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Behaving with Respect to Dogs: Children's Mastered Dog-Safety Skills May Not Generalize Naturalistically

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Dog bites are a common danger to children. Behavioral safety training strategies are more effective than nonbehavioral strategies, but questions remain about whether learned responses generalize to new dogs and settings. Three preschool-aged girls who exhibited unsafe dog-greeting behavior during in situ assessments were taught to safely greet unfamiliar, leashed dogs using TAGteach™ (TAGteach International, 2016). The children acquired the six-step behavior chain, but responding did not generalize to a novel dog, handler, and setting even after completing the training three times in progressively more-naturalistic settings. These results suggest a need to investigate effective strategies for teaching safety skills around dogs. They also question whether dog-safety training via online modules, classroom-based instruction, or video modeling is sufficient to improve young children's behavior around dogs in natural settings.

Keywords: TAGteach, safety skills, dog, generalization

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Ethics statement: All procedures in this study conform to US PHS policy and were approved by both the Rollins College Institutional Review Board and the Rollins College Institutional Animal Care and Use Committee.

Data sharing statement: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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More than 4.5 million people are bitten by dogs each year in the United States (Centers for Disease Control and Prevention, n.d.). Over 800,000 of those individuals, almost one in five, require medical attention as a result. Children are bitten more often than other age groups (American Veterinary Medical Association, n.d.) and are more likely than adults to be severely injured if bitten.

Several aspects of children's own behavior contribute to their being bitten. Mathews and Lattal (1994) analyzed the factors contributing to the frequency and severity of dog bites to children. One factor includes children's lack of training in how to safely approach and interact with dogs. Children are likely unprepared to discriminate between cues exhibited by the dog which signal whether the dog is safe or unsafe to approach at any given time. Indeed, even adults often do not discriminate dog body signals well without training (Meintz et al., 2018). The danger to children may be heightened by several unique features of dog-child interactions. First, children move quickly and in unpredictable ways, with their faces at a height putting them in close proximity to a dog's mouth, increasing the likelihood bites will be more severe (Shen et al., 2017). Second, caregivers may underestimate the amount of supervision needed in dog-child interactions. One reason for insufficient supervision could be caregivers' own lack of training. Another reason is prevalent media presentations of dangerous child behavior as acceptable, commonplace, and even cute (e.g., hugging, riding, or lying on the family dog). Addressing child and caregiver behavior presents opportunities to decrease the likelihood of negative outcomes in dog-child interactions.

Mathews and Lattal (1994) suggested strategies for preventing dog bites that included training for caregivers and children that is empirically supported, socially valid, cost effective, and feasible to use and disseminate. Unfortunately, there is a relative lack of empirically-supported interventions on this topic (Schwebel et al., 2012). In fact, few studies have included live dogs in training or assessment components, and few have assessed whether safety behaviors generalize to naturalistic contexts. In a systematic review and meta-analysis of dog-safety interventions, Shen et al. (2017) reported a wide range of methodologies that included traditional classroom-based education, videos, computer simulations, and role playing. After excluding articles based on a variety of criteria (such as focusing on caregivers only, or because they included fewer than 10 participants), the authors reviewed 12 experiments. Of these, only one used a live dog during training and assessment (Chapman et al., 2000). Chapman et al. randomly assigned classrooms of children to receive one-time, group instruction with a live dog and handler in the classroom, or to not receive dog-safety instruction. To assess whether safety behaviors changed as a result of the intervention, the researchers watched the children at a playground with a dog tethered inside. They showed that a higher percentage of children who had not received the intervention patted the dog, while a lower percentage of those who had received the intervention patted the dog. While this study has the distinct strength of training and assessing with a live dog, it does leave room for a more detailed characterization of the learning process and a more fine-grained analysis of the children's behavior toward the test dog. For example, it would be interesting to know how, within the intervention group, individual children's level of active participation in the lesson related to their patting the test dog. Focusing on individual participants' behavior, rather than aggregating results into percentages, would allow a complimentary depiction of how behavior changed across experiences. Across the studies reviewed by Shen et al. (2017), the most commonly assessed outcome of training was the children's knowledge about safety around dogs, which particularly benefitted from video instruction. However, verbal responses on a quiz do not necessarily predict behavior in situ. For example, Schwebel et al. (2012) found that children who experienced dog safety instruction via computer software (*The Blue Dog*; https://www.thebluedog.org/en/) reported recognizing more risks related to dogs than did children who received an unrelated (i.e. fire safety) instruction; however, the groups did not

differ in the number of unsafe behaviors they performed when tested with a live dog post-training. Concerningly, regardless of dog-safety or fire-safety training type, all children displayed more unsafe behaviors toward the live dog after training than during the pre-training live-dog test. The authors propose that this was related to increased familiarity with the situation and that the pre-training live dog assessment was a positive experience for the children. In summary, this study illustrates that knowledge about safety is not the same as safe behavior, and it raises questions about the generality of the effects of training to the naturalistic environment outside the classroom, where dogs are typically encountered.

Behavioral strategies for addressing dog safety have advantages over knowledge-based interventions and assessments. Shen et al. (2017) reported larger effect sizes were found for behavioral versus knowledge-based outcomes in their meta-analysis, possibly because the former involved higher-quality, rigorous studies that assessed outcomes with greater validity. Another advantage of behavioral interventions is they are more effective with a wider variety of participants, including younger children (Shen et al., 2017). Edwards and Poling (2011), in their review of animal research studies published in the *Journal of Applied Behavior Analysis,* recommended the behavioral approach to preventing dog bites discussed by Mathews and Lattal (1994) and advocated for systematic evaluations of such interventions.

TAGteach™ (TAGteach International, 2016) is an increasingly widely used behavioral intervention strategy for teaching behavior chains. The acronym TAG stands for Teaching with Acoustical Guidance™. An audible, nonverbal stimulus is presented contingent on the correct response, or tag point™, by the learner. The nonverbal stimulus is referred to as the tagger ™. Its form can vary, but it is typically a clicker identical to those used in animal training. The cited benefit of the stimulus is that it becomes a conditioned reinforcer through its association with other reinforcers such as praise, tangible items, or edibles that are often earned and delivered via a token economy. TAGteach has been demonstrated to be successful for training skills as diverse as golf swings (Fogel et al., 2010), dance movements (Quinn et al., 2015), football tackling (Harrison & Pyles, 2013), and surgical knot tying (Levy et al., 2016). A first advantage of TAGteach is that it gives precisely-timed auditory feedback for complex behavior chains. The behavior chain of greeting a dog is much like a dance sequence, in that the learner must execute a choreographed series of behaviors. The component behaviors involved in greeting a dog, such as petting the side of the dog and taking a step back from the dog, must happen in the correct order and location. Thus, dog-greeting is similar to the other behaviors to which TAGteach has been applied. A second advantage to using TAGteach in this application is that it is (to our knowledge) the first extension of TAGteach to safety skills. Given the recent prevalence of TAGteach, it is relevant to apply TAGteach to movement skills outside sports and surgery. A third benefit to using TAGteach is that it allows a tentative evaluation of whether skills learned via TAGteach generalize to a naturalistic setting, which has seldom been assessed in other TAGteach studies.

Aside from TAGteach, behavioral skills training (BST) is also very successful at teaching skills, including safety skills (Miltenberger et al., 2015). However, BST is more commonly used for teaching behaviors that may vary from one situation to the next as opposed to a strictly defined sequence, or chain, of responses (Stewart et al., 2007). The current study chose to use TAGteach because of the ability to use precisely-timed feedback, the opportunity to apply TAGteach to a safety context, and the potential to tentatively assess whether skills learned through TAGteach generalize naturalistically.

The purpose of the current research was to see whether dog-safety skills acquired behaviorally generalized to a naturalistic setting. We used TAGteach to teach preschool-aged children to safely approach leashed, unfamiliar dogs. We taught the safety skills across settings which were progressively more like the naturalistic context of meeting a dog who is on leash with their owner. After children mastered the skills in each learning context, we assessed

whether mastered skills generalized to the naturalistic context. We predicted that skills may not generalize from the training to naturalistic context. Thus, the goal of the study was not to experimentally assess an intervention, but instead to assess generalization of mastered skills.

Method

Participants and Settings

The study was approved by both the Institutional Review Board and the Institutional Animal Care and Use Committee (protocol 1531) of Rollins College. Participants were three typically-developing girls who were 4-5 years old, attended a laboratory preschool at a small liberal arts college in the south-eastern United States, and were living in homes with at least one dog. Participants were included if, during the initial baseline assessment, they engaged in any behavior that could be considered potentially unsafe when approaching the dog, such as touching near the dog's mouth, grabbing the tail, hugging the dog, or putting their faces in close proximity to the dog's face. Parents provided informed consent prior to these initial observations, and the child's teacher sought and received the child's assent to participate immediately prior to each session. Each of eight sessions lasted approximately 20 min and were conducted in a small meeting room in the school or on a sidewalk directly outside the school.

Each session throughout the study included either a therapy dog the child had not met before or a toy dog. Fifteen certified therapy dogs were recruited from the following organizations: Alliance of Therapy Dogs, Be an Angel Therapy Dogs, and PAWS Therapy Dogs. Dogs' breeds differed (i.e. mixed breed, Akita, beagle, Belgian Tervuren, Bernese mountain dog, golden retriever, Labrador retriever, Portuguese water dog) to promote generalization and increase external validity. Researchers recruited therapy-dog handlers who reported that their dogs had worked with young children previously and demonstrated tolerance of inappropriate handling by them. Handlers provided informed consent and accompanied their dogs during sessions. Handlers also participated in sessions by responding affirmatively when children asked permission to pet the dog. Although the handlers had been advised they could intervene at any time if they felt the situation was potentially unsafe for the dog or child, none ever did so.

Materials

TAGteach session materials included three small plastic dinosaur toys, a whiteboard to administer the token system, sticker books from which the children chose backup reinforcers, and a song in the participants' repertoires ("Mary Had a Little Lamb"). Whereas many TAGteach procedures use a clicker as the tagger, we used a bicycle bell mounted on a small piece of PVC pipe to avoid extinguishing the clicker's conditioned reinforcing function for the therapy dogs. A video camera and tripod recorded all sessions. TAGteach sessions with the toy dog included a stuffed polyester dog resembling a seated Boston terrier, 16 in. tall, with a leash held by a researcher acting as the dog's owner.

Task Analysis/Tag Points

The current study focuses on a particular context: when a child and their parent meet a leashed dog outdoors and in the presence of the dog's owner. In order to operationally define safe dog-approach behavior, . we surveyed current curricula instructing children to safely meet leashed dogs and interviewed two humane educators employed at a major animal welfare organization in the north-western United States. From these resources, six specific tag points were developed. The tag points are behavioral criteria that the learner must achieve to earn each tag (to get each reinforcer). The tag points were formulated to meet the WOOF^{TM} criteria for tag points (TAGteach International, 2016). According to these criteria, each tag point should be *What you want* (i.e., naming the response), *One criterion* (i.e., setting a criterion for

a successful response), *Observable and definable* (i.e., operationally defining the response), and *Five words or less* (i.e., using concise language). Although the same six tag points were used for all three participants, the wording of each tag point varied slightly to allow the learner to individualize their tag points (e.g., "Ask the owner" instead of "Ask permission"). Table 1 presents the tag points and a brief description of each. The operational definition of safe dog-approach behavior consisted of the following six tag points: Ask permission, wait 2 seconds, step to the side, pet the shoulder, bring hand to side, and step back.

Table 1
Safe Dog-Greeting Steps

Tag Point	Description
1. Ask permission	Ask the handler for permission to pet the dog
2. Wait 2 seconds	Wait for approximately 2 seconds
3. Step to the side	Move slowly to the side of the dog
4. Pet the shoulder	Extend hand to pet the dog's side or shoulder
5. Bring hand to side	Move hand back to the side of body
6. Step back	Take one step away from the dog

Design

The present study consists of an AB design with probes. The purpose of the study was to assess whether mastered performance generalized in naturalistic probe sessions. Our purpose was not to determine whether TAGteach was the reason for potential skill acquisition. Thus, the internal validity concerns of AB designs are not as relevant as they would be, were we aiming to determine the reason for skill mastery. To achieve the goal of assessing generalization, our overall design consisted of teaching safety skills to mastery in three settings progressively more like the naturalistic setting; we then probed for generalization after each teaching phase.

Prior to TAGteach, we conducted a brief baseline assessment of participants' behavior around dogs, in which participants interacted with unfamiliar dogs. The purpose of baseline was only to ascertain whether participants behaved unsafely. This was immediately confirmed. Therefore, even though all study dogs were experienced therapy dogs who frequently worked with children, we minimized the number of sessions in baseline as an important safety measure. In addition to safety concerns, there would have been no benefit to running additional baseline sessions, as we did not need a stable baseline to which to compare the effects of an experimental intervention.

As an overview, the study consisted of baseline, then a brief two-part pairing procedure to establish the conditioned reinforcer, then the TAGteach intervention. The three TAGteach phases represented progressively more-naturalistic training contexts: 1. Toy dog indoors, 2. Therapy dog indoors, 3. Therapy dog outside. Each TAGteach phase continued until mastery. Single-trial baseline assessments (i.e., probes) occurred between each training phase. Sessions lasted approximately 5-20 min. Thus, each subject experienced the following sequence of conditions (number of sessions): baseline (1); TAGteach with toy dog indoors (2); probe (1); TAGteach with dog indoors (1); Probe (1); TAGteach with dog indoors (1), Probe (1)

Baseline and Probes

Baseline trials assessed participant performance before the intervention; probe trials assessed whether participants' experiences with TAGteach generalized to a different handler/ dog combination. Baseline and probe trials were identical and represented the naturalistic

situation of meeting a leashed dog while walking with an adult. These trials occurred outdoors with novel therapy dogs and their handlers. Each participant came outdoors individually after assenting to the teacher's request to participate. Researchers stated the dog's name and oriented the participant to the dog without instruction (e.g., "This is Beckett. Have you ever seen a dog so fluffy?"). Researchers assessed the participant's behavior in meeting the dog while providing no programmed consequences. The trial ended when the participant walked away from the dog or after approximately 10 s of incorrect responding. After a probe ended, the next training trial began.

TAGteach

The researchers who implemented TAGteach were two doctoral-level behavior analysts who studied the TAGteach resources (with the first author completing the TAGteach fundamentals training course available at TAGteach.com) and consulted with another doctoral-level behavior analyst who also completed the fundamentals course. Additionally, the 2nd author has supervised prior TAGteach research by TAGteach-certified individuals. All procedures comprising the TAGteach method were followed in this study with the exception of the addition of verbal praise with the tagger (see below).

After baseline, and before beginning the first TAGteach session for each participant, we carried out a two-part pairing procedure in order to establish the tagger (bell) as a conditioned reinforcer. In these two game-like pairing procedures, the tagger (bell) was paired with reinforcement (TAGteach International, 2016). In the first pairing procedure, we used the song "Mary Had a Little Lamb." All three steps of the TAGteach International (2016) protocol for introducing the tagger and tag point (i.e., 1. Teacher tags self; 2. Learner tags teacher; 3. Teacher tags learner) were followed using the tag point "lamb." Thus, during this pairing procedure, the researcher and the participant sang the song together, first with the teacher tagging (ringing the bell) for each of her own utterances of "lamb," then second with the participant holding the tagger and tagging each of the teacher's utterances of "lamb," and third with the teacher tagging each time the participant said "lamb." In the second pairing procedure, the learner hid red, green, and yellow dinosaur toys behind her back, revealing them one by one in random order. The same three steps described above were followed, with the tag point of revealing the green dinosaur. When the learner achieved the tag point (revealed the green dinosaur), the teacher rang the bell and delivered social praise (e.g., "You got it!"). Although not part of the TAGteach International (2016) protocol, verbal praise was included with the tag because the participants were young and had a history of reliably receiving praise from their teachers for correct behavior.

In addition to the TAGteach procedure, we implemented a token economy system. During the session, earning four check marks on a whiteboard would result in the participant getting to choose a sticker from multiple available sticker books. One check mark was delivered each time a participant correctly performed a tag point.

Immediately after the tagger-reinforcement pairing was complete, the TAGteach intervention began in the same session. The researcher discussed the objective of the lesson with the participant: "to learn to greet a dog safely, which is important because *[participant inserted reason here]."* The researcher coached responses to the effect of dogs do not always want to be petted or the dog might bite or get uncomfortable if petted. Following the TAGteach focus funnel™, (TAGteach International, 2016), the researcher gave the specific task-analysed instructions to the participant and then modeled all six steps of the procedure for safely petting a leashed dog. The researcher then used TAGteach to teach each individual step of the task analysis in sequence.

During TAGteach, we taught each tag point one at a time, and cumulatively. The first requirement was only Tag Point 1 (ask permission). When the participant mastered only this

skill, we then taught Tag Point 2 (wait two seconds) as part of a two-step behavior chain, so that the requirement was to ask permission, then wait two seconds. Training trials repeated until mastery of these two steps. Upon mastery, we then added the third tag point, and trained until mastery of the first three tag points, and so on, so that training within a phase was complete when the participant performed all six tag points to mastery. Mastery was defined as the participant performing the series of tag points at least 80% correctly on three trials in a row. The 80% criterion is functionally a 100% criterion on trials with fewer than five tag points (i.e.. in a three-tag-point chain, all tag points must be correct to score 80% correct; in a five-tag-point chain, at least four tag points must be correct). We repeatedly used TAGteach to produce mastery of all six tag points across three phases: 1. TAGteach with a toy dog indoors (one session focusing on Tag Points 1-3 and a second session on Tag Points 4-6); 2. TAGteach with a therapy dog indoors (one session); and 3. TAGteach with a therapy dog outdoors (one session). Thus, each child mastered all six tag points three times across three dog/setting combinations. Probes, identical to baseline and described above, occurred after each phase and assessed generalization of the training to the outdoors with a novel therapy dog.

At the beginning of each TAGteach intervention session and when each new tag point was introduced, the researcher stated the individual tag point. For example, when starting to work on the first tag point, she stated, "The tag point is ask permission." She then proceeded through the three-step process described above (teacher tags self, learner tags teacher, teacher tags learner). The third step (teacher tags learner) remained in effect until the learner achieved mastery of that tag point. Each correct trial resulted in a tag, brief verbal praise, and a check mark on the whiteboard. When the participant earned four check marks the session paused for 2-3 min while she selected a sticker and placed it on herself or her clothing. Incorrect trials resulted in the researcher stating, "Try again." The researchers followed the "three-try rule" (TAGteach International, 2016), in which if the learner performed three trials of the same tag point incorrectly, the tagger returned the learner to an earlier mastered tag point (i.e., the prior "point of success;" TAGteach International, 2016) and the process for that tag point began anew with the teacher tagging herself, and so forth. When the learner achieved mastery of that tag point for three trials in a row, the next tag point was presented. All TAGteach sessions followed this same procedure.

Response Measurement and Reliability

The main outcome measure was whether the participant completed the tag points correctly or incorrectly. Researchers collected data from the videos recorded during sessions. For example, if tag point 3 was being taught on that trial, the researcher recorded whether the participant completed each of tag points 1, 2, and 3 correctly or incorrectly.

For 100% of the trials, two trained researchers independently recorded whether the participant completed each of the six tag points correctly or incorrectly. Trial-by-trial inter-observer agreement (IOA) was calculated for each session by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. Treatment integrity was assessed using a checklist including seven aspects of each tag point (TAGteach International, 2016): The tag point was delivered using proper phrasing; the teacher modeled the tag point while tagging herself; the learner tagged the teacher performing the tag point; the teacher tagged each instance of the learner correctly performing the tag point; incorrect behavior was not tagged; a minimum of three consecutive correct trials were completed before moving on; and the lesson was repeated after three incorrect attempts. Treatment integrity was calculated for each TAGteach session, dividing the number of correctly implemented aspects by the sum of the correctly and incorrectly implemented aspects.

Social Validity

Upon completion of the study, participants' parents completed a questionnaire assessing the intervention. Parents rated statements regarding importance, practicality, and satisfaction on a Likert scale with the following points: strongly disagree, disagree, neutral, agree, strongly agree.

Data Analysis

Our research question of whether mastered performance generalized to a naturalistic setting will be assessed by comparing the percent (and number) of tag points performed correctly during the training trials to the percent (and number) of tag points performed correctly during naturalistic probe trials. As training will progress until each individual participant achieves mastery, the percent (number) correct during training will be 100% (6 tag points). We will present data for each participant and each trial, allowing visual analysis of the difference between training and probe performance.

Results

Baseline and TAGteach Phase 1: Toy Dog Indoors

Figure 1 shows the first three conditions for each participant, which were baseline, TAGteach training indoors with a toy dog, and the first probe session. The figure presents two related data paths. Dots depict the percent of steps correct (left axis). Boxes indicate whether individual tag points were performed correctly (filled) or incorrectly (unfilled; right axis). If a box is absent (neither filled nor unfilled), that tag point was not yet being taught. For example, on trial 6, Bianca was learning tag point 2. She performed Tag Point 1 correctly performed Tag Point 2 incorrectly. She was 50% correct on that trial.

All three participants shared an overall pattern of behaving unsafely in baseline, mastering the safe sequence during TAGteach, and performing no safe behaviors in the first generalization probe.

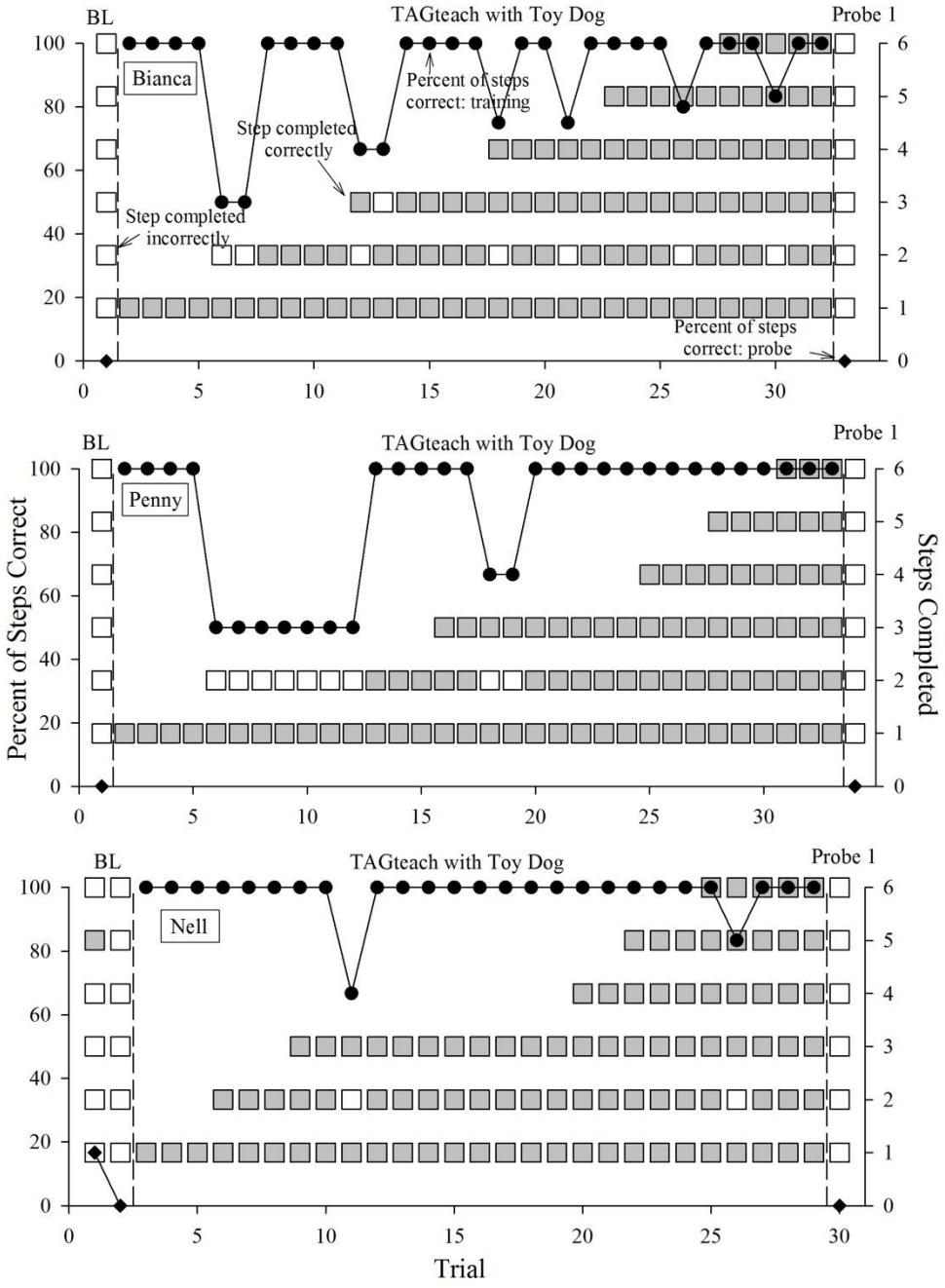
In baseline, during which participants encountered a therapy dog outdoors in a naturalistic setting, Bianca performed no correct dog-greeting tag points and engaged in unsafe behavior by putting her hand in the dog's face. She completed TAGteach training with the toy dog in the classroom in 31 trials across two sessions (for all participants, Tag Points 1-3 were taught in Session 1; Tag Points 4-6 were taught in Session 2). During this training she made seven errors on Tag Point 2 and one error on Tag Point 3, and she made no errors on the other tag points. During the subsequent probe outdoors with a therapy dog, she completed no tag points correctly.

Penny performed no correct dog-greeting tag points in baseline and engaged in unsafe behavior by putting her hands in the dog's face and hugging the dog. She completed TAGteach training with the toy dog in the classroom in 32 trials across two sessions. During the first training session she made nine errors on Tag Point 2 and zero errors on the other tag points, and she made no errors in the second training session. During the probe outdoors, she completed no tag points correctly.

Nell performed one tag point out of 12 opportunities correctly in baseline and engaged in unsafe behavior by putting her hand in the dog's face and jumping. She completed TAGteach training with the toy dog in the classroom in 27 trials across two sessions. During this training she made two errors on Tag Point 2 and no errors on the other tag points. When she achieved mastery in this TAGteach phase with a toy dog in the classroom, we probed her performance outdoors with a therapy dog. She completed no tag points correctly in this probe session. Thus, in the first generalization probe after mastering the tag points indoors with a toy dog, none of the participants performed any of the tag points correctly.

Figure 1

Percent of Steps Correct and Steps Completed Correctly in Baseline, TAGteach with Toy Dog, and Probe 1 for Each Participant



Note. The left axis represents percent of steps correct on TAGteach trials (circles and line) and on probe and baseline (BL) trials (diamonds). The right axis represents steps completed (squares) on each trial; filled squares indicate correctly completed tag points, and open squares indicate incorrectly completed tag points. Absence of a square indicates the tag point was not trained on that trial. Data are shown for each participant.

TAGteach Phase 2: Therapy Dog Indoors

Figure 2 presents the second TAGteach training phase, in which participants relearned the tag points with a therapy dog (rather than a toy dog) in the classroom, followed by a probe outdoors with a novel therapy dog. Bianca completed this training in 22 trials, with two errors on Tag Point 2 and one error on Tag Point 3. During the probe, she performed two tag points correctly (Tag Points 2 and 5). Penny completed training in 22 trials with two errors on Tag Point 2. During the probe, she performed one tag point correctly (Tag Point 3). Nell completed training in 20 trials with zero errors. She then performed one out of six tag points correctly (Tag Point 5) on the subsequent probe. Thus, in the second generalization probe after mastering the tag points in two contexts, participants performed one or two tag points correctly.

TAGteach Phase 3: Therapy Dog Outdoors

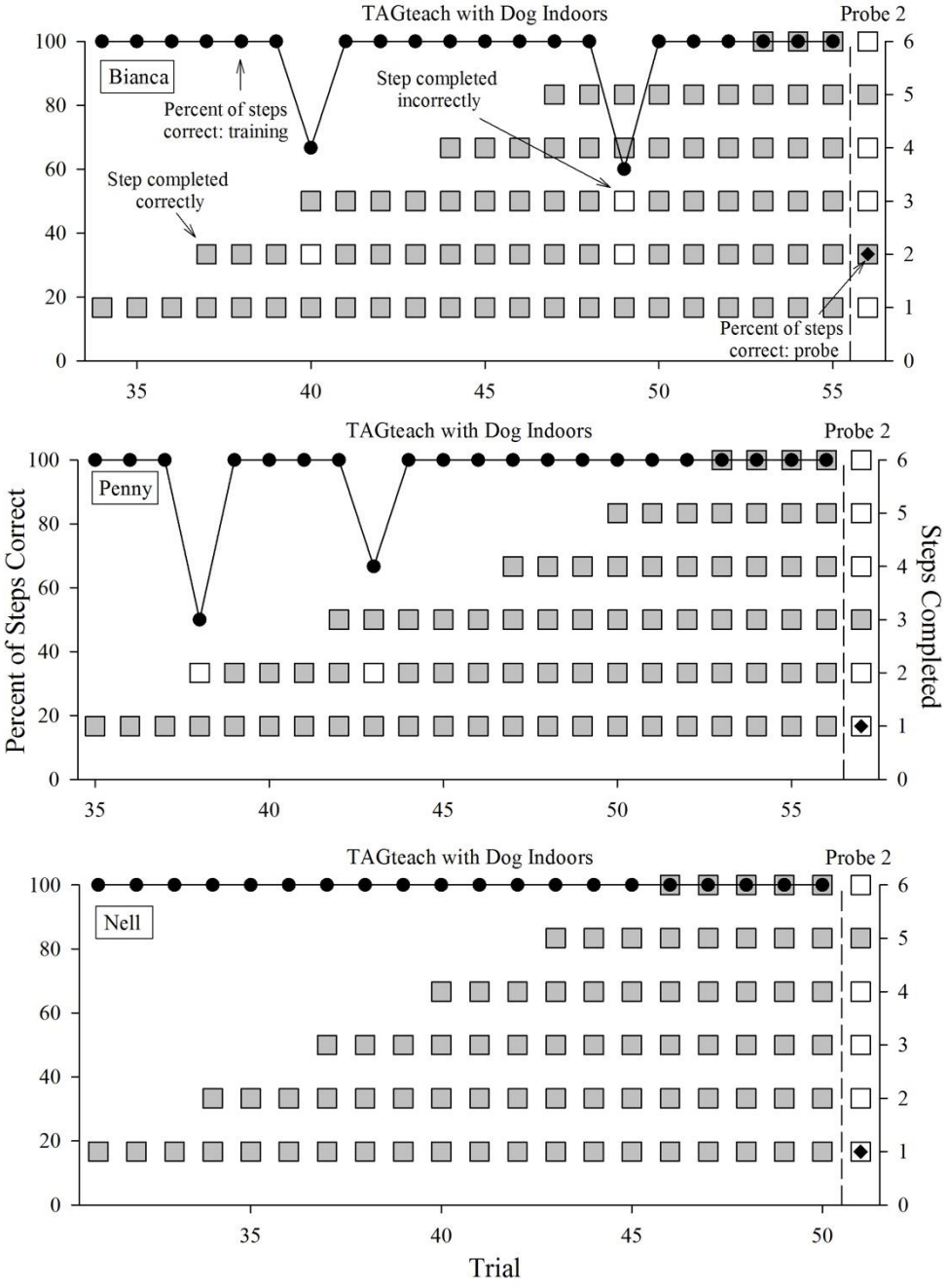
Figure 3 presents the third TAGteach training phase, in which participants relearned the tag points with a therapy dog outdoors in the naturalistic setting, followed by a probe. Bianca completed training in 20 trials with no errors. Penny completed training in 22 trials, with one error on Tag Point 3 and one error on Tag Point 4. Nell completed training in 26 trials with one error on Tag Point 4 and two errors on Tag Point 3. All three of these errors occurred while training Tag Point 4, so after the third error Nell was retrained on Tag Point 3 before moving back to Tag Point 4. Next, the probe took place in the same location as the training, with a novel therapy dog and no instruction. Bianca performed only the sixth tag point correctly; Penny performed only the second tag point correctly; and Nell performed three Tag Points correctly (3, 5, and 6). Thus, after the third context of TAGteach training, Bianca's and Penny's performance remained at 17% (one tag point) correct, and Nell's generalization performance improved to 50% correct.

Due to low performance accuracy after three phases of TAGteach, we then implemented flexible prompt fading (Leaf et al., 2016), which modestly improved skill generalization. These data are available upon request.

IOA was calculated for 47% of trials, including a minimum of 30% of trials in each condition. IOA was 96% (range 67%-100%).Treatment integrity data were collected for all TAGteach sessions with an overall mean of 94% (range 71%-100%). Table 2 shows that parents rated the training experience overall as highly socially valid, with a mean score of 4.52 (approximately "agree") out of 5 ("strongly agree") across all questions proposing beneficial effects of study participation. Across the two questions proposing harmful effects, the mean score was 1.17 (approximately "strongly disagree").

Figure 2

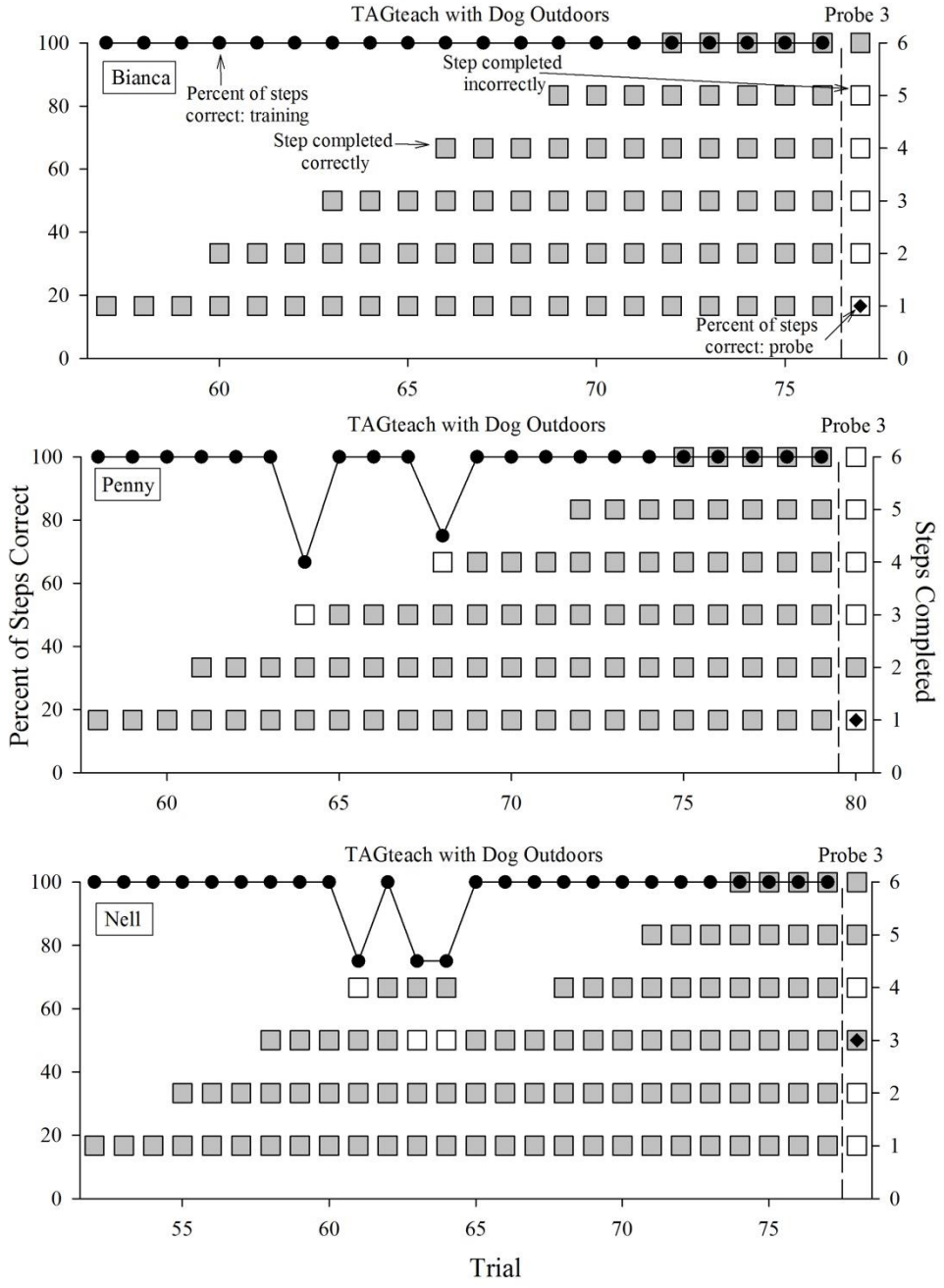
Percent of Steps Correct and Steps Completed Correctly in TAGteach with Dog Indoors and Probe 2 for Each Participant



Note. The left axis represents percent of steps correct on TAGteach trials (circles and line) and on probe trials (diamonds). The right axis represents steps completed (squares) on each trial; filled squares indicate correctly completed tag points, and open squares indicate incorrectly completed tag points. Absence of a square indicates the tag point was not trained on that trial. Data are shown for each participant.

Figure 3

Percent of Steps Correct and Steps Completed Correctly in TAGteach with Dog Outdoors and Probe 3 for Each Participant



Note. The left axis represents percent of steps correct on TAGteach trials (circles and line) and on probe trials (diamonds). The right axis represents steps completed (squares) on each trial; filled squares indicate correctly completed tag points, and open squares indicate incorrectly completed tag points. Absence of a square indicates the tag point was not trained on that trial. Data are shown for each participant.

Table 2
Social Validity Survey Questions and Results

Question	Participant 1	Participant 2	Participant 3
1. My child's knowledge regarding appropriate, safe dog-greeting behavior has increased.	Strongly Agree	Agree	Agree
2. My child behaves more safely around unfamiliar dogs after participating in this research/training.	Strongly Agree	Agree	Agree
3. My child behaves more safely around dogs at home (or other familiar dogs) after participating in this research/training.	Agree	Neutral	Agree
4. This research/training resulted in negative effects on my child's behavior around dogs.	Strongly Disagree	Strongly Disagree	Strongly Disagree
5. I believe the dog-greeting steps listed above are child-friendly and easy to follow.	Strongly Agree	Strongly Agree	Agree
6. I believe my child experienced discomfort while participating in this research/training.	Strongly Disagree	Strongly Disagree	Disagree
7. It is important for children to be informed about how dogs can be approached safely.	Strongly Agree	Strongly Agree	Agree
8. I am pleased that this research/training was implemented early in my child's life.	Strongly Agree	Strongly Agree	Agree
9. The skills taught in this research/training are valuable to my child in a variety of settings.	Strongly Agree	Agree	Strongly Agree
10. I would recommend participation in this research/training to other parents for their children.	Strongly Agree	Agree	Strongly Agree
11. Do you have a dog at home OR are there familiar dogs with which your child regularly interacts?	Yes	Yes	Yes

Note. Response options for the first 10 questions were: strongly disagree, disagree, neutral, agree, strongly agree, not applicable; for question 11 options were yes and no

Discussion

The aim in this study was to investigate whether dog-safety skills mastered in a teaching context generalized beyond the teaching context into the naturalistic context of meeting a leashed dog with owner. Children completed behavioral TAGteach training to mastery in three

contexts: (a) in classroom with a toy dog, (b) in classroom with a therapy dog, and (c) outdoors with a therapy dog. Thus, all children performed the dog-greeting behavior completely correctly in each of these contexts. After performance was mastered in each individual context, generalization probes were conducted with a novel therapy dog and novel handler outdoors. We found that, despite training to mastery, performance did not generalize to the new dog and handler.

Our main conclusion from these results was that although children performed the safety behaviors correctly in the teaching context, they did not perform them correctly on the next new dog. One of the main contributions of this research is that it included a direct, in situ assessment of children's safety behavior after training. Most previous research assessed children's responses to a questionnaire, verbal responses to spoken prompts, or responding in a role-playing scenario. The best standard for testing the effectiveness of any safety training, however, is to assess performance in situ (Miltenberger et al., 2015). In the current study conducted with young children, dog safety training in the classroom did not result in correct in situ responding. This calls into question whether dog safety training with online modules, classroom-based instruction, or video modeling can effectively improve young children's behavior around dogs. We also noted that, after the study, children were proficient at stating the steps aloud but then often completed the steps incorrectly immediately thereafter. This provides additional evidence that simply talking about safe behavior is not a valid proxy for demonstrating safe behavior.

Perhaps one reason why TAGteach mastery did not result in generalized performance is that our mastery criterion of 80% correct across three trials was too low, although this is a common mastery criterion in applied behavior analysis (Richling et al., 2019). However, examining the results shows that Nell and Penny were always 100% correct in the last three trials of each TAGpoint, and Bianca was 100% correct on 42 out of the 45 mastery trials across the three TAGteach conditions. Therefore it does not seem likely that raising our mastery criterion would have resulted in stronger generalization. Another limitation is that on trials involving close proximity to the dog, the participants occasionally accessed petting the dog even after incorrectly performing tag points, in that they rushed forward or extended a hand at the improper time. We did not prevent this behavior, as doing so would have required standing directly between the child and the dog, which would have been counter to our goal of minimizing the salience of our own presence as an aspect of the training context. We did redirect participants immediately when this occurred.

Our study's AB design precluded any conclusions about why children mastered the safety behaviors. It is possible that the passage of time, maturation, history, or other factors were responsible for skill acquisition (Petursdottir & Carr, 2018). Regardless of why children acquired the skills, our results still conclusively addressed our aim of assessing whether mastered skills generalized to the naturalistic setting. It is clear they did not generalize, as indicated by comparing the skilled performance in training to the skill-absent performance in probes. Finally, in a different study aiming to establish whether TAGteach itself was responsible for performance, one might expect to see skill maintenance in probe conditions. We did not find skill maintenance in probes. Instead of this being a threat to our design, it is the main thing we were assessing and is consistent with our conclusion that mastered performance did not generalize.

The current research is limited in its ability to assess whether children who engage in a safe dog-greeting behavior chain are less likely to experience dog bites than those who engage in a less-safe behavior chain. We must also acknowledge that a young child's safest strategy in meeting a dog is perhaps to not approach at all, but this strategy may also preclude access to reinforcers associated with safe interactions with pets. Also, the children enrolled in this research were very young, at 4-5 years of age. Dog bites were among the 10 most frequent

causes of nonfatal emergency department visits in the United States for children ages 5-9 in 2017 (National Center for Injury Prevention and Control, 2019) so this intervention aimed to establish safe behavior before this age. However, older children may have more extra-experimental experience inhibiting responses and generalizing new skills than these young children did, so older children may respond better to similar training. There may also be personal and experience factors at play in determining that, for some children, touching a dog is a very potent reinforcer. Future research could focus on identifying and teaching these children in particular. This study also did not include conditions in which the handler denied permission to pet the dog. Children must learn to discriminate between permission granted and denied rather than simply asking and then proceeding to petting.

It is important to note that our six-step task analysis of safely meeting a leashed dog was formulated specifically for this research project and does not apply to all situations. In consultation with educational professionals whose role is to educate children about dog safety at a major animal shelter, we aimed to identify a series of observable behaviors which minimized risk. Other educators and researchers who use another sequence of safe behaviors may still find the current study informative in deciding how to teach children their own preferred sequence of behavior. We expect that, regardless of the specific sequence of safe behaviors, our main finding still applies: mastered dog-safety behavior cannot be assumed to generalize from the training to naturalistic context. It is possible this failure to generalize resulted from the difference in stimulus conditions between the training and generalization contexts. However, when Persicke et al. (2014) probed for generalization of flat-footed walking following implementation of TAGteach to correct toe-walking by a 4-year-old with autism (the same age group as our participants), the behaviour did maintain in novel environments. On the other hand, when LaMarca et al. (2018) measured generalization of a successful TAGteach intervention for compliance in neurofeedback training, the authors found it necessary to reshape using TAGteach for four out of their seven participants (i.e., children ages 6-8 years old who were diagnosed with autism). This failure to generalize occurred even though follow-up sessions were conducted in the same setting where initial training was conducted to mastery. As a result, LaMarca et al. reported that further research is needed on identifying viable means of improving skill generalization following TAGteach training. Our results in the current study support this recommendation.

The current research focused only on the behavior of children meeting leashed dogs under the supervision of an adult and in the presence of the dog's handler. Dog bites occur in at least two additional child-dog interaction contexts: (a) children interacting with their own family's dog in their home, or another family's dog while visiting that family's home, and (b) children being approached by free-roaming dogs. In each of these contexts the recommended safe behaviors differ markedly. For example, children are approached by free-roaming dogs rarely in developed countries (but more often in developing countries) and there may be a high rate of poor outcomes per instance. This combination of low instance but high risk is shared with other, similar threats such as gun accessibility, abduction, sexual abuse, or poisoning (Miltenberger et al., 2015). One popular curriculum for the free-roaming dog scenario is the Be A Tree program (Doggone Safe, 2018), which instructs children to fold their hands, look at their feet, and count silently until the dog goes away. Future research should examine acquisition and generalization of this skill set compared to the skills that were targeted in the current study.

Adult supervision of children interacting with their pet dogs remains very important in the home as well. In the current study, proper performance did not come under stimulus control of the dog, and we suspect that prompting by adults may be a key factor for young children when faced with such an attractive stimulus as a novel dog. We expect that is also the case in the home because, in both contexts, unsafe behaviors are likely to be acquired and maintained

by immediate reinforcement in the form of close contact with the dog. Parents must be vigilant to prevent unsafe behavior and to prompt and differentially reinforce alternative, safe behavior even with regard to the family pet. Otherwise, children must make complex discriminations on their own, including whether the dog is engaged in a behavior where aggression could be more likely to occur (e.g. eating) or is exhibiting precursors to biting which can seem subtle even to adults (e.g., hard stare). The topography of children's possible unsafe behaviors also varies more widely with their own pets. Common examples of children's unsafe behavior when interacting with their own pets include laying on the dog, pulling on or putting their fingers into the dog's ears, and attempting to ride the dog. Researchers should study behavioral strategies for increasing the likelihood of safe behaviors in the home. The best approach will undoubtedly be multifaceted and include training parents on discriminating safe and unsafe child behavior around dogs, teaching children to engage in safe behavior, maintaining a high level of supervision when children are near dogs, and helping older children act consistently well around dogs when supervision is absent.

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