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A Randomized Trial Evaluating Child Dog-Bite Prevention in Rural China Through Video-Based Testimonials

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ABSTRACT

Dog-bite injuries pose a significant threat to children around the world. School-aged children are especially at risk of injuries because of their cognitively immature tendency toward poor perception of vulnerability regarding risky behaviors. This risk is elevated further for millions of school-aged children living in rural China due to the large number of stray dogs, all potential rabies carriers. Effective intervention programs for pediatric dog-bite injuries are sparse. Most existing programs were based on public health concerns and only involve the impartment of safety knowledge to children. They produced mixed results in changing actual behaviors with dogs. Based on the Health Belief Model and empirical evidence from pilot studies, the current study developed and evaluated whether viewing a 36-minute educational video of testimonials would change children's safety knowledge, perceived vulnerability, and simulated behaviors with dogs. Using a repeated measure case control (between-subjects) design, 280 third- and fourth grade children in a rural Chinese elementary school were randomly assigned to one of two conditions: dog-bite prevention testimonial video (treatment), or drowning-prevention testimonial video (comparison treatment). One week before and after the intervention, children's safety knowledge, perceived vulnerability were assessed using self-report questionnaires and children's simulated behaviors with dogs were

assessed with the dollhouse task. Regression analysis revealed that children who watched the dog-bite prevention testimonial video had significantly increased safety knowledge, higher perceived vulnerability, and safer simulated behaviors with dogs. Mediation analysis revealed that the intervention successfully changed children's simulated behaviors with dogs through increased safety knowledge and perceived vulnerability toward dogs. The incorporation of testimonials into educational programs to reduce risky interactions between children and dogs has implications for future development of interventions for other types of unintentional injuries among children. The parallel effect of both improved safety knowledge and heightened perceived vulnerability on children's behavioral changes is also noteworthy.

Keywords: dog-bite, injury, prevention, testimonial, child

DEDICATION

This dissertation is dedicated to my parents and my wife

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CHAPTER 1

INTRODUCTION

Literature Review

Dogs are sometimes described as "man's best friend". As much companionship and comfort as dogs bring to human families, dog bite injuries to humans, especially to children, have received minimal but increasing attention by both scholars and the public. Dog-related injuries mainly consist of two categories, bites and scratches. A 'dog bite' is here defined as 'any break in the skin caused by a dog's teeth, regardless of the intention.' A 'dog scratch' is here defined as 'any bruise or break in the skin caused by a dog's claws, regardless of the intention.' In this dissertation, we refer to both kinds of injuries using the general term of 'dog-bite injuries'.

Most previous studies on pediatric dog-bite injuries were epidemiological in nature and conducted in developed nations. In this section of the dissertation, we will review current literature on understanding and preventing pediatric dog-bite injuries around the world, which leads to the hypotheses and design of the study. Three major questions will be addressed: (1) Epidemiology: What is the current situation of pediatric dog bite injury and what is its impact on children's health? (2) Risk factors: What causes pediatric dog bite injuries? and (3) Interventions: What measures can we take to prevent pediatric dog bite injuries?

Epidemiology of Pediatric Dog-Bite Injury and Impact on Children's Health

Global Overview

Dog-bite injuries occur all around the world, although individuals in different cultures might get bitten by dogs for different reasons because of widely varying culture-driven human-dog relations across the globe. In developed areas, dogs are usually raised as family pets and companions to family members, including children. However, in middle-and-lower-income countries, people often keep dogs as guardians to protect the family against outsiders. Children in these areas usually have less access to informative education on safe interactions with dogs and inferior/expensive medical resources for treatment after exposure to dog bites (Shen et al., 2013b; Van Doorslaer et al., 2006).

Developed Regions

In the United States, it is estimated that at least 400,000 pediatric dog bite injury incidents occur annually, with an incidence rate of 1.3 : 1000 (Jalongo, 2008). This number may even be underestimated because minor incidents are unlikely to be reported. For example, according to a study in Pennsylvania in the 1980s, the actual occurrence of pediatric dog bite injuries was 36 times higher than the rate reported to health authorities (Beck & Jones, 1985). A significant portion of these victims are children younger than 14 years old (Horisberger, Stärk, Rüfenacht, Pillonel, & Steiger, 2004; Ndon, Jach, & Wehrenberg, 1996; Sacks, Lockwood, Hornreicht, & Sattin, 1996; Yeh et al., 2011). For instance, children in the US between the age of 5 and 9 years old are about four times

more likely than adults to become victims of dog-bite injuries (Weiss, Friedman, & Coben, 1998). Males are 1.4 to 3 times more likely than females to become victims of dog bite injuries (Brogan, Bratton, Dowd, & Hegenbarth, 1995; Moore, Sischo, Hunter, & Miles, 2000; Overall & Love, 2001).

Children in other developed regions, including Europe, also suffer from pediatric dog-bite injuries. For example, one study reported that in Belgium, among 1000 children under the age of 15 years old, 22 were victims of dog bite injuries every year (De Keuster, Lamoureux, & Kahn, 2006). Other researchers in Austria provided more data. It was found that during the period between 1994 and 2003, 342 Austrian children (M age =5.9 years old) were bitten by a dog and sought medical attention (incidence rate = 0.5: 1000; Schalamon et al., 2006). In another study, researchers reviewed all cases of Austrian children under the age of 17 years old who were treated for dog bite injuries between 1994 and 2003 at the Department of Pediatric Surgery at the Medical University of Graz, a Level One trauma center that treats more than ten thousand children each year (Schalamon et al., 2006). There were a total of 341 children with mean age of 5.9 years old treated for dog bite injuries during that decade. The annual incidence of pediatric dog bite injuries was at 0.5:1000 for children under the age of 17. Similar data are reported elsewhere in Europe, such as the Netherlands (Cornelissen & Hopster, 2010).

The pattern of injuries by age distribution in Austria was somewhat different than data from most other parts of the world. Children at the age of 1 were more likely than any of their older counterparts to be victims of dog bites, and the chance to get bitten by

dogs decreased as age increased. This is inconsistent with most other studies, which show children are more likely to be bitten by dogs as their age increases from toddlers to adolescents because of the gained mobility and risk-taking behaviors. According to the authors in this study, one possible explanation of this counter-intuitive finding was that 'in a dog's view of rigorous hierarchal system in a pack, they may regard newborns and toddlers as subordinate and feel the need to defend their own position in the pack against this intruder (Schalamon et al., 2006).

Besides North America and Europe, other developed regions including Australia, Singapore, Japan and South Korea also share similar epidemiological characteristics of pediatric dog bite injuries with North America and Europe. Newer data are needed for these countries, but a study in late 60's in Japan estimated that about 245,000 people were bitten by dogs every year (Carding, 1969). With an estimated population of 103,172,000 in Japan in 1969, the equivalent incidence ratio would be 2.4:1000. In Australia in 1980, it was estimated that 38,000 people every year needed anti-rabies treatment with a minimum incidence ratio of 1.8:1000 annually, and children from 2 to 10 years old were among the most vulnerable age groups in the country (Nixon, Pearn, & McGarn, 1980).

Developing Regions

Reports on dog bite injuries from most developing regions, including Africa, Latin America and South/Southeast Asia are relatively scarce. The few existing studies suggest

that children suffer more frequently and severely from dog-bite injuries than their counterparts in more developed regions in the world (Dwyer, Douglas, & Van As, 2007; Shen et al., 2009; Si et al., 2008; Yeh et al., 2011; Yin et al., 2010), possibly due to the low levels of education, medical care and dog-management in these regions. It was estimated that the incidence rate for pediatric dog bite injuries in developing regions may be over 100 times the rate in developed countries (Bhanganada, Wilde, Sakolsataydorn, & Oonsombat, 1993; Dwyer et al., 2007; Georges & Adesiyun, 2008; Si et al., 2008).

For example, researchers in South Africa, one of the more developed countries in Africa, identified 2021 pediatric dog-bite injuries during a 13-year period in a local medical unit, accounting for 1.5% of all trauma unit presentations (Dwyer et al., 2007). The mean age of these children was 6.84 (SD = 3.30) years old, with peak incidence for children aged 4-7 years old (Dwyer et al., 2007). The situation is even more urgent in other less developed areas in Africa such as the United Republic of Tanzania (Cleaveland, Fèvre, Kaare, & Coleman, 2002).

Situations in Asia are more complicated due to the dense population and vast economic diversity on this continent. In some countries, the dense population and relatively weak economy lead to a high level of medical expenses per person (Van Doorslaer et al., 2006). This financial burden of treating dog-bite injuries is even more severe considering the vast prevalence of stray dogs (potentially rabies carriers) in many nations (Bhanganada et al., 1993; Kato, Yamamoto, Inukai, & Kira, 2003). As a result, children are not only under the increased threat of dog-bite injuries, but also at a heightened risk

of rabies infections. For example, it was reported that 5.3% of all injuries seen in one emergency room in Bangkok, Thailand, were from dog bites, with children and teenagers accounting for 55% of them. However, due to the high cost of medical care and imported vaccines, these potential exposures to rabies were not 'always managed optimally' (Bhanganada et al., 1993).

Other Asian countries are rapidly developing and becoming more and more economically capable of implementing intervention programs to prevent pediatric dog-bite injuries. However, due to the lack of adequate high-quality empirical research, children living in these countries are still at risk of dog-bite injuries. For example, researchers in Hong Kong assessed all patients younger than 22 years old at the local emergency department between 2003 and 2004 with a diagnosis of animal bite. They found that 89% of the bites were due to dog bites, and the mean age of the dog bite victims was 11.82 years old (Standard Deviation = 6.39). Further, children less than 10 years old had a higher risk of serious injuries such as bites to the face (25%, compared to 2% for older patients) (Hon et al., 2007). Epidemiologists in Taiwan used insurance data from 2000 to 2007 and compared 4660 patients with dog bites and 18,640 controls without dog bites to examine relevant risk factors. They found that young children were among the most vulnerable populations for dog bites (Yeh et al., 2011).

On mainland China, the target country for the present research, it was reported that from 1996 to 2006, China experienced a rabies incidence increase of about 2000%, and the rate has remained stable since (Si et al., 2008). With this increasing rabies incidence

rate, pilot epidemiology studies on injury prevention suggested that animal bites are among the three leading causes of injury among rural Chinese, with incidence rates particularly high for children (Shen et al., 2009; Yin et al., 2010). Dog-bite injuries to children are especially concerning considering the large presence of dogs due to the fact that women and children tend to raise dogs for protection after male adults leave their villages to seek work in larger cities (Duan, 2008). These dogs escape fences and wander rural areas, reproducing and posing threat to children (Deng, Tan, & Zhang, 2004; Guo, Zhu, Wu, & Hai, 2007). However, research addressing pediatric dog-bite injuries in high-risk rural China is lacking. Pilot studies from our laboratory in 3 rural provinces of China found that at least 30% of children in Grades 3 to 6 reported a personal history of dog-bite injury (Shen et al., 2013a).

Impact of Dog-bite Injuries on Children's Health

Death and physical injuries. Although fatalities related to dog bites are relatively rare (Ozanne-Smith, Ashby, & Stathakis, 2001), research shows that children are the most common victims in those fatal incidents. For example, from 1979 to 1988, there were 157 dog bite-related deaths reported to health authorities or covered by news stories in the US, among which 70% of the victims were children under the age of 10 (Sacks et al., 1989). The number of deaths in the following six years from 1989 to 1994 was reduced to 109, but children younger than 10 years old still comprised the majority of victims (57%) (Sacks et al., 1996).

Risk factors for fatal dog attacks include: (a) Injured body parts: A number of studies indicate that children are more likely to be bitten on the face, neck and head than older victims, which leads to higher likelihood of fatal injuries (Abuabara, 2006; De Munnynck & Van de Voorde, 2002; Tsokos, Byard, & Püschel, 2007); (b) Breeds: The breeds that are likely to be responsible for these deaths are Pit Bulls, German Shepherds and Rottweilers, although the risk of each breed needs to be better informed by the actual population of each breed (Sacks, Sinclair, Gilchrist, Golab, & Lockwood, 2000); (c) Dog management: In addition to injured body parts and breed, unrestrained dogs on owners' property seem to be an important risk factor in causing such deaths (De Munnynck & Van de Voorde, 2002; Sacks et al., 1996).

More commonly, children suffer from non-fatal severe injuries which may lead to physical disability. In the literature, a 'severe' dog bite injury is defined as one in which 'the dog repeatedly bit its victim, and the victim or the person intervening had extreme difficulty terminating the attack' (Wright, 1985). The characteristics of these cases, when investigated, were very similar to the fatal dog bite cases mentioned above. Most of victims in this category were children under the age of 10 years old, with the attacking dogs usually owned or familiar to the victims, the attacks often occurred on owners' property, and victims were most likely to be injured in the head, face, neck or shoulders (Bernardo, Gardener, Rosenfield, Cohen, & Pitetti, 2002; Karlson, 1984; Wright, 1985). The rate of such severe injuries is much higher than dog bite-related fatalities. For example, it was estimated that there were about 16,000 severe dog bite facial injuries seen in the hospi-

tals annually in the United States, and almost all victims were children younger than 10 years old (Karlson, 1984). In one study, researchers reviewed data from three large city hospitals in Seattle, Kansas City and Tacoma, and found that boys were more likely than girls to suffer from severe dog bite injuries with a ratio of 3:2, and children needed an average of 6 days' hospital stay for recovery (Standard Deviation = 5) with 30% of them in the intensive care unit (Brogan et al., 1995).

Of course, children also suffer from injuries that are less severe, such as scratches and bleeding in the hands, arms, legs or feet. These less-severe physical injuries usually do not need medical attention beyond home first-aid (e.g., bandages, washing) in developed nations. In developing countries where the risk of rabies is more prominent, even small scratches and cuts should be treated with rabies vaccines.

Risk of rabies infection. In addition to fatal and non-fatal physical injuries, the other health impact of dog bites is the risk of infection of rabies. Rabies is a viral disease that affects the central nervous system of any species but only circulates in mammals usually via saliva from bites or scratches. With an incubation period of often less than three months, the spread of virus would usually result in the eventual death of the infected (World Health Organization, 2013). Although almost all mammals can carry the rabies virus, the most common carriers of the rabies virus are dogs (Panichabhongse, 2001).

Rabies occurs in all areas across the world. In developed nations such as the United States and Canada, cases of human infection of rabies remain very low, at a level of less

than 6 cases per year from 1993 to 2002 (Belotto, Leanes, Schneider, Tamayo, & Correa, 2005). In Japan, one of the most developed countries in Asia, rabies was largely eradicated in the 1950s through governmental efforts such as vaccination of family dogs and elimination of stray dogs, although in 2006 two human rabies cases occurred in Japan; they were later confirmed to be brought from travels in the Philippines (Tamashiro, Matibag, Ditangco, Kanda, & Ohbayashi, 2007). Other developed regions in Asia, such as Singapore, South Korea and Taiwan are also rabies-free (Wildea et al., 2007).

Despite this occasional occurrence in developed countries, almost all cases currently reported are from developing countries particularly in Asia and Africa, where rabies infection is prevalent (World Health Organization, 2013). Specifically, according to the estimates by World Health Organization, over 55,000 people die of endemic rabies around the world every year, with 56% of the deaths in Asia and 44% in Africa, with dogs being the major source of rabies in these two regions (Tamashiro et al., 2007). The widespread nature of rabies carriers among animals in developing regions also posits a major public health problem due to the lack of sufficient medical resources such as vaccines for both humans and dogs.

In China, one recent study (Si et al., 2008) reported that from January 1990 to July 2007, the rate of human rabies in China was characterized by a U-shaped curve when it reached the bottom of almost zero in 1996 but then increased rapidly during the following ten years, and has remained high ever since. Considering the vast population in Chi-

na, it was estimated that more than 3500 people are currently infected by rabies each year in China, which is almost 600 times more than the North American countries.

Psychological impact. Research on the psychological effects of trauma on children suggest that significant emotional reactions are likely to follow traumatic events such as dog bites (Armsworth & Holaday, 1993). For children who suffer from minor dog-bite injuries, negative emotions and feelings could emerge towards dogs, even the familiar ones. Children who are bit by dogs are less likely to initiate interactions with dogs in the future and exhibit more fear when meeting with dogs in daily life (Shen, Li, Xiang, Lu, & Schwebel, 2014). For victims of more serious injuries, symptoms of anxiety might occur. For instance, in one study of 22 children victims of dog bite injuries, more than 50% of them developed symptoms of posttraumatic stress disorder in two to nine months after the injury, and the risk of post-traumatic stress disorder is especially increased with more serious injuries such as multiple and/or deep wounds (Peters, Sottiaux, Appelboom, & Kahn, 2004).

Risk Factors of Pediatric Dog-bite Injuries: An Ecologically Developmental Perspective

In 1979, Bronfenbrenner published his widely recognized work, *The Ecology of Human Development: Experiments by Nature and Design*, in which he proposed the Ecological Theory of Human Development (Bronfenbrenner, 1979). Later, an individual's own biology was also taken into consideration, and the theory was termed as

'Bio-Ecological Systems Theory of Development'. According to Bronfenbrenner (1979), the ecological environments that affect an individual's development consist of five major systems: Microsystem, Mesosystem, Exosystem, Macrosystem and Chronosystem. The Bio-Ecological Theory of Development can be applied to the risk factors that influence pediatric dog bite injuries, as detailed below.

Microsystem

The Microsystem refers to the environment that immediately influences a child's development, such as family, school and neighborhood. The microsystem is the most extensively studied system in the bio-ecological theory of development and exerts significant influence on pediatric dog bite injuries from numerous aspects, including physical and psychological characteristics of the child, his/her family environment including parents' education level, socioeconomic status and supervision, and if the child lives in a neighborhood where stray dogs are prevalent.

Individual factors. As discussed above, researchers have consistently found that children's age is closely related to the likelihood of becoming dog bite victims. Children are more likely to be bitten by dogs than adults both in developed nations such as the United States (Brogan et al., 1995; Moore et al., 2000; Overall & Love, 2001; Sacks et al., 1989), Australia (Ozanne-Smith et al., 2001), France (Mcheik, Vergnes, & Bondonny, 2000), and Switzerland (Horisberger et al., 2004), and in low income countries like

South Africa (Dwyer et al., 2007) and Trinidad (Georges & Adesiyun, 2008). The age group that is especially vulnerable to dog bite injuries is children under 14 years old (Avner & Baker, 1991; Bernardo et al., 2002; Brogan et al., 1995; Chun, Berkelhamer, & Herold, 1982; Gandhi, Liebman, Stafford, & Stafford, 1999; Karbeyaz & Ayranci, 2014; Reisner et al., 2011). These young children are vulnerable because they are both physically and psychologically underdeveloped compared to adults (Schwebel & Pickett, 2012). When they encounter dogs, their short stature, poor information processing capacity, poor judgment of risk and immature executive functions (e.g. the ability to plan and inhibit) place them at greater risk of dog-bite injuries (Yeh et al., 2011). Specifically, among young children, their capacity to understand the distinction between living creatures as 'playmates' and non-living objects as 'play toys' may not be fully developed, for example, until the age of 10 (Chouinard, 2007). Until then, young children might seek to interact with a dog without realizing it is an unsafe 'object' to play with and thus get injured by the dog (Avner & Baker, 1991). Among older children, comparatively poor perception of vulnerability and underestimated severity of the consequences of personal actions are common patterns from 3rd to 6th grade, placing children of this age group in more frequent risky interactions with dogs (Shen, et al., 2013a).

Immediate environmental factors. In addition to individual factors, ecological theories emphasize the importance of immediate environments in the microsystem that influence children's development, including families, communities and schools. These en-

vironments interact directly with children on a daily basis and could contain risk factors that lead to pediatric dog-bite injuries.

For instance, parents play an important role in determining the timing of having children and owning a family dog. It is safer to wait for children to grow older before owning a family dog because infants and toddlers are generally at more risk of becoming victims of severe dog bites than older children and adolescents (Lauer, White, & Lauer, 1982). Another family factor that influences children's chances of getting bitten by dogs is adult supervision. Researchers have repeatedly emphasized the importance of this factor in preventing pediatric dog bite injuries (Bernardo et al., 2002; Boenning, Fleisher, & Campos, 1983; Gandhi et al., 1999; Patronek, Sacks, Delise, Cleary, & Marder, 2013).

Influences from communities and schools are also not negligible. Resources in the local community such as libraries and volunteers for advocating dog-safety could help enhance residents' safety knowledge on dogs and train children to behave safely with dogs (Beaver, 2001). The management of stray dogs could contribute to the reduction of pediatric dog bites, and vaccination of dogs could also help eliminate of rabies infection even if pediatric dog-bite injuries occur (Cleaveland, Kaare, Tiringa, Mlengeya, & Barrat, 2003). School administrations could also make efforts to develop lessons to educate children on how to interact safely with dogs, and to ban parents from bringing family dogs to schools whenever possible (Chapman, Cornwall, Righetti, & Sung, 2000).

Mesosystem

The Mesosystem involves relations or links between different sub-environments within the microsystem that impact the child directly, such as relations between family and school, or neighborhood and peers. For example, the presence of stray dogs in the local community and parents' reactive attitude toward them might influence how children would interact (riskier or more conservatively) with dogs. As another example, researchers found that living in a more violent community could lead to parents buying larger and more aggressive dogs to protect their families. This increasing presence of vicious dogs could pose significant threat to the safety of children living in these families and communities (Chun, Berkelhamer, & Herold, 1982).

Exosystem

In the Exosystem, the environment usually exerts indirect impact on children. An example of this is how a parent's work environment might influence children's experience at home. In traditionally agricultural countries such as China, recent economic development has led many parents in rural villages to flood into large cities to seek higher-paid jobs, leaving many of the 150 million children under age 14 (compare to the total population of 207 million in the United States) living with grandparents (according to the local officials' estimates). These 'left-behind' families usually keep one or more unleashed dogs to guard the house (Duan, 2008). Because of the lower mobility of elderly grandparents and the high activity levels of children, children are often left unsupervised

playing in risky ways with dogs at home or on the street, which increases the risk of dog-bite injuries (Deng et al., 2004; Guo et al., 2007).

Macrosystem

The fourth level of the ecological theory is Macrosystem, where larger social contexts, such as culture and religious beliefs may influence child dog-bite injury risk. Culture and religion might exert a significant impact on the interaction practice between children and dogs, especially the interaction with stray dogs that are not familiar to children because of culturally-driven perceptions of children's safety of such interactions.

Different cultures hold different perceptions of the roles of animals (including dogs) in their daily practice. For example, individuals in Buddhist cultures such as Thailand generally hold beliefs that it is good and encouraged to care and protect stray animals around them. This practice, though consistent with religious practices, could lead to a large population of stray dogs living among people, and those stray dogs could carry potential risks including dog bites and rabies infections (Bhanganada et al., 1993). Balancing cultural and religious beliefs with public health is a challenge.

In more developed countries such as the United States and Japan, dogs are usually seen as a 'family friend' to both adults and children in the household. As a 'formal member of the family', these pet dogs are not only treated well by the family but also taken care of by veterinarians and vaccinated against rabies. This leads to a significant decrease of dog bite occurrences and also rabies cases when bites do happen, compared

to lower-income countries. However, pediatric dog-bites still occur (Moore et al., 2000; Overall & Love, 2001). One possible explanation is that children interact with dogs at inappropriate times such as when dogs are eating, sleeping or caring for puppies. It is also possible that parents usually trust their dogs not to harm children even when their children interact riskily with them (Brogan et al., 1995; Moss & Wright, 1987).

Chronosystem

The last level is Chronosystem, which refers to the influence of time and history on the previous systems and hence on children's developmental course. Time may impact children's chances of getting bitten by dogs via three ways: age-related maturity, previous history of dog bites, and experience of risky interactions with dogs. Age effects have been previously discussed in Section 'Epidemiology of Pediatric Dog-Bite Injury and Impact on Children's Health'.

Other Critical Risk Factors

There are several other risk factors that affect pediatric dog-bite injuries, beyond the ones included in the Bronfenbrenner ecosystem model. These factors include age, sex and breed of dogs, dog ownership, and the presence of stray versus owned dogs in the local region.

Age, sex and breed of dogs. Age of dogs may be an important risk factor for child dog bites. A few studies suggest younger dogs are especially likely to posit risk to newborns and toddlers in the family compared to older dogs (Gandhi et al., 1999; Overall & Love, 2001; Ozanne-Smith et al., 2001). This may be because they view small children as subordinates that should not intrude into their territory, and/or because young children prefer playing with small dogs rather than "scary" large dogs (which is also related to another risk factor, breed of dog). In some regions, younger dogs are more dangerous than adult dogs because of rabies, such as in the case of Thailand. It is reported that in Thailand, animals are not vaccinated against rabies until they reach 3 months old (Mitmoonpitak, Tepsumethanon, & Wilde, 1998).

Concerning the sex of dogs that bite children, although testosterone was found increase a dog's aggressive behaviors toward other dogs (Hopkins, Schubert, & Hart, 1976), no data yet support the idea that castration might affect dogs' behavior towards humans (Overall & Love, 2001). Given the fact that male dogs are more likely to bite humans than female dogs, regardless of whether the dog is neutered or not (Overall & Love, 2001; Ozanne-Smith et al., 2001), it is possible that differences of other unidentified hormones between male and female dogs might have contributed to the sex differences of dogs that bite children.

Besides age and sex, the breed of dogs has been discussed quite intensely in the literature as mentioned in previous sections. In almost all regions around the world, Pit Bulls (Gandhi et al., 1999; Sacks et al., 1989), German Shepherds (Avner & Baker, 1991;

Sacks et al., 1989; Schalamon et al., 2006), Rottweilers (Sacks et al., 2000), Chow Chows (Overall & Love, 2001) and Dobermans (Avner & Baker, 1991; Schalamon et al., 2006) are among the top dangerous dog breeds recorded although the actual mechanism underneath the relation between these breeds and causes of dog-bite injuries needs further investigation.

Dog ownership. Studies suggest that most dogs that bite children in the United States are familiar to the victims; they are typically owned by parents, relatives or neighbors (Avner & Baker, 1991; Bernardo et al., 2002; Bernardo, Gardner, O'Connor, & Amon, 2000; Gandhi et al., 1999). Similar results have been found in pediatric dog bite injuries in Europe (Horisberger et al., 2004; Schalamon et al., 2006), Africa (Dwyer et al., 2007), Central and South America (Georges & Adesiyun, 2008), and Asia (Shen et al., 2013a). However, in parts of the world like Nepal and Thailand where stray dogs are more prevalent and protected, usually to comply with Buddhist teaching, residents care about and protect stray dogs, and hence children are more likely to be injured by unfamiliar dogs compared to other regions of the world (Bhanganada et al., 1993; Kato et al., 2003). The risk of stray dogs will be discussed further in the next section, 'Presence of stray vs. owned dogs'.

Research supports the notion that the majority of dog bites are inflicted by familiar dogs. In addition to the higher frequency of interaction between children and familiar dogs, experimental studies revealed another possible mechanism underneath this connec-

tion: perceived risk. When researchers showed 125 undergraduates 8 slides of the same dog with different assumptions about dog ownership (stray dog, neighbor's dog, or their own dog), and asked them the perceived likelihood of getting bitten by that dog, a main effect for the ownership of dog was found. Undergraduates believed that the closer the relationship between them and the dog, the less likely that they would get bitten by that dog (Moss & Wright, 1987). This lower perceived risk for familiar dogs could explain why children are more likely get bitten by dogs owned by their family, relatives or neighbors.

Presence of stray versus owned dogs. In developed regions such as North America and Europe, dogs are usually kept as pets and family members. These family 'owned' dogs usually stay on their owners' properties and do not wander around in the community, which might at least partially explain why the majority of pediatric dog bite injury cases are reported on owners' property in these regions rather than on the street (Bernardo et al., 2002; Horisberger et al., 2004).

Stray dogs, defined as 'dogs that have unidentifiable owners and often wander on streets', are a much more significant cause of pediatric dog bite risk in developing countries where stray dogs are prevalent. For example, in Thailand the majority of dog bites to humans are from stray dogs (Bhanganada et al., 1993). One study compared the stray dog presence between the city of Kathmandu in Nepal and Shimotsui in Japan (Kato et al., 2003). The density of stray dogs was 2930 per square kilometer (km^2) in Kathmandu,

while in Shimotsui the number was only 225 stray dogs/km^2, which was considerably lower albeit still not negligible. Furthermore, stray dogs are usually not vaccinated against rabies in developing countries due to the lack of sufficient management, thus positing a more serious threat to humans, especially children. This is because children are more likely to be bitten on the head and face and therefore rabies viruses spread more quickly to victims' brain system, leading to fatalities (Mcheik et al., 2000). It was reported that in 1999 Nepal around 35,000 people required treatment after exposure to rabies (Kato et al., 2003). In comparison, this number was 0 in Japan (Tamashiro et al., 2007).

Progress on Pediatric Dog-Bite Injury Prevention

Preventive efforts to reduce dog-bite injuries among children are few. In fact, a systematic review of pediatric dog-bite injury prevention programs in 2009 was only able to locate two studies that met the inclusion criteria (Dupperrex, Blackhall, Burri, Jeannot, 2009). But similar efforts have been increasing over the last decade. The focus of these prevention programs could be categorized into the two parties involved in the dog-bite injury: management of dogs and education of children.

Improving management of dogs is one approach to reduce pediatric dog-bite injuries. Community efforts to license and vaccinate family-owned dogs (Beaver, 2001) and castration of potentially dangerous male adult dogs in and outside houses (Hopkins et al., 1976; Totton et al., 2010) seem to be effective ways to reduce dog-bite risk of children.

For instance, researchers in Tanzania found that dog-bite injuries from suspected rabid dogs greatly decreased after the implementation of dog vaccination in the local district, but not in other districts that didn't receive the vaccination (Cleaveland et al., 2003)

A more psychologically-based approach to reduce pediatric dog-bite injuries is to develop prevention programs to train children how to avoid risky interactions with dogs. Most empirical efforts in this domain focus on preventing pediatric dog-bite injuries via educational strategies ranging from traditional one-way (adult to child) educational programs (Beaver, 2001; Chapman et al., 2000; Dixon, Pomerantz, Hart, Lindsell, & Mahabee-Gittens, 2013; Spiegel, 2000) to interactive lesson plans (Szecsi, Barbero, Del Campo, & Toledo, 2010; Wilson, Dwyer, & Bennett, 2003) and self-teaching lessons using animation computerized tasks (Meints & De Keuster, 2006, 2009).

As an example of traditional educational programs, Spiegel (2000) implemented an educational program with written materials and a video to teach 486 elementary school-aged children in Maryland on dog safety. Questionnaires assessing children's understanding about dog behaviors and how to avoid dog bites were used to evaluate the program. Researchers found the program effective in improving children's understanding of dog safety rules but did not evaluate the change in children's actual behaviors around dogs with behavioral assessments. Beaver (2001) introduced a comprehensive community approach to publicize dog safety knowledge via various media tools including newsletter, radio and television, but did not report the effectiveness of this program.

Other researchers adopted a more interactive approach to intervention programs. For example, Chapman et al. (2000) developed a 30 minute demonstration lesson delivered by an accredited dog handler. A total of 346 children aged 7-8 were assigned to intervention or control group and their behaviors with a tethered dog on the school playground were videotaped and coded. Children in the intervention group showed significantly greater precautionary behaviors than children in the control group, supporting the effectiveness of this intervention for changing children's behaviors with dogs. Other interactive programs were also attempted with similar age groups by using various interactive strategies such as song singing, storytelling and role playing (Szecsi et al., 2010; Wilson et al., 2003) but no behavioral changes were evaluated in these programs.

A third type of intervention is computerized lesson plans. For example, The Blue Dog software program utilized an interactive compact disc and graphic animation to teach and assess knowledge on interacting safely with dogs for children as young as 3 years old (Meints & De Keuster, 2006, 2009). Results of these studies usually indicated improved levels of safety knowledge about dogs. Schwebel and his colleagues added two behavioral evaluations to children trained by The Blue Dog: a dollhouse task (recall of safe behaviors in simulated dollhouse scenarios) and observed behaviors with an actual unfamiliar live dog (Schwebel, Morrongiello, Davis, Stewart, & Bell, 2012). No significant improvement in safety behaviors were detected from either assessment, although children's knowledge about safety with dogs was enhanced.

The mixed results from these intervention programs might indicate one potential flaw in current design of educational lessons. The brochures, videos, and software developed to educate children are largely based on the idea that increasing children's level of safety knowledge will lead directly to changes in actual behaviors. However, this might not be the case in preventing dog-bite injuries (Schwebel, 2012), especially among school-age children (ages 8-14), since a major risk factor for various injuries at that age is underestimated perception of injury likelihood, which leads to risky and sometimes injurious behavior patterns (Morrongiello & Rennie, 1998). Focusing specifically on dog-bite risk among school-aged children in rural China, our pilot study of over 1,500 3rd-6th grade students found that perceptions of invulnerability, but not mastery of safety knowledge, predicted self-reported risky interactions with dogs (such as disturbing a sleeping dog or playing harshly with their own dog) and history of dog bites (Shen et al., 2013a). An alternative, to be tested in the present study, is whether changing children's perceived risk and attitudes toward dogs might be more effective in inducing behavioral changes when interacting with dogs.

Statement of the Current Study

Pediatric Dog-Bite Injury Risk in Rural China

As reviewed in previous sections, there are 150 million children under the age of fourteen years old currently living in rural China. The large number of family dogs and stray dogs (Deng et al., 2004) and prevalence of rabies among these dogs (Si et al., 2008)

as reviewed above are not the only factors placing these children for higher risk of dog-bite injuries. Our pilot study on 101 cases of pediatric dog-bite injuries in rural China indicated a heightened risk for school-aged children because almost all of them walk to and from school on public streets, sometimes a mile or more each way, where stray and loose dogs, all potential carriers of rabies, are prevalent. These risks are even more increased by the socioeconomic status data we obtained from the pilot study: Children in rural China are part of families with low income (median <US $5800 per year; Shen et al., 2014) and low parent education levels (average 5.6 years for mothers, 7.2 years for fathers; Shen et al., 2014), which not only causes their parents to leave home and seek higher-paid work in urban cities as reviewed in previous sections, but also may result in lack of proper education to children on safe interaction with dogs.

Rationale for the Intervention Program

Change of Perceived Vulnerability as Target of Intervention in the Current Study

The idea generated by our previous research, that children's perceived vulnerability might serve as a key factor influencing risky behaviors with dogs is grounded in one of the most widely used theoretical models for health-related behavior change, the Health Belief Model. The Health Belief Model has been extensively utilized in various scientific and professional domains to explain preventive-health behaviors, sick-role behaviors and clinical practices (Janz & Becker, 1984). The Health Belief Model states that the likelihood an individual will change his/her health-related behaviors to prevent undesirable

outcomes depends on that individual's perception of vulnerability among other factors (Redding, Rossi, Rossi, Velicer, & Prochaska, 2000). According to the Health Belief Model, perceived vulnerability is a critical factor in producing perceived threat that directly motivates an individual to change his/her health-related behaviors (Glanz, Rimer, & Viswanath, 2008).

In the case of dog-bite injuries, perceived vulnerability refers to children's perceived likelihood of injury when interacting riskily with dogs. If a child perceives him/herself highly vulnerable to bites as a result of risky behavior with dogs, then the child perceives a threat from engaging in such behaviors. According to the Health Belief Model, this perceived threat would lead to decreased likelihood of risky actions in the future. Therefore, according to the Health Belief Model, an intervention targeting youth to perceive greater vulnerability to bites may prove successful in promoting children's safe behaviors with dogs, and therefore reducing bite risk. Others have used this strategy to reduce children's risk-taking on playgrounds (Morrongiello & Matheis, 2007a) and to increase sun protection behaviors (Jackson & Aiken, 2000).

Educational Testimonial as a Tool to Influence Perceived Vulnerability

Changing perceived vulnerability is not easy. Communication psychologists recommend subjective experiential testimonial as an effective strategy to persuade individuals to change their perceptions (Slater & Rouner, 1996). A testimonial usually involves a first-person account offering a relatively detailed description of a specific event (such

as a dog-bite injury), including but not limited to the antecedents, process and consequences of that event as experienced by that person. Brief reflection and summary by that person may also be included in the testimonial. For example, one recent study compared four types of persuasive strategies on perceived risk of infection of hepatitis B virus among 118 men who have sex with men. The four strategies included testimonial, statistical evidence, mere assentation of risk, and nothing (control). It was found that testimonial increased participants' risk perception significantly more than the other comparison methods (De Wit, Das, & Vet, 2008). The authors theorized that the testimonial worked most effectively for the targeted population because it circumvented the common defensive responses to health behavior changes and thus established better personal connections between the persuader and message recipient. Those personal connections lead to changed perceptions and then changed behaviors.

Similar persuasive strategies that focus on creating personal connection between the communicator and recipient have been used in child safety interventions, although all studies targeted adults instead of children. For example, in one study researchers compared the effect of tailored injury prevention information and non-tailored information on promoting parent adoption of safety practices for their children (Nansel, Weaver, Jacobsen, Glasheen, & Kreuter, 2008). The tailored group used multiple strategies to create participant-specific safety advice, such as printing the child's name on the top of the page and presenting information especially relevant to the participating family (obtained during pre-visit). Results confirmed that parents in the tailored group were more

likely to adopt safety practices suggested in the instructions than the non-tailored group; this change was attributed to the personal connection made to the target parents and children.

There is one other reason educational testimonial based on localized real-life stories that connect to individuals might be useful to children. Testimonials help children imagine real-life scenarios, whether they be situations or "near-misses" they have encountered themselves or those they can relate to because they connect to the storytellers' stories. In both cases, those memories may arouse strong emotional reactions (De Wit et al., 2008). According to the risk-as-feeling hypothesis, aroused emotions can invoke changes in individuals' health-related behaviors even if they are contradictory to their initial cognitive preferences (Loewenstein, Weber, Hsee, & Welch, 2001). Studies have found that both emotion and cognition influence children's risk-taking in potentially injurious situations (Morrongiello & Matheis, 2007b).

Therefore, intervention strategies that target changing perceived vulnerability of children toward dogs might be more effective than solely improving their safety knowledge. Testimonial is likely to serve as a potential tool to effectively influence children's perceived vulnerability. In the case of rural China, we believe these strategies will function most effectively if the testimonial is delivered by adults (parents and teachers). As part of a collectivist culture, Chinese children respect and even admire authorities. Pilot research we conducted in rural China found that children learned dog safety lessons more effectively from adults than from peers (Shen et al., 2013b). Thus a testimonial

narrative delivered by an adult is likely to be a highly persuasive source to change children's perceived vulnerability and behaviors with dogs.

Significance of the Current Study

The significance of the current study is three-fold. First, in terms of public health significance, the intervention developed in this study comprises a unique and to our knowledge the first theory-based and empirically-tested intervention program aimed at reducing dog-bite injuries in a very large but under-studied population of highly vulnerable children in rural China. However, the results of this study also have theoretical implications beyond rural China, including relevance to intervention development in the United States. Second, from the perspective of research methodology and theory, the incorporation of theory and evidence from communication psychology, health psychology, and social psychology to implement first-person testimonial accounts into an intervention program on dog-bite injury prevention is innovative and novel. It has the potential to generalize to other domains of unintentional injury prevention. Third, from a data analysis perspective, the adoption of mediation analysis (detailed below) to not only understand if an intervention works, but also to ascertain the underlying mechanisms for why the intervention might work is rare but critical. Such strategies could help researchers understand better the factors influencing health behavior changes and develop more effective intervention programs for multiple public health domains.

Specific Aims and Hypotheses of the Current Study

The overarching aim of this study is to investigate the effects of exposure to dog-bite educational testimonials on children's cognitive and behavioral risks of dog-bite injuries. Using a repeated-measures experimental design, children were randomly assigned to one of two groups to watch dog-bite educational testimonials (intervention group) or drowning-prevention educational testimonials (comparison group). Drowning prevention was chosen as the comparison group because drowning is also one of the major causes of injury/deaths among rural Chinese children (e.g., Guo, 2010; Zhang, Chen, Deng, Xu, & Hu, 2003). All participants were tested both before and after the training on three outcome measures: safety knowledge, perceived vulnerability and behaviors with dogs. Safety knowledge and perceived vulnerability were measured by self-report questionnaires, while behaviors were measured by simulated behaviors with dogs in a dollhouse task that was adapted from previous research (Schwebel et al., 2012).

The first aim was to test the effect of intervention on children's safety knowledge, perceived vulnerability and simulated behaviors with dogs respectively. Children in the intervention group were hypothesized to demonstrate more knowledge about safety with dogs (Hypothesis 1; as measured by the child-dog interaction safety knowledge questionnaire), higher perceived vulnerability (Hypothesis 2; as measured by the child-dog interaction perceived vulnerability questionnaire), and safer simulated behaviors with dogs in the dollhouse task (Hypothesis 3) than those in the comparison group.

The second aim was to evaluate the mechanism of how the intervention works. It was hypothesized that perceived vulnerability and safety knowledge would mediate the effect of intervention on children's simulated behaviors with dogs. Specifically, training with dog-bite educational testimonial was expected to increase perceived vulnerability and safety knowledge, which would lead to safer simulated behaviors with dogs in the dollhouse task.

CHAPTER 2

METHOD

Participants

A total of 280 children in Grades 3 and 4 of Mayao Elementary School in rural Zhejiang Province, China, participated in the study (Mean age = 10.03 years, SD = 0.83; 48.9% boys). As shown in Figure 1, Mayao Elementary School is located in the rural regions of Zhejiang Province, near the East Coast of China, with annual household income less than $8,000 in our sample at the time of the study. Participants were randomly assigned to one of the two groups: watching testimonial video on dog-bite prevention or watching testimonial video with the same length and structure but on a different topic, drowning prevention. Institutional Review Board approval was obtained from University of Alabama at Birmingham on 04/18/2014. Informed consent was obtained from children's parents and all participating children provided signed informed assent.

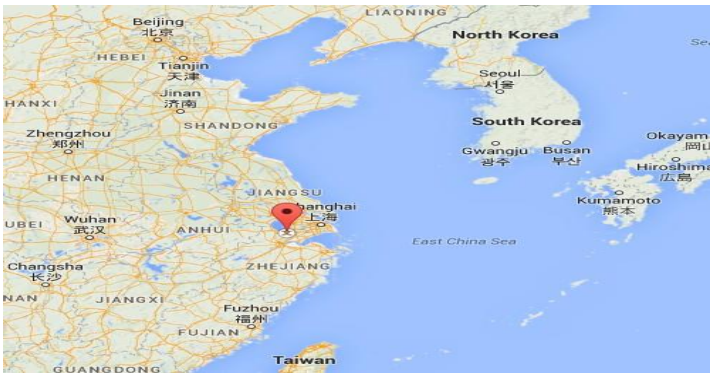


Figure 1. *Geographic Location of Mayao Elementary School, Zhejiang Province, China*

General design

This study was a randomized controlled trial design with pre- and post-tests. Figure 2 illustrates the design graphically. There was one week between pre-test and intervention, and one week between intervention and post-test. At both pre-test and post-test, children completed self-report questionnaires addressing safety knowledge and perceived vulnerability. Children were also assessed at each visit with a dollhouse task to measure their simulated behaviors with dog. Details of measures appear in Section "Measures". The intervention comprised of watching a testimonial video on dog-bite prevention (intervention group) or watching a testimonial video with the same length and structure but on a different topic, drowning prevention (comparison group); details appear below in Section "Intervention".

Measures

All participating children completed two self-report questionnaires, a child-dog interaction safety knowledge questionnaire and a child-dog interaction perceived vulnerability questionnaire, at both pre- and post-intervention tests. All participating children also completed an interactive dollhouse task at pre- and post-intervention tests to assess their simulated behavior with dogs.

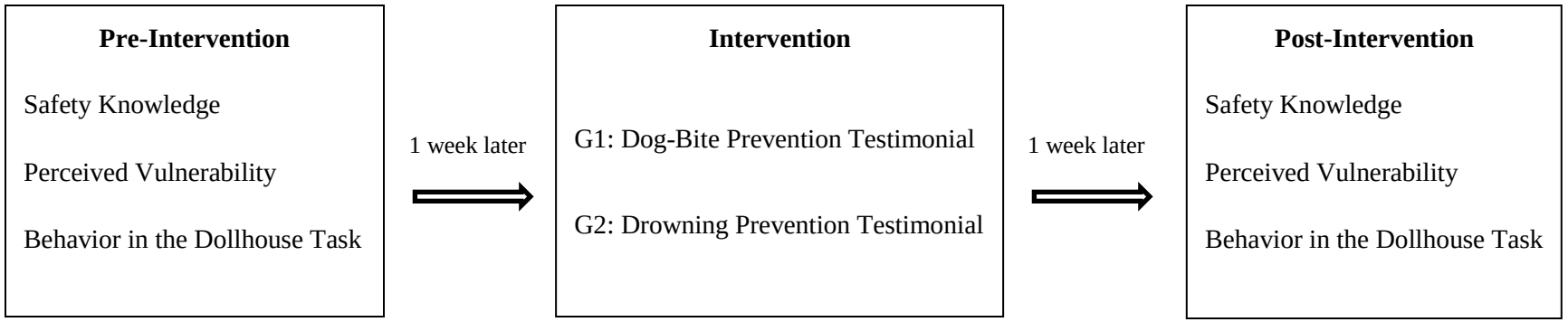


Figure 2. *Overview of Randomized Controlled Trial Design (N=280)*

The Child-Dog Interaction Safety Knowledge Questionnaire

The Child-Dog Interaction Safety Knowledge Questionnaire was a measure of children's knowledge about safety with dogs. We developed this questionnaire for use in pilot research with similar age groups of children in rural China and it demonstrated adequate construct validity (significant correlation with risky attitudes/beliefs, $r = -.43$, $p < .01$; and risky interactions with dogs, $r = -.23$, $p < .01$) (Shen et al., 2013a).

Development of this questionnaire consisted of several steps. Based on a thorough review of scientific literature on child-dog interaction safety, the instrument underwent expert review and face validity review by senior members of research team, both of whom were familiar with Chinese culture. Translation and back-translation from English to Chinese was completed by social scientists fluent in both languages. The questionnaire assessed children's knowledge about 'dos' and 'don'ts' when encountering dogs in typical daily scenarios in rural China. An example item was as follows: *What should you do when you are knocked over by a dog? A. Get up and run away from the dog as fast as you can; B. Roll into a ball and lie still; C. Fight to protect yourself from the dog, especially by kicking it; D. Yell at the dog to scare it away.* Participants were scored on the percentage of correct responses out of 24 items. Final scores can range from 0-100%, with higher scores indicating better mastery of safety *knowledge* around dogs.

The Child-Dog Interaction Perceived Vulnerability Questionnaire

The Child-Dog Interaction Perceived Vulnerability Questionnaire is a 18-item measure of children's perceived vulnerability toward child-dog interactions. Also developed in pilot research (Shen et al., 2013a), it had strong internal reliability (Cronbach's α = .77). An example item from the instrument was: *I think a small scratch from a dog bite does not need going to hospital*. Items were scored on a 5-point scale, reversed if needed so that higher scores indicate greater perceived vulnerability. Final scores were averaged across all items with a range of possible scores from 1 to 5.

The Dollhouse Task

The dollhouse task assessed children's simulated behaviors with dogs by asking children to decide and describe what to do following eight different real-life situations involving dogs. Based on a model used in our previous research in the United States (Schwebel et al., 2012), the features of the dollhouse were adapted to the rural Chinese environment by changing the typical western-style house to a traditional Chinese farmer's house and constructing a simulated rural landscape with a public street at the front door. The 8 scenarios and questions in our previous study were also adapted to include 4 scenarios and questions on in-home safety with family owned dogs and 4 scenarios and questions about on-street safety with stray dogs. It asked children to decide and describe what to do following these eight different real-life situations involving dogs.

An example was as follows: *Act out child playing on the street in front of the house while a stray dog approaches from behind the child. Say: "(Child's Name) is playing outside his/her house. A stray dog comes along the street toward (Child's Name). What will (Child's Name) do now?"* Children's responses to each scenario were recorded verbatim and coded as safe (2), medium (1) or unsafe (0) by the researcher on site, with an objective coding system established and inter-rater reliability achieved (>.95) in pilot testing to assure valid coding. Children's final scores were computed as the average of all eight scores ranging from 0 to 2, with higher scores indicating safer behaviors with dogs.

Demographics

Demographic information was collected from both the parent and the child using a brief questionnaire at the pre-intervention test. The Child Demographic Questionnaire collected information on children's age, gender, ethnicity, dog-bite history, dog exposure frequency and daily risky practice with dogs. The Parent Demographic Questionnaire, which was delivered to parents by children, obtained household income and parents' educational background.

Intervention

The intervention comprised a 36-minute video specifically developed for this study, which displayed educational testimonials of real-life dog-bite experiences from four adult actors (two male, two female) unfamiliar to the participants. In the video, each of the four adults presented a nine-minute educational testimonial about a child being bit by a dog. Each of the educational testimonials was based on real-life events (Shen et al., 2014) but was scripted in collaboration with the presenters to achieve uniform presentation and accomplish learning objectives. Child victims in the testimonial stories were of the same age as the target group. For each educational testimonial, the following topics were covered: (1) self-introduction; (2) introduction about child victim's background and circumstances; (3) antecedents/circumstances of the dog-bite incident (how the child got bit, what the child was doing, what the dog was doing); (4) consequences of the incident (how bad was the injury, how the child was treated, what happened to the dog after the bite); (5) mistakes, errors, decisions, and actions the child victim made, including the low perceived vulnerability the child may have had, plus alternative cognitions/behaviors that would have been safer; and (6) a summary of safety rules and lessons learned from this incident. In collaboration with a dissertation committee member and film expert Professor Michelle Forman, the videos were edited to incorporate illustrative pictures and texts and create a vivid and emotion-arousing lesson.

A second group of randomly-assigned children (comparison group) watched an educational testimonial video also developed for this study with the same length and structure but on a different topic, drowning prevention, which is another major cause of childhood injury/deaths among rural Chinese children (Guo, 2010; Zhang et al., 2003). Topics addressed in this video included not retrieving toys from water; not playing in water or swimming when children were tired, thirsty or sick; not playing hard in water or holding breath under water for competition; and never playing in water or swimming without adult supervision. They too were based on real-life stories and were presented by the same four adults.

Procedure

IRB approval was obtained from University of Alabama at Birmingham and an approval letter was obtained from the participating school, Mayao Elementary School. Signed informed consent was obtained from students' parents/caregivers and signed informed assent from students themselves. Participants completed the study in three phases over three weeks: pre-intervention test in Week 1, intervention implementation (dog-bite prevention or drowning prevention) in Week 2, and the post-intervention test in Week 3.

Week 1: Pre-Intervention Test

Prior to the start of the study, a research room was secured from the participating school for the dollhouse task for both pre- and post-test. Another room, the computer room, which housed 40 desktop computers, was also reserved from the school for delivering the testimonial videos to the participating children.

In week 1, all participating children first completed the child-dog interaction safety knowledge and perceived vulnerability questionnaires in the classroom, with two research assistants supervising each classroom. Each child used a pre-assigned numeral as identification number throughout this study. After completion of the two questionnaires, each child was taken individually, in a random order, to the research room to complete the dollhouse task. Others remained in their classroom completing assigned work with their teachers. Since intervention group membership was assigned later by a randomization procedure in the second week, group membership was unknown to the researchers and participants during the pre-intervention tests.

To ensure fidelity of the delivery of the dollhouse task, the principal investigator's mentor trained the investigator in the United States prior to data collection in China to ensure a standardized delivery of protocol. Written guidelines were prepared for researchers.

Week 2: Intervention Implementation

Intervention implementation commenced in Week 2, about one week after children's completion of pre-intervention tests. The training videos were delivered by individual desktop computers with headphones to each participating child in the computer room. Each child was randomly assigned to watch one of the two testimonial videos (dog-bite prevention or drowning prevention). Random assignment occurred within the same classrooms to reduce clustering influences in our data analysis. Sufficient space between students was ensured, and each training session was supervised by two research assistants to prevent participants from viewing videos or activities on other children's screens. Consent processes ensured children knew they may be assigned to either of the two groups.

Week 3: Post-Intervention Test

The post-intervention test was carried out one week after the intervention following the same procedure as the pre- intervention test. The same questionnaires on safety knowledge and perceived vulnerability as well as the dollhouse task were tested among all children. Because intervention group membership was randomly assigned in the computer room and was inaccessible to researchers, group membership of all participants was unknown to researchers administering post-intervention tests.

Data Analysis Plan

Preliminary analyses were performed first. Missing data, outliers and assumption violations were examined, followed by descriptive and correlational analysis among demographic and outcome variables at both pre- and post-test. Independent samples *t*-test and chi-square tests were performed to examine group differences on demographic and outcome measures between the intervention group and the comparison group. Primary analyses included the evaluation of the effects of the intervention on children's post-intervention safety knowledge (Hypothesis 1), perceived vulnerability (Hypothesis 2) and simulated behaviors (Hypothesis 3) using hierarchical linear regressions, controlling for pre-intervention test scores and demographic variables. Regression analyses were conducted using IBM SPSS 21.0. The fourth hypothesis was evaluated by testing the mediational roles of safety knowledge and perceived vulnerability in the effect of intervention on children's behavioral changes using 95% confidence interval bias-corrected bootstrapping methods. This analysis was conducted using Mplus 6.0.

CHAPTER 3

RESULTS

Preliminary Analysis

Missing Data

Thirty-one (11%) out of the 280 participants had missing data on at least one variable in the current study. Together, the missing data constituted 0.3% of total data points. Four participants missed the pre-dollhouse task due to scheduling conflicts at the time of testing in the school. Five participants were missing the Parent Questionnaire due to the unavailability of literate caregivers at the time of the study. Other missing data occurred in the Child Questionnaire, most likely because children overlooked questions at the bottom of a page while turning to the next page. Relations between missingness and other variables were examined using bivariate correlation analysis. It was found that missingness was not significantly correlated with any of the variables of interest in this study. Since far less than 5% of data points were missing, listwise deletion and estimations (e.g. imputation) are likely to produce similar results. Therefore, listwise deletion was applied to all missing data.

Assumption Testing

Before testing assumptions, outliers were checked and no outliers were found. Assumptions for univariate analyses were tested by examining normality, linearity and homoscedasticity. Values of skewness and kurtosis were examined for each outcome variable and mediator. All variables were close to normal distribution but lightly skewed (skewness values were close to 0, ranging from -.87 to .87, Standard Error=.15). The kurtosis for all variables ranged from -.09 to .73, with Standard Error of .29. A visual check of normality plots did not reveal severe deviations from normality. Therefore, all outcome variables and mediators were analyzed using their original scales.

The linearity assumption was checked by examining linear associations between each predictor (independent variables), mediators and outcome (dependent) variables. Bivariate scatterplots were visually checked and no violations of the linearity assumption. The homoscedasticity assumption was also examined by visual inspection of bivariate scatterplots. No violations of this assumption were found. Multicollinearity was examined by performing bivariate correlation analyses between all independent variables as well as mediators. All correlation coefficients were below .60. To further examine this assumption, Tolerance and Variance Inflation Factor were checked in a linear regression model which included all the independent variables and mediators to predict the dependent variable. It was found that the Tolerance statistic was high and Variance Inflation Factor values were all close to 1, which confirmed the data met the assumption of no multicollinearity among independent variables.

Descriptive and Correlation Analysis

First, descriptive statistics were considered for the demographic variables of the sample. Table 1 presents descriptive data (percentage or mean and standard deviation) for children who participated, both overall and by intervention group. Chi-square tests (or independent samples t tests for continuous variables) were performed to examine whether there was any significant difference on the demographic and pre-test (baseline) factors between the intervention and control groups. As expected given the randomization scheme, no differences were found between the groups on any of the demographic variables. The safety knowledge, perceived vulnerability and simulated behavior in the dollhouse task also did not differ prior to intervention.

Next, a correlation matrix was constructed including the major outcome variables of interest plus demographic variables. As shown in Table 2, as expected, intervention condition was not significantly correlated with pre-intervention scores on safety knowledge, perceived vulnerability and behavior in the dollhouse task. Intervention condition was also not correlated with any of the demographic variables, including age, gender, ethnicity, socioeconomic status, dog-bite history, dog exposure, dog ownership, and daily risky practice. Watching dog-bite testimonials was positively correlated with children's safety

Table 1. *Descriptive Data: Percentages and Means*

Variable	Overall (N=280)	Intervention (N=143)	Control (N=137)	x^2
Age (years) [a]	10.03 (.83)	10.03 (.82)	10.02 (.84)	.17
Gender (% Male)	48.90	47.20	50.70	.35
Ethnicity (% Han)	91.80	93.00	90.40	.61
Caregiver's Education				
% No School Education	6.90	7.00	6.70	
% Elementary School	35.00	31.00	39.30	
% Junior High School	43.30	46.50	40.00	2.56
% Senior High School	13.00	14.10	11.90	
% >= College	1.80	1.40	2.20	
Annual Household Income				
% <=48,000RMB (~$8,000)	54.40	53.20	55.60	3.78
Dog-bite History (% Yes)	20.00	19.90	20.10	.01
Dog Exposure				
% < once a year	35.00	40.60	29.20	
% >= once a year but not eve-	30.70	28.60	32.90	4.03
ryday	34.30	30.80	38.00	
% at least once everyday				
Dog Ownership (% Yes)	41.40	39.90	43.10	.30
Daily Risky Practice[a] (1-5 scale)	1.80 (.60)	1.77 (.58)	1.83 (.61)	-.87
Pre-Knowledge[a] (% correct)	46.52 (12.61)	46.55 (11.81)	46.49 (13.43)	.05
Pre-Perceived Vulnerability[a]				
(1-5 scale)	3.79 (.61)	3.81 (.60)	3.77 (.62)	.50
Pre-Behavior in Dollhouse Task[a]				
(0-2 scale)	1.20 (.43)	1.21 (.43)	1.19 (.43)	.41
Post-Knowledge[a] (% correct)	58.87 (15.31)	66.52 (13.14)	50.88 (13.21)	9.93***
Post-Perceived Vulnerability[a]				
(1-5 scale)	4.38 (.57)	4.57 (.45)	4.19 (.62)	5.81***
Post-Behavior in Dollhouse Task[a]				
(0-2 scale)	1.45 (.39)	1.58 (.34)	1.31 (.41)	5.99***

Note. [a] Mean (Standard Deviation) were reported for this continuous variable, and independent samples *t* test was performed for this variable

Note. *** $p < .001$

Table 2. *Correlation Matrix for Major Outcomes and Demographic Variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	--														
2. Gender	.01	--													
3. Ethnicity	-.02	-.02	--												
4. Socioeconomic Status	-.09	.00	.11	--											
5. Dog-Bite History	-.01	.06	.02	-.06	--										
6. Dog Exposure	-.07	.08	.09	-.10	.10	--									
7. Dog Ownership	.04	.03	-.09	-.02	.06	.36**	--								
8. Daily Risky Practice	-.02	.19**	-.01	-.02	.11	.48	.33**	--							
9. Condition	.01	-.04	.05	.07	-.01	-.11	-.03	-.05	--						
10. Pre-Knowledge	.06	-.05	.01	.05	.06	-.01	.10	-.18**	.01	--					
11. Pre-Perceived Vulnerability	.06	-.07	-.02	-.02	.09	-.15*	.05	-.33**	.03	.48**	--				
12. Pre-Behavior	.07	-.12**	-.01	.05	.03	-.15*	.07	-.21**	.03	.36**	.32**	--			
13. Post-Knowledge	.04	-.10	-.05	.09	.01	-.12*	-.08	-.19**	.51**	.40**	.37**	.27**	--		
14. Post-Perceived Vulnerability	.10	-.07	-.10	.07	-.02	-.19*	-.02	-.26**	.33**	.31**	.56**	.28**	.59**	--	
15. Post-Behavior	-.01	-.03	-.03	.07	-.04	-.16*	-.02	-.16**	.34**	.34**	.26**	.63**	.52**	.44**	--

Note. *p<.05; **p<.01

knowledge (r=.51, p <.01), perceived vulnerability (r=.33, p<.01), and simulated safe behaviors with dogs in the dollhouse task (r=.34, p<.01) in post-intervention tests.

Main Analysis

Testing Hypothesis 1: The Effect of Intervention on Children's Safety Knowledge

We hypothesized that children in the intervention group would have increased level of safety knowledge compared to the children in the control group. This hypothesis was tested using hierarchical linear regressions to evaluate whether condition (intervention vs control) predicted post-intervention safety knowledge after controlling for demographic factors and pre-intervention safety knowledge.

Table 3 shows the results of this analysis. In the first step, demographic variables were entered as independent variables, including children's age, gender, ethnicity, socioeconomic status, dog-bite history, exposure frequency to child-dog interactions, dog ownership, and daily risky practice with dogs. Pre-intervention safety knowledge was also entered in the first step. The dependent outcome variable was children's post-intervention safety knowledge. All independent variables in the first step accounted for 19% of the variance in the outcome, R^2 = .19, F (9, 261) = 6.62, p < .001. As expected, none of the demographic variables were predictive of post-intervention safety knowledge, while children who had more pre-intervention safety knowledge were likely to have more post-intervention safety knowledge (B=.45, t=6.32, p<.001).

Table 3. *Hierarchical Linear Regression Analysis Predicting Children's Post-Intervention Safety Knowledge on Child-Dog Interaction*

	Step 1			Step 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	.44	1.06	.02	.36	.87	.02
Male Gender	-2.04	1.76	-.07	-1.54	1.45	-.05
Han Ethnicity	-3.18	3.16	-.06	-4.72	2.61	-.09
Socioeconomic Status	1.41	1.21	.07	.86	1.00	.04
Dog Bite History	.13	2.20	.01	-.01	1.81	.00
Dog Exposure	-.1.07	1.25	-.06	-.09	1.03	-.01
Dog Ownership	-1.59	1.94	-.05	-1.63	1.60	-.05
Daily Risky Practice	-1.88	1.74	-.07	-1.83	1.43	-.07
Pre-Knowledge	.45	.07	.37***	.45	.06	.37***
Intervention	-	-	-	15.93	1.43	.52***
R^2 change		.19			.26	
df for R^2 change		9/261			1/260	
F for R^2 change		6.62***			123.51***	

Note. *** $p < .001$

In the second step, intervention was entered into the model as an independent variable to evaluate whether the intervention predicted post-intervention safety knowledge after variance from demographic variables and pre-intervention safety knowledge was controlled. Being in the intervention group accounted for a significant proportion of the variance, R^2 change = .26, F (1, 260) =123.51, $p < .001$. Children in the intervention group had significantly higher level of safety knowledge about dogs compared to those in the control group (B=15.93, t=11.11, p<.001), supporting the hypothesis.

Testing Hypothesis 2: The Effect of Intervention on Children's Perceived Vulnerability

We hypothesized that children in the intervention group would have increased level of perceived vulnerability on child-dog interactions compared to those in the control group. This hypothesis was tested using hierarchical linear regression analyses to evaluate whether condition (intervention vs control) predicted post-intervention perceived vulnerability after controlling for the same set of demographic factors and pre-intervention perceived vulnerability.

Table 4 shows the results of this analysis. In the first step, the same set of demographic variables as used to test Hypothesis 1 was entered as independent variables, along with pre-intervention perceived vulnerability. All independent variables in the first step accounted for 34% of the variance in children's post-intervention perceived vulnerability, $R^2 = .34$, F (9, 261) = 15.20, $p < .001$. None of the demographic variables predicted post-intervention perceived vulnerability, while children who had higher pre-intervention perceived vulnerability were more likely to have higher post-intervention perceived vulnerability (B=.51, t=9.93, p<.001). In the second step, intervention was entered into the model as an independent variable to evaluate whether being in the intervention predicted post-intervention perceived vulnerability, after demographic variables and pre-intervention perceived vulnerability had been controlled for. Being in the intervention accounted for a significant proportion of the variance, R^2 change = .10, F (1, 260) =46.68, $p < .001$. Children in the intervention group had signif-

icantly higher perceived vulnerability about child-dog interactions compared to those in the control group (B=.37, t=6.83, p<.001), supporting the hypothesis.

Table 4. *Hierarchical Linear Regression Analysis Predicting Children's Post-Intervention Perceived Vulnerability on Child-Dog Interaction*

Variable	Step 1			Step 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Age	.05	.04	.07	.04	.03	.06
Male Gender	-.02	.06	-.02	-.01	.05	-.01
Han Ethnicity	-.19	.11	-.09	-.23	.10	-.11
Socioeconomic Status	.06	.04	.08	.05	.04	.07
Dog Bite History	-.06	.07	-.04	-.06	.07	-.04
Dog Exposure	-.03	.04	-.04	-.01	.04	-.01
Dog Ownership	-.03	.07	-.02	-.02	.06	-.02
Daily Risky Practice	-.03	.06	-.03	-.03	.06	-.03
Pre-Knowledge	.51	.05	.54***	.51	.05	.54***
Intervention	-	-	-	.37	.05	.32***
R^2 change		.34			.10	
df for R^2 change		9/261			1/260	
F for R^2 change		15.20***			46.68***	

Note. ***p < .001

Testing Hypothesis 3: The Effect of Intervention on Children's Simulated Behavior with Dogs

We hypothesized that children in the intervention group would have safer simulated behaviors with dogs in the dollhouse task than those in the control group. This hypothesis was tested using hierarchical linear regression analyses to evaluate whether condition (intervention vs control) predicted post-intervention behavior with dogs in the dollhouse

task after controlling for the same set of demographic factors and pre-intervention behavior.

The results of this analysis are presented in Table 5. In the first step, the same set of demographic variables as used in testing Hypotheses 1 and 2 was entered as independent variables, along with pre-intervention behavior. All independent variables in the first step accounted for 41% of the variance in children's post-intervention behavior, R^2 = .41, F (9, 257) = 20.11, p < .001. None of the demographic variables predicted post-intervention behavior, while children who had safer pre-intervention behavior with dogs in the dollhouse were more likely to have safer post-intervention behavior with dogs in the dollhouse task (B=.58, t=12.67, p<.001). In the second step, intervention was entered into the model as an independent variable to evaluate whether being in the intervention predicted post-intervention behavior with dogs in the dollhouse task after demographic variables and pre-intervention behavior had been controlled for. Being in the intervention accounted for a significant proportion of the variance, R^2 change = .10, F (1, 256) =50.34, p < .001. Children in the intervention group had significantly safer behaviors with dogs in the dollhouse task than those in the control group (B=.25, t=7.10, p<.001), supporting the hypothesis.

Table 5. *Hierarchical Linear Regression Analysis Predicting Children's Post-Intervention Behavior in the Dollhouse Task*

	Step 1			Step 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	-.02	.02	-.05	-.02	.02	-.05
Male Gender	.03	.04	.04	.04	.04	.06
Han Ethnicity	-.04	.07	-.03	-.07	.06	-.05
Socioeconomic Status	.01	.03	.01	-.01	.02	-.01
Dog Bite History	-.03	.05	-.03	-.03	.04	-.03
Dog Exposure	-.03	.03	-.07	-.01	.03	-.03
Dog Ownership	-.05	.04	-.06	-.05	.04	-.06
Daily Risky Practice	.01	.04	.02	.01	.03	.02
Pre-Knowledge	.58	.05	.64***	.58	.04	.64***
Intervention	-	-	-	.25	.04	.31***
R^2 change		.41			.10	
df for R^2 change		9/257			1/256	
F for R^2 change		20.11***			50.34***	

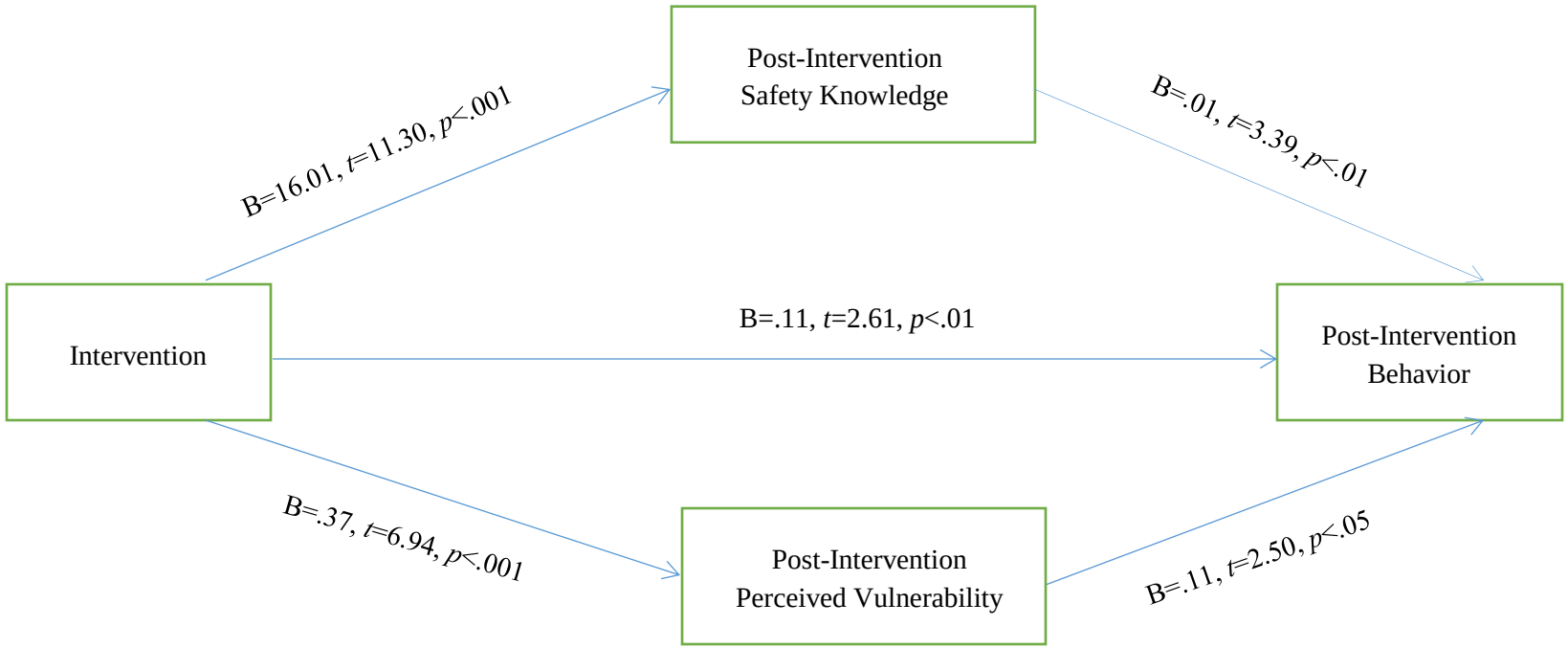
Note. ***$p < .001$

Testing Hypothesis 4: The Mechanism of the Intervention Effect

The testing of Hypothesis 3 supported the existence of an effect of the video-based testimonials on simulated behaviors in the dollhouse task. The fourth hypothesis stated that perceived vulnerability and safety knowledge would mediate the effect of the intervention on children's simulated behaviors with dogs in the dollhouse task. The bootstrapping method with 95% bias-corrected confidence estimates and 10,000 bootstrap resamples (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004, 2008) was applied to test a two-mediator model with training condition (intervention or comparison treatment) as the independent variable, post-test scores on simulated behaviors with dogs in the dollhouse task as the dependent variable, and post-test scores on safety

knowledge and perceived vulnerability as two parallel mediators, controlling for pre-test scores on knowledge, perceived vulnerability and simulated behaviors, and demographic variables including age, gender, ethnicity, socioeconomic status, dog-bite history, exposure frequency to child-dog interactions, dog ownership, and daily risky practice with dogs.

Results of this analysis are presented in Figure 3. The mediation role of perceived vulnerability was supported (B=.04, 95% CI= [.01, .08]). Children who watched the video-based testimonials on dog-bite prevention had significantly higher perceived vulnerability (B=.37, t=6.94, p<.001), and this increased perceived vulnerability was related to significantly safer simulated behaviors at post test for this group of children (B=.11, t=2.50, p<.05). The mediation role of safety knowledge was also supported (B=.10, CI= [.04, .17]). Children who watched the testimonials on dog-bite prevention had significantly more safety knowledge (B=16.01, t=11.30, p<.001), and this increased safety knowledge was related to significantly safer behaviors at post-test among these children (B=.01, t=3.39, p<.01). The direct effect between training condition and children's simulated behaviors was still significant after taking into account these two mediators (B= .11, t=2.61, p<.01), suggesting partial mediation.



Note: Age, gender, ethnicity, socioeconomic status, dog-bite history, dog exposure, dog ownership, and daily risky practice were controlled for in this analysis

Figure 3. *The Mechanism of the Intervention Effect*

CHAPTER 4

SUMMARY AND DISCUSSION

Summary of Findings

This study examined three hypotheses that were proposed to evaluate the effectiveness of the video-based testimonials on improving rural Chinese elementary school children's safety knowledge, perceived vulnerability, and simulated behaviors with dogs. All three of these hypotheses were supported. Specifically, the results showed that: (1) Children in the intervention group, who watched the video-based testimonials on dog-bite prevention, had a significantly increased level of safety knowledge about child-dog interaction safety than those in the comparison group, who watched similar video-based testimonials on the topic of drowning prevention; (2) Children in the intervention group showed increased perceived vulnerability on child-dog interactions compared to those in the comparison group; and (3) Children in the intervention group demonstrated increased safe simulated behaviors with dogs in the dollhouse task than those in the comparison group.

The fourth hypothesis was that perceived vulnerability and safety knowledge would mediate the effect of the intervention on children's simulated behaviors with dogs in the dollhouse task. This hypothesis was tested using 95% bias-corrected bootstrapping me-

diation analysis and the mediational roles of both perceived vulnerability and safety knowledge in the effect of the intervention on children's simulated behaviors were confirmed, supporting Hypothesis 4. In other words, training with video-based testimonials improved children's safety knowledge and increased their perceived vulnerability toward child-dog interactions, which in turn led to safer behaviors with dogs in the dollhouse task. In addition, perceived vulnerability and safety knowledge only partially mediated the effect of the intervention on simulated behaviors, suggesting there are other mechanisms that also underlie this intervention effect that were unaccounted for in this study.

Discussion of Findings

Effect of Intervention on Children's Safety Knowledge

Historically, dog safety knowledge has been one of the most common targets for pediatric dog-bite interventions in the literature (Dixon et al., 2013; Mello, Getz, Lapidus, Moss, & Soulos, 2007; Meints & De Keuster, 2006, 2009; Spiegel, 2000; Szecsi et al., 2010; Wilson et al., 2003). The significant role of safety knowledge in previous interventions may arise from two assumptions. First, with the ultimate goal to change children's behaviors with dogs, it is reasonable to assume that the improvement of knowledge would play a foundational role for potential behavioral changes, an assumption supported by the Health Belief Model (Janz & Becker, 1984). Second, the impartment and assessment of safety knowledge is seen as an objective, accessible and convenient method to assess success of intervention program. However, the learning of rules

and facts requires primarily memorization and repetition of rules and guidelines. While the video-based testimonials in the current study taught various safety rules and knowledge about child-dog interactions, these lessons were integrated into four vividly presented stories via first-person account with textual, graphic and musical illustrations. The goal was to ingrain the safety knowledge into school-aged children's minds by helping them better learn and process cognitive information using emotional stimuli (De Wit et al., 2008; Loewenstein et al., 2001) rather than through repetitive memorization effort.

Consistent with previous findings from other interventions, the video-based testimonials in the current study did significantly improve safety knowledge about child-dog interactions among children in the intervention group compared to those in the comparison group. Children in the intervention group increased their score on safety knowledge from only 46.55% before the intervention to 66.52% after the intervention, while their counterparts in the comparison group improved less (46.49% pre-intervention to 50.88% post-intervention). This significant improvement of safety knowledge on child-dog interactions among children in the intervention group indicated that effective learning of safety rules and facts can be achieved through a computerized story-telling method which is both attention-drawing for school-aged children and cost-effective for mass delivery via the school system. In fact, this finding is also consistent with the broader literature on learning, which suggests that children learn most efficiently through real-life

scenarios during which emotion and cognition interact with each other to enhance the learning experience (Loewenstein et al., 2001; Morrongiello & Matheis, 2007b).

Effect of Intervention on Children's Perceived Vulnerability

Unlike safety knowledge, individuals' perceived vulnerability has received far less attention in the field of pediatric dog-bite prevention. A systematic search in the current literature failed to return any published intervention on pediatric dog-bite injuries that explicitly targeted perceived vulnerability in children, although similar strategies were applied successfully in the prevention of other types of pediatric injuries (Jackson & Aiken, 2000; Morrongiello & Matheis, 2007a).

This study included perceived vulnerability as a major intervention target based on the Health Belief Model, which states that individuals' health-related behaviors can be modified by changes in perceived vulnerability, among other factors (Janz & Becker, 1984). This study chose first-person testimonial accounts as a way to change children's perceived vulnerability for two reasons. First, communication psychology suggests that subjective experiential testimonial is among the most effective strategies to change individuals' perceptions (De Wit et al., 2008; Slater & Rouner, 1996). Second, according to the *risk-as-feeling hypothesis*, testimonials that involve strong emotional reactions have the potential to change individuals' health-related behaviors even if the new behavioral pattern is contradictory to their psychological preferences (Loewenstein et al., 2001).

The success of the current study in changing children's perceived vulnerability provides additional evidence supporting the effectiveness of first-person testimonials in changing children's perceptions (Janz & Becker, 1984), thus holding important implications for the development of intervention programs for dog-bite prevention and other pediatric health-related issues in future research.

Effect of Intervention on Children's Simulated Behavior with Dogs

Actual behavior between a child and a dog – how the pair interacts – is probably the most important outcome for any intervention program on pediatric dog-bite injury prevention. Although an intervention may aim to improve children's safety knowledge or to increase children's perceived vulnerability, ultimately an intervention program must make children behave safely with dogs to prevent injuries from such interactions. Previous studies that included behavioral assessment have produced inconsistent findings in terms of the effectiveness of interventions on changing children's behaviors with dogs (Chapman et al., 2000; Schwebel et al., 2012).

This study assessed children's behaviors with dogs in a simulated task (the doll-house task; adapted from Schwebel et al., 2012). Results revealed that the video-based testimonials effectively improved children's simulated behaviors with dogs in the intervention group but not in the comparison group. Children in the intervention group demonstrated safer behaviors not only with family-owned dogs that they might play with at home, but also stray dogs that they might encounter on public streets in rural China.

This finding is particularly significant since previous research found almost equal chance of dog-bite injuries for school-aged children in rural China inside and outside the home settings (Shen et al., 2014).

Mediating Effect of Perceived Vulnerability and Safety Knowledge

Our final hypothesis sought to understand the underlying mechanisms in how the video-based testimonials worked to effectively change children's simulated behaviors with dogs. Cognition is viewed as playing the most important role in behavioral changes (Mahoney, 1974). However, many previous interventions targeting behavioral changes of child-dog interactions only focused on one cognitive aspect, children's factual knowledge, as the intervention strategy (e.g., Dixon et al., 2013; Mello et al., 2007; Meints & De Keuster, 2006, 2009; Spiegel, 2000; Szecsi et al., 2010; Wilson et al., 2003). Mixed results from these previous intervention efforts remind us that there might be other crucial aspects of cognition such as perceived vulnerability that also play a role in changing children's behaviors with dogs. Research in other areas of health-related behaviors confirms this possibility (e.g., Tolvanen, Lahti, Miettunen, & Hausen, 2012).

Thus, Hypothesis 4 of the current study explored the mediating roles of both factual knowledge and perceived vulnerability in the effect of the intervention on children's behavioral changes. On the one hand, the results supported the previously noted role of factual knowledge in improving children's safe behaviors with dogs. On the other hand, it was found that perceived vulnerability also played a significant role in modifying chil-

dren's behaviors with dogs, which suggested a new potential strategy to prevent dog-bite injuries among children that has been largely missing from the previous literature.

One next step in the literature may be to explore factors in the intervention that promote the effect of perceived vulnerability (among other perceptual characteristics) on children's behavioral outcomes in child-dog interactions. For example, developmental psychology research suggests children's behaviors are influenced differently by emotion and cognition at different developmental stages (Morrongiello & Matheis, 2007b). The video-based testimonials developed in this study incorporated emotional stimuli (such as graphics and music) in addition to cognitive training. However, it is not yet clear how emotion and cognition respectively contributed to the positive effect of the intervention. It may be valuable in future research to try to parse out the relative contributions of emotional stimuli and cognitive training on children's behavior change at different ages/developmental stages.

It should also be noted that even after accounting for both knowledge and perceived vulnerability, there was still a significant direct effect of training on behavioral changes. This suggests that there are still other factors that influenced children's behaviors with dogs that were unaccounted for in the current study. Examples of such factors that warrant the attention of future research include children's temperamental characteristics (e.g., Lahat et al., 2012; Rudasill, Reio, Stipanovic, & Taylor, 2010) and self-efficacy (e.g.,

Webb, Joseph, Yardley, & Michie, 2010), both of which are associated with behavioral outcomes in the intervention literature.

Developmental Considerations on the Fitness between the Video-Based Testimonials and the Target Sample

The video-based testimonials in the current study focused specifically on children at an average age of ten years old, who attended 3rd or 4th grade at a school in rural China. This choice of sample was based on both developmental factors and public health risks for children at this age group. Cognitively, typically-developing 10-year-olds are at the developmental stage described by Piaget as the 'concrete operational' stage, at which children tend to think logically about concrete events but are not yet able to process abstract thoughts (Piaget, 1964). This tendency to process concrete events corresponds with the testimonial stories presented in the current intervention, in which children were expected to learn from the real-life events but not abstract lessons.

Emotionally, the invocation of emotional fear plays an important role in the success of the intervention. In middle childhood, youth have gradually grown out of the stage of fearing events in the immediate environment, and are starting to develop fears of anticipatory events that do not posit a threat at the moment (Gullone, 2000). The emotional stimuli incorporated in the current intervention utilized this fear of anticipatory events, in this case potential dog-bite injuries, by incorporating emotional stimuli such as background music and graphic illustration and description.

In terms of public health risks, previous research showed that compared to toddlers and pre-school children who were injured by dog bites mostly at home, school-aged children are at greater risk of dog-bite injury because they were found equally likely to get bitten by dogs both at home and on public streets (Shen et al., 2014). The intervention in the current study targeted this especially vulnerable age group by incorporating two testimonials for preventing dog-bite injury at home and two on public streets, thus working to minimize the risk of dog-bite injury regardless of the children's location.

Future research might consider how the current intervention would apply to different age groups. For older children, the summary lessons at the end of each testimonial story could emphasize more abstract safety lessons rather than focusing solely on concrete stories. For implementation of this intervention with younger children (e.g., pre-school-aged), both the content and form of the current intervention may need adjusting. Testimonial stories for pre-school children may need to focus more on in-home safety with dogs rather than stray dogs outside the home (Shen et al., 2014). They also might use more graphic and lively elements to mimic the more 'immediate environment' that pre-school children respond to. The length of testimonials also should be shortened to capture the attention of children at this younger age.

Cultural Considerations on the Video-Based Testimonials

The video-based testimonials in the current study were designed for implementation in rural China, and therefore incorporated a few unique characteristics to fit that culture. For example, the four presenters of the testimonial stories were all native Chinese speakers who spoke standard Mandarin Chinese commonly taught in rural schools of China. Additionally, these four presenters were representative of the interpersonal environment of children in rural China in terms of age (younger and older adults), gender ratio (3 females and 1 male, as mothers are more likely to take care of children and school teachers are mostly female), societal roles (school teacher, parents and grandparents), and geographic origin (both northern and southern China).

The current intervention could likely be applied to children living in urban Chinese cities if we adopted one major change in the content of the testimonials. Specifically, children from urban China do not share the same risk from stray dogs on public streets as those from rural China because they interact mostly with pet dogs (e.g., He & Pu, 2010). Thus, children in urban China might be trained with testimonial stories on safe interactions with pet dogs, with testimonials concerning stray dogs omitted.

Testimonial-based interventions such as the one used in this study also could be adopted for use in other cultures that share similar characteristics with rural China. Examples include countries and cultures in South Asia, Latin America and Africa. Of course, respective changes in the presenters' demographic characteristics (age, gender,

societal roles, etc.) and the content and form of the testimonials would need to be implemented. For example, in regions where local residents are more accustomed to face-to-face interactions at social gatherings rather than via 'virtual' channels such as television or computer screens, in-person presentation of testimonial stories at local community gatherings or religious facilities could replace electronic delivery via computer screens.

There may also be potential to adapt testimonial-based training to high-income countries and cultures. For example, health-related attitudes and behaviors of children living in more developed Western countries might be more influenced by peer groups rather than by parents and school teachers (e.g., Gardner & Steinberg, 2005). Therefore, instead of using adults as storytellers, the testimonial stories might be more effective if they are presented by children at similar ages as the target population of children. Similar to children in urban China, the content of testimonials directed toward high-income nations may also need to emphasize safe interactions with pet dogs in homes rather than stray dogs in public places.

Strengths and Limitations

This study had several methodological strengths. First, previous interventions on pediatric dog-bite injury prevention usually incorporated traditional teaching methods such as repetition of lessons and produced mixed results. The video-based testimonials

developed in this study incorporated first-person testimonial accounts recommended by communication psychologists to prevent dog-bite injuries among children, therefore extending previous intervention approaches. Second, in addition to the traditional outcome measure of safety knowledge, this study also evaluated children's perception change (perceived vulnerability). This study also assessed children's simulated behaviors with dogs, a critical evaluative criterion for the success of an intervention on dog-bite prevention. Finally, to the authors' knowledge there has been no published intervention effort to systematically protect children in rural China from dog-bite injuries, despite the large number of stray dogs (all possible carriers of rabies) in this region. The development and evaluation of the video-based testimonials in this study could provide new directions for the protection and promotion of the welfare for the 150 million children living in rural China.

There are also several limitations of this study. First, out of safety and efficiency concerns, this study measured children's simulated behaviors with dogs in the dollhouse task rather than actual behaviors with live dogs. Future research should include measurement of children's interactive behaviors with live dogs (e.g., Schwebel et al., 2012). Second, this study evaluated outcomes just one week after implementation of the intervention. Future research should incorporate a longer timeframe in the study design to assess cognitive, perceptual and behavioral outcomes of the testimonial-based intervention multiple times and across longer time periods. Finally, this study included a rela-

tively large but still limited sample of children from a single school in rural China. Future research should evaluate the effectiveness of the testimonial-based intervention among children in an expanded geographic region and for a wider range of age and socioeconomic backgrounds in rural China. Future work could also expand to other developing regions of the world.

Implications

Broader implications of this study are three-fold. First, in terms of public health implications, there are 150 million children currently living in rural China who are at significant risk of dog-bite injuries and potentially rabies infection. However, preventive efforts for this enormous population are scarce. To our knowledge, this study was the first empirically-supported intervention program aimed at reducing dog-bite injuries in a large but greatly under-studied and highly vulnerable population of children. Safer child-dog interactions gained from the intervention in this study have the potential to help these vulnerable children engage safely with pet dogs in the home, avoid risky approaches to stray dogs on public streets in rural China, and safely rescue themselves in dangerous situations when aggressive stray dogs approach these children and adult protection is not immediately available. To achieve this, large-scale dissemination of this intervention program is needed. Considering the relatively low socioeconomic status of rural Chinese families, and thus the lack of adequate access to Internet and social media

in home settings, dissemination may be most efficiently achieved via cooperation with local media enterprises and broadcasting via mass media such as radio and television. Another alternative may be cooperating with local school systems, most of which have access to multimedia equipment and Internet, to help disseminate the intervention program.

Second, in terms of implications for psychological science, this study evaluated and supported the efficacy of a video-based testimonial intervention that was uniquely based on behavioral and psychological theories. The Health Belief Model offers unique guidance and opportunities to develop effective intervention strategies that may change individuals' health-related behaviors. This study reminds us of the scientific significance of developing theory-based interventions to solve public health problems.

Finally, in terms of analytic strategy, the adoption of mediation analysis is among the few attempts in the intervention research literature to not only understand if an intervention works, but to also ascertain the underlying mechanisms of how the intervention works. Other researchers working to promote health-related behaviors among populations with diverse individual and cultural backgrounds could utilize this and other analytic strategies, such as multi-level analysis to help better understand different psychological and behavioral factors explaining the efficacy of intervention programs.

Conclusions

This study developed a video-based testimonial intervention based on psychological theories to prevent pediatric dog-bite injuries in rural China. This intervention was evaluated among 280 3rd and 4th grade children in rural China and was found effective in improving children's safety knowledge, increasing perceived vulnerability and simulated safe behaviors with dogs. Perceived vulnerability and safety knowledge both played a significant mediating role in translating the training into behavioral improvement. The testimonial-based intervention has the potential to be disseminated to the broad population in rural China and be applied to children in other age groups and cultures with proper adjustments. This study has important implications for future research in the development of injury prevention programs and psychological theories.

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APPENDIX

DISSERTATION INSTITUTIONAL REVIEW BOARD APPROVAL

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Institutional Review Board for Human Use

Form 4: IRB Approval Form
Identification and Certification of Research
Projects Involving Human Subjects

UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The Assurance number is FWA00005960 and it expires on January 24, 2017. The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56.

Principal Investigator:	SHEN, JIABIN
Co-Investigator(s):	
Protocol Number:	**X140211001**
Protocol Title:	*A Randomized Trial Evaluating Child Dog-Bite Prevention in rural China through Video-Based Testimonials*

The IRB reviewed and approved the above named project on 4/2/15. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This Project will be subject to Annual continuing review as provided in that Assurance.

This project received EXPEDITED review.

IRB Approval Date: 4/2/15

Date IRB Approval Issued: 4-2-15

IRB Approval No Longer Valid On: 4-2-16

Member - Institutional Review Board for Human Use (IRB)

Investigators please note:

The IRB approved consent form used in the study must contain the IRB approval date and expiration date.

IRB approval is given for one year unless otherwise noted. For projects subject to annual review research activities may not continue past the one year anniversary of the IRB approval date.

Any modifications in the study methodology, protocol and/or consent form must be submitted for review and approval to the IRB prior to implementation.

Adverse Events and/or unanticipated risks to subjects or others at UAB or other participating institutions must be reported promptly to the IRB.

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