Remote Training of Dental Students and Professionals to Promote Cooperative Behavior in Patients with Intellectual and Developmental Disabilities

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Accepted: 21 March 2022 / Published online: 2 April 2022 © The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

Many individuals diagnosed with intellectual and developmental disabilities (IDD) are uncooperative during routine dental exams, leading to poor oral health in this population. Few studies have evaluated methodologies for preparing dental students and professionals to work effectively with patients diagnosed with IDD. In this study, experimenters used remote behavioral skills training (BST) to train dental students and professionals how to implement a practical intervention that included tell-show-do, contingent praise, and noncontingent reinforcement. Results suggested that group training conducted via videoconferencing was effective for teaching six of seven participants to implement the intervention in the absence of post-training feedback. This approach appears useful for quickly and efficiently training current and future dental professionals to implement behavior techniques to promote patient compliance.

Keywords Dental care · Behavior analysis · Behavior skills trainings · Group training · Intellectual and developmental disabilities · Compliance

Routine professional dental care is important for maintaining good oral health, which, in turn, may reduce the risk of other serious health issues, such as cardiovascular disease, coronary heart disease, and diabetes mellitus (U.S. Department of Health and Human Services, 2000). However, research indicates that individuals

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with intellectual and developmental disabilities (IDD) have less access to dental care than those without disabilities (Ward et al., 2019) and suffer from poorer oral health (Wilson et al., 2019). Patient anxiety and noncompliance during examinations is a commonly cited barrier to receiving routine dental care (Duker et al., 2017; Gabre et al., 1999; Morgan et al., 2012; Wilson et al., 2019; Zhou et al., 2017). Research suggests that many individuals with IDD may engage in problem behavior to escape dental examinations (Altabet, 2002; Cumella et al., 2000; Kupzyk & Allen, 2019) and that dentists may exclude individuals with IDD from their practice as a result of these behavioral difficulties (Byrappagari et al., 2018; Casamassimo et al., 2004; Derbi et al., 2016; Duker et al., 2017). Some dental professionals also may require the use of restraints, sedation, or anesthesia to treat patients with IDD (Boynes et al., 2010; Connick et al., 2000; Dougherty, 2009). Such procedures come with risks and may deter caregivers from seeking services for their children (e.g., Kannikeswaran et al., 2009).

In light of these findings, it is not surprising that dental students and professionals often report feeling unprepared to serve this population (e.g., Byrappagari et al., 2018; Dao et al., 2005; Wolff et al., 2004; see also El-Yousfi et al., 2019, for a review). For example, in a survey of 562 dental students and professionals, only about 38% reported that their dental education well prepared them to serve this population and only about half reported that they planned to treat or currently treated patients with disabilities (Smith et al., 2006). Professional training appears to be key to improving patients’ access to dental care, as dental students and professionals who reported receiving the most preparation for treating patients with IDD also were the most likely to report serving this population or an intention to do so in the future (e.g., Dao et al., 2005; Vainio et al., 2011). Nonetheless, this specialized training is limited to just a few hours of didactic classroom instruction at many dental schools (Albino et al., 2012).

To address this problem, the Commission on Dental Accreditation (CODA) adopted a requirement in 2020 that all U.S. dental schools must train dental students to assess and manage the treatment of patients with IDD and other special needs and that all dental hygiene students must be competent in treating these patients. While this requirement may impact the future quality and availability of care provided by newly trained dental professionals, it does not address the training needs of those who are currently practicing. Continuing education for dental professionals must be time- and cost-efficient to ensure wide-spread accessibility while still improving dental practices and the care of patients with IDD. Dental schools also must now identify effective yet cost-efficient ways to provide this specialized training to all students to maintain their CODA accreditation (Waldman et al., 2005). As such, the field would benefit from further development and evaluation of curricula to prepare dental professionals to work effectively with patients with IDD.

In light of the behavioral difficulties that often hinder service provision to patients with IDD, curricula for current and future dental professionals should include strategies for promoting cooperative behavior. Research has identified a number of behavior-analytic interventions that are effective for increasing cooperation or decreasing physiologic measures of fear during dental exams (see Kupzyk & Allen, 2019, for a review). Most interventions are based on a presumption that uncooperative behavior
is maintained by escape or avoidance of aversive stimuli associated with dental procedures. These interventions, typically implemented in some combination, include tell-show-do (e.g., Luscre & Center, 1996; Mah & Tsang, 2016), escape extinction (McConnell et al., 2020; Szalwinski et al., 2019), graduated exposure (Altabet, 2002; Carter et al., 2019; Conyers et al., 2004; Cuvo et al., 2010), reinforcement for cooperation (e.g., Allen et al., 1992; Maguire et al., 1996), and noncontingent reinforcement in the form of frequent breaks or continuous access to preferred items (e.g., Isong et al., 2014; O’Callaghan et al., 2006). Thus, training curricula can draw on an extensive empirical base of efficacious interventions for individuals with IDD.

However, in most studies involving patients with IDD, treatment was implemented by behavior specialists rather than by dentists and included procedures that may be difficult for dental professionals to implement as part of routine exams. For example, when implementing escape extinction, the dentist must continue the dental procedures regardless of the patient’s response, using physical prompts as needed to ensure cooperation. Dentists may be unwilling or unable to implement such procedures, particularly with large patients (e.g., adults) or those who engage in severe problem behavior, such as aggression. Graduated exposure requires the dentist to break down the dental procedures into a series of steps and to introduce the steps gradually over time. For example, the dentist might initially just ask the patient to enter the exam room and sit in the dental chair during appointments before introducing the next exam step (e.g., placement of the bib) if the patient continues to cooperate with earlier steps. Successful treatment with graduated exposure often requires a lengthy number of appointments. As such, graduated exposure may be both time- and cost-prohibitive for dentists to incorporate into routine service provision.

Dentists are unlikely to adopt interventions like graduated exposure and escape extinction as the first-line standard of care due to the cost, time, and expertise needed to implement them effectively (Allen et al., 1990). However, other potentially effective interventions, such as tell-show-do, contingent reinforcement, and noncontingent reinforcement, are relatively less intensive and more practical to implement as the standard of care for patients with IDD. It might be advantageous for dental training curricula to focus on these first-line behavior management strategies. If these strategies do not promote acceptable levels of cooperation with a particular patient, the dental professional could then refer the patient to a behavior specialist for more intensive intervention (Allen et al., 1990).

However, further research is needed on the effectiveness and acceptability of efficient training approaches that extend beyond didactic classroom instruction for dental students and professionals (Krause et al., 2010). Behavioral skills training (BST), which consists of instructions, modeling, and practice with feedback, is a highly efficacious training approach that has been used in a few prior studies to train dental professionals (e.g., Allen et al., 1992; Graudins et al., 2012).

For example, Graudins et al. (2012) used BST to teach three dental students to implement escape extinction and contingent reinforcement when providing exams and cleanings to young children with ASD. Training began with a 45-min lecture after which the participant viewed a 20-min video of a provider implementing the procedures with a patient. The participant then practiced the procedures in role play with the experimenter, who provided feedback. The role play continued until the
participant implemented 80% of the steps correctly. In the final phase of training, the participant practiced the skills with young patients with ASD while the experimenter provided feedback until the participant implemented 90% of the steps correctly for two consecutive sessions. Results showed that all participants successfully mastered the skills after no more than 4 total hours of training. Furthermore, the participants’ skills maintained when they implemented a different type of dental procedure with the children (bitewing X-rays), and all of participants rated the training procedures and intervention as acceptable.

Results of Graudins et al. (2012) suggest that BST could be utilized in a cost-effective way to train dental students and professionals to promote cooperative behavior in patients with IDD. However, the field would benefit from extensions of this work. First, as noted previously, escape extinction, a component combined with contingent reinforcement in Graudins et al., may not be feasible for dentists to implement with some patients, such as adults with IDD. An intervention package that excludes escape extinction should include additional procedures to increase its potential effectiveness, such as tell-show-do and noncontingent reinforcement. However, such a package of procedures would be more complex than that taught in Graudins et al. Second, the experimenter in Graudins et al. repeatedly observed participants working with actual patients and provided feedback until the participants met a performance criterion. Such an arrangement may not be financially or practically feasible for some dental schools or current dental professionals. Thus, further research is needed on cost-effective ways to train current and future dental professionals.

Virtual training, in particular, may prove beneficial for helping to prepare dental professionals to promote cooperative behavior in patients with IDD. Numerous studies have demonstrated the efficacy of using remote modalities (e.g., videoconferencing) to train caregivers and staff to work effectively with individuals with neurodevelopmental disabilities (e.g., see Neely et al., 2017; Tomlinson et al., 2018; Unholz-Bowden et al., 2020, for reviews). In these studies, the experimenter implemented elements of BST while videoconferencing with trainees (e.g., via Zoom™) by describing and modeling the procedures and arranging for the trainees to practice the skills while the experimenter provided feedback. Remote training modalities may increase trainees’ access to qualified trainers by removing geographical barriers and reducing costs (Lindgren et al., 2016). Remote training also may ensure that access to training continues despite disruptions to in-person modalities (e.g., pandemic-related restrictions). Further research is needed to evaluate the feasibility and efficacy of using remote BST with dental professionals. In particular, group training formats that do not necessarily require the trainer to observe the trainee working with actual patients might enhance the cost-efficacy and accessibility of the training.

The purpose of this study was to evaluate the effectiveness and acceptability of remote videoconferencing to teach small groups of dental students and professionals to implement behavioral procedures when conducting routine dental exams and cleanings with adults with IDD. The intervention was comprised of multiple procedures that could be readily implemented by dental professionals within the context of routine dental exams. Furthermore, all training was conducted via role play with
the experimenter to evaluate the efficacy of a training approach that does not require in-person patients.

**Method**

**Participants and Settings**

The experimenter recruited seven participants by sending flyers via email to dental faculty and by sharing information about the study to students attending classes at a local dentistry school. Eligible participants had access to an internet-enabled device with webcam (e.g., laptop), high-speed internet (i.e., minimum download/upload speed 400kbps/400kbp), and a second person (e.g., spouse or friend) who was available to serve as an in-person, simulated patient during mock dental exams to assess the outcome of the training. (Access to actual patients was unavailable for all but one participant due to the COVID-19 pandemic.) Participants included currently enrolled dental students, an undergraduate student who was entering dental school in the upcoming semester, and a practicing dentist and dental hygienist with less than 1 year of experience. All participants had little to no prior experience or coursework that focused on working with the IDD population. Table 1 displays information about each participant. Participants received a $100 gift card for completing the training.

Individuals were eligible to serve as in-person simulated patients if they felt comfortable being in close proximity with the participant, had access to headphones and a cell phone, and could follow simple instructions (e.g., “Close your mouth, now”). All of the simulated patients were above the age of 18 years. Additional information about each simulated patient is displayed in Table 2. Individuals serving as simulated patients received a $25 gift card for completing the baseline and post-training sessions. Two patients diagnosed with IDD were participants during generalization sessions. Sophia was a 21-years-old woman who was diagnosed with Down syndrome and a severe intellectual disability. Sophia had not received dental services for 3 years because prior dentists indicated that she needed to receive general anesthesia for routine exams. Stella was a 20-year-old woman who was diagnosed with Down syndrome and an intellectual disability. Her mother reported that she had engaged in problem behavior during past dental exams and, as such, received general anesthesia for all her dental visits. She also had not received a routine cleaning from a dentist for the 3 years preceding the study. However, 1 year prior to the current study, Stella participated in a different study, during which an experimenter conducted a mock dental exam while evaluating the effectiveness of tell-show-do and praise for compliance. Stella complied with 100% of the steps during this mock dental exam.

Participants were located in their homes for all baseline, training, and post-training sessions. Generalization sessions took place at a university-based medical clinic that specialized in the care of adults with IDD.

The experimenter was a graduate student studying applied behavior analysis. She had 4 years of experience providing behavior analytic services to individuals with IDD and their families, with more than 1 year of experience working with patients...
### Table 1: Participant Information

| Participant | Field of Dentistry | Education                        | Prior Experience with IDD Patients | Previous Relevant Coursework |
|-------------|--------------------|----------------------------------|------------------------------------|-----------------------------|
| Gina        | Dental             | Fourth-Year Student              | < 1 month (specialized school clinic) | None                        |
| Mya         | Dental             | Second-Year Student              | None                              | 3-week class                |
| Pratyusha   | Dental             | Second-Year Student              | None                              | 3-week class                |
| Ximena      | Dental Hygiene     | Graduated < 6 Months             | < 6 months (specialized school clinic) | None                        |
| Matt        | Dental             | Graduated < 12 Months            | None                              | None                        |
| Rocco       | Dental             | Fourth-year Undergraduate Student| None                              | None                        |
| Finn        | Dental             | Second-Year Student              | None                              | 3-week class                |

IDD: Intellectual and Developmental Disabilities
and professionals in a health care setting. Other graduate faculty and students in the applied behavior analysis program assisted with the research by serving as simulated patients and confederate trainees during the training and collecting data. The experimenter trained each research assistant to perform their responsibilities.

### Materials

Instruments needed to complete the mock dental exams included a chair, bib, dental explorer (i.e., sickle probe), mirror, toothbrush, toothpaste/polish, floss, gloves, and a mask. Prior to baseline, the experimenter asked the participants to gather these materials but provided a list of suggested substitutes if they did not have access to a tool (e.g., a spoon as a mirror). Before each session, the experimenter showed the participant a patient profile that included the mock patient’s name, age, diagnosis (e.g., Down syndrome and profound intellectual disabilities), past dental history (e.g., required general anesthesia to be seen for a routine dental exam), and caregiver-reported highly preferred items of the patient (e.g., soft and squishy items). All highly preferred items were those that the participant could find in their homes (e.g., a pasta box for items that shake and make noise).

### Response Measurement and Reliability

The primary dependent variable was the percentage of opportunities with correct implementation of the behavioral procedures while the participant completed a dental exam. Prior to the study, the experimenter consulted with dental faculty to create a task analysis of a mock dental exam (see Table 3 for the dental exam task analysis). Trained observers used paper and pencil to score correct or incorrect implementation of each behavioral procedure during each opportunity within a session (See Table 4 for a list of the behavioral procedures). Some components could only be implemented once during each session (1, 2, 3, 11, 12 in Table 4), whereas others had multiple opportunities within and across dental exam steps. An opportunity to provide the patient with access to a preferred item was scored for each dental exam step to document whether the participant ensured that the patient had access to the item for the duration of the exam. For each mock dental exam, the experimenter calculated the number of components implemented correctly divided by the

| Participant | Simulated Patient(s) | Relationship       |
|-------------|----------------------|--------------------|
| Gina        | Kevin                | Husband            |
| Mya         | JT                   | Friend             |
| Pratyusha   | Marco                | Significant Other  |
| Ximena      | Mateo                | Husband            |
| Matt        | Mario                | Brother            |
| Rocco       | Anna/John            | Girlfriend/Friend  |
| Finn        | Lauren               | Friend             |

Table 2 Simulated Patient Information
A second observer collected data independently for at least 30% of sessions during each phase for each participant. The experimenter calculated exact interobserver agreement (IOA) between the primary and secondary data collectors by dividing the number of agreements by the agreement plus disagreements and multiplied by 100. Mean IOA was 88% for Gina, 88% (range, 86%–92%) for Finn, 88% (range, 80%–96%) for Mya, 79% (range, 70%–88%) for Pratyusha, 85% (range, 82%–88%) for Ximena, 90% (range, 88%–94%) for Matt, and 91% (range, 90–92%) for Rocco. Due to technical issues, IOA was not collected for any of Ximena’s baseline sessions and for Matt’s generalization sessions.

**Table 3  Task Analysis of Dental Exam**

| Initial Steps                                                                 |
|------------------------------------------------------------------------------|
| Place bib on chest and hooked around neck                                     |
| Put on mask                                                                  |
| Put on the gloves                                                            |
| Inspection of teeth with mirror and explorer                                |
| Have patient open their mouth                                                |
| Insert mirror into mouth for 5 s                                              |
| Touch one tooth with pick (while mirror is in place)                         |
| Touch 5 top teeth with pick/mirror                                           |
| Touch 5 bottom teeth with pick/mirror                                        |
| Brushing                                                                     |
| Hold electric/manual brush close to mouth                                    |
| Have patient open their mouth for brush                                      |
| Touch one tooth with brush                                                   |
| Brush surface bottom side with brush (left)                                  |
| Brush inside bottom side with brush (left)                                   |
| Brush outside bottom side with brush (left)                                  |
| Brush surface bottom side with brush (right)                                 |
| Brush inside bottom side with brush (right)                                  |
| Brush outside bottom side with brush (right)                                 |
| Brush surface top side with brush (left)                                     |
| Brush inside top side with brush (left)                                      |
| Brush outside top side with brush (left)                                     |
| Brush the surface top side with brush (right)                                |
| Brush inside top side with brush (right)                                     |
| Flossing                                                                     |
| Floss one tooth (both sides)                                                 |
| Floss one side of bottom row                                                 |
| Floss other side of bottom row                                               |
| Floss one side of the top row                                                |
| Floss other side of the top row                                              |

total number of opportunities and multiplied by 100. A second observer collected data independently for at least 30% of sessions during each phase for each participant. The experimenter calculated exact interobserver agreement (IOA) between the primary and secondary data collectors by dividing the number of agreements by the agreement plus disagreements and multiplied by 100. Mean IOA was 88% for Gina, 88% (range, 86%–92%) for Finn, 88% (range, 80%–96%) for Mya, 79% (range, 70%–88%) for Pratyusha, 85% (range, 82%–88%) for Ximena, 90% (range, 88%–94%) for Matt, and 91% (range, 90–92%) for Rocco. Due to technical issues, IOA was not collected for any of Ximena’s baseline sessions and for Matt’s generalization sessions.
**Experimental Design**

The experimenter attempted to divide the seven participants into groups of three based on their availability to attend the training sessions. However, recruitment and scheduling issues prevented the inclusion of at least three trainees during each group training session. Thus, research assistants served as confederate trainees who acted as dental or dental hygiene students so the group number was held constant at three across the study (with one exception, see further description below). The confederates were instructed to engage in responding that was similar to the participants, who were unaware that the confederates were research assistants.

Each participant attended one group training that lasted approximately 90 min. Throughout the study, the experimenter conducted a total of five group trainings. The first training included Gina, Mya, and one research assistant who served as a confederate. The second group training included Pratyusha and Ximena; the research assistant scheduled to serve as a confederate participant became ill shortly before this training, and the experimenter was unable to locate a substitute. Each of the remaining three group trainings consisted of one participant (Rocco, Matt, or Finn) and two research assistants who served as confederates. The experimenter staggered introduction of the training across different length baselines for the participants who attended the same training group. Within each of these training groups, the experimenter exposed each member to the training package at the same time. A nonconcurrent multiple baseline design across participants was used to evaluate the effects of group BST on implementation of the treatment package. For the purpose of demonstrating control via the nonconcurrent multiple baseline design, the baseline lengths were staggered across a group of three participants and a group of four participants.

| Table 4 Components of Intervention |
|------------------------------------|
| 1. Sets up dental materials prior to exam |
| 2. Has potential preferred items ready prior to exam |
| 3. Greets the patient at beginning of exam (e.g., "It's nice to see you, today! I like your shirt.") |
| 4. Provides access to reported preferred item (e.g., iPad) |
| 5. Labels material or instrument (e.g., bib, mirror) and explains what they will do with it |
| 6. Completes described step (e.g., places bib on participant) |
| 7. Provides praise contingent on compliance with a step |
| 8. Provides 15-s break contingent on noncompliance or challenging behavior |
| 9. Provides a 15-s break in between dental exam steps |
| 10. Provides a 15-s break during steps that last longer than 15 s |
| 11. Provides statement that exam is complete at end of exam |
| 12. Provides general praise for completion at end of exam |
Procedure

Baseline (In Person)

The participant completed in-person, mock dental exams with the simulated patient while the experimenter observed remotely. All mock dental tools and a copy of the dental exam task analysis were available. The experimenter instructed the participant to refrain from completing any real dental work. Prior to each baseline exam, the experimenter displayed a patient profile using the screen share feature of Zoom™. The simulated patient wore headphones, and a research assistant provided instructions to the simulated patient via cellphone about how to behave so that the participant had an equal number of opportunities to respond to compliance, noncompliance, and problem behavior during each session.

The experimenter instructed the participant to complete as many steps in the exam task analysis as possible and to let the experimenter know when the exam was finished. Sessions were terminated when the participant completed all steps in the task analysis, provided a vocal statement that the exam was finished (e.g., "the appointment is finished for today."), or if the session time elapsed (i.e., 15 min). The experimenter provided no feedback.

Group Training (Virtual)

The experimenter conducted each group training during a single approximately 90-min remote meeting. The experimenter e-mailed a handout to the participants 24 h before the start of the training. The handout included definitions, examples, and detailed instructions on how to implement tell-show-do, contingent praise for compliance, noncontingent access to preferred items, frequent noncontingent breaks, and escape contingent on noncompliance or problem behavior. The experimenter reviewed the handout at the start of the group training. The participants could ask questions at any time. Next, the experimenter shared her computer screen and showed the participants a 10-min video of the experimenter modeling the intervention with a research assistant who role played as a patient. The latter 3 min of the video showed the experimenter implementing a virtual mock dental exam with the research assistant role playing as a patient in a different location than the experimenter. The purpose was to show the participants how to conduct a virtual mock exam (e.g., deliver instructions while gesturing towards the webcam with a tool in their hand) and how the research assistant (as a simulated patient) would indicate their compliance, noncompliance, or problem behavior during the exam step. The research assistant simulated compliance with an exam step in the virtual roleplay by completing the step (e.g., sitting in a chair and placing a bib on themselves immediately after the participant delivered the instruction or simulated the step) or by keep their mouth open. The research assistant simulated noncompliance with a step by not opening their mouth, shaking their head no, or saying “no” at a conversational level. The research assistant simulated problem behavior directed at the participant (e.g., aggression) by engaging in the behavior towards the webcam (e.g., punching towards the webcam).
Following the video demonstration, the participants engaged in remote role play with the research assistants, who followed prepared scripts to ensure the participant had an equal number of opportunities to practice implementing the procedures when patients engaged in compliance, noncompliance, and problem behavior. At the start of each role-play session, the experimenter displayed a patient profile using the screen share feature of Zoom™. The participant then gathered the relevant materials (e.g., toothbrush and a pillow to use as a preferred item). The experimenter also suggested materials (e.g., a napkin to simulate a bib) and items that could be used as preferred items for the patient. Each group member took a turn role playing with the research assistant while the other group members observed. To increase the time efficiency of the training, each group member implemented just a portion of the mock exam (i.e., the initial steps and one longer duration step, such as flossing) while implementing the intervention and observed the remaining group members perform other portions of the exam (e.g., inspection with mirror and pic).

The experimenter delivered immediate praise and corrective feedback to the participants throughout the role play. For corrective feedback, the experimenter included a rationale for the feedback and an example of how to implement the component correctly. After delivering corrective feedback, the experimenter asked the participant to perform the step again. Participants continued to take turns practicing in role play until they completed 90% of the steps correctly across two mock exams. Once a group member met this criterion, they watched the other group members practice until all had met the criterion.

No later than 30 min (range, 10 min–30 min) following the group training, the experimenter emailed the participants another copy of the handout, along with a 10.5-min video of a research assistant implementing the intervention during a mock exam with a simulated patient while the experimenter narrated aspects of the demonstration. This was a different video than that shown during the group training. The experimenter instructed the participants to review the handout and video before the post-training appointment but did not collect information on whether the participants did so.

**Post Training (In Person)**

The experimenter scheduled the post-training sessions for each participant no more than 3 days (range, 1–3 days) after the training. All post-training sessions for each participant occurred during a single remote meeting with the experimenter. Post training sessions were identical to baseline sessions. Participants conducted a mock dental exam with the same simulated patient from baseline (with the exception of Rocco), while the experimenter observed remotely. Rocco’s baseline simulated patient was not available for the post-training sessions so he recruited a different person for this phase. Sessions continued until the participant implemented at least 90% of the steps correctly across at least three consecutive mock exams. If the participant’s responding fell below 90%, the experimenter provided the participant with feedback that described their correct and incorrect responses.
Generalization Probes (Matt Only)

Due to the ongoing COVID-19 pandemic, only one participant (Matt) had an opportunity to apply the trained skills to actual patients receiving routine dental exams. He conducted exams with two patients on the same day, approximately 6 weeks after the end of the post-training phase. Prior to the exam, the experimenter provided information about the patient that was similar to that provided about the simulated patients, including the patient’s name, age, past dental history (e.g., required general anesthesia to be seen for a routine dental exam), and caregiver-reported highly preferred items of the patient that Matt could bring into the treatment room. The patients’ caregivers also were asked to bring at least one preferred item to the appointment.

Social Validity

The experimenter asked each participant to complete two surveys to obtain their opinions about the behavioral intervention and training procedures. The first survey was a modified version of the Treatment Acceptability Rating Form (Reimers & Wacker, 1988). The experimenter sent the survey to each participant via e-mail immediately after they completed the post-training sessions (see Table 5). The participants returned the completed survey to the experimenter via e-mail. The

| Table 5 | Mean Ratings (with Ranges) on a 7-point Scale for Each Item on the Social Validity Survey |
|---------|------------------------------------------------------------------------------------------------------------------|
| Items   | Participants                                                                                                     |
| 1. How acceptable do you find the behavioral procedures? (1 = not at all acceptable; 7 = very acceptable)    | 6.8 (6–7)                                                      |
| 2. How likely is the behavioral procedures to make permanent improvements in your patient’s behavior during future dental appointments? (1 = unlikely; 7 = very likely) | 6.5 (5–7)                                                      |
| 3. How costly will it be to carry out these behavioral procedures with your patients? (1 = not at all costly; 7 = very costly) | 3.8 (1–7)                                                      |
| 4. How willing are you to carry out these behavioral procedures? (1 = not at all willing; 7 = very willing) | 6.8 (6–7)                                                      |
| 5. How much appointment time will it be needed for you to carry out these behavioral procedures with your patients? (1 = little time; 7 = much time) | 4.6 (1–7)                                                      |
| 6. How confident are you that these behavioral procedures will be effective for your patients during future appointments? (1 = not at all confident; 7 = very confident) | 6.0 (5–7)                                                      |
| 7. How willing would you be to change your exam routine to carry out these behavioral procedures? (1 = not at all willing; 7 = very willing) | 6.5 (5–7)                                                      |
| 8. How disruptive will it be to your practice to carry out these behavioral procedures? (1 = not at all disruptive; 7 = very disruptive) | 2.9 (1–6)                                                      |
| 9. How effective are these behavioral procedures likely to be for your patients during future appointments? (1 = not at all effective; 7 = very effective) | 6.0 (5–7)                                                      |
| 10. How well will these procedures fit into the typical dental routine? (1 = not at all well; 7 = very well) | 5.7 (4–7)                                                      |

Excludes Matt’s second set of ratings (completed after the generalization probes)
experimenter asked Matt to complete this survey immediately after the post-training sessions and again after the generalization probes to evaluate whether his responses would change after implementing the procedures with actual patients. The second survey, a modified version of that developed by Elliot and Von Brock Treuting (1991) and distributed via Qualtrics™, evaluated their satisfaction with the training procedures (See Table 6). The experimenter sent a Qualtrics™ link to the participants approximately 6 months after their completion of the study (with the exception of Finn, who received it 1 day after his completion of the study). Due to the lengthy delay between the end of the study and the survey receipt, the experimenter provided the participants with a $10 gift card for completing this second survey.

### Procedural Integrity

For the baseline and post-training sessions, a primary observer collected data on the experimenter’s procedural integrity by scoring the following procedural components as correct, incorrect, or not applicable based on the experimenter’s performance during the entire session: (a) displayed necessary materials prior to each session, (b) instructed participants that they had 15 min to complete the mock dental exam and to implement the procedure to the best of their abilities, (c) provided no feedback (baseline only), (d) provided feedback on all correct and incorrect steps immediately after the session (post training only), and (e) provided feedback if participant responding was below 90% (post training only). For the group training sessions, a primary observer collected data on the experimenter’s procedural integrity by scoring the following procedural components as correct, incorrect, or not applicable based on the experimenter’s performance during the entire session: (a) reviewed instructions on handout and provided examples, (b) answered all relevant questions, (c) presented video model, (d) role played with each group member, (e) provided immediate feedback for all steps performed correctly, (f) provided immediate feedback for all steps performed incorrectly, (g) modeled incorrectly performed steps for the participant, if needed, (h) continued role play until each participant met the mastery criteria. The data were calculated as the percentage of steps performed correctly. The experimenter’s procedural integrity was 100% for all baseline and group training sessions. The experimenter’s procedural integrity during post training averaged 96% (range, 66%–100%). As described further below, the lower level of

| Table 6 Mean Ratings (with Ranges) on a 6-point Scale for Each Item on the Social Validity Survey |
|-------------------------------------------------|
| 1. Most dental/dental hygiene students would find this training acceptable | 6.0 |
| 2. This training should improve my effectiveness when conducting a routine dental exam with patients diagnosed with IDD | 6.0 |
| 3. I would suggest this training to others | 6.0 |
| 4. This training will benefit the patients/future patients in my clinic | 6.0 |
| 5. This training is consistent with other types of trainings I have received | 5.2 (4–6) |
| 6. I liked this training | 5.8 (5–6) |

1 = Strongly Disagree, 6 = Strongly Agree
procedural integrity occurred with two participants when the experimenter deviated from the specified criterion for providing feedback on the participants’ performance. A second observer collected data on the experimenter’s procedural integrity simultaneously and independently for at least 30% of sessions during each phase for each participant. Exact agreement was calculated by comparing the observer’s data and dividing the number of agreements by the number of agreements plus disagreement, and multiplying the sum by 100. An agreement was defined as the two observers both scoring a response as correct, incorrect, or not applicable. Mean IOA was 97.4% (range, 66%–100%).

Results

Results for all participants are shown in Fig. 1. As described previously, baseline lengths were staggered within and across members of the five training groups. To demonstrate experimental control, the seven participants were divided into two groups consisting of participants who were members of the same training group (Gina and Mya; Pratyusha and Ximena) and those who were trained with confederates only (Rocco, Matt, Finn). Baseline lengths were staggered across one group of three participants and one group of four participants. Data for the group of three participants are shown in the left panel. Mean percentage of opportunities with correct implementation was 28% (range, 23–35%) for Gina, 46% (range, 45–48%) for Finn, and 28% (range, 21–37%) for Mya. Two of the three participants’ performance showed an immediate increase to high levels during the in-person post-training sessions and met the mastery criterion in the absence of feedback. Mean performance was 98% (range, 94–100%) for Gina and 91% (range, 91–92%) for Finn. Due to experimenter error, Gina received feedback after each post-training session even though her performance was above 90%. Mya required eight post-training sessions before she met the mastery criterion. Mya should have received experimenter feedback following the first five post-training sessions, which were below 90%. However, due to experimenter error, Mya did not receive feedback after the fourth session. Her performance gradually increased across the first five sessions, averaging 95% (range, 93–97%) across the last three sessions in the absence of additional feedback.

Data for the remaining four participants are shown in the right figure. Mean percentage of opportunities with correct implementation was 47% (range, 40–57%) for Pratyusha, 31% (range, 23–35%) for Rocco, 61% (range, 45–75%) for Ximena, and 43% (range, 35–48%) for Matt. All four participants showed an immediate increase to high during the in-person post-training sessions and met the mastery criterion in the absence of feedback. Mean performance was 94% (range, 91–97%) for Pratyusha, 96% (range, 93–100%) for Rocco, 95% (range, 89–100%) for Ximena, and 97% (range, 94–100%) for Matt. During Matt’s generalization exams, his correct implementation of the treatment package was 90% during Sophia’s exam and 92% during the Stella’s exam. Matt’s most common error during these sessions was omitting the noncontingent break during dental exam steps that exceeded 15 s.

All of the participants completed the first survey that solicited their opinions about the intervention procedures. Overall, participants’ responses on this survey
indicated that they found the intervention to be acceptable, that they believed it would be effective with their patients, and that they would be likely to use it with patients in the future (see Table 5; excludes Matt’s second set of survey responses). However, some of the participants indicated that the intervention would be costly and time consuming to implement. Specifically, two participants rated the procedures as relatively costly (i.e., a “6” or “7” on the scale), and four participants rated the procedures as needing a great deal of time (i.e., a “6” or “7” on the scale). However, only one participant indicated that the procedures would be disruptive to their practice. Matt’s ratings remained unchanged or increased to reflect higher levels of social acceptability following the generalization probes, with the exception of his ratings for the relatively cost (shifted from a “3” to a “5”) and disruption to the routine exam (shifted from a “2” to a “3”). Four of the seven participants completed the second survey that solicited their opinions about the training procedures. The
responses of these participants indicated that they were highly satisfied with the training procedures (See Table 6).

**Discussion**

Remote group BST appears to be a promising approach for preparing dental students and professionals to promote cooperative behavior in patients with IDD during routine dental procedures. Most notably, for six of seven participants, the skills acquired during remote role play with the experimenter transferred to in-person implementation with a simulated patient in the absence of feedback. Mya was the only participant who did not meet the mastery criteria with group training alone and required experimenter-delivered feedback during the post-training sessions. The one participant (Matt) who had an opportunity to conduct sessions with two adults with IDD also demonstrated maintenance and generalization of the skills to actual patients. This relatively brief training was effective even though the intervention contained multiple components, including show-tell do, contingent praise for compliance, frequent breaks, and continuous access to preferred items.

Results replicate and extend prior studies demonstrating the efficacy of BST for training dental professionals (Allen et al., 1992; Graudins et al., 2012). This evidence-based approach would enhance the efficacy of commonly used didactic forms of instruction (e.g., lecture) and provided a much-needed supplement to other important information about serving patients with IDD. The relative brevity of the training and its effectiveness in the absence of hands-on practice with actual patients suggests that it might be feasible for training both in-service dental professionals and dental students. These findings also replicate and extend prior research on remote training of caregivers by (a) including dental students and professionals, (b) conducting all practice sessions via remote role play, and (c) using a group training format (see Neely et al., 2017; Tomlinson et al., 2018; Unholz-Bowden et al., 2020, for reviews).

Several limitations should be addressed in further research. First, due to the COVID-19 pandemic, participants were not located in a dental setting and did not implement the procedures with actual patients (with the exception of Matt). Instead, participants completed the entire study from their homes and recruited individuals within their social circle to serve as simulated patients. Prior to starting baseline sessions, the experimenter helped the participants arrange the home environment (e.g., living room) to more closely resemble a dental setting and find substitutes for dental tools when actual tools were not available to them. A research assistant provided scripted instructions to the stimulated patients via headsets during baseline and post training sessions to ensure that the participants had an equal number of opportunities to respond to compliant, noncompliant, and problem behavior. Nonetheless, it is unclear whether training would be adequate to promote generalization of these skills to patients diagnosed with IDD in practice. Future research on group remote training should assess the outcomes in a dental setting and with actual patients.

Although Matt conducted the procedures with two actual patients, this evaluation also had some limitations. Due to the COVID-19 pandemic, he did not have
the opportunity to conduct baseline sessions with actual patients, which weakens the evaluation of generalization. In addition, about 1 month prior to the generalization sessions, Matt observed a dentist correctly implementing the intervention with two patients. The contribution of this additional observation to the maintenance and generalization of Matt’s performance is not clear. Furthermore, both patients were cooperative with all of the dental exam steps even though they had a history of receiving restraint, sedation, or general anesthesia during routine dental exams and had not received care from a dentist in more than 3 years. The first patient initially did not open her mouth when Matt instructed her to so, but she complied with this instruction on Matt’s third attempt and was compliant with the remaining steps. The second patient’s mother thought the appointment went so well that she asked Matt if he would be willing to take her daughter as a regular patient at his clinic. Although these clinical outcomes are a strength that could be attributed to Matt’s use of the recommended procedures, it also limited opportunities to observe Matt implementing certain aspects of the intervention (e.g., response to problem behavior).

A third limitation is that the group trainings included no more than three trainees at a time. It is likely that such trainings will need to include a larger number of trainees, particularly those that are embedded within dental school curricula. Thus, the effectiveness and efficiency of this training must be evaluated with larger groups in further research. A fourth limitation is that the training did not include guidelines for fading the intervention across dental appointments. Future research on training curricula for dental students and professionals should include guidelines for how to increase the amount of time working in a patient’s mouth and how to thin the reinforcement schedule (e.g., Allen et al., 1992).

As noted previously, another limitation was that the experimenter errored when delivering feedback to two participants during their post-training sessions. After Gina’s first two post trainings session, the experimenter delivered feedback even though her performance was above 90%. The contribution of this feedback to her outcomes is not clear. Conversely, the experimenter inadvertently omitted feedback following Mya’s fourth post-training session even though her responding was still below 90%. It is possible that she would have met the mastery criterion more quickly in the absence of this error. It also should be noted that the experimenter introduced the training when the baseline performance of three participants (Gina, Mya, Matt) was on a slight increasing trend. However, the abrupt increase in their responding during post-training sessions helps support the internal validity of the findings.

A final limitation is inherent in the training modality. That is, participants may not have been as fully engaged during the remote training as they would have been during in-person training. For example, Rocco appeared to be attending to the experimenter while she was talking to him (e.g., eyes oriented to the screen, nodding his head), but sometimes would reply “What?” or “Are you talking to me?” when the experimenter asked him a question. Future studies may consider incorporating even more interactive activities during the remote group training to increase the likelihood of participants attending throughout. For example, trainees could be instructed to collect data on the accuracy of their fellow trainee’s performance during the role plays and to provide feedback to their peers (e.g., Hinkle et al., 2021; Thomas, 2013).
Overall, the participants found the intervention to be socially acceptable, although several indicated that it might be relatively costly and time consuming to implement. However, these participants did not have opportunities to practice these procedures in a dental setting with actual patients, so their responses should be considered within this context. The ratings for Matt, who completed the survey before and after he implemented the procedures with patients, supports the social validity of the intervention for dental professionals. In fact, Matt contacted the experimenter after his post-training sessions to inform her that he implemented the procedures with a patient with IDD before the generalization sessions. He reported that he found it to be effective in promoting compliance with the new patient.

In summary, results indicate that remote group BST is a promising approach for disseminating interventions to dental students and professionals regarding effective practices for improving cooperative behavior in patients with IDD. These findings have important implications for increasing access to routine professional care by helping to prepare future professionals in accordance with the CODA requirements and by training current professionals. Nonetheless, the content of this training is just subset of the knowledge and competencies needed to provide quality care to patients with IDD. Thus, additional research is needed to fully inform a comprehensive curriculum in this area.

**Acknowledgements** This study was conducted by the first author under the supervision of the second author in partial fulfillment of the requirements of the M.A. degree in behavior analysis. We thank David F. Fray, DDS, and Erin Thomas, DDS for their assistance in recruiting participants and Hussian Alabdulmuhsin, Ning Chen, Jennifer Darce, Alyssa Embry, Andrea Hoang, Amanda King, Matthew Matteucci, Lyndsy Reyes, and Emma Walker for their assistance with the trainings.

**Funding** No funding was received for conducting this study.

**Declarations**

**Editorial Process** This manuscript has not been previously published and has not been (nor will be) submitted elsewhere during the review process.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review board of the university and with the 1964 Helsinki declaration and its later amendments. The study was approved by the Committee for the Protection of Human Subjects at the University of Houston, Clear Lake.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflicts of Interest** The authors have no relevant financial or non-financial interests to disclose.

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