure 1A). Half of the respondents clicked between 6 and 15 times during the hazard test (i.e. the inter-quartile range). Almost one-third (31.8%) of respondents clicked at least once during each hazard window and thus were considered to have identified all six hazards (Figure 1B) and a further quarter (24.5%) missed only one. No one scored zero (note that only respondents that clicked at least once are included in this analysis, but clicks could have been outside hazard windows), and 5.5% and 6.9% identified 1 and 2 hazards, respectively. Hence, 1 in 8 respondents (12.5%) identified 2 or fewer hazards, a quarter (25.2%) identified 3 or less, 43.8% identified 4 or less hazards (Figure 1C); more than half of the respondents (56.2%) identified at least 5 of the 6 hazards. The most commonly identified hazard was Crate (n = 247, 88.2%), followed by Door (n = 238, 85.0%), Eat (n = 224, 80.0%) and Cuddle (n = 214, 76.4%) – all of which were identified by more than three-quarters of respondents. The other two hazards were only identified by just over half of the respondents: Sofa (n = 149, 53.2%) and Fed (n = 147, 52.5%). Overall, there was a significant difference in detection

between the hazards (χ^2 (df = 3, n = 175, p < 0.0001)), with the first (sofa) and last (fed) being least frequently identified.

In total, 2921 clicks were recorded by all respondents during the hazard video. Overall, the mean number of clicks by all respondents in each second of video was 18.6 and the median was 10, with a minimum of 0 and maximum of 144. A quarter of all seconds in the video, had 4 or fewer clicks and another quarter of the second 23 or more. Three-quarters of all clicks (n = 2194, 74.1%) occurred during one of the hazard windows. Within the hazard windows there was an average of 31.3 clicks per second, compared to 8.3 clicks per second outside the hazard windows. There were 3 periods when there were >23 clicks per second (i.e. the third quartile value) outside of pre-specified hazard windows. The first of these occurred at t = 47 seconds, when there were 43 clicks. This was immediately before the Cuddle hazard (Table 2), and while one dog was shown within the crate. It is notable that this dog lip-licked at this time, perhaps raising concerns among some viewers that the dog was stressed (Beerda et al., 1997). The second occurred at t = 58-59, when there were 51 and 54 clicks, respectively. This scene showed one child following a dog as it moved away (from the Cuddle hazard). The third occurred at t = 135-36, when there were 29 and 32 clicks, respectively. This scene showed the unwrapping of a life-sized stuffed toy dog, which may have been interpreted by some viewers as a potential hazard (indeed, as noted below, one respondent commented that her/his dog was reactive to toy dogs).

In all cases, Hosmer-Lemeshow test statistics indicated no evidence of poor model fit (Table 3). Examination of delta-beta values identified 2 potentially influential responses for the model for Cuddle. No other model had influential responses identified. Comparison of the Cuddle model output run using datasets with and without the 2 potentially influential

responses indicated that exclusion of these responses did not materially affect the results, so the models including these responses are presented here.

A range of factors were found to be associated with identification of specific hazards, using multivariable logistic regression (Table 3). Participants who reported that they have a professional role with dogs had more than twice the odds of detecting Sofa compared those without a professional role. There was also evidence that those with the longest experience of owning dogs were more likely to detect this hazard, even after allowing for age group. Indeed, the oldest age group (55 years and over) had significantly lower odds of detecting the Sofa hazard compared to 18- to 34-year-olds.

Identification of Cuddle was associated with age and educational groups, and whether the respondent lived with children, independent of age. Those respondents in the 18-34 year age category were most likely to detect this hazard; the odds of detection was significantly lower among those over 55 years of age. Compared to participants who completed secondary school (e.g A-levels in England) as their highest education attainment, those with post-school education had three times the odds of detecting the cuddle hazard, whereas those completing schooling to approximately age 16 years (e.g. GCSE examinations in England), or other qualifications were not significantly different to the reference group. Respondents living with children were significantly less likely to detect this hazard.

The only variable associated with identification of the crate hazard was age, with those over 55 years being significantly less likely to detect this hazard compared to 18- to 34-year-olds.

Identification of the Eat hazard was associated with time owning a dog and the type of work of the respondent. Compared to participants reporting that they had always owned a dog,

299 those who had never owned a dog, had owned a dog between 6-10 years or 11-15 years, all
300 had markedly lower odds of detecting this hazard. Compared to those reporting their
301 employment as home duties, participants with paid or unpaid employment were
302 considerably more likely to detect the Eat hazard, whereas there was no significant
303 difference detected for those that were retired or had no employment. Inclusion of the
304 variable describing whether or not respondents worked professionally with dogs (likely to
305 be a form of paid employment) was not significant in the multivariable model, and while its
306 inclusion did modify the odds ratios for type of work somewhat, it did not alter
307 interpretation of the model and greatly increased the range of the confidence intervals, so
308 was not included here.

309 Identification of the Door and Fed hazards were only associated with the respondents' role
310 with dogs. The odds of identification of Door was three times greater for those with a
311 professional role with dogs, compared to others without such a role, whereas those with a
312 professional role had twice the odds of detecting Fed, compared to others.

313 *Qualitative responses*

314 Thirty-seven (13%) of respondents provided comments after the video. Eleven participants
315 discussed other potential hazards in the video. These included the potential for dogs to
316 react to the excitement shown by the children when opening the delivered package, the
317 lack of adult supervision of the children during some scenes (note that although the video
318 was filmed to give this impression, at least 2 adults were in the room with the children at all
319 times) and two dogs being fed side-by-side. Others noted hazards that might arise in similar
320 situations, such as those due to noisy play by children or that his/her dog was afraid of
321 stuffed toys, and that this could provoke a response.

Six participants commented that some or all of the situations presented in the video were normal interactions and did not present a hazard. For example:

> "I think all these situations are perfectly normal for any family with a dog that is trained properly."
>
> "I felt that these are family dogs so I'm sure that the dogs see the kids as part of their pack, so no real risk."
>
> "The dog is a familiar so petting on the sofa will be a normal learned behavior. Branding this as dangerous in a family situation would be far fetched."

However, four respondents noted that everyday interactions can pose hazards:

> "…even well-behaved, well-trained, well-cared for family pets have limits."

Six respondents suggested the educational potential of the video, either for themselves of others:

> "Some eye opening omissions on my behalf and great feedback offered. I will be taking these notes on board with my own dog."
>
> "Really useful tool for teaching people as these activities are all seemingly mundane but present concerns."

Discussion

This is, to the best of our knowledge, the first study to investigate the use of a hazard perception video to detect respondents' ability to detect potential bite hazards associated with interaction with dogs in the home. We contend that the results suggest that this approach may be usefully employed to assess detection of hazards. In addition, comments from several participants hints that this method may be a potential means of educating people about dog related hazards in the home, although this suggestion needs further

investigation. The study provides novel information regarding people's ability to understand dog behaviour and warning signs for bites. It also provides some victim-level predictors of hazard detection associated with detection of potential bite hazards, including: people who do not work with dogs being less likely to recognise the risk of opening a door to a delivery and letting dogs out, respondents with children less likely to recognise children cuddling dogs as potentially hazardous, and older respondents being less likely to identify a number of hazardous situations.

The self-selected population that completed the hazard perception test demonstrated considerable ability to detect the hazards presented in the video, with over half identifying 5 or 6 out of 6 hazards and three-quarters identifying at least half (3/6) of the hazards. Nevertheless, these proportions were less than that found by Dixon et al. (2012) in a study that used a set of 14 questions posed as short descriptions of scenarios with dogs (n = 7) or still photographs of dogs (n = 7), where the mean score for adults (all parents) was 13/14 and 92% scored at least 11/14 (78.5%). This may suggest that the use of the hazard video was more challenging for respondents, potentially because they had to respond in real-time to the hazards thereby limiting opportunity for reflection and contemplation. Further, respondents in Dixon et al. (2012) only had to indicate whether or not they would respond in a particular way to the dog in the scenario or still image, and hence may have been more likely to obtain a correct answer through guessing.

It is worth highlighting that some respondents commented that some, or all, of the presented hazards were normal interactions; hence, this supports our assumption that the hazard situations were observable and that not clicking indicated that respondents did not deem a situation to be hazardous, rather than no click being due to them not being

368 observed. The hazards that were least often detected, Sofa and Fed, may suggest that these
369 are more likely to be perceived as safe interactions by the respondents in this study.
370 However, these two hazards were also the first and last shown in the video, respectively,
371 and it is possible that some respondents' concentration was lower at this time. Hence, we
372 cannot assess whether these differences were due to the nature of the potential hazard or
373 to their placement in the video.

374 A range of factors were associated with detection of hazards, and these varied between the
375 hazards. Age was associated with detection of three hazards (Sofa, Cuddle and Crate) and in
376 each case respondents 55 years or older were least likely to detect the hazard. This finding
377 is consistent with reports that children under 5 years are often bitten by their grandparent's
378 dog (Mannion et al., 2015), but is in contrast to previous research finding that children
379 under the care of grandparents are less likely to suffer unintentional injury in general (Bishai
380 et al., 2008). Hence, this finding may suggest that despite older people generally being more
381 risk averse regarding children, this may not apply to risks due to dogs in the home, perhaps,
382 at least in part, because older people are less likely to identify signs of stress in dogs and
383 hence may be less likely to intervene sufficiently early to prevent injury (Mariti et al., 2012).

384 Another finding of this study that raises concern for injury prevention to children is that
385 living with children was associated with reduced detection of the Cuddle hazard, even after
386 controlling for respondent's age. Previous research has identified that just over half of
387 people (54%, n = 402, 82.4% mothers; 7.1% grandmothers; 5.3% fathers; 1.5% grandfathers;
388 and 3.7% other) agreed that "As long as the child is nice to the dog, he/she is allowed to
389 play or cuddle up with dog as much as he/she wants" (Arhant et al., 2016). This behaviour
390 has been advocated in books for children (Slater & Howard, 2010) and is frequently

391 portrayed and discussed positively in social media (For example, see the hashtag
392 #kidswithdogs on Instagram, Facebook and Twitter). Recognition that this behaviour may be
393 threatening to dogs (Coren, 2016) and therefore may be a risk for bites to children (Reisner
394 et al., 2011) may be a useful target for bite prevention interventions.

395 Experience with dogs was also found to influence detection of four of the six hazards used in
396 this study. In this study, experience was assessed in two ways; ownership experience and
397 working with dogs. Participants who reported that they had 'always owned a dog' had
398 greater odds of detecting the Sofa and Eat hazards compared to those that had 'never
399 owned a dog'. Working with dogs was associated with enhanced detection of Sofa, Door
400 and Fed. In contrast, these measures of experience were not associated with identification
401 of two hazards; Cuddle and Crate. These results suggest that the effect of experience may
402 be more nuanced than the total lack of effect identified in a previous study (Dixon et al.,
403 2012). Previously, dog owners have shown enhanced capacity to detect extreme canine
404 warning signs, but were also found to be poor observers when it came to detecting more
405 subtle signs of stress signalling (Mariti et al., 2012). This may fit with their similar ability to
406 detect Cuddle and Crate where perhaps the video more clearly suggests risk of stress for the
407 dog than during other hazards. Alternatively, perhaps some risk reduction behaviours are
408 more well-known and accepted as social norms, such as not eating around a dog, compared
409 to others such as not approaching a resting dog or shutting a dog away before opening the
410 front door.

411 Several studies have reported that males are bitten more frequently than females (Georges
412 & Adesiyun, 2008; Shuler et al., 2008; Westgarth et al., 2018). However, there was no
413 significant difference shown between males and females in their ability to detect hazards

within this study. There are at least four possible explanation for this finding. First, the underrepresentation of males within the sample may have reduced statistical power and hence our ability to detect an effect. Further, reduced recognition of risks by males may have been a cause of their low participation (due to low interest in the subject matter), with males more adept at being aware of bite risks being more likely to participate. Alternatively, males and females may not differ with regard their ability to detect bite risks and the often observed higher bite frequency for males (Georges & Adesiyun, 2008; Holzer et al., 2019; Rajshekar et al., 2017; Súilleabháin, 2015; Westgarth et al., 2018) may be due to their assessment of, and response to, observed risks, rather than a failure to identify these risks (Flynn et al., 1994). Finally, there may truly be no difference in bite hazard detection, and indeed bite frequency of bites, between males and females, as occasionally suggested (Abraham & Czerwinski, 2019).

The role of education as an intervention for dog bite prevention remains unclear. Previous studies have not identified level of education as being associated with ability to identify behavioural indicators of stress in dogs (Mariti et al., 2012) or with risk of dog bites (Gilchrist et al., 2008; Shuler et al., 2008; C Westgarth et al., 2018). In contrast, in this study, education level was associated with detection of only one hazard (Cuddle), with participants who have completed Higher Education being most likely to detect this hazard. Parental education level is associated with lower rates of childhood injury (Bishai et al., 2008). Lower educational attainment may be associated with higher deprivation, which is associated with higher risk of bites (Health and Social Care Information Centre (HSCIC), 2014).

While this study has demonstrated that a hazard perception video approach can be successfully used to the study of dog bite hazard detection, this approach does not evaluate

437 the whole causal pathway for bites. In common with many studies assessing detection of
438 dog bite risks (Demirbas et al., 2016; Dixon et al., 2012; Meints & De Keuster, 2009;
439 Schwebel et al., 2012; Spiegel, 2000; Wilson et al., 2003), this study did not assess the
440 degree to which the ability to detect hazards using this approach measures this ability in
441 real life, or the extent to which it is associated with altered bite risk. Indeed, having been
442 'ever bitten' or 'bitten in last 12 months' was not associated with any hazard detection in
443 this study; however, whilst the hazard test used here measures current hazard detection,
444 the two survey variables measure past bite risk and previous bites may cause increased
445 sensitivity to bite hazards (Westgarth & Watkins, 2015). Furthermore, whether or not a bite
446 occurs will be a function of, at least, the opportunity to be bitten (e.g. exposure to dogs) and
447 the ability to prevent a bite should exposure to dogs occur.

448 The self-selecting sample used in this study was not representative of the general UK
449 population, with females, people with dogs and people with higher education being over-
450 represented. Respondents to surveys about dog ownership are often predominantly female
451 (e.g. Howell et al., 2016; King et al., 2009; Powell et al., 2018). This may reflect a propensity
452 for females to complete surveys (Dunn et al., 2004; Groves et al., 1992; Kalmijn & Liefbroer,
453 2011), different relationships with dogs for females compared to males (Herzog, 2007),
454 greater burden of care responsibility undertaken by females for dogs (Fifield & Forsyth,
455 1999), or other factors. Given the relative underrepresentation of males in the current
456 study, the effect of participant sex shown here should be interpreted with caution and
457 future studies should aim to address this imbalance. As is commonly reported (Kalmijn &
458 Liefbroer, 2011), participants with higher educational attainment were more likely to
459 complete this survey, with around two-thirds of respondents having completed higher

460 education, compared to an estimated 42% of 21-to 64-year-olds in the UK population (ONS,
461 2017). The survey respondents were also over-representative of dog owners and those who
462 work with dogs. Although dogs are believed to be present in about a quarter of UK
463 households (PFMA, 2018) over 90% of respondents reported currently owning at least 1
464 dog. Similarly, over a quarter of respondents indicated they had a professional role with
465 dogs. Although the proportion of people in the UK who work with dogs is not known, this
466 result is likely to be considerably greater than in the general population. All these responder
467 biases may also be influenced by the use of social media to disseminate the survey – the
468 posts may have been be re-shared more among these groups resulting in their greater
469 exposure to the call to participate. Whatever the causes of this bias, we highlight that the
470 results presented here pertain to a relatively limited population and care should be
471 exercised when extrapolating the current findings beyond this group.

472 This study also highlights several developments that could enhance the value of hazard
473 identification videos for future research. We recommend that future studies could randomly
474 assign respondents to one of two or more videos, with the order of the hazards varied
475 between these to explore the effect of timing within the video. Inclusion of variation in the
476 hazards presented could help reveal the extent to which respondents are clicking on general
477 versus specific representations of the hazard, as demonstrated by Millman et al. (2015)
478 using a similar approach to investigate identification of food hygiene hazards. For example,
479 inclusion of risk mitigation measures (as we recommended within the feedback to
480 respondents), such as the child calling the dog on the sofa to them rather than approaching
481 it or shutting the dog away behind another door or a baby-gate when opening the front
482 door. We also suggest exploration of the effect of the use of more 'hazard-free' footage that

include low-risk interactions with or around dogs in order to identify were people are identifying most or all interaction with dogs as risk, rather than the specific hazards being tested. Future development could also use a wider range of hazard scenarios, such as alternative indoor hazards as well as outdoor hazards. In addition, inclusion of auditory hazards, such as growls, could be investigated. Finally, whether the use of the video as an intervention actually changes knowledge or behaviour needs specific evaluation.

Conclusions

Hazard perception testing could be a useful tool for assessment of knowledge regarding dog bite risk situations, and potentially an educational tool for increasing knowledge and hopefully changing practices around dogs. Approaching dogs when sleeping on the sofa, eating around dogs, feeding dogs close to children, and letting dogs out when doors open for deliveries, may be high risk situations worth targeting, in particular with people with less dog-related experience. Further, people with children may perceive children cuddling and restraining dogs as low risk and not requiring intervention. Finally, older people may be poorer at identifying a number of potential dog bite hazard situations and thus are a potential target for interventions.

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Conflicts of interest

CM developed and manages the online software used in this study (http://www.clicklearner.co.uk/). Other authors declare no conflicts of interest.

References

Abraham, J. T., & Czerwinski, M. (2019). Pediatric Dog Bite Injuries in Central Texas. *Journal of Pediatric Surgery*, *54*(7), 1416–1420. https://doi.org/10.1016/j.jpedsurg.2018.09.022

Aldridge, G. L., & Rose, S. E. (2019). Young Children's Interpretation of Dogs' Emotions and Their Intentions to Approach Happy, Angry, and Frightened Dogs. *Anthrozoös*, *32*(3), 361–374. https://doi.org/10.1080/08927936.2019.1598656

Amici, F., Waterman, J., Kellermann, C. M., Karimullah, K., & Bräuer, J. (2019). The ability to recognize dog emotions depends on the cultural milieu in which we grow up. *Scientific Reports*, *9*(1), 16414. https://doi.org/10.1038/s41598-019-52938-4

Arhant, C., Beetz, A. M., & Troxler, J. (2017). Caregiver Reports of Interactions between Children up to 6 Years and Their Family Dog—Implications for Dog Bite Prevention. *Frontiers in Veterinary Science*, *4*. https://doi.org/10.3389/fvets.2017.00130

Arhant, C., Landenberger, R., Beetz, A., & Troxler, J. (2016). Attitudes of caregivers to supervision of child–family dog interactions in children up to 6 years—An exploratory study. *Journal of Veterinary Behavior: Clinical Applications and Research*, *14*, 10–16. https://doi.org/10.1016/j.jveb.2016.06.007

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

Bishai, D., Trevitt, J. L., Zhang, Y., McKenzie, L. B., Leventhal, T., Gielen, A. C., & Guyer, B. (2008). Risk factors for unintentional injuries in children: Are grandparents protective? *Pediatrics*, *122*(5). https://doi.org/10.1542/peds.2007-2995

Cameron, O., Al-Himdani, S., & Oliver, D. W. (2017). Not a plastic surgeon's best friend: Dog bites an increasing burden on UK plastic surgery services. *Journal of Plastic,*

Reconstructive and Aesthetic Surgery, *70*(4), 556–557. https://doi.org/10.1016/j.bjps.2016.12.007

Chapman, S., Cornwall, J., Righetti, J., & Sung, L. (2000). Preventing dog bites in children: Randomised controlled trial of an educational intervention. *British Medical Journal*, *320*(7248), 1512–1513. https://doi.org/10.1136/bmj.320.7248.1512

Christley, R. M., & Diggle, P. J. (2018). Statistical modelling. In M. V. Thrusfield & R. M. Christley (Eds.), *Veterinary Epidemiolopy* (pp. 492–519). John Wiley & Sons.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Editio). Lawrence Erlbaum Associates.

Coren, S. (2016). *The Data Says "Don't Hug the Dog!"* Psychology Today. https://www.psychologytoday.com/us/blog/canine-corner/201604/the-data-says-dont-hug-the-dog

De Keuster, T., Lamoureux, J., & Kahn, A. (2006). Epidemiology of dog bites: A Belgian experience of canine behaviour and public health concerns. *Veterinary Journal*, *172*(3), 482–487. https://doi.org/10.1016/j.tvjl.2005.04.024

Demirbas, Y. S., Ozturk, H., Emre, B., Kockaya, M., Ozvardar, T., & Scott, A. (2016). Adults' Ability to Interpret Canine Body Language during a Dog–Child Interaction. *Anthrozoos*, *29*(4), 581–596. https://doi.org/10.1080/08927936.2016.1228750

Dhillon, J., Hoopes, J., & Epp, T. (2018). Scoping decades of dog evidence: a scoping review of dog bite-related sequelae. *Canadian Journal of Public Health*, 364–375. https://doi.org/10.17269/s41997-018-0145-3

Dixon, C. A., Mahabee-Gittens, E. M., Hart, K. W., & Lindsell, C. J. (2012). Dog bite prevention: An assessment of child knowledge. *Journal of Pediatrics*, *160*(2), 337-341.e2. https://doi.org/10.1016/j.jpeds.2011.07.016

560 Dixon, C. A., Pomerantz, W. J., Hart, K. W., Lindsell, C. J., & Mahabee-Gittens, E. M. (2013).
561 An evaluation of a dog bite prevention intervention in the pediatric emergency
562 department. *Journal of Trauma and Acute Care Surgery*, *75*(4 SUPPL. 3), 308–312.
563 https://doi.org/10.1097/TA.0b013e31829be2bc
564 Dunn, K. M., Jordan, K., Lacey, R. J., Shapley, M., & Jinks, C. (2004). Patterns of consent in
565 epidemiologic research: Evidence from over 25,000 responders. *American Journal of*
566 *Epidemiology*, *159*(11), 1087–1094. https://doi.org/10.1093/aje/kwh141
567 Duperrex, O., Blackhall, K., Burri, M., & Jeannot, E. (2010). Education of children and
568 adolescents for the prevention of dog bite injuries (Review). *Cochrane Database of*
569 *Systematic Reviews*, *2*. https://doi.org/10.1002/14651858.CD004726.pub2
570 Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human*
571 *Factors*, *37*(1), 32–64. https://doi.org/10.1518/001872095779049543
572 Endsley, Mica R., & Rodgers, M. D. (1994). Situation Awareness Information Requirements
573 Analysis for En Route Air Traffic Control. *Proceedings of the Human Factors and*
574 *Ergonomics Society 38th Annual Meeting*, 71–75.
575 Fein, J., Bogumil, D., Upperman, J. S., & Burke, R. V. (2019). Pediatric dog bites: a
576 population-based profile. *Injury Prevention*, *25*(4), 290–294.
577 https://doi.org/10.1136/injuryprev-2017-042621
578 Fifield, S. J., & Forsyth, D. K. (1999). A pet for the children: Factors related to family pet
579 ownership. *Anthrozoos*, *12*(1), 24–32. https://doi.org/10.2752/089279399787000426
580 Flynn, J., Slovic, P., & Mertz, C. K. (1994). Gender, Race, and Perception of Environmental
581 Health Risks. *Risk Analysis*, *14*(6), 1101–1108. https://doi.org/10.1111/j.1539-
582 6924.1994.tb00082.x
583 Georges, K., & Adesiyun, A. (2008). An investigation into the prevalence of dog bites to

584 primary school children in Trinidad. *BMC Public Health*, *8*, 85.
585 https://doi.org/10.1186/1471-2458-8-85
586 Gilchrist, J., Sacks, J. J., White, D., & Kresnow, M. J. (2008). Dog bites: Still a problem? *Injury*
587 *Prevention*, *14*(5), 296–301. https://doi.org/10.1136/ip.2007.016220
588 Golinko, M. S., Arslanian, B., & Williams, J. K. (2017). Characteristics of 1616 Consecutive
589 Dog Bite Injuries at a Single Institution. *Clinical Pediatrics*, *56*(4), 316–325.
590 https://doi.org/10.1177/0009922816657153
591 Gordon, R. A., Kaestner, R., & Korenman, S. (2007). The effect of maternal employment on
592 child injuries and infectious disease. *Demography*, *44*(2), 307–333.
593 Groves, R. M., Cialdini, R. B., & Couper, M. P. (1992). Understanding The Decision to
594 Participate in a Survey. *Public Opinion Quarterly*, *56*(4), 475.
595 https://doi.org/10.1086/269338
596 Health and Social Care Information Centre (HSCIC). (2014). *Dog bites: hospital admissions in*
597 *most deprived areas three times as high as least deprived*.
598 http://content.digital.nhs.uk/article/4722/Dog-bites-hospital-admissions-in-most-
599 deprived-areas-three-times-as-high-as-least-deprived
600 Herzog, H. A. (2007). Gender differences in human-animal interactions: A review.
601 *Anthrozoos*, *20*(1), 7–21. https://doi.org/10.2752/089279307780216687
602 Holzer, K. J., Vaughn, M. G., & Murugan, V. (2019). Dog bite injuries in the USA: Prevalence,
603 correlates and recent trends. *Injury Prevention*, *25*(3), 187–190.
604 https://doi.org/10.1136/injuryprev-2018-042890
605 Horswill, M. S., & McKenna, F. P. (2004). Drivers' hazard perception ability: Situation
606 awareness on the road. In S. Banbury & S. Tremblay (Eds.), *Cognitive Approach to*
607 *Situation Awareness* (pp. 155–175). Aldershot.

608 Howell, T. J., Mornement, K., & Bennett, P. C. (2016). Pet dog management practices among
609 a representative sample of owners in Victoria, Australia. *Journal of Veterinary Behavior:*
610 *Clinical Applications and Research*, *12*, 4–12.
611 https://doi.org/10.1016/j.jveb.2015.12.005
612 James, N., & Patrick, J. (2004). The role of situation awareness in sport. In S. Banbury & S.
613 Tremblay (Eds.), *A Cognitive Approach to Situation Awareness: Theory and Application*
614 (pp. 297–316). Ashgate.
615 Kalmijn, M., & Liefbroer, A. C. (2011). Nonresponse of secondary respondents in multi-actor
616 surveys: Determinants, consequences, and possible remedies. *Journal of Family Issues*,
617 *32*(6), 735–766. https://doi.org/10.1177/0192513X10390184
618 King, T., Marston, L. C., & Bennett, P. C. (2009). Describing the ideal Australian companion
619 dog. *Applied Animal Behaviour Science*, *120*(1–2), 84–93.
620 https://doi.org/10.1016/j.applanim.2009.04.011
621 Laffoy, M. (1997). Childhood accidents at home. *Irish Medical Journal*, *90*(1), 26–27.
622 Maksymowicz, K., Janeczek, A., Szotek, S., Łukomski, R., & Dawidowicz, J. (2016). Dog bites
623 in humans in a large urban agglomeration in the southwest of Poland, an analysis of
624 forensic medical records. *Journal of Veterinary Behavior: Clinical Applications and*
625 *Research*, *12*, 20–26. https://doi.org/10.1016/j.jveb.2015.12.007
626 Mannion, C. J., Graham, A., Shepherd, K., & Greenberg, D. (2015). Dog bites and
627 maxillofacial surgery: What can we do? *British Journal of Oral and Maxillofacial*
628 *Surgery*, *53*(6), 522–525. https://doi.org/10.1016/j.bjoms.2015.02.022
629 Mariti, C., Gazzano, A., Moore, J. L., Baragli, P., Chelli, L., & Sighieri, C. (2012). Perception of
630 dogs' stress by their owners. *Journal of Veterinary Behavior: Clinical Applications and*
631 *Research*, *7*(4), 213–219. https://doi.org/10.1016/j.jveb.2011.09.004

632 Mckenna, F. P., & Crick, J. L. (1994). *Hazard perception in drivers: a methodology for testing*
633 *and training*. https://trl.co.uk/sites/default/files/CR313.pdf
634 Meints, K., Brelsford, V., & De Keuster, T. (2018). Teaching children and parents to
635 understand dog signaling. *Frontiers in Veterinary Science*, *5*(NOV), 1–14.
636 https://doi.org/10.3389/fvets.2018.00257
637 Meints, K., & De Keuster, T. (2009). Brief report: Don't kiss a sleeping dog: The first
638 assessment of "the blue dog" bite prevention program. *Journal of Pediatric Psychology*,
639 *34*(10), 1084–1090. https://doi.org/10.1093/jpepsy/jsp053
640 Millman, C., Christley, R., Rigby, D., Dennis, D., O'Brien, S. J., & Williams, N. (2017). "Catch
641 22": Biosecurity awareness, interpretation and practice amongst poultry catchers.
642 *Preventive Veterinary Medicine*, *141*. https://doi.org/10.1016/j.prevetmed.2017.04.002
643 Millman, C., Rigby, D., Jones, D., & Edwards-Jones, G. (2015). A real-time test of food hazard
644 awareness. *British Food Journal*, *117*(8), 2112–2128. https://doi.org/10.1108/BFJ-09-
645 2014-0317
646 Morrongiello, B. A., Schwebel, D. C., Stewart, J., Bell, M., Davis, A. L., & Corbett, M. R.
647 (2013). Examining parents' behaviors and supervision of their children in the presence
648 of an unfamiliar dog: Does the Blue Dog intervention improve parent practices?
649 *Accident Analysis and Prevention*, *54*. https://doi.org/10.1016/j.aap.2013.02.005
650 Morzycki, A., Simpson, A., & Williams, J. (2019). Dog bites in the emergency department: A
651 descriptive analysis. *Canadian Journal of Emergency Medicine*, *21*(1), 63–70.
652 https://doi.org/10.1017/cem.2018.2
653 ONS. (2017). *Graduates in the UK labour market: 2017*.
654 https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentan
655 demployeetypes/articles/graduatesintheuklabourmarket/2017#steady-increase-in-the-

number-of-graduates-in-the-uk-over-the-past-decade

Overall, K. L., & Love, M. (2001). Dog bites to humans--demography, epidemiology, injury, and risk. *Journal of the American Veterinary Medical Association*, *218*(12), 1923–1934. https://doi.org/10.2460/javma.2001.218.1923

Peters, V., Sottiaux, M., Appelboom, J., & Kahn, A. (2004). Posttraumatic stress disorder after dog bites in children ´. *European Journal of Pediatrics*, *144*, 121–122.

PFMA. (2018). *Pet data report: State of the Nation*. https://www.pfma.org.uk/_assets/docs/annual-reports/PFMA-Pet-Data-Report-2018.pdf

Powell, L., Chia, D., McGreevy, P., Podberscek, A. L., Edwards, K. M., Neilly, B., Guastella, A. J., Lee, V., & Stamatakis, E. (2018). Expectations for dog ownership: Perceived physical, mental and psychosocial health consequences among prospective adopters. *PLoS ONE*, *13*(7), 1–13. https://doi.org/10.1371/journal.pone.0200276

R Core Team. (2019). *R: A language and environment for statistical computing* (version 3.6.0). R Foundation for Statistical Computing. https://www.r-project.org/

Rajshekar, M., Blizzard, L., Julian, R., Williams, A. M., Tennant, M., Forrest, A., Walsh, L. J., & Wilson, G. (2017). The incidence of public sector hospitalisations due to dog bites in Australia 2001–2013. *Australian and New Zealand Journal of Public Health*, *41*(4), 377–380. https://doi.org/10.1111/1753-6405.12630

Reisner, I. R., Nance, M. L., Zeller, J. S., Houseknecht, E. M., Kassam-Adams, N., & Wiebe, D. J. (2011). Behavioural characteristics associated with dog bites to children presenting to an urban trauma centre. *Injury Prevention*, *17*(5), 348–353. https://doi.org/10.1136/ip.2010.029868

Schwebel, D. C., Morrongiello, B. A., Davis, A. L., Stewart, J., & Bell, M. (2012). The blue dog:

Evaluation of an interactive software program to teach young children how to interact safely with dogs. *Journal of Pediatric Psychology*, *37*(3), 272–281. https://doi.org/10.1093/jpepsy/jsr102

Shen, J., Rouse, J., Godbole, M., Wells, H. L., Boppana, S., & Schwebel, D. C. (2017). Systematic Review: Interventions to Educate Children about Dog Safety and Prevent Pediatric Dog-Bite Injuries: A Meta-Analytic Review. *Journal of Pediatric Psychology*, *42*(7), 779–791. https://doi.org/10.1093/jpepsy/jsv164

Shuler, C. M., DeBess, E. E., Lapidus, J. a, & Hedberg, K. (2008). Canine and human factors related to dog bite injuries. *Journal of the American Veterinary Medical Association*, *232*(4), 542–546. https://doi.org/10.2460/javma.232.4.542

Slater, T., & Howard, A. (2010). *Smooch Your Pooch*. Cartwheel Books.

Spiegel, I. B. (2000). A pilot study to evaluate an elementary school-based dog bite prevention program. *Anthrozoos*, *13*(3), 164–173. https://doi.org/10.2752/089279300786999789

Súilleabháin, P. (2015). Human hospitalisations due to dog bites in Ireland (1998-2013): Implications for current breed specific legislation. *Veterinary Journal*, *204*(3). https://doi.org/10.1016/j.tvjl.2015.04.021

Westgarth, C, Brooke, M., & Christley, R. M. (2018). How many people have been bitten by dogs?: A cross-sectional survey of prevalence, incidence, and factors associated with dog bites in a UK community. *J Epidemiol Community Health*, *0*(1), 1–6. https://doi.org/10.1136/jech-2017-209330

Westgarth, C, & Watkins, F. (2017). Impact of dog aggression on victims. In *Dog bites; a multidisciplinary perspective* (pp. 309–321). 5m Publishing.

Westgarth, Carri, & Watkins, F. (2015). A qualitative investigation of the perceptions of

female dog-bite victims and implications for the prevention of dog bites. *Journal of Veterinary Behavior: Clinical Applications and Research*, *10*(6), 479–488. https://doi.org/10.1016/j.jveb.2015.07.035

Wilson, F., Dwyer, F., & Bennett, P. C. (2003). Prevention of dog bites: Evaluation of a brief educational intervention program for preschool children. *Journal of Community Psychology*, *31*(1), 75–86. https://doi.org/10.1002/jcop.10038

Winter, J. (2015). *Provisional monthly topic of interest: admissions caused by dogs and other mammals*. Health and Social Care Information Centre. http://www.hscic.gov.uk/catalogue/PUB17615/prov-mont-hes-admi-outp-ae-April 2014 to February 2015-toi-rep.pdf

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Table 1. Demographic and other information for respondents in this study, including for all that completed the questionnaire (n = 532), those that completed the questionnaire but not the hazard test (n = 264) and those that completed the questionnaire and the hazard test (n = 268).

		Completed questionnaire (+/- Hazard test) n = 532		Completed questionnaire only n = 264		Completed questionnaire and hazard test n = 268		p-value*
		n	%	n	%	n	%	
Gender	Female	469	88.2	239	90.5	230	85.8	0.1†
	Male	63	11.8	25	9.5	38	14.2	
	Missing	0	0.0	0	0.0	0	0.0	
Age group	18 - 34 years	194	36.5	105	39.8	89	33.2	0.3†
	35 - 54 years	253	47.6	119	45.1	134	50.0	
	55+ years	85	16.0	40	15.2	45	16.8	
	Missing	0	0.0	0	0.0	0	0.0	
Highest educational attainment	Completed secondary school	72	13.5	36	13.6	36	13.4	0.6†
	Completed school at around 16 years of age	97	18.2	49	18.6	48	17.9	
	Higher education	343	64.5	168	63.6	175	65.3	
	Other	15	2.8	10	3.8	5	1.9	
	Missing	5	0.9	1	0.4	4	1.5	
Type of work	Home duties	35	6.6	14	5.3	21	7.8	0.3†
	Paid employment	397	74.6	203	76.9	194	72.4	
	Unpaid employment	25	4.7	10	3.8	15	5.6	
	Retired	39	7.3	16	6.1	23	8.6	
	No employment	35	6.6	21	8.0	14	5.2	
	Missing	1	0.2	0	0.0	1	0.4	
Gross Household Income	< £10,000	43	8.1	22	8.3	21	7.8	0.7†
	£10,001 - 20,000	74	13.9	39	14.8	35	13.1	
	£20,001 - 40,000	158	29.7	71	26.9	87	32.5	
	£40,001 - 60,000	111	20.9	56	21.2	55	20.5	
	£60,001 - 80,000	66	12.4	31	11.7	35	13.1	
	> £80,000	43	8.1	25	9.5	18	6.7	
	Missing	37	7.0	20	7.6	17	6.3	
Country of residence	England	484	91.0	242	91.7	242	90.3	0.5†
	Scotland	24	4.5	9	3.4	15	5.6	
	Wales	23	4.3	12	4.5	11	4.1	
	Northern Ireland	0	0.0	0	0.0	0	0.0	
	Missing	1	0.2	1	0.4	0	0.0	
Live with Kids	No	355	66.7	170	64.4	185	69.0	0.3†
	Yes	177	33.3	94	35.6	83	31.0	
	Missing	0	0.0	0	0.0	0	0.0	
Role with dogs	Not professional	408	76.7	213	80.7	195	72.8	0.047†
	Professional	123	23.1	51	19.3	72	26.9	
	Missing	1	0.2	0	0.0	1	0.4	
Time owned a dog	Never owned a dog	40	7.5	18	6.8	22	8.2	0.3†
	Only as a child	20	3.8	9	3.4	11	4.1	
	0 to 5 years	47	8.8	26	9.8	21	7.8	
	6 to 10 years	67	12.6	30	11.4	37	13.8	
	11 to 15 years	39	7.3	26	9.8	13	4.9	
	always owned a dog	316	59.4	153	58.0	163	60.8	
	Missing	3	0.6	2	0.8	1	0.4	
Number of dogs currently owned	0	40	7.5	18	6.8	22	8.2	0.99§
	1-2	280	52.6	140	53.0	140	52.2	
	3-4	177	33.3	88	33.3	89	33.2	
	5+	33	6.2	16	6.1	17	6.3	
	Missing	2	0.4	2	0.8	0	0.0	
Have attended dog training	Yes	351	66.0	171	64.8	180	67.2	0.2†
	No	181	34.0	93	35.2	88	32.8	
	Missing	0	0.0	0	0.0	0	0.0	
Ever bitten by a dog	Yes	261	49.1	121	45.8	140	52.2	0.1†
	No	271	50.9	143	54.2	128	47.8	
	Missing	0	0.0	0	0.0	0	0.0	

Bitten by a dog in last 12 months	Yes	34	6.4	12	4.5	22	8.2	0.2†
	No	220	41.4	106	40.2	114	42.5	
	Missing	7	1.3	3	1.1	4	1.5	

* Chi-squared test p-value compares, for each variable, respondents who completed the questionnaire but not the hazard test and those that completed both the questionnaire and the hazard test

† 'Missing' category ignored in calculation of chi square test

§ 'Never owned a dog' and 'Missing' category ignored in calculation of chi square test

Table 2: Summary of dog bite hazards presented in the video, including a still image from within the time range for each

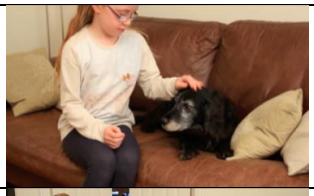
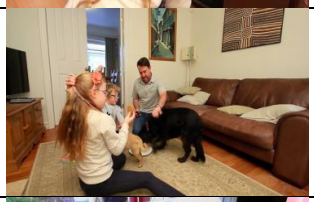
Description	Short name	Timing within video	Still from the video	Comments on safety and welfare
Child approaches dog resting on the sofa and pets it	Sofa	0.18-0.22		The filmed approach was part of a sequence of interactions with the dog which captured a moment when the dog's head was low enabling the suggestion of resting
Child restrains dog to cuddle it	Cuddle	0.48-0.54		The restraint in this scene was brief and mild, and the dog was able to leave the 'cuddle' if desired.
Child leans into dog crate/bed to pet dog	Crate	1.01-1.06		The crate contained a stuffed toy dog during scenes involving ''interaction' by a child; this was spliced into sequences showing a dog entering and leaving the crate
People eating on floor around dogs	Eat	1.13-1.33		Scene was filmed in multiple takes, with breaks for the dogs and children, and treats provided for the dogs.
Person opens the door to a delivery and dogs run out	Door	1.44-1.59		The delivery person was the owner of the dogs and the dogs were aware that she was on the other side of the dog before it was opened.
Dogs are fed near to where children are playing	Fed	2.22-2.35		Filmed in multiple takes. Where possible only dogs or children were present during filming. In scenes with both children and dogs they were kept as separate as feasible

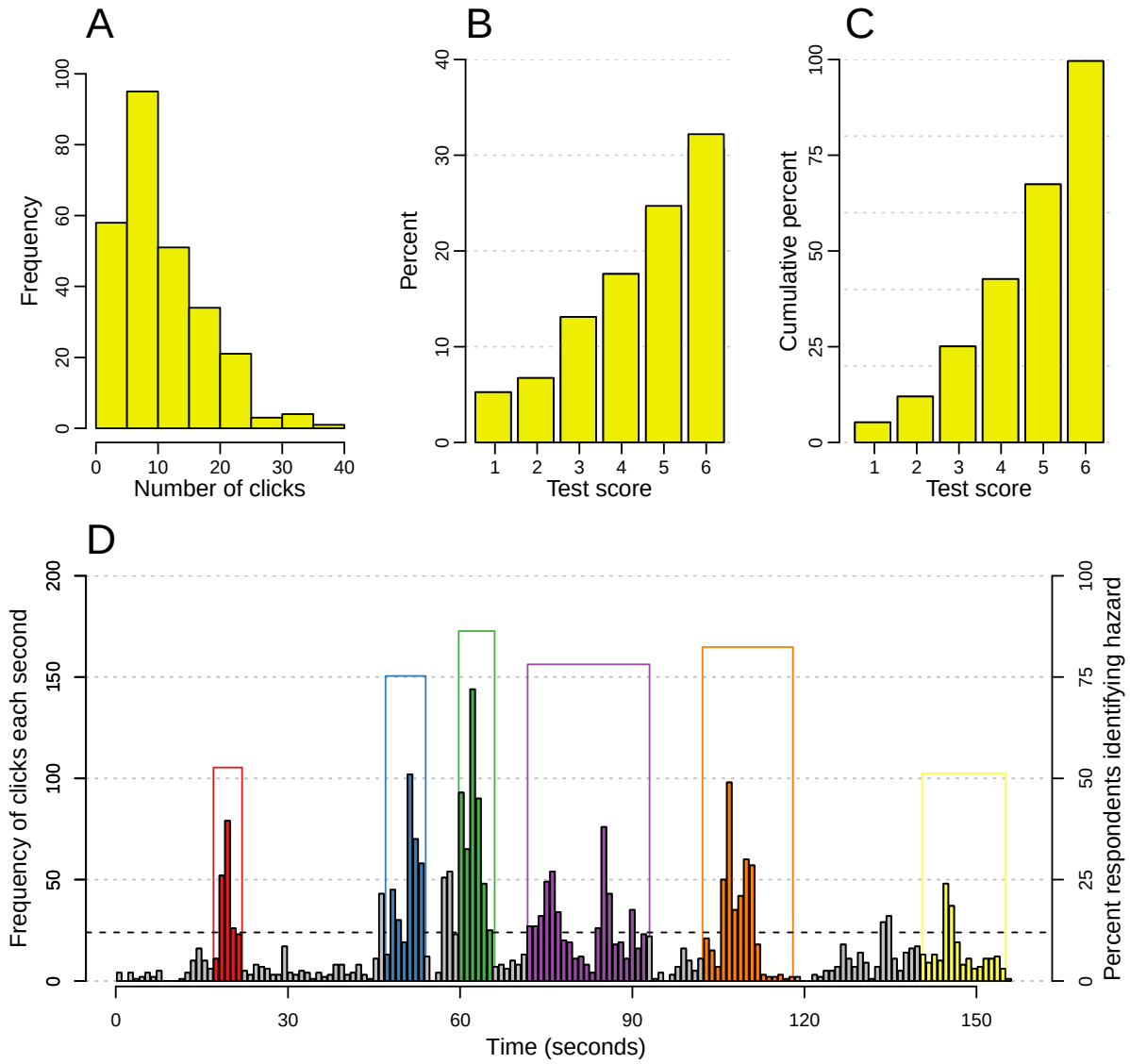
Table 3. Outcome of multivariable analyses assessing factors associated with each of the hazards among 268 respondents who completed the questionnaire and hazard test. Only significant variables are included in these final multivariable models.

Outcome Category levels	Levels	Odds ratio	Lower CI (2.5%)	Upper CI (97.5%)	P value
Sofa (Hosmer & Lemeshow Goodness of Fit χ^2 = 5.934, *df* = 8, *p* = 0.65)					
Age group	18 - 34 years	Ref			0.02
	35 - 54 years	0.9	0.5	1.7	0.7
	55+ years	0.3	0.1	0.8	0.01
Role with dogs	Not professional	Ref			0.02
	professional	2.2	1.1	4.3	0.02
Time owned a dog	Never owned a dog	Ref			0.008
	Only as a child	1.4	0.3	6.6	0.7
	0 to 5 years	2.6	0.7	9.5	0.2
	6 to 10 years	1.0	0.3	3.4	0.9
	11 to 15 years	4.1	0.8	19.8	0.08
	always owned a dog	3.8	1.3	10.8	0.01
Cuddle (Hosmer & Lemeshow Goodness of Fit χ^2 = 4.0631, *df* = 120 *p* = 0.85)					
Age group	18 - 34 years	Ref			0.02
	35 - 54 years	0.7	0.3	1.4	0.3
	55+ years	0.3	0.1	0.7	0.005
Live with Kids	No	Ref			0.02
	Yes	0.5	0.2	0.9	0.02
Highest educational attainment	Completed secondary school	Ref			0.001
	Completed school at around 16 years of age	0.9	0.3	2.4	0.8
	Higher education	3.0	1.3	7.0	0.01
	Other	0.5	0.1	3.4	0.5
Crate (Hosmer & Lemeshow Goodness of Fit χ^2 <0.0001 , *df* = 8, *p* ≈ 1)					
Age group	18 - 34 years	Ref			0.03
	35 - 54 years	0.8	0.3	2.1	0.6
	55+ years	0.3	0.1	0.7	0.01
Eat (Hosmer & Lemeshow Goodness of Fit χ^2 = 1.2814, *df* = 6, *p* = 0 97)					
Time owned a dog	Never owned a dog	Ref			0.02
	Only as a child	1.5	0.2	9.0	0.7
	0 to 5 years	1.9	0.4	8.4	0.4
	6 to 10 years	0.9	0.3	2.8	0.8
	11 to 15 years	0.7	0.2	3.2	0.4
	Always owned a dog	3.2	1.1	9.4	0.04
Type of work	Home duties	Ref			0.009
	Paid employment	4.4	1.6	12.3	0.004
	Unpaid employment	5.4	0.9	32.6	0.07
	Retired	1.5	0.4	5.4	0.6
	No employment	1.1	0.3	5.0	0.9
Door (Hosmer & Lemeshow Goodness of Fit χ^2 <0.0001 , *df* = 8, *p* ≈ 1)					
Role with dogs	Not professional	Ref			0.01
	professional	3.0	1.1	8.1	0.03
Fed (Hosmer & Lemeshow Goodness of Fit χ^2 <0.0001 , *df* = 8, *p* ≈ 1)					
Role with dogs	Not professional	Ref			0.01
	professional	2.2	1.3	4.0	0.01

Figures

Figure 1. Responses of 268 respondents during the dog hazard video: the distribution of the total number of clicks by each respondent (Figure 1A); the percent of respondents achieve each possible score (Figure 1B); and, the cumulative percent of respondents achieving each possible score (Figure 1C). In Figure 1D, the histogram (grey bars) indicates the number of respondents who clicked each second of the video (left axis) and the percent of respondents who clicked at least once within each hazard window (right axis); red bar – Sofa; blue bar – Cuddle; green bar – Crate; purple bar – Eat; orange bar – Door; yellow bar – Fed.

Figure 1.


A
Frequency
Number of clicks
B
Percent
Test score
C
Cumulative percent
Test score
D
Frequency of clicks each second
Percent respondents identifying hazard
Time (seconds)