RUNNING HEAD: CHILDREN’S UNDERSTANDING OF DOG’S EMOTIONS

**Young children’s interpretation of dog’s emotions and their intentions to approach happy, angry and frightened dogs**

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**Abstract**

The current study aimed to investigate the extent to which young children’s risk of being bitten by a dog might be explained by a lack of ability to accurately recognize dog’s emotions and a lack of knowledge about how to behave appropriately around dogs showing different emotions. One hundred and seventeen children aged 4 to 7 years were shown fifteen images and fifteen video clips of happy, angry and frightened dogs. After each image or clip a series of questions were asked to assess children’s accuracy and confidence in recognizing the dog’s emotional state and their inclination to approach the dog. Results indicated that children were least accurate when presented with frightened dogs with only just over half of 4- to 5- year olds accurately recognizing frightened dogs. Children were inclined to approach frightened and happy dogs, but not angry dogs, and this was true regardless of whether they had correctly identified the emotion or not. Therefore, the results suggest that although some children struggle to recognize when a dog is frightened, the more concerning issue is children’s lack of understanding of how to behave appropriately around dogs, especially regarding approaching frightened dogs. Therefore, learning how to behave appropriately around dogs should be key in any dog bite prevention programs aimed at young children.

Key Words: *children, emotion recognition, emotion understanding, dog, dog-bite prevention.*

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 Young children (0 to 9 years old) have been found to be at the highest risk of being bitten by a dog (Kahn, Bauche, & Lamoureux, 2003; Mullins & Harrahill, 2008). Furthermore, the number of hospital admissions due to dog bites has increased by 76% in the last decade with admissions continuing to increase (Health & Social Care Information Centre, 2015). The increasing instances of dog bites among children is an international phenomenon (Bjork et al., 2013; Gilchrist, Sacks, White & Kresnow, 2008; Ozanne-Smith, Ashby & Stathakis, 2001) and can be seen from data obtained during telephone interviews (de Keuster, Lamoureux & Kahn, 2006; Sacks, Kresnow & Houston, 1996) as well as hospital admissions (Kahn, et al, 2003; Kasbekar, et al., 2013; Schalamon et al. 2006). Dog bites not only lead to a range of often serious injuries among children (e.g. Venkatesh, Bhaskar & Vepakkomma, 2016) but also psychological consequences as over 50% of bitten children develop symptoms of post-traumatic stress disorder (PTSD) (Peters, Sottiauz, Appelboom, Kahn, 2004). To prevent dog bites among children a better understanding of why children are likely to get bitten is required.

Explanations for why young children are at the highest risk of being bitten by dogs tend to focus on two factors, children’s ability to interpret a dog’s emotional state and children behaving inappropriately around dogs. Relating to the first of these, eye tracking evidence suggests that children show atypical scan patterns for faces of aggressive dogs (Meints, Allen, & Watson, 2010) and Meints, Racca and Hickey (2010) found that children misinterpret still images of angry dog faces as "smiling and happy". Furthermore, Lakestani, Donaldson, & Waran, (2014) found, using video clips, that children were particularly poor at accurately recognizing dogs showing fear. They concluded this after showing 4- to 10-year-olds and adults video clips of friendly, aggressive and fearful dogs and finding that for all age groups the percentage of correct responses was lowest for fearful dogs and highest for aggressive dogs. Specifically, it was found that the youngest children struggled the most to correctly recognize videos of fearful dogs as only 20% of 4-year-olds and 30% of 6-year-olds responded correctly when presented with video clips showing fearful dogs. However, adults also seem to struggle to accurately identify fearful dogs. Indeed, Meints, Brelsford, Just and de Keuster (2014) presented adults and 3- to 5-year-old children with short video clips of distressed dogs and found errors were made by age groups in interpreting lower, medium and higher-level distress signals (as described by Shepherd, 2009). Nevertheless, both children’s and adults’ accuracy improved after training was given in interpreting dog signaling behavior, although the lower level distress signals were the hardest to recognize and to learn.

The second common explanation to why young children are more likely to get bitten by a dog is their tendency to behave inappropriately around dogs. Children tend to act in unpredictable ways around dogs (Millot, Filiatre, Gagnon, Eckerlin, & Montagner, 1988; Morrongiello, Marlenga, Berg, Linneman, & Pickett, 2007) and seem to have poor knowledge of how to behave appropriately around dogs. Dixon, Mahabee-Gittens, Hart, & Lindsell (2012) found that although 72% of children (age 5 to 15 years) reported previous or current dog ownership, 43% of them failed a knowledge test of safe behavior around dogs, with children stating they would approach dogs in unsafe situations, such as when the dog is eating or chained up. Worrying low scores on knowledge tests are an international phenomenon (Shen et al., 2013) and on average children score below 50% (Schwebel, Li, McClure, & Severson, 2016). Increasing appropriate behavior around dogs may significantly reduce dog bites as Reisner, et al. (2011) and Reisner, Shofer, & Nance (2007) report that the majority of dog bite injuries are the result of a child-initiated interaction.

 Dog bite prevention programs (e.g. BARK, Be a Tree, Blue Dog, Delta Dog Safe, Prevent a Bite) generally aim to improve children’s ability to accurately interpret dog signaling behavior and increase their knowledge of safe behavior around dogs. These programs have been evaluated (e.g. Chapman, Cornwall, Righetti & Sung, 2000; Meints & de Keuster 2009; Schwebel, Li, McClure & Severson, 2012; Spiegel, 2000; Wilson, Dwyer & Bennet, 2003) and some evidence of short-term positive benefits found. However, the outcome measures are varied (Duperrex, Blackhall, Burri, & Jeannot, 2009; Shen et al., 2017), with most focusing on children’s ability to identify risky situations, or performance on knowledge tests, rather than their ability to interpret dog signaling behavior and actual behavior around dogs.

To inform future development and evaluation of dog bite prevention programs research considering both explanations for children getting bitten, that is their ability to recognize dogs’ emotions and their behavior around dogs, is needed. Previous research on the topic does not consider whether one explanation has more importance than the other. Similarly, although some studies evaluating dog bite prevention programs have considered measures of both emotion recognition and safe behavior in their evaluations others have focused on just one of these aspects. Consequently, research which concurrently investigates children’s ability to interpret a dog’s emotional state and their behavior intentions around that dog is required, to inform the content of dog bite prevention programs as well as their evaluation.

**The current study**

The current research aims to concurrently investigate whether young children can recognize dogs’ emotions, their confidence in their recognition and their intention to approach dogs with varying emotional states. Children aged 4 to 5 and 6 to 7 years were shown images and video clips and asked a series of questions to assess how accurately they could identify the dog’s emotion, how confident they were in this decision and how likely they would be to approach the dog. Both images and videos were used to reflect the range of stimuli previously used (e.g. Lakestani, et al., 2014; Schwebel, et al., 2012). The dogs in the images and videos were showing behaviour consistent with the emotional states of happy, angry and frightened, again this is consistent with previous research in the area (e.g. Lakestani, et al., 2014; Lakestani, & Donaldson, 2015). The age groups of 4 to 5 and 6 to 7 years were selected as these children are vulnerable to being bitten by a dog as they are more likely to misinterpret the dogs emotional state of a dog (Lakestani, et al., 2014) and initiate more interactions with dogs compared to older children (Lakestani, & Donaldson, 2015).

Based on Lakestani, et al.’s (2014) findings, it was expected that children would be more accurate in their recognition of happy and angry compared to frightened dogs. Furthermore, it was expected that accuracy scores would be higher in the older, compared to the younger, age group, and that children would be more accurate in their recognition of all emotions in videos, compared to images, due to more information being available for them to interpret. It was unknown whether confidence levels would differ for correct and incorrect responses. However, it was thought that if a child was less confident then they would be more likely to indicate that the dog felt the emotion to a lesser extent, thereby receiving a lower confidence score. Consequently, it was anticipated that this measure would provide insight as to whether children were uncertain of the emotion that the dog was displaying or misinterpreting it as an alternative emotion. It was anticipated that children would indicate intentions to approach angry and frightened as well as happy dogs as previous research has shown poor understanding of how to behave safely around dogs (Dixon et al., 2012; Shen et al., 2013; Schwebel et al., 2016).

**Method**

**Participants**

Fifty-seven children aged 4 to 5 (mean age 4y, 6m, SD 6.05m) and 61 children aged 6 to 7 (mean age 6y 3m, SD 5.45m) participated. One child’s data was removed from the 6 to 7 group due to parents withdrawing consent, resulting in a total sample of 117. Gender distribution was relatively equal (4 to 5 years = 32 males, 6 to 7 years = 29 males). Among the 4-to 5-year-olds 42% reported current (n=24) or previous (n=3) dog ownership. This was slightly higher among the 6- to 7-year-olds with 66% reporting current (n=38) or previous (n=2) dog ownership. All children had English as their first language and attended First schools, which educate children between the ages of 4 to 9 years, in Staffordshire, UK. An approximately similar number of children were recruited from each school for each age group. Ethical approval was obtained from Staffordshire University, Faculty of Health Sciences Ethics Committee. Informed consent was given by the head teachers at the schools, the children (verbally) and their parents.

**Stimuli**

Thirty images and 22 video clips were obtained from google searches by the first author. Only those containing one dog, not containing any people, toys or food were selected. All dogs were in a natural environment, such as, a home setting, garden, park or street. No inclusion or exclusion criteria relating to the breed of dog were used, therefore the selected images showed a variety of breeds, including; German Shepard, Chihuahua, Spaniel and Rottweiler. The video clips were all between 6-11 seconds long and five included the sound of the dog growling or barking. No other sounds could be heard as this may have distracted or biased participants.

The 30 images and 22 clips were reviewed by two vet nurses (also dog owners for >10 years) who had extensive experience in caring for and treating a wide range of dogs and two experienced dog owners (owners for > 10 years). Like the procedure used by Pongrácz, Molnár, Dóka and Miklósi (2011) and Bloom and Friedman (2013) each of these individuals rated each image and video for the emotions happy/playful, defensive/aggressive and frightened/aggressive on a 5-point Likert-type scale (1 = no expression of the emotion, 5 = strong expression of the emotion). In order to help raters differentiate between defensive/aggressive and frightened/aggressive Shepherd’s (2009) ladder of aggression was referred to and it was explained that dogs showing behaviors at the low to mid-levels should be rated more highly for frightened/aggressive behavior and dogs showing behaviors more consistent with the highest levels should be rated more highly for defensive/aggressive behavior. This resulted in 15 images and 19 video clips for which all individuals agreed that one of these emotions was being expressed strongly (4 or 5) and the other two much less so (1 or 2). The 15 images[[1]](#endnote-1) included five of dogs rated high for each of the three emotions; happy/playful, defensive/aggressive and frightened/aggressive. From the 19 video clips, 15 were then chosen by the first author so that five clips for each of the three emotions were include with as many of these including sound as possible (3 angry and 2 happy). A table summarizing the characteristics of each clip can be seen in Appendix 1.

The final stimuli were reviewed by a professional dog behaviorist who confirmed that all stimuli of frightened/aggressive dogs contained signaling behavior characteristic of the low- to mid-levels of Shepherd’s (2009) aggression ladder (e.g. avoiding eye contact, lowered hind quarters, tail tucked between legs) whereas defensive/aggressive dogs showed signaling behavior consistent with the higher levels (stiff body posture, staring, growling, barking). Furthermore, it was confirmed that the dogs labeled as happy/playful were displaying signaling behavior consistent with this, this included dogs looking relaxed (relaxed body posture, smooth hair, ears and eyes in relaxed position for breed) as well as alert and playful looking dogs (smooth hair, wagging tails, pricked ears). Finally, the images and videos were viewed by two parents of 4-year-olds and headmistresses at both first schools to ensure they were age-appropriate.

**Measures**

**Emotion Chart***.* An emotion chart was constructed using images of three characters from the Disney Pixar film Inside Out, one representing each of the three emotion categories of the dogs; happy/playful, defensive aggressive and frightened/aggressive. The words ‘Happy’, ‘Angry’ and ‘Frightened’ were written above the character representing each emotion in different colors (happy in yellow, angry in red and frightened in purple). Each character had a 5-point Likert type scale beneath it, showing different extremes of that emotion in smiley faces. On each scale the first, third and fifth face was labelled: ‘not very happy/angry/frightened’, ‘a bit happy/angry/frightened, and’ very happy/angry/frightened.’

**Approach Questions.** The five approach questions from the Children’s Treatment of Animals Questionnaire (Thompson & Gullone, 2003) were used. Scores on this questionnaire had been found to be reliable (Cronbach’s α =.81, N= 61) and to correlate highly with measures of empathy towards others (Thompson & Gullone, 2003). The five approach questions were: Would you pat this dog?’, ‘Would you play with this dog?’, ‘Would you cuddle this dog?’, ‘Would you brush this dog?’ and ‘Would you sit next to this dog?. The responses were presented to the children as a 5-point scale (‘yes’ = 5, ‘maybe’ = 3, ‘no’ =1). Points two and four were not labeled but were used if children expressed uncertainty in their response. The responses of yes, maybe and no were used instead of the original ‘Often’, ‘Sometimes’ and ‘Never’, as in this study the questions related to a specific dog in a specific situation (as shown in the image or video) rather than the child’s behaviors over time.

**Procedure**

Each child was interviewed individually in a quiet area of the school by the first author during two 15- to 20-minute sessions. In one session, the video clips were shown and in the other the images were shown, the order was counterbalanced both between (images and videos) and within (emotion) each session. After asking questions about the participants’ age and whether they owned a dog the researcher explained that they would be showing the child pictures /videos of dogs and asking them how they thought each dog was feeling. The researcher explained the three emotions to the child using the emotion chart, giving examples of when the child may feel this way. For example, feeling frightened when alone in the dark. It was then explained to the child that they would be required to answer a few questions about how they would behave around each dog. Once the child indicated that they were happy to help the first image/video was shown using a tablet (10.1” screen). This was used to show all images and clips, each was displayed for as long as the child took to respond to the questions (all responses were noted down by the researcher).

All children were first asked, ‘How do you think this dog is feeling?’. Children were encouraged to use the emotion chart to indicate their answer. To assess children’s confidence in the emotion that they had selected they were then asked, ‘How happy/angry/frightened do you think the dog is feeling?’ This was done by referring to the Likert type scale on the emotion chart. For example, if the child picked happy, the researcher would ask, ‘do you think the dog is feeling (pointing at the faces on the scale) not very happy, a little bit happy, or very happy (only points 1, 3 and 5 were labelled). Finally, children were asked the five approach questions (e.g. ‘Would you play with this dog?’). This procedure was repeated for each image and clip. After taking part, each child was thanked and returned to their class.

**Scoring**

Accuracy scores were calculated as the number of images/clips where the emotion selected by the child was the same as that recognized by the vet nurses and lay raters. Confidence scores were the strength of the emotion the child indicated the dog as showing on the Likert scale (1= low level of emotion, 5 = high level of emotion). Approach scores were calculated for each image/clip based on the child’s mean response to the five approach questions (a high score indicated a greater intention to approach the dog).

**Results**

**Ability to Accurately Recognize Emotion Shown**

The descriptive statistics in Table 1 suggest that 4- to 5-year-old and 6- to 7-year-old children are relatively good at recognizing angry dogs but less good at recognizing frightened and happy dogs. Specifically, frightened dogs were accurately recognized by 56% of 4- to 5-year-olds and 76% of 6- to 7-year-olds. There was no significant gender difference in children’s overall accuracy scores, *t*(115) = 0.67, *p* = 0.503, 95% *CI LL* = -0.159, *UL* = 0.324, *d* = 0.12. Similarly, among the 4- to 5-year-olds there was no significant difference in the accuracy of scores of those who were growing up in houses with dogs compared to those who were not, *t*(55) = 1.99, *p*= 0.052, 95% *CI LL* = -0.003, *UL* = 0.602, *d* = 0.50. However, among the 6- to 7-year-olds, those growing up in a house with a dog had significantly higher accuracy scores (*M* = 3.98, *SD* = 0.669) compared to those without (*M*= 3.63, *SD* = 0.36), *t*(58) = 2.23, *p*=.030, 95% *CI LL* = 0.358, *UL* = 0.161, d=0.65.

A three-way mixed ANOVA of emotion (happy, angry & frightened) x age group (4-5, & 6-7 years) x format (images & video) on accuracy scores was carried out[[2]](#endnote-2). Significant interactions were found for; emotion and age, *F*(2, 224)= 5.66, *p*=0.004, *ɳ*²= .03, format and age *F*(1, 112)= 7.12, *p*=0.009, *ɳ*²= 0.06 and emotion and format, *F*(2, 224)= 23.64, p<0.001, *ɳ*²= 0.09. The three way interactions was non-significant, *F*(2, 224)= 0.25, *p*=0.780, *ɳ*²= <0.01. The responses relating to frightened and happy dogs were normally distributed however, the responses relating to angry dogs indicated negative skew across both formats and age groups (<-1.5 and >-2.5) as most children scored highly. Transformations could not be used as the skew was not present across all conditions, therefore, non-parametric contrasts using Wilcoxon and Mann-Whitney tests were carried out. These are reported in Table 2. The interaction between emotion and age was explained by the 6- to 7-year-olds being significantly better than 4- to 5-year-olds at accurately recognizing frightened dogs, but there being no significant difference between the age groups in ability to recognize happy and angry dogs. The interaction between format and age was the result of the 4- to 5-year-olds having significantly higher accuracy scores for images compared to videos, whereas for the 6- to 7-year-olds the format of presentation made no significant difference. These age differences accounted for the significant main effect of age, *F*(1, 112)= 28.55, *p*<0.001, *ɳ*²= 0.11, with the 4- to 5-year-olds obtaining significantly lower accuracy scores (*M*=3.34, *SE*=0.08) in response to images and videos compared to 6- to 7-year-olds (*M*=3.90, *SE*=0.07). However, across both age groups children more accurately recognized the emotions of happy and angry dogs presented in images, whereas frightened dogs were more accurately recognized when presented in a video. Due to this interaction between format and emotion no significant main effect of format (images: *M*=3.68, *SE*=0.05, videos: *M*=3.56, *SE*=0.07) was found, *F*(1, 112)= 2.87, *p*=0.093, *ɳ*²= 0.03. However a significant main effect of emotion was found, *F*(2, 224)= 65.68, *p*<0.001, *ɳ*²= 0.27). This was the result of significantly higher accuracy scores for angry (*M*=4.39, *SE*= 0.06) compared to happy (*M*=3.13, *SE*=0.09), *Z*= 8.19, *p*<0.001, *N*=117, r = 0.76 and frightened (*M*=3.35, *SE*=0.10) dogs, *Z*= 7.25, *p*<0.001, *N*=117, r=0.67.

**Confidence in Emotion**

The mean confidence scores in Table 3 indicate that for all emotions, regardless of whether it was correct or incorrect and whether the dog had been presented in an image or video, children were relatively confident. Furthermore, there was little indication of age differences or differences between the emotions. This was supported by the four-way mixed ANOVA of emotion (happy, angry & frightened) x age group (4-5, & 6-7 years) x format (images & video) x accuracy (correct emotion & incorrect emotion) on confidence scores as no significant results were identified (all *p values* > .16, with *ɳ*²<.01). However, when 14 outlying data points (Z-scores < -3), due to low confidence scores, were removed a significant three-way interaction between emotion, accuracy and format *F*(2,8)= 5.37, *p*=0.033, *ɳ*²= 0.06 and a two-way interaction between accuracy and emotion, *F*(2,8)= 4.60, *p*=0.047, *ɳ*²= 0.06, were identified[[3]](#endnote-3). However, as these both had small effect sizes there is little consistent or convincing evidence that children’s confidence, as measured by the strength of emotion that they thought was being displayed, differs depending on their age, the emotion being shown or the format of presentation.

**Intention to Approach Dog**

The mean approach scores in Table 4 suggest that children, regardless of age and regardless of whether the dogs were presented in images or videos, report that they would be unlikely to approach angry dogs but would approach happy and frightened dogs. A three-way mixed ANOVA of emotion (happy, angry & frightened) x age group (4-5, & 6-7 years) x format (images & videos) was carried out on responses to the approach questions[[4]](#endnote-4). A significant effect of emotion was found, *F*(2, 218)= 422.07, *p*<0.001, *ɳ*²=0.24. All other main effects and interactions were non-significant (*p values* > 0.07, with *ɳ*²<0.01). As data were negatively skewed for happy and frightened dogs (most children reporting a high likelihood of approaching these dogs) but positively skewed for angry dogs (most children reported a low lowlihood of approaching these dogs) transformations could not be carried out to produce normally distributed data. Therefore, Wilcoxon tests were used to carry out the post-hoc comparisons for emotion. These indicated that children’s intention to approach angry dogs was significantly lower than their intention to approach happy, *Z*=-8.83, *p*<0.001, *N*=117, *r* = -0.82, or frightened dogs, *Z*=-8.82, *p*<0.001, *N*=117, *r* = -0.81. However, there was no significant difference in their intention to approach happy compared to frightened dogs *Z*=1.13, *p*=0.260, *N*=117, *r* = -0.10. To confirm that these findings were not a result of children’s misidentification of dogs’ emotions, for example saying that they would approach a dog that they had recognized as happy but according to the categorization by dog experts was frightened, the 3-way ANOVA was repeated using the emotion identified by the child to define the emotion variable. The conclusions to this were very similar, with follow up tests again indicating that children were significantly more likely to approach frightened, *Z*=8.60, *p*<0.001, *N*=117, *r* =0.80, and happy, *Z*=8.78, *p*<0.001, *N*=117, *r* =0.81, compared to angry dogs. Therefore, the evidence that children intend to approach frightened dogs is consistent with 81% of children reporting that they would approach dogs that they had recognized as frightened (compared to 31% approaching dog they recognized as angry and 94% approaching dogs they recognized as happy).

**Discussion**

The current study aimed to strengthen the findings of previous research that young children often find it difficult to recognize the emotions of dogs, (Meints et al., 2010; Meints et al., 2014) particularly frightened dogs (Lakestani et al., 2014). Furthermore, the aim was to tie this explanation back to the real-life implications of how this could lead to the high number of bites in this population. This was achieved through following up the child’s choice of emotion by questioning their intention to approach that dog, thus giving an indication of how the child’s accuracy and confidence in their answer influenced their likelihood of approaching the dog.

Findings indicated that 4- and 6-year-old children were significantly worse at recognizing frightened and happy compared to angry dogs. This confirmed the hypothesis and is in accordance with previous research (Lakestani, et al. 2014). Furthermore, 4-year-old children were significantly worse at recognizing frightened dogs compared to 6- year-olds. This confirms the hypothesis that children’s ability to accurately read dogs’ emotions improves with age and is in accordance with previous research (Lakestani, et al. 2014; Meints et al., 2014). Children in the current sample recognized frighten dogs more accurately than Lakestani et al. (2014) found as our 4-year-olds identified 56% of the images and clips of frightened dogs correctly compared to 20% in Lakestani et al.’s study and the difference was similar for the 6-year-olds too (76% compared to 30%). It may be that the stimuli in the current study were easier for the children to interpret, especially as still images were used as well as video clips and younger children had higher accuracy on images compared to videos. This suggests that the additional information present in a video may be too complex for the younger children to perceive and make sense of, whereas when less information is presented (e.g. just one moment in time) then they are more able to make a correct interpretation. This clearly has implications for real-world exposure to dogs where children will be presented with a multitude of information. Evidence suggests that training children, and indeed adults, using videos to recognize dog signaling behavior can be successful in increasing accuracy of interpretations (Meints et al., 2014). Such training should be included in dog bite intervention programs.

Alongside children being less able to recognize frightened dogs accurately it also appears that they are more likely to behave inappropriately around frightened dogs as 81% of children would approach a dog that they had identified as frightened. Indeed, they reported that they would be as likely to approach a frightened dog as they would a happy one. This finding supports the previous research suggesting that children have a lack of knowledge of safe practices around dogs (e.g. Dixon et al., 2012; Shen et al., 2013; Schwebel et al., 2016). Therefore, it is important that intervention programs to reduce dog bites in young children emphasize how to behave appropriately around dogs, especially frightened ones. Furthermore, evaluations of intervention programs must consider this as a key outcome variable as the data presented here clearly indicates that accurate recognition of emotion will not be sufficient to prevent dog bites. Even when young children accurately recognize the emotion shown by a dog they do not know how to behave safely around fearful dogs.

To extend the finding that young children are more likely to incorrectly recognize dog signaling behavior relating to fear and are more likely to approach dogs showing signs of fear, future research must consider the following. Ecologically valid stimuli must be selected, ideally videos including appropriate sound and in which the dog signaling behavior has been verified by dog behavior experts. The context of the videos and images used in the current study was unknown and the content was not fully controlled (e.g. locations the dogs were in, inclusion of sound etc). This is a limitation which future research should address. Furthermore, a more thorough investigation of children’s intended behavior around dogs with different mental states would be valuable as the current study only considered children’s intention to approach the dog or not. Moreover, as evidence suggests that dog bites to children most commonly occur in the family home, and from a dog known to the child (Kahn et al, 2003), further investigation would benefit from considering how children who have experience with dogs compared to those who do not. This should be done using reports of dog experience from adults as children may not be a reliable source of this information. Furthermore, research investigating parents ability to recognize a dogs’ mental state and appropriate supervision around dogs is likely to be beneficial to preventing dog bites as children tend to be bitten when a parent is present (Reisner et al., 2011). Ideally, future research, both with children and adults should promote better understanding of dog signaling behavior and safe behavior through including a full debriefing in which feedback is given to the participant about their performance and correct behavior around dogs. Indeed, recent research suggest that training on dog signaling behavior can improve accuracy even in children as young as 3-years-old (Meints, et al., 2014).

Preventing dog bites in young children is complex. It has been suggested (e.g. de Keuster, & Overall, 2011) that multi-disciplinary approaches that recognize both dog and human factors is required and that developmental variables effecting the way that children behave around dogs might be key (Love & Overall, 2001). Based on the current finding, that even when children accurately recognize a dog as frightened they still intend to approach that dog, it could be argued that the development of Theory of Mind(ToM) may be influential. ToM involves understanding other’s mental states may differ from one’s own (Wimmer & Perner, 1983). Although children as young as two years seem to understand that the beliefs of others may differ to their own (see Baillargeon, Scott, & He, 2010) an understanding of the subjective nature of desires does not seem to develop until around the age of four (Rieffe, Terwogt, Koops, Stegge, & Oomen, [2001](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4471385/#CR37)). While there is little direct evidence of transfer of ToM knowledge to non-human intentions, Harris (2008) found that 2-year-old children can attribute emotions to animals and that children as young as three were able to predict emotional reactions of toy animals in hypothetical situations (Harris, Johnson, Hutton, Andrews, & Cooke, 1989). Taken together this evidence seems to suggest that although young children may be able to recognize emotions in dogs they may struggle to understand that the emotion may lead to a different desire, different expressions and different emotional reactions in the dog compared to themselves. This may explain why children in the current study intended to approach frightened dogs; although they recognize the emotion they may not realize that the dog, unlike themselves, may feel threatened by physical reassurance, such as a pat or hug (Reisner, et al., 2007). Therefore, future research investigating whether there are links between a child’s ToM development, particularly their understanding of the desires of others, and their intention to approach frightened dogs may provide new direction for dog bite prevention programs. This could be valuable as short-term ToM interventions have successfully increased theory of mind skills (Begeer, 2014).

**Conclusions**

The current study makes an original contribution to our understanding of dog bite prevention in young children as it suggests that even when children can recognize the mental state of the dog correctly they may behave in a way that is likely to result in them getting bitten. This has significant implications for dog bite prevention programs as it suggests that these must include training children how to behave around dogs, especially frightened dogs, as training them to accurately interpret dog signaling behavior alone will not reduce their risk of being bitten.

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1. The photos can be sent to anyone interested, upon request. [↑](#endnote-ref-1)
2. This analysis included three outliers (z scores <-3), when these data points were removed and the analysis rerun the outcomes were similar in terms on whether they were significant or not. [↑](#endnote-ref-2)
3. Although children were generally more confident about their correct than incorrect responses, and more confident in their responses based on videos than images, for frightened dogs their confidence was higher for their incorrect responses based on images compared to those based on video. [↑](#endnote-ref-3)
4. This analysis included seven outliers (z scores <-3) all relating to low approach scores for happy dogs). With these data points removed the analysis was rerun and the outcomes were similar in terms on whether they were significant or not. [↑](#endnote-ref-4)