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Training children with autism spectrum disorders to be compliant with a physical exam

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ABSTRACT

The purpose of this study was to train children with autism spectrum disorders to be compliant with a 10-component physical examination. After a physician assistant administered an exam pretest, noncompliance on steps of the exam were considered with respect to a skill deficit and escape from aversive stimuli. A package of training procedures was implemented, including preference assessment, priming DVD, various prompts, contact desensitization (i.e., fading in aversive stimuli), shaping, escape extinction, and differential reinforcement of other behavior. Results showed the efficacy of the intervention procedures, maintenance of responding, and stimulus generalization of responses. The study provides a model for the assessment and intervention of noncompliance to health care procedures by children with autism spectrum disorders.

Individuals with developmental disorders, including autism, experience more health related problems than their peers without a disability (Sigafoos, Arthur, & O'Reilly, 2003). Consequently, these individuals might be subjected to more medical visits than their neurotypical peers. Unfortunately, children with developmental disabilities often are noncompliant with health care procedures. Consequently, personnel might not obtain essential information directly from the children regarding their health status and prognosis. Instead, professionals might have to rely on either minimal direct or indirect (e.g., prior records, parent report) medical information because the children are uncooperative during an exam (Tsai, 2005).

For essential health care procedures, restrictive means are often used to obtain compliance (e.g., physical restraint or sedation). Additionally, parents might forego elective health care procedures for their children because of their noncompliance. A topic that has received little attention in the literature is how to provide behavioral support to facilitate compliance to health care procedures for children with developmental disabilities, such as autism spectrum disorders.

Applied behavior analysis offers principles and procedures that can provide an effective approach to facilitate health care compliance. Health care procedures often can be analyzed as a behavioral sequence of steps that can be operationally defined. Children's performance on the steps could be scored and subjected to a compliance analysis. Subsequently, the reason for noncompliance could be considered by using functional behavioral assessment techniques. Training procedures can then be developed with consideration of the reasons for noncompliance.

For example, health care noncompliance might be a function of variables such as: (a) organismic factors (e.g., attention deficit, sensory hyperreactivity), (b) motivating operations (e.g., change in child's daily routine) that might increase the aversiveness of the medical stimuli and health care demands that then evoke escape behavior, (c) escape or avoidance from primary or conditioned aversive health care stimuli (e.g., injections, health care personnel, touch), and (d) lack of skill to

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comply with task demands (i.e., insufficient response acquisition, maintenance, stimulus or response generalization, or fluency).

Although compliance with many health care procedures merely requires passive tolerance by the child while the practitioner performs a routine, other forms of compliance require that the child emit learned behavior. Examples of the latter include performing visual discriminations for vision screening, taking a series of deep breaths during a lung exam, and opening the mouth and sticking out the tongue for a designated duration during the mouth/throat exam. Compliance to health care demands such as these also requires a certain level of receptive language to comprehend requests.

Although there is a small body of experimental research that has demonstrated the efficacy of behavioral interventions with health care procedures by children with developmental disabilities, the research with children with autism is even more limited. Behavioral dental treatment packages, for example, have been used to decrease fearful reactions to dental stimuli or increase compliance to dental exams. Procedures have included: reinforcement, shaping, and fading (Kohlenberg, Greenberg, Reymore, & Hass, 1972); desensitization, video modeling, and reinforcement (Luscre & Center, 1996); visual pedagogy (Backman & Pilebro, 1999); desensitization (Altabet, 2002); desensitization, differential reinforcement, video priming, and escape extinction (Huckfeldt, 2006).

Behavioral intervention for compliance to vision exams also has been conducted. Nonverbal children with autism were taught a simultaneous visual discrimination by stimulus fading as part of vision acuity testing (Newsom & Simon, 1977). School children with autism that were scored as untestable by a certified vision screener were taught to comply with the behavioral demands for the state mandated vision screening (Simer & Cuvo, 2009). Training procedures included preference assessment, match-to-sample discrimination training, transfer of stimulus control procedures, differential reinforcement, and choice making.

Several experimental studies have tested the effects of behavioral interventions on compliance with medical procedures by children and youth with autism. Compliance with respiratory treatment was shaped for a boy with cystic fibrosis, autism, and severe mental retardation (Hagopian & Thompson, 1999). A behavioral intervention package that included modeling, counterconditioning, escape extinction, and differential reinforcement based shaping procedures was used to increase compliance with electroencephalographic procedures by children and youth with developmental disabilities, including autism (Slifer, Avis, & Frutchey, 2008). Stimulus fading and differential reinforcement were used to teach tolerance of blood draws when checking glucose levels in an 18-year-old male with autism, mental retardation, and diabetes (Shabani & Fisher, 2006). Children with autism were taught to swallow pills by a treatment package consisting of fading in pill size, verbal instructions, in vivo modeling, visual, gestural, and physical prompting, differential reinforcement, and behavioral rehearsal (Ghuman, Cataldo, Beck, & Slifer, 2004).

The purpose of this study was to demonstrate the application of behavioral procedures to train children with autism to undergo a 10-component physical exam. A physical exam is a fundamental procedure included in the medical component of autism diagnosis and for acute and chronic medical conditions throughout the lifespan. Children with autism often are noncompliant with physical exams for reasons previously cited. In the present study, participants with autism spectrum disorders did not successfully complete all 10 components of a physical exam. A behavioral intervention package, including contact desensitization, shaping, video priming, various prompts, differential reinforcement of other behavior, and escape extinction was implemented to train compliance.

1. Method

1.1. Participants

All children who were receiving services from the Southern Illinois University Carbondale Center for Autism Spectrum Disorders (CASD) were invited to receive a no cost 10-component physical exam conducted by a university Physician Assistant (PA) Program faculty member. This exam was conducted as a clinical service and also functioned as a pretest for research participants. Parents of children who did not pass all 10 physical exam components were solicited for their child's research participation. Additional inclusion criteria for participants were: (a) having been diagnosed with either autism or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) by their pediatrician or CASD, (b) having a history of noncompliance during medical exams based on parent report, (c) having written parental permission to participate, (d) having joint attention, (e) being responsive to response consequences, (f) following a visual schedule, and (g) following simple instructions. Criteria (d)–(g) were documented during participants' therapy sessions by CASD staff. Six children who met the inclusion criteria participated. The University's Institutional Review Board approved the study.

Bridget, 5 years old and diagnosed with autism, attended CASD and an early childhood classroom. Her mother reported that during previous visits to her physician, Bridget rarely exhibited problem behavior. When she engaged in noncompliance and escape during these visits, it typically was when the physician used the tongue depressor during the mouth/throat exam. In addition to regular check-ups, Bridget was exposed to medical procedures to receive sutures, be administered an EEG, and be admitted to a hospital with the flu.

Landon, 6 years old and diagnosed with autism, attended CASD and was in a self-contained kindergarten classroom for children with autism and communication disorders. Landon's mother indicated that he engaged in kicking, crying, screaming, noncompliance, and escape during previous visits to the physician. In addition to regular check-ups, Landon had endured medical procedures, such as receiving sutures, X-rays, antibiotic injections, and treatments for severe illnesses.

During medical exams, his mother counted up to a predetermined number to help Landon understand when that exam component would end and to help him tolerate the exam.

Alex, 4 years old and diagnosed with PDD-NOS, attended a pre-kindergarten classroom in addition to CASD. His mother reported that Alex had emitted severe fearful behavior during visits to the physician (e.g., crying, verbal protesting, verbal self-regulation, arm flapping, noncompliance, and escape). In addition to regular check-ups, Alex had medical exams when he had acute illnesses.

Craig, a 3-year-old male diagnosed with PDD-NOS, attended CASD and pre-kindergarten. According to parental report, Craig had problem behavior (e.g., verbal protesting, pushing medical instruments away, turning his head away from the doctor) during medical examinations. He only had been to the doctor for routine medical exams.

Mark, a 3-year-old male diagnosed with autism, attended CASD and pre-kindergarten. According to parental report, Mark previously had been compliant during medical examinations until he had blood drawn following a routine exam. Since then, he has engaged in noncompliant behaviors during examinations, including crying, protesting, curling up on the table, and turning away from the doctor.

Corey, a 5-year-old male diagnosed with autism, had individual therapy sessions at CASD and at home, and attended pre-kindergarten. According to parent report, Corey frequently engaged in problem behaviors during medical examinations, including screaming, pushing the doctor, and kicking. Corey had routine medical exams and surgery to implant bilateral tubes in his ears.

1.2. Researchers

The two experimenters were Board Certified Assistant Behavior Analysts and behavior analysis graduate students. Experimenter 1, who implemented the procedures for the first cohort of participants (i.e., Bridget, Landon, and Alex) had a prior training relationship with Bridget and Landon. Approximately 1 year later, Experimenter 2 implemented the procedures for the other three participants with whom she had no prior relationship. These experimenters collected data only on participants' behavioral compliance; they did not obtain medical information.

The PA faculty member, who was certified and licensed in Illinois, had no prior contact with participants. She performed the exams and provided medical information to parents. A parent or grandparent accompanied the child to each exam conducted by the PA, but not sessions conducted by the experimenters.

1.3. Setting and materials

A medical office in the Physician Assistant Program on the campus of Southern Illinois University Carbondale was used for the pre- and posttests. The office had a waiting room and several exam rooms that each contained one chair, an exam table covered with paper, a pillow at the end of the table, a sink, two-way mirror, video equipment, and medical instruments (e.g., stethoscope, otoscope, tongue depressors) on a counter. Preferred toys were on the floor. Photographs of a child appropriately engaging with medical equipment were on the counter.

Training occurred in a room at CASD that included a portable folding exam table covered with paper; a pillow was placed at the top of the table. A step stool was at the other end of the table for participants to climb on the table. The room also included two cube chairs, preferred items, and the same medical instruments that were in the exam room in a translucent box.

A 9 min DVD of a typically developing child successfully completing a physical examination in the exam room was created to prime participants for their upcoming exam. The DVD allowed participants to see the target responses modeled without contacting the potentially aversive stimuli or undergoing the actual exam. The priming DVD included a dinosaur puppet that narrated the steps of the exam components and praised the compliant behavior of the child model in the DVD. It also showed close-ups of the medical equipment, and used visual techniques to attract the attention of the participants (e.g., medical instruments bounced across the screen). Still clips of a child responding appropriately to the final step of each exam component were made from the DVD and used during the research.

Alex also received training in his bedroom to provide additional sessions prior to a scheduled break from CASD services. The experimenter took an exam table, medical equipment, and step stool to the child's house.

1.4. Data collection and interobserver agreement

Three graduate students were trained to collect data by didactic instruction, video tape recordings, and performance feedback. The experimenter reviewed the target behaviors' operational definitions with the observers, and scored arbitrarily selected exam and training videos. Observers were considered reliable when they scored three consecutive training videos with at least 80% agreement with the experimenter. Interobserver agreement was calculated by dividing the number of steps/intervals both observers agreed by the number of agreements plus disagreements and multiplying by 100%.

After observers were trained, they collected data via videotape to decrease reactivity that could occur by having them in the exam and training rooms. Data were collected on compliance to the 10 components of the physical exam. For some steps, compliance merely involved tolerance to what the PA did to the participant (e.g., PA performed exam components while child laid on table, PA looked into participant's ears and throat with an otoscope). For other steps, compliance required the

participant to emit behavior while tolerating the PA's behavior. Compliance to the lung and heart exams, for example, required the child to meet breathing response requirements and be still and quiet for 30 s consecutively while the PA placed the stethoscope on the back and chest.

Observers collected data on compliance or non-compliance with each step of the desensitization hierarchy for each exam component. Specifically, observers recorded a "+" if the child complied with a specific step of the hierarchy and a "−" if the child did not comply. The reliability formula was the number of steps on which both observers agreed divided by the number of agreements plus disagreements multiplied by 100%. Interscorer reliability for compliance during the exams and training trials was 100%.

Problem behavior was also scored using 10 s partial interval recording. If aggression, escape, avoidance, or protesting occurred during a 10 s interval, observers circled the code corresponding to that behavior on the data sheet. Aggression was defined as any attempt to hit, kick, scratch, pinch, or engage in property destruction. Escape was defined as any attempt to terminate existing contact with personnel or medical instruments. Avoidance was defined as engaging in behavior to prevent contact with these stimuli. Escape and avoidance behavior are reported as one variable in Section 2. Protesting was defined as saying "no", whining, or crying. Reliability was assessed for all exams. The reliability formula for each of these target behaviors was the number of intervals both observers scoring agreed divided by the number of agreements plus disagreements multiplied by 100%. Interscorer reliability for escape, avoidance, aggressing, and protesting for the six participants across all exam and training trials ranged between 85 and 100%.

1.5. Exam and training fidelity

Data were collected on the fidelity with which the experimenters and PA implemented exam and training procedures according to the written protocols. Independent observers scored a "+" if the exam or training step was implemented according to the protocol, and a "−" if the step was not implemented as required. Observers, trained with video recordings, were considered reliable when they and an experimenter had at least 80% scoring agreement for three consecutive video clips. Fidelity was calculated by dividing the number of steps that an observer agreed with the experimenter's or PA's implementation behavior by the number of agreements plus disagreements and multiplying by 100%. Fidelity data were collected on 26–46% of the training sessions across all participants; agreement ranged between 87 and 100% across all steps for all participants. Data also were collected on 100% of the physical exams conducted by both the experimenters and PA and ranged between 94 and 100% implementation fidelity.

1.6. Experimental design

A multiple probe across responses design was replicated across two cohorts of three participants each. Bridget, Landon, and Alex began the experiment concurrently with Experimenter 1, and, at a later date, Craig, Mark, and Corey participated with Experimenter 2. Target responses that were not in the training phase had one baseline probe weekly to reduce potential pitfalls of repeated measurement (Cuvo, 1979). The first exam component that had a steady baseline was introduced to training. Other exam components were successively exposed to training in a staggered fashion as responding stabilized for the previous component.

1.7. Procedures

1.7.1. Parent questionnaire

Several weeks prior to the pretest, parents completed a questionnaire that asked about their child's: (a) behavior during past medical exams, (b) stimulus preferences, and (c) medical history. This parent report was used to determine the child's history of compliance in medical contexts, select items for stimulus preference assessment, and exclude potentially aversive stimuli in the research environments.

1.7.2. Physical exam

The exam had 10 components that were determined by observing the PA examine a typically developing child. Six of the components were based on examination of major body organs (i.e., lung, heart, abdomen, nose, mouth/throat, and ear) that the PA identified as key for diagnosing young children. Four additional components were added to enable the exam to occur. Target behaviors, prompting strategies, and response consequences were developed for each of the 10 components of the exam and are described below.

During the pretest and subsequent tests, the PA showed the child the medical instrument to be used and a picture of a typically developing peer modeling the terminal step of each component; she also provided verbal instructions. Compliance to instructions resulted in descriptive praise, and the child progressed to the next exam step. Consequences for noncompliance for each step are stated below. The PA used prompts and response consequences during the pretest because they are commonly used in medical practice, and to avoid the need for more intensive behavioral intervention. Two poster boards that listed the steps of the exam were on the medical clinic exam room wall to help ensure procedural fidelity by the PA. Preferred toys were available continuously. The duration of the pretest was approximately 10 min. It served both to screen potential participants for inclusion and as their pretest. The 10 exam components and their definitions are presented below.

1.7.3. Component 1: Participant enters room

Participant walks into examination room without adult assistance when the PA says, "*Come in here*." If the participant refused to enter the room, the PA presented preferred toys to encourage the child to walk into the room. If this did not occasion the child's entrance, the PA allowed the child to hold her hand as they walked toward the examination room. If the child refused to walk into the room with the PA, the child was permitted to walk in while holding the parent's hand. When the child entered the room, assessment progressed to component 2.

1.7.4. Component 2: Participant plays for 3 min

Participant interacts with toys, PA, or medical instruments for 3 min independently or when the PA says, "*Let's play*." If the participant moved around the room and did not play with toys, the PA attempted to engage the child either by commenting on the toys or holding up a toy and saying, "Hey, look at this!" After 3 min, the assessment progressed to component 3.

1.7.5. Component 3: Participant sits on exam table

When PA shows photo of sitting and says, "*Sit on table*," *participant climbs onto exam table and sits with legs hanging over end of table*. If the child did not climb onto the table, the PA placed toys on the table and repeated the request. If the child still did not climb onto to the table, the PA physically guided the child to the table. If the child still refused to climb onto the table or emitted emotional behavior (i.e., verbal protesting), the PA attempted to complete the remaining exam components while the child sat or stood beside the exam table.

1.7.6. Component 4: Participant complies with lung exam

After the PA says "I'm going to listen to your lungs/back." and shows photo of lung exam, participant remains still and seated on table while PA lifts shirt and moves stethoscope on child's back. If the child did not comply, the PA said, "Look, I'm going to listen to Mommy's back" and then modeled the exam on the mother. Subsequently, the PA said, "Now, it's your turn. I'm going to listen to your back." If the child still did not comply, the PA proceeded to component 5.

1.7.7. Component 5: Participant complies with heart exam

After PA says, "I'm going to listen to your heart/chest" and shows photo of heart exam, participant remains still and seated on table while the PA lifts shirt and moves stethoscope on child's chest. Procedures were similar to component 4.

1.7.8. Component 6: Participant lies down on table

When PA shows photo of child lying down on table and says, "Lie down on table", participant lies down on table. If the child did not respond to the request, the PA used a gesture prompt by patting the exam table. If the child still did not lie on the table, the PA physically guided the child to lie down. If the child still did not comply, the PA proceeded to component 7 and allowed the child to sit-up while she conducted the abdominal exam.

1.7.9. Component 7: Participant complies with abdominal exam

After PA shows photo of abdominal exam and says, "I'm going to listen to/touch/drum on your tummy", participant remains still and lying on table, allows shirt to be lifted, and allows abdominal quadrants to be palpated. Subsequently, child sits-up on exam table. Procedures were similar to component 4. If the child did not sit-up, the child was physically guided to a sitting position and the PA proceeded to step 8.

1.7.10. Component 8: Participant complies with nose exam

After the PA shows photo of the nose exam and says, "I'm going to look in your nose", participant remains still and seated on table and allows PA to look in each nostril with an otoscope. Procedures were similar to component 4.

1.7.11. Component 9: Participant complies with mouth/throat exam

After PA shows photo of mouth exam and says, "I'm going to look in your mouth", participant remains still and seated on the examination table, opens mouth, sticks out tongue, and allows PA to look in the mouth with an otoscope. Procedures were similar to component 4.

1.7.12. Component 10: Participant complies with ear exam

After PA shows photo of the ear exam and says, "I'm going to look in your ears," participant remains still and seated on the examination table, and allows PA to look in ears with otoscope. Procedures were similar to component 4. If the child still did not allow the PA to examine his ears or if the child engaged in problem behavior, the PA concluded the exam.

1.8. Functional behavioral assessment

The experimenters conducted observational recording of the children's noncompliant behavior during the pretest. Also, parents were questioned about their responses on the parent questionnaire, including their child's noncompliant behavior during past medical exams. Consideration was given to organic impairments, motivating operations, escape/avoidance, and skill deficits as potential functions of the noncompliant behavior. It was hypothesized that when children did not comply

because of a skill deficit, they simply did not emit the target behavior as defined. They did not engage in emotional responding, problem behaviors, or other attempts to escape. For example, it was hypothesized that Bridget and Landon had skill deficits related to the breathing frequency requirements for the lung exam and mouth opening duration for the mouth/throat exam.

Evidence for escape and avoidance behavior was inferred from emotional and physical responses (e.g., crying, whining, attempting to leave room, pushing away medical instruments) that appeared to be members of a functional response class whose members were reinforced by removing or preventing contact with aversive stimuli. For example, it was hypothesized that escape was the function of aversive sensory stimulation (i.e., otoscope touch) related to the ear exam for Bridget and the nose exam for Landon.

For Alex, problem behavior occurred on the exam table, lung, heart, abdomen, mouth, nose, and ear components. He began engaging in emotional behavior when the PA showed him the first visual prompt and asked him to sit on the table; problem behavior then occurred continuously until the exam was terminated. It was hypothesized that Alex's behavior was a function of generalized avoidance of conditioned aversive medical stimuli based on his past history in medical environments.

Intervention procedures were tailored to the two hypothesized functions of noncompliance (i.e., lack of skill and escape/avoidance). Regardless of function, the procedures were methodologically similar with respect to a gradual approach to modifying behavior. For skill deficits, the approach was shaping responses by successive approximations. For escape/avoidance behavior, the procedures involved contact desensitization or fading in aversive stimuli while preferred stimuli were available. Some medical exam components required both desensitization and shaping for different steps in their hierarchies.

1.9. Preference assessment

The parent questionnaire and child's CASD clinician identified six items that the child preferred. These items were tested using a brief paired stimulus preference assessment (Fisher et al., 1992) that occurred prior to the baseline and approximately every 2 weeks thereafter. The child sampled each item for 30 s before the assessment began. Edibles and items that emitted noise were not used.

1.10. Baseline

Baseline data were taken by the experimenters only on the pretest exam components for which the child was noncompliant. Data were collected on the child's compliance with each step of the hierarchy for each of these components. See Table 1 for steps of the lung exam hierarchy. No prompts or response consequences were provided for responding during baseline.

1.11. Training

1.11.1. Priming video model

Parents were requested to show their children the priming DVD daily after baseline and during training. Parents were asked to record how frequently their child watched the DVD, and rate their child's level of interest in the video each time. A 5-point Likert type rating scale was used; a score of 1 signified that the child showed no interest in the video and a score of 5 indicated that the child attended to the video for its entire duration. The experimenter trained the parents on data collection by reviewing the operational definitions of each of the five levels on the interest scale. The definitions also were listed on the data collection sheet.

Table 1
Desensitization/shaping hierarchy for lung exam.

Steps	Description
1.	Child plays with preferred toys when stethoscope is placed in front of the child, but 1 ft away.
2.	Child plays with preferred toys when stethoscope is mixed among the toys.
3.	Child tolerates the clinician moving the stethoscope on his back for 3 s, when preferred toys are present.
4.	Child tolerates the clinician moving the stethoscope on his back for 5 s, when preferred toys are present.
5.	Child tolerates the clinician moving the stethoscope on his back for 10 s, when preferred toys are present.
6.	Child tolerates the clinician moving the stethoscope on his back for 20 s, when preferred toys are present.
7.	Child tolerates the clinician moving the stethoscope on his back for 30 s, when preferred toys are present.
8.	Child tolerates the clinician moving the stethoscope on his back for 3 s, when no toys are present.
9.	Child tolerates the clinician moving the stethoscope on his back for 5 s, when no toys are present.
10.	Child tolerates the clinician moving the stethoscope on his back for 10 s, when no toys are present.
11.	Child tolerates the clinician moving the stethoscope on his back for 20 s, when no toys are present.
12.	Child tolerates the clinician moving the stethoscope on his back for 30 s, when no toys are present.
13.	Child tolerates step 12 and takes one deep breath when clinician says "Deep breath" and models.
14.	Child tolerates step 12 and takes three deep breaths when clinician says "Deep breaths" and models.
15.	Child tolerates step 12 and takes six deep breaths when clinician says "Deep breaths" and models.

1.11.2. Photo prompts

At the beginning of each training session, the experimenter presented the photo of the last step of the hierarchy accompanied by the corresponding verbal instruction. If the participant did not comply, the photo was represented and the response was verbally prompted again. At the end of the session, the experimenter provided descriptive praise, pointed to the photo, and gave the child preferred items. At the completion of the study, each family was provided a set of photographs to be used at future medical visits.

1.11.3. Contact desensitization

Contact desensitization (i.e., fading in exposure to aversive stimuli or counterconditioning) was used when it was hypothesized that medical procedures functioned either as primary or conditioned aversive stimuli and evoked escape or avoidance behavior. Proximity to the aversive stimuli was faded in while the participants had access to preferred stimuli. Desensitization hierarchies were created for each component of the medical examination. Table 1 shows the 15-step hierarchy for the lung exam.

For all the hierarchies, at first the aversive stimulus (e.g., otoscope) and the photo were merely present in the room approximately 30 cm from the child while he or she played with preferred toys. After three consecutive sessions of the child tolerating the physical proximity of the aversive stimulus, it was mixed among an assortment of preferred toys on a table. If the child remained at the table for 10 s, access to preferred items was provided. Again, to advance to the next step of the desensitization hierarchy, the child was required to tolerate the aversive stimulus at its increased proximity for three consecutive sessions. This criterion was required for advancement to all other steps that involved increased physical proximity, intensity, or touch (see Table 1).

The next steps in the hierarchies involved the child tolerating the aversive stimulus placed on or near the appropriate body part (e.g., stethoscope on chest) for increasing durations of time when preferred toys were available. These durations varied and depended on the specific medical instrument, as well as the minimum amount of time required for the PA to obtain diagnostic information. The desensitization steps to the lung exam, shown in Table 1, required the child to tolerate longer increments of time (3, 5, 10, 20, and 30 s) with the stethoscope moving on the back. After the child tolerated the medical stimulus for the maximum required time with toys present, the next steps involved tolerating the stimulus for the same time increments without toys present.

At the end of the session, the experimenter showed the child the photo of the exam component being trained and provided descriptive praise and highly preferred items for 30 s. After three consecutive sessions with the child tolerating the aversive stimulus, the next step of the hierarchy was targeted. When the child tolerated greater contact with each aversive stimulus, compliance was reinforced with brief access to preferred items. When the child did not tolerate greater contact but engaged in problem behaviors, escape extinction was used. Fading in exposure to the aversive stimuli continued until compliance occurred. Mastery required that the child complete the final step in each hierarchy for three consecutive sessions under training conditions. Each training session took less than 5 min.

1.11.4. Shaping

Shaping was used when lack of compliance during the pretest was hypothesized to be a skill deficit (e.g., lung and mouth/throat exams for Bridget and Landon). The lung exam, for example, required the child to take six deep breaths while tolerating the stethoscope on the back for 30 s. The breathing requirement was shaped from 1, to 3, to 6 deep breaths. For the mouth/throat exam, the participants' behavior was shaped to open the mouth and stick out the tongue for increasing durations (i.e., 1 s, 5 s, 10 s). Each training session took less than 5 min.

1.11.5. Differential reinforcement of other behavior (DRO)

A DRO procedure was used for all steps of the hierarchies for all exam components. The duration of the DRO interval varied across steps. Preferred items were provided for 30 s at the end of the intervals if problem behavior did not occur during the interval. Aversive stimuli were not removed when reinforcers were presented, and data continued to be taken regarding compliance to the task demands. If participants engaged in escape, aggression, or protesting while engaging with preferred items, they were removed until the participant completed a 10 s interval without problem behavior.

1.11.6. Escape extinction

All participants engaged in escape behavior; therefore, escape extinction was used as a response consequence. When a child emitted escape, aggression, or protesting during training, the aversive stimulus remained present until the child tolerated it for an entire 10 s interval. Subsequently, the child received access to the preferred item and that aversive stimulus was not represented for the remainder of the session.

1.12. Response maintenance probes

After participants met the training criteria for an exam component, on-going weekly maintenance probes for that component were conducted until the participant passed the physical exam posttest. Baseline conditions were in effect during maintenance probes, which permitted an evaluation of whether behavior change was durable over time without programmed contingencies.

In addition, Experimenter 1 conducted a complete physical exam maintenance probe (i.e., all 10 components) in the CASD training room after Bridget, Landon, and Alex completed training. The behavioral procedures were identical to those used by the PA at the clinic during the pretest; however, the setting and the person conducting the exam were different. The purpose of this probe was to assess whether the children would comply with all 10 components of the physical exam, and not just those trained, when performed in sequence.

There was a 1-month delay after training before the PA could perform the physical exam posttest for the second cohort of participants. Experimenter 2, therefore, conducted three additional maintenance probes prior to the posttest. The procedures for the 10-component exam were similar to those used during the pretest, with the addition of the photos as cues for the exam components. The PA also was present during these maintenance probes as an observer to promote stimulus generalization across examiners on the posttest; the PA did not participate in the exam.

1.13. Stimulus generalization test

Following successful completion of the three maintenance probes at CASD by Experimenter 2 for the second cohort, the PA conducted another 10-component physical exam at CASD to test for generalization across examiners. Stimulus generalization across examiners would have occurred if the participant was compliant for responses not passed during the pretest when examined by the PA. This physical exam took approximate 10 min.

1.14. Physical exam posttest

The PA repeated the complete 10-component physical exam in the medical clinic after the previous conditions were completed at CASD for all participants. The posttest conditions were identical to those of the pretest. Stimulus generalization across settings and examiners was considered to have occurred if the child complied with responses during the posttest that were not performed on the pretest.

1.15. Training to extend responding to the stimulus class

Participants in the first cohort who did not respond successfully to all 10 components of the posttest received additional intervention in the medical clinic setting. Training was conducted until the child successfully complied with all exam components for three consecutive trials. Subsequently, the PA examined the child under pre–posttest conditions.

2. Results

2.1. Bridget

Bridget did not comply with 3 of the 10-pretest components. It was hypothesized that noncompliance for the lung and mouth/throat exams was a function of both a skill deficit and escape. Escape also was assumed to be the function of nontolerance to the ear exam. Bridget escaped for 15% and protested for 2% of the pretest intervals.

Fig. 1 shows data for Bridget's compliance to these three exam components that were trained. Baseline, probes, and maintenance data are identified by triangles. Intervention data are represented by squares. Although Bridget did not comply with the lung exam during the pretest, her baseline performance was either at or near the highest step of the hierarchy. It was inferred that exposure to the pretest conditions might have facilitated improved performance during the subsequent baseline probes shown on the figure. Consequently, training for the lung exam was not implemented. Fig. 1 also shows stable baselines for the mouth/throat and ear exams prior to training; performance improved only after training was initiated.

With respect to the mouth/throat exam, Bridget tolerated only the first 3 of the 11 steps during baseline. When Step 4 was targeted for training, Bridget engaged in high rates of problem behavior and refused to open her mouth for the required 5 s. After three attempts (trials 7–9), Bridget still refused to open her mouth. On trial 9, she picked up the otoscope and pointed it toward her open mouth. When the experimenter held the otoscope and pointed it toward Bridget's mouth, she accomplished step 6 of the hierarchy. Subsequently, Bridget's performance progressed rapidly. Baseline probes on trials 18, 25, and 29 indicate that Bridget complied without prompts or consequences. She met the compliance criterion on three consecutive training trials after 26 intervention trials over 7 days; the average number of trials per day was 4. Fig. 1 shows that Bridget maintained her performance during weekly probes under baseline conditions.

The ear exam baseline shows tolerance for 2–6 steps with no trend. She began training with step 3, and progressed slowly between steps 2 and 6. After mastering step 6, a probe on trial 67 showed Bridget complied with all 14 steps of the ear exam, She attained the acquisition criterion in 31 sessions over 7 days, averaging 5 trials per day. No on-going maintenance data were collected on this component because Bridget returned to the PA for the posttest less than 1 week after training for the ear exam. The total training time, not including assessment, was approximately 3.5 h.

Bridget complied with all 10 components of the physical exam probe conducted at CASD by the experimenter compared to 7 components on the pretest. Subsequently, Bridget passed all 10 components on the posttest administered by PA at the medical clinic. Maintenance data were then collected under the same conditions as the pre- and posttests 1 month after the

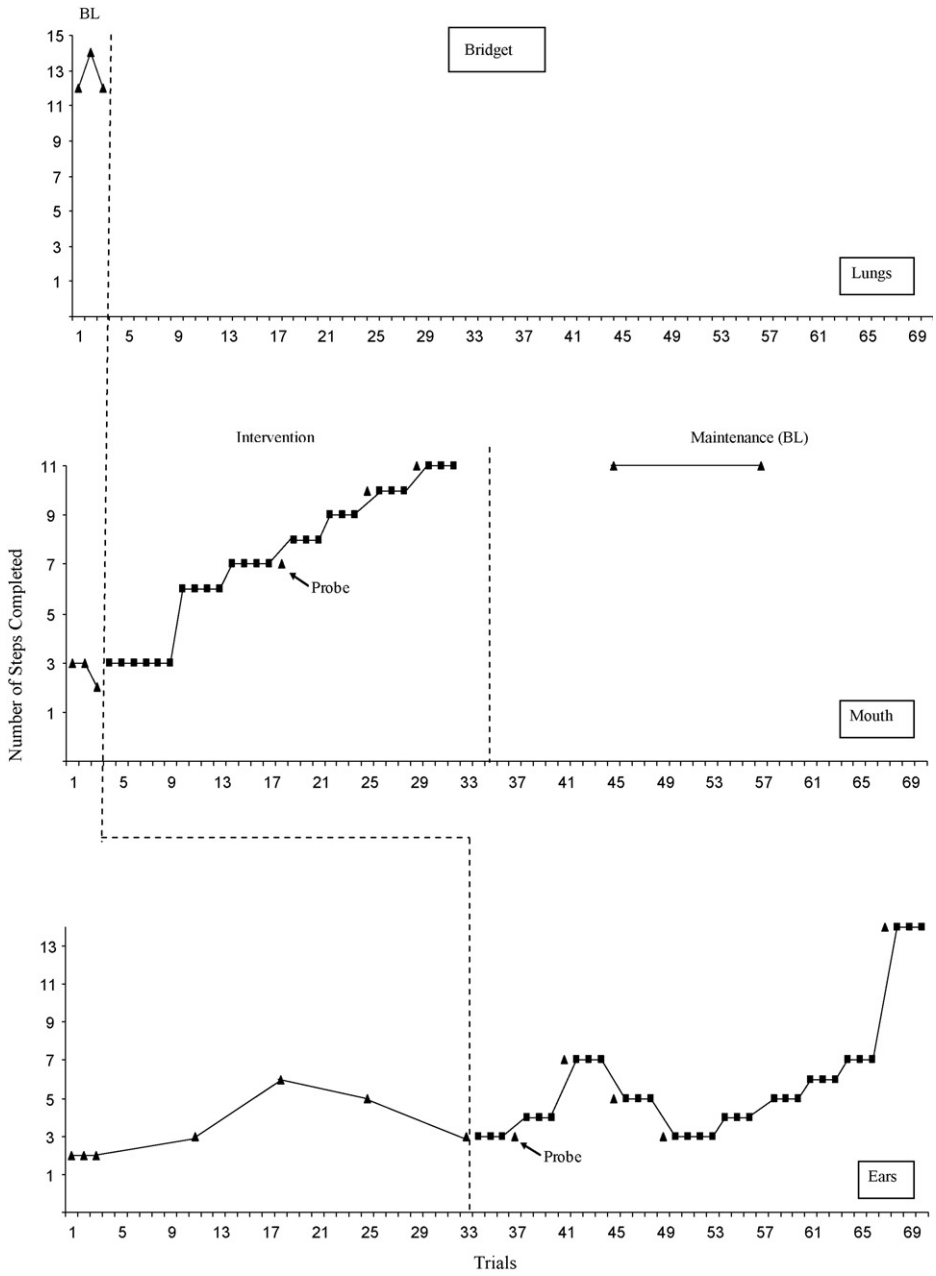

Fig. 1. Effects of an intervention package on Bridget's compliance to medical exam components.

latter; Bridget complied with 100% of the steps. She did not engage in eloping, aggressing, or protesting during any of these exams.

Bridget's attention to the priming DVD was scored eight times by her mother. Bridget's attention was rated from 1 (did not watch) to 5 (watched all) and averaged 3. Bridget talked at home about various aspects related to a doctor's visit (e.g., "breath in, breath out") shown on the DVD, and was observed on numerous occasions singing the song on the DVD.

2.2. Landon

Landon did not comply with 3 of the 10-pretest components, which were then trained: (a) lung (i.e., take deep breaths), (b) nose, and (c) mouth/throat exams (i.e., hold mouth open for 10 s) (see Fig. 2). He escaped for 20%, aggressed for 0%, and protested for 24% of the pretest intervals. After a stable baseline for the nose exam, training began with step 3; the hierarchy was mastered in 15 trials over 5 days (3 trials per day). When probed, Landon performed steps 5–7 without direct training

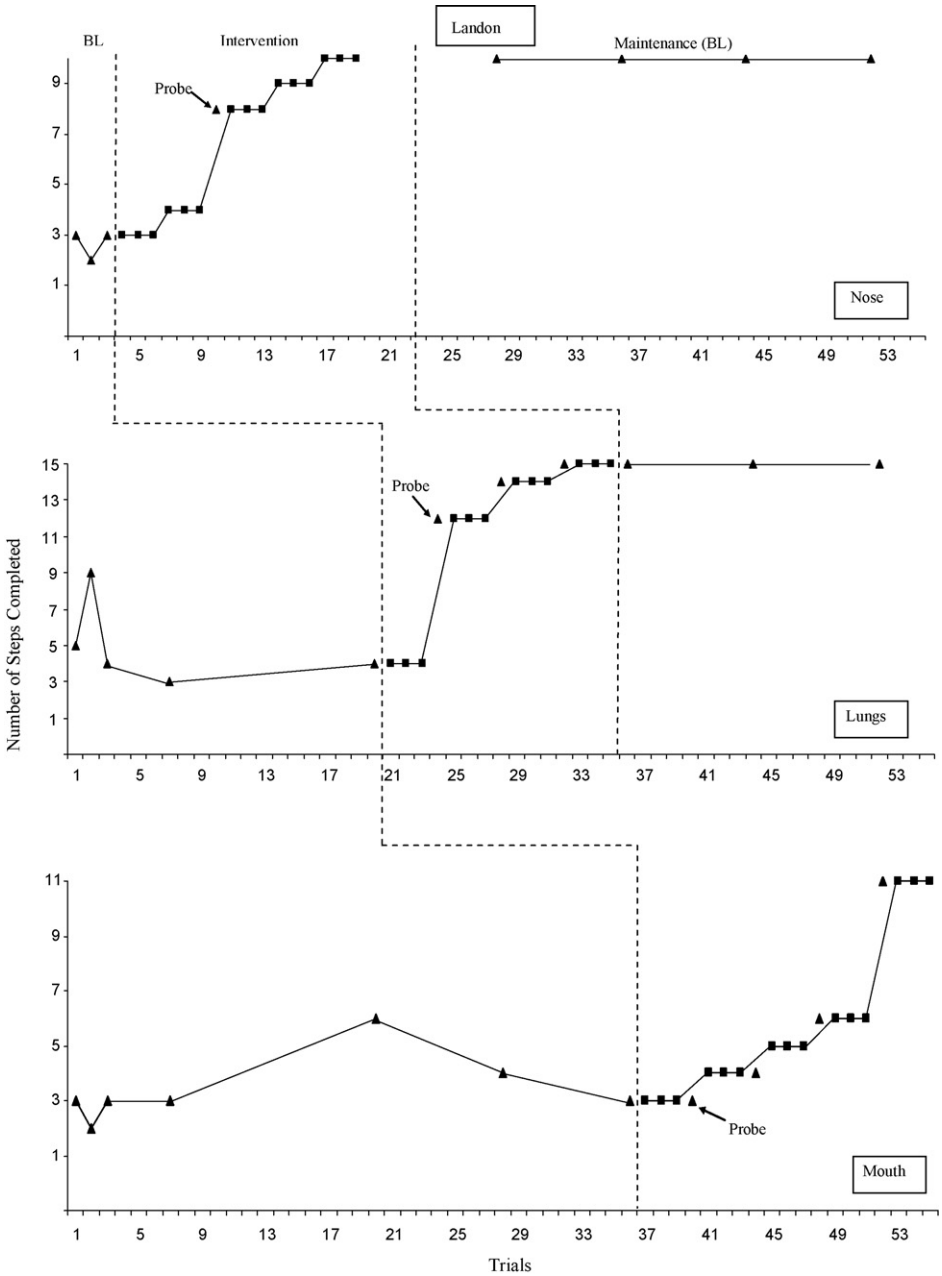

Fig. 2. Effects of an intervention package on Landon's compliance to medical exam components.

suggesting generalized responding. Maintenance probes demonstrated that Landon continued to perform at criterion level for the nose exam.

For the lung exam, there were 12 training sessions over 4 days, with 3 trials per day. Training began with Step 3, and after meeting the performance criterion, a baseline probe (trial 24) showed that Landon complied with 12 steps of the hierarchy without direct training. After step 12 was trained, a baseline probe (trial 28) indicated that Landon complied with step 14 of the hierarchy. Weekly maintenance probes showed that he continued to comply.

After seven mouth/throat baseline probes, Landon made incremental progress during 15 training sessions. He also showed generalized responding on some steps. No on-going maintenance data were collected because he returned to the PA for the posttest less than 1 week after meeting the training criterion. The total training time, not including exams, was approximately 3.5 h.

Next, Landon successfully completed all 10 components of the physical exam probe conducted by the experimenter at CASD; he escaped during 2% of the intervals, aggressed 0%, and protested 21%. He also completed all 10 components of the

posttest performed by the PA in the medical clinic compared to 7 during the pretest. Posttest performance indicated that he generalized across examiners and settings for the three components that were trained. Landon escaped during 8% of the intervals, aggressed for 0%, and protested for 20% during the posttest, showing decreases in both escaping and protesting from the pretest. Landon also completed all 10 components of the exam during the 1-month follow-up after the posttest. He escaped and protested for 11% of intervals each, but did not aggress. Landon watched the priming DVD six times with a mean rating of 2.5 on the 5-point scale. His mother indicated that Landon occasionally ejected the DVD and protested when it was started.

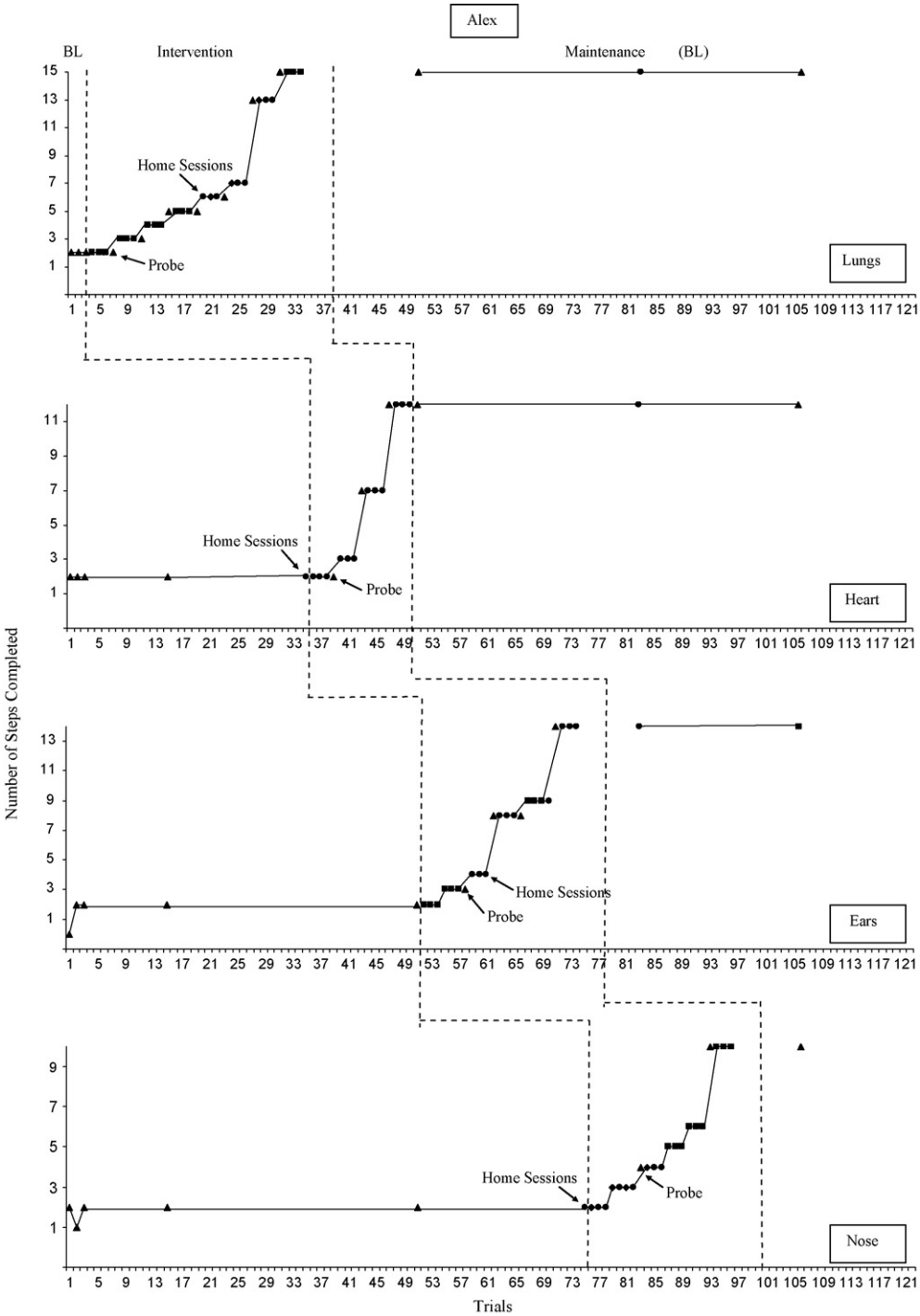

Fig. 3. Effects of an intervention package on Alex's compliance to medical exam components.

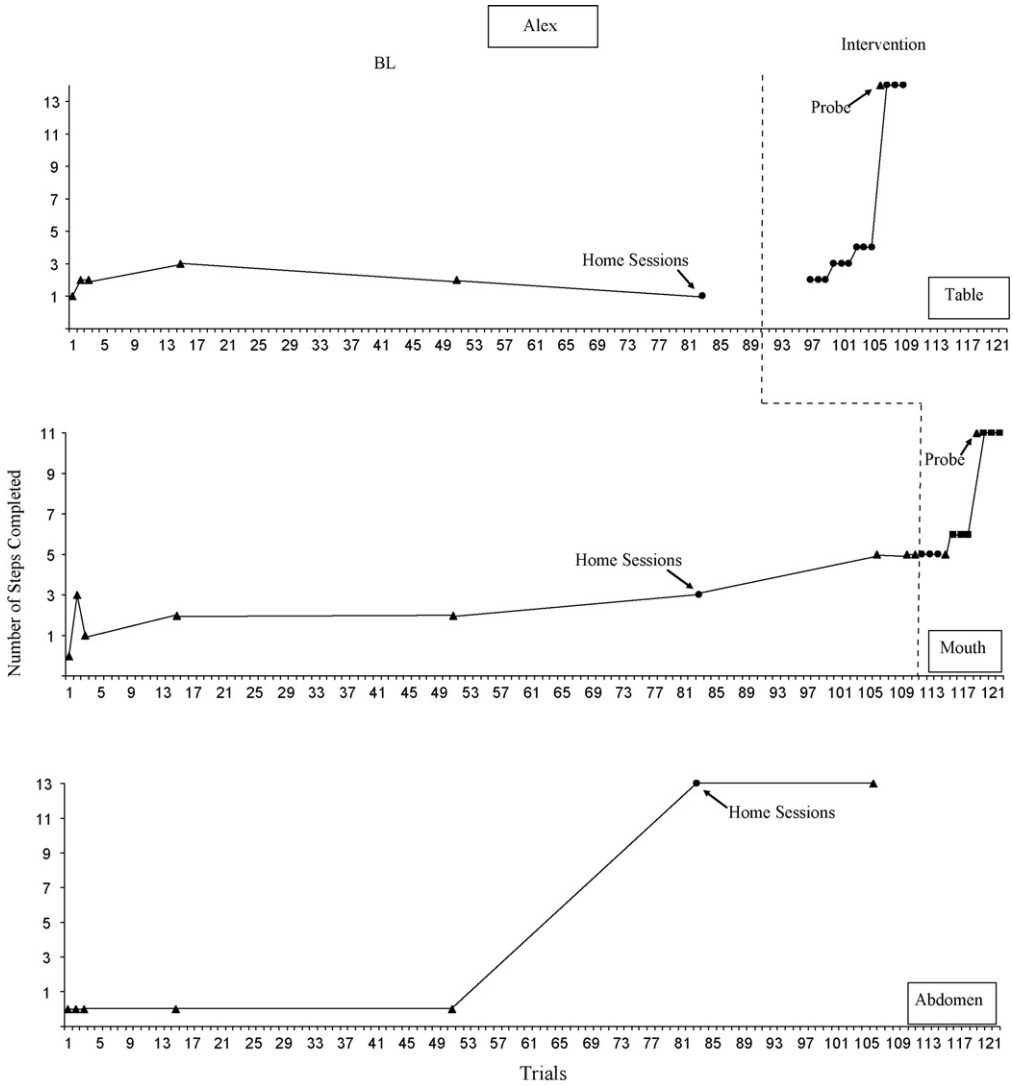

Fig. 3. (*Continued*).

2.3. Alex

Alex complied with only 2 of the 10-pretest exam components. Consequently, the lung, heart, abdominal, nose, mouth/throat, and ear exams, as well as lying on the examination table, were targeted for training. His avoidance behavior interfered to such a degree that the pretest was terminated when Alex became highly distressed and could not be calmed. He protested for 53% of the intervals, escaped for 25%, but did not aggress. Fig. 3 shows the effects of the training package on Alex's compliance behavior for the exam components trained; circles indicate home sessions.

Baseline probes show that Alex consistently complied with only the first two steps of the lung exam prior to training. He had 24 training sessions at CASD and in his home over 5 days, with an average of 5 trials per day. Alex rapidly mastered steps 2–7. After he mastered step 7, a probe showed that Alex complied with 13 steps of the hierarchy. After meeting criterion on step 13, Alex performed all 15 steps of the lung exam under baseline conditions. It was not necessary to train steps 8–12 and 14. Weekly maintenance probes indicate that Alex maintained his responding to the lung exam under baseline conditions while other components of the physical exam underwent training. The acquisition and maintenance of skills across both CASD and home settings show that Alex responded to an expanded stimulus class of two physical settings.

Compliance to the heart exam was trained next. During four baseline sessions at CASD and one at home, Alex's compliance consistently remained at two steps on the hierarchy. He showed rapid improvement during 12 training sessions over 2 days, with an average of 6 sessions per day. Although Alex only complied with a previously mastered step on the first baseline probe (trial 39) during training, he tolerated steps 4–6 and 8–11 that had not been trained, on all subsequent probes.

These results indicate that Alex improved his compliance to steps of the heart exam by exposure to training for previously mastered steps. Maintenance probes at Alex's home and CASD showed criterion performance.

After a stable baseline for the ear exam, 18 training trials occurred over 4 days, with an average of five sessions per day. Alex showed incremental improvement correlated with training steps 2 and 3. After training step 4 at his home, a baseline probe (trial 62) indicated that Alex complied with steps 5–8 without direct training. A probe conducted after Alex mastered step 9 (trial 71) showed that he complied with all 14 steps of the hierarchy (i.e., he complied with steps 10–14 without training). One maintenance probe at CASD and one at Alex's home 1 week later showed that he complied with the ear exam over time under baseline conditions.

For the nose exam, six baseline probes were conducted in Alex's home and at CASD. He received 19 training sessions during 3 days, with an average of 6 sessions per day. After quickly mastering steps 2 and 3, a probe on trial 83 showed that Alex also complied with step 4. Steps 5–6 were trained to mastery, and a probe on trial 93 showed that Alex complied with all 10 steps of the nose exam. Steps 7–10 were performed without training. Alex demonstrated maintenance of his nose exam compliance during weekly probes at CASD.

Compliance to lying on the table was trained next over 12 sessions during 2 days, averaging six trials per day. After steps 2–4 were mastered, a baseline probe showed that Alex complied with all 14 steps. Steps 5–14 did not require direct training, suggesting generalized responding from previous training. On-going maintenance data were not collected because Alex returned to the PA for the posttest less than 1 week after he mastered the table component.

The mouth/throat exam baseline was conducted next. Nine probes at CASD and Alex's home showed an upward trend. Baseline performance stabilized at step 5, and then training occurred over nine sessions lasting 2 days, with an average of four trials per day. After step 6 was trained, a baseline probe showed that Alex complied with all 11 steps. This suggests that training on previous steps improved Alex's tolerance of subsequent untrained steps in the hierarchy. On-going maintenance data were not collected because Alex returned to the PA for the posttest less than 1 week after mastering the mouth/throat component.

Data for the abdominal exam (see Fig. 3) show consistent noncompliance for all steps of the first five baseline probes; on the sixth (trial 83) and seventh baseline probes (trial 113) Alex tolerated all 13 steps. Since no direct training occurred for the abdominal exam, generalized compliance from previous training is suggested. The total training time, not including assessment, was approximately 6.5 h.

Alex successfully completed all 10 components of the physical exam probe conducted by the experimenter at CASD, without problem behavior. Subsequently, he completed three of the posttest components performed by the PA in the medical clinic compared to two during the pretest. Alex did not comply to the lung, heart, abdominal, nose, mouth/throat, and ear exams, as well as lying on the examination table. Similar to the pretest, Alex's avoidance behavior interfered to such a degree with the posttest that it was terminated. He protested for 55% of the intervals, escaped for 47%, but did not aggress.

Despite successfully tolerating all 10-exam components at CASD when tested by the experimenter, Alex did not tolerate all posttest components when the examiner and setting were changed. It was decided, therefore, that Alex required further training in the criterion setting where the pre- and posttests occurred (i.e., the medical clinic). The experimenter conducted three training sessions at the medical clinic to extend responding to the physical setting stimulus class. During the three training sessions, Alex successfully completed all 10-exam components. During the first training session, he escaped during 4% of the intervals, aggressed 0%, and protested 7%. During the second and third training sessions in the medical clinic, Alex did not engage in any problem behavior.

Next, Alex underwent a second posttest with the PA in the medical clinic. He successfully completed all 10-exam components and did not engage in any problem behavior. The PA collected maintenance data 1 week and 1 month after the second posttest at the medical clinic. During both follow-ups, Alex successfully completed all components of the physical exam, without problem behavior.

Alex viewed the priming DVD five times, with a mean rating of 3.8. He would cover his ears immediately before certain sound effects played on the DVD, and immediately uncover his ears upon cessation of the sound. Those sounds on the DVD appeared to function as either primary or conditioned aversive stimuli.

2.4. Craig

Craig did not comply with any of the 10-pretest components; an escape function was inferred. He engaged in escape behavior during 33% of the pretest intervals and protesting during 40%; he did not engage in any aggressive behavior. The upper three panels of Fig. 4 show the effect of training on compliance to the heart, mouth/throat, and ear exams. For the heart exam, Craig was not compliant during baseline; he only allowed the stethoscope to be placed on his chest for 10 s three times before he attempted to escape by pushing it away. He reached the acquisition criterion in 15 training sessions. Compliance to the table, lung, abdominal, and nose components also increased to the criterion level suggesting that exposure to heart exam training procedures (e.g., use of the stethoscope) and the priming video were sufficient to increase compliance for the four untrained components.

The baseline probes for compliance to the mouth/throat exam indicated that Craig opened his mouth when it was modeled, but when the otoscope was presented Craig would close his mouth and turn away. He met the acquisition criterion in 13 training sessions. Craig also was consistently non-compliant for the ear exam baseline probes. Following the statement

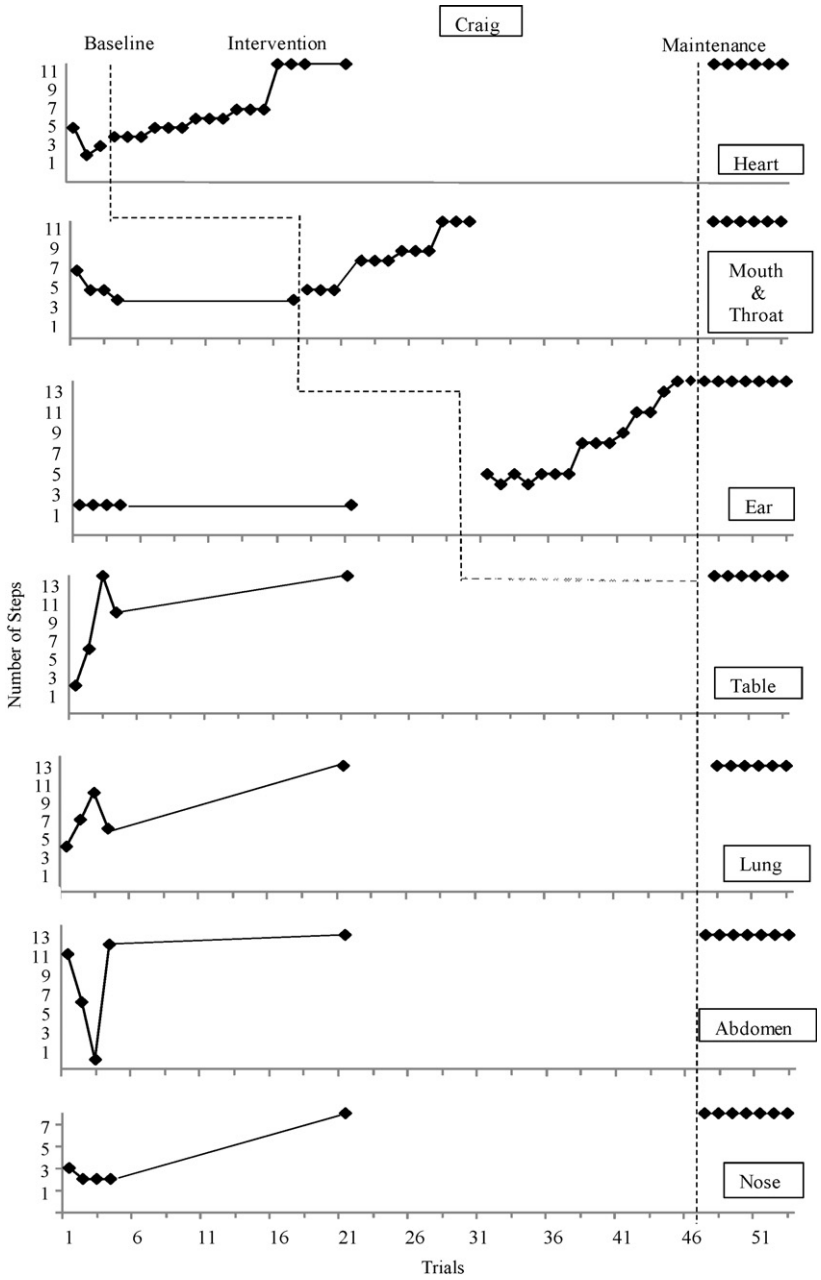

Fig. 4. Effects of an intervention package on Craig's compliance to medical exam components.

"I'm going to look in your ears", he would cover his ears and say, "No, no, no." while trying to turn away from the experimenter and otoscope. Training required 17 sessions.

Craig successfully completed all 10-exam components when the: (a) experimenter conducted three physical exam probes at CASD approximately 1 month following training, (b) PA conducted the stimulus generalization across examiners probe at CASD, (c) PA performed the posttest at the medical office. He did not engage in problem behavior during any of these exams. Craig's mother reported that he watched the priming DVD at least once and often multiple times during the day. She consistently rated his attention to the DVD as 5. Craig would talk about "Smiley Saurus" (i.e., the priming video character) during training.

2.5. Mark

Mark did not comply with any of the 10-pretest components (see Fig. 5). He engaged in escape for 54% of the intervals, protesting for 82%, but no aggressive behavior. An escape function for noncompliance was inferred. Subsequently, three

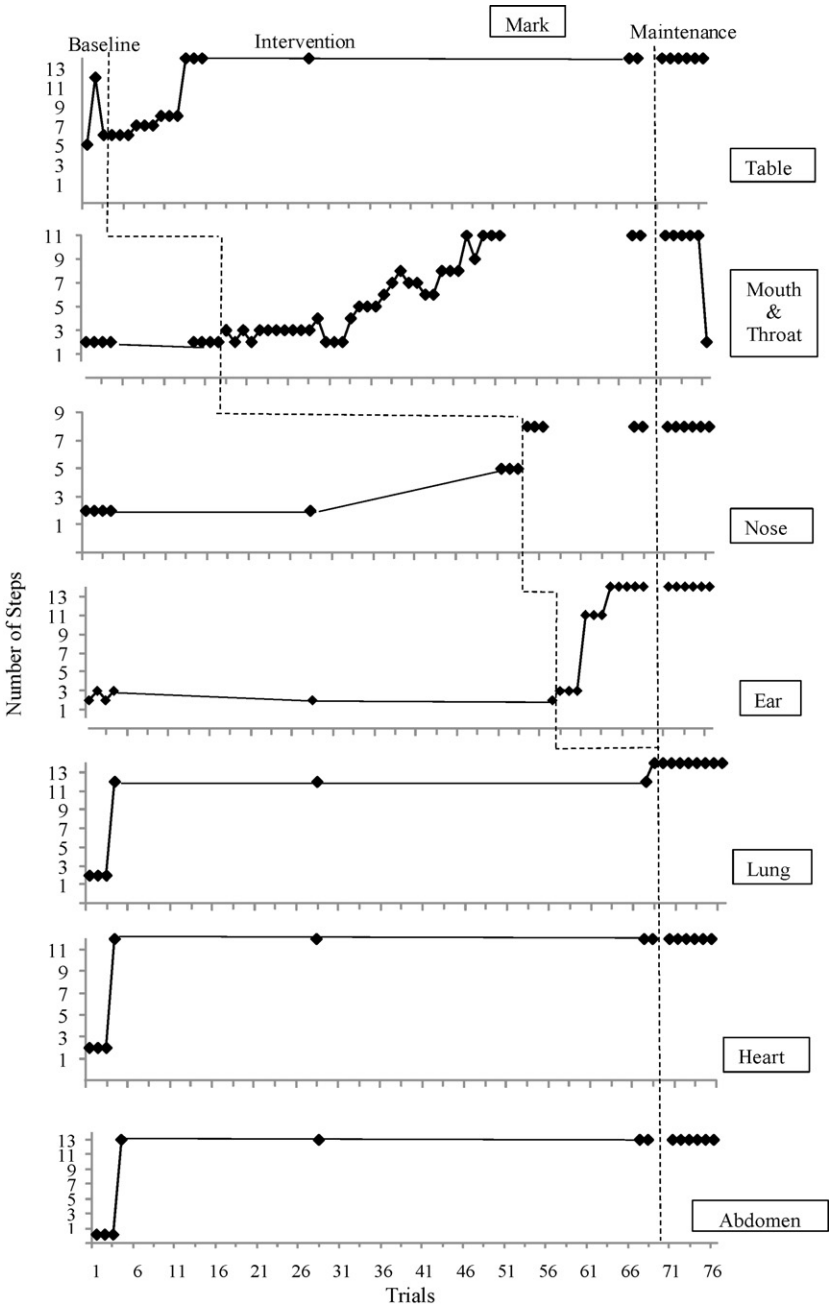

Fig. 5. Effects of an intervention package on Mark's compliance to medical exam components.

baseline probes show that Mark was not compliant when asked to lie down on the exam table. When placed on the table by his father, Mark would either try to climb back down or curl into the fetal position instead of lying flat on his back. Mark required 12 training sessions to comply with this component that also resulted in generalized compliance to abdominal, heart, and lung exam components. Following mastery of the exam table component, on-going maintenance probes were conducted for the remainder of the study.

Baseline probes for compliance to the mouth/throat, nose, and ear exams indicate that Mark was not compliant. When asked to open his mouth, Mark would turn away from the experimenter and push the otoscope away. Mark required 38 training sessions for the mouth/throat exam. For the nose exam, Mark would turn his face away when the otoscope was brought near his nose. He received six training sessions for this component. During the ear exam, when he was told "I'm going to look in your ears" he would cover his ears and try to turn away from the experimenter and otoscope. Mark received 10 training sessions for this component.

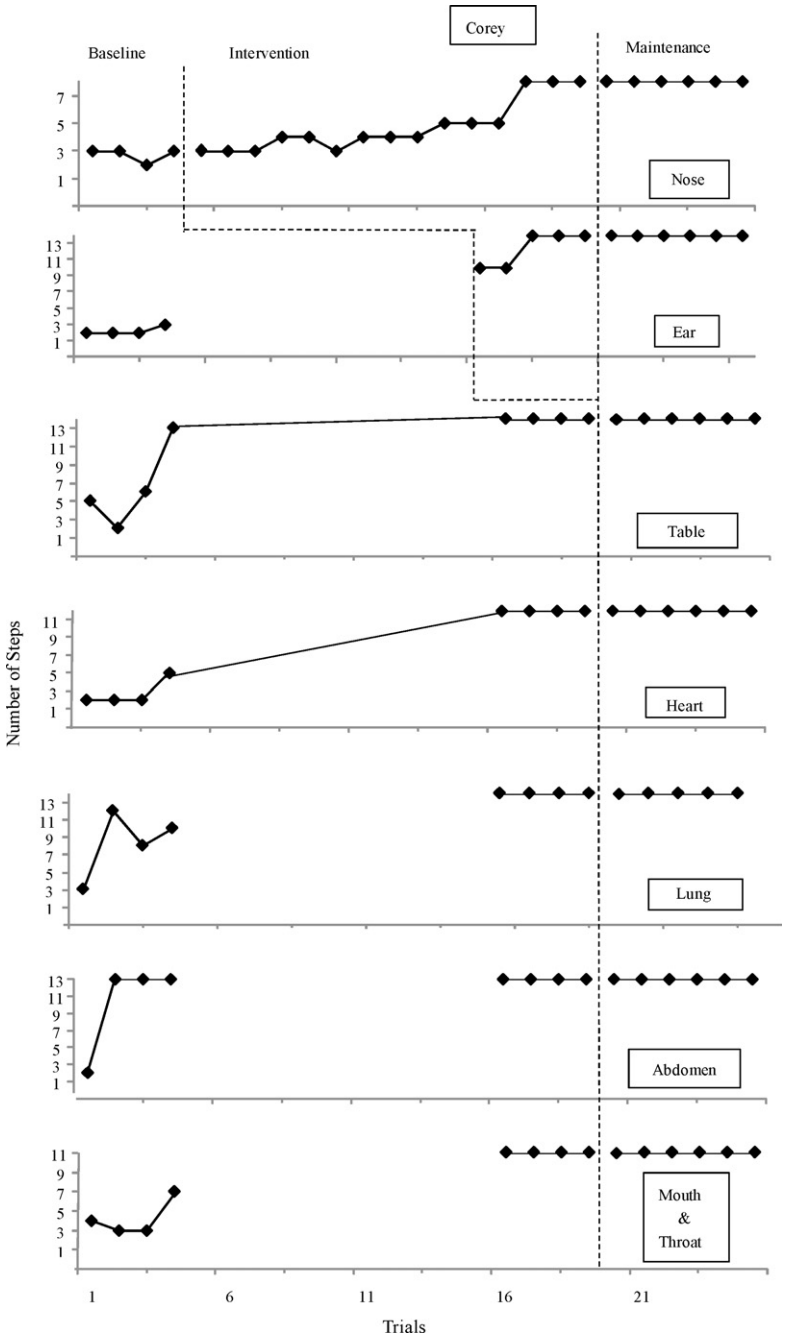

Fig. 6. Effects of an intervention package on Corey' compliance to medical exam components.

Mark complied with all 10-exam components during three maintenance probes conducted by the experimenter approximately 1 month following training, and when examined by the PA at CASD. The latter suggests stimulus generalization across examiners. During the posttest at the medical clinic, Mark refused to open his mouth to complete the mouth and throat exam component, but complied with the other nine components. Mark did not engage in problem behavior during any of these exams. He watched the priming DVD 1–2 times each day throughout training. His father rated Mark between 3 (i.e., watched half) and 5 (i.e., watched all).

2.6. Corey

Corey did not comply with any of the 10-pretest components (see Fig. 6). He engaged in protesting and escape during 23% of the intervals, and aggression during 8%. Escape appeared to be the function of noncompliance to the exam components.

During the nose exam baseline, Corey would turn his face away when the otoscope was brought near his nose. He received 15 training sessions for this component. For the ear exam, following the statement "I'm going to look in your ears," Corey would make a face, cover his ears, and try to turn away from the experimenter and otoscope. He required five training sessions. After training these two components, Corey also met the acquisition criterion for five other exam components for which he was noncompliant during the pretest (see Fig. 6).

Corey passed all 10-exam components when: (a) probed for maintenance three times by the experimenter approximately 1 month following training, (b) tested for stimulus generalization across examiners by the PA at CASD, and (c) posttested by the PA at the medical office. Corey did not engage in problem behavior during any of these exams. He watched the priming DVD 1–2 times each day throughout the training and was scored 5 each time.

3. Discussion

A behavioral intervention package, including preference assessment, contact desensitization (i.e., counterconditioning, fading in aversive stimuli), shaping, video priming, prompting (i.e., photo and in vivo modeling, gestural, physical), verbal instructions, DRO, and escape extinction was successfully implemented to train compliance to a 10-component physical exam by children with autism spectrum disorders. No known behavioral research has investigated techniques to increase the compliance of children with autism to a multicomponent physical exam. Similar behavioral procedures have been used to teach children with autism to be compliant with other medical (e.g., Ghuman et al., 2004; Shabani & Fisher, 2006), vision (Newsom & Simon, 1977; Simer & Cuvo, 2009), and dental (e.g., Luscre & Center, 1996) procedures. These behavioral interventions can be of great benefit to children with autism and other developmental disabilities who otherwise might have to forego healthcare procedures, have data collected indirectly, or be subjected to restrictive means (e.g., drugs, physical restraint) to obtain their compliance.

The participants were trained by Board Certified Assistant Behavior Analysts to comply with the components of a physical exam at the children's autism center, and then the children generalized responding to the medical clinic and the Physician Assistant examiner. This suggests that training in the criterion medical setting with medical personnel, may not always be necessary if stimulus generalization can be programmed to occur. In the present study, generalization might have been facilitated because the medical equipment and physical exam procedures were the same during training as those used in the medical clinic, and the PA was present during maintenance probes for cohort 2. For children who exhibit high levels of escape/avoidance responding across all exam components, such as Alex, further training in the medical setting may be necessary to promote compliance across setting and examiner stimulus classes.

Training compliance to some exam components also generalized to other untrained components for some participants. They also maintained their compliance to the physical exam response requirements under baseline conditions up to 1 month after the end of training. Future research should address whether the training package as implemented would promote generalization to the children's regular health care providers in their natural setting. Efforts to promote applied behavior analysis within pediatrics would benefit from recommendations that have been made (Allen, Barone, & Kuhn, 1993).

The demonstration that the physical exam training hierarchies could be adapted, either as steps to desensitize children to aversive medical stimuli or as successive approximations to shape behavior, shows the utility of the hierarchies regardless of the function of noncompliance (i.e., escape/avoidance vs. skill deficit). The incremental steps in the hierarchies either increased the children's tolerance to aversive stimuli by fading them in or shaped by successive approximations responses that were not in participants' behavioral repertoires.

This experiment tested a multiple component package to maximize the overall effect of the intervention. Because a training package was used, the contribution of its individual components is not known. Now that the efficacy of the package has been demonstrated, it could be dismantled in future research. A component analysis could determine which specific procedures are required to achieve efficacy with greater efficiency.

Another limitation of this experiment is that other potentially aversive components of a medical exam were not included in this study (e.g., vital signs, growth parameters). Nevertheless, the present research presents a model for assessment and intervention that could be generalized to other medical procedures.

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