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Increasing passive compliance to wearing a facemask in children with autism spectrum disorder

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The current study taught 6 children with autism spectrum disorder (ASD) to increase passive compliance of wearing a facemask across sequentially increasing durations of time. A changing-criterion design embedded within a nonconcurrent multiple baseline design was used to evaluate the effectiveness of a resetting differential reinforcement of other behavior (DRO) without escape extinction procedure on passive compliance. Terminal probe sessions determined DRO fading intervals. Results showed that 2 participants acquired mastery level passive compliance (30 min) without fading during the initial baseline sessions. The remaining 4 participants acquired mastery level passive compliance following fading intervals within the DRO intervention. Participants' passive compliance generalized across 2 novel settings. This study replicates previous studies and extends empirical support for the use of DRO without escape extinction interventions for increasing passive compliance with medical devices in children with ASD.

Key words: differential reinforcement of other behavior, facemask, passive compliance, SARS-CoV-2

In response to the 2020 global pandemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the World Health Organization (WHO, 2020) and the Centers for Disease Control (CDC, 2020) recommended a number of guidelines to mitigate the spread of the disease (e.g., social distancing, wearing facemasks). Guidelines were adopted by many communities, and in some cases, took the form of enforceable policies (e.g., mask mandates). The WHO and CDC recommended that community members wear facemasks (e.g., surgical masks, fabric masks) to reduce transmission of the virus as individuals may not discriminate their potential risk to community members (asymptomatic, presymptomatic; CDC, 2020; Furukawa et al., 2020; WHO, 2020). Individuals with limited communicative skills and deficits in rule-governed behavior may not (a) possess the necessary skills to reliably tact initial symptoms of the SARS-CoV-2 virus (e.g., difficulty breathing, digestive discomfort), and/or (b) respond to instructions from health organizations such as the WHO and CDC. In light of such limiting conditions, alternative behavioral interventions are needed to increase compliance with the suggested best practices for well-being.

A review of the literature indicates that individuals with autism spectrum disorder (ASD) often engage in various noncompliant behaviors when instructed to complete or tolerate a

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variety of medical or hygiene procedures (Cuvo, 2011). Compliance with these procedures can be characterized by being either active or passive (Cuvo, 2011). Active compliance involves active responding on the child's part by emitting specific behaviors following instructions by healthcare professionals. For example, when an adult instructs a child to "put on a facemask," the child independently engages in the correct sequence of steps to properly put on a facemask. Passive compliance involves the child simply allowing, or tolerating, the application of various medical procedures and materials without engaging in escape or avoidance behaviors. For example, when an adult places a facemask on a child, the child abstains from engaging in escape or avoidance behaviors (e.g., aggression, mask removal, elopement).

Previous research has evaluated the effectiveness of a variety of procedures to increase both active and passive compliance with medical procedures. Interventions often make use of differential reinforcement procedures with or without escape extinction, including differential reinforcement of other behavior in which the absence of the target behavior is reinforced (DRO; Carton & Schweitzer, 1996; Cook et al., 2015; Cox et al., 2017; Cuvo, Godard et al., 2010; Cuvo, Reagan et al., 2010; Dufour & Lanovaz, 2020; Hagopian & Thompson, 1999; Iwata et al., 1990; Shabani & Fisher, 2006; Slifer et al., 1993; Wheatley et al., 2020) or differential reinforcement of alternative behavior procedures in which a specific target behavior is reinforced (DRA; Slifer et al., 2008; Slifer et al., 2002; Stuesser & Roscoe, 2020). Recently, Dufour and Lanovaz (2020) used a DRO procedure without escape extinction to increase passive compliance to wearing a heart rate monitor in two participants with ASD. That is, reinforcement was contingent on tolerating the device for a specific duration of time. Experimenters provided enthusiastic praise and access to preferred edibles contingent on tolerating the heart rate monitor for increasing durations. Instances of challenging behavior or attempts to remove the device resulted in a brief break from the device and reset the DRO interval for that trial (i.e., resetting DRO). Participants acquired mastery-level compliance following the fading of DRO intervals in a pre-programmed manner from 5 s to 90 s.

In another recent study designed to increase compliance during medical procedures, Stuesser and Roscoe (2020) used DRA for compliance and stimulus fading without escape extinction to increase compliance with routine medical examination procedures with four individuals with ASD. The authors found that the DRA for compliance without the use of escape extinction was not sufficient to increase compliance for three of four participants. Accordingly, the authors included a modified stimulus fading procedure in which each step of the medical exam was gradually introduced to the participant to increase compliance to socially significant levels. As with Dufour and Lanovaz (2020), their results indicated that escape extinction was not necessary to increase compliance with the medical exam process. Similar interventions without escape extinction have also been used to increase compliance with other medical procedures (cystic fibrosis treatment; Hagopian & Thompson, 1999; functional magnetic resonance imaging [fMRI]; Cox et al., 2017; Slifer et al., 2002; hemodialysis; Carton & Schweitzer, 1996; needle phobia; Shabani & Fisher, 2006; pediatric neuroimaging; Slifer et al., 1993).

Although the aforementioned studies did not require escape extinction procedures to increase compliance, other studies have found that it was a necessary component of their treatment package. For example, Cook et al. (2015) implemented a resetting differential negative reinforcement of other behavior (DNRO) with a response blocking procedure to increase passive compliance of wearing a medical bracelet for one participant with ASD. Experimenters allowed breaks from wearing the medical bracelet contingent on compliance (i.e., wearing the bracelet without attempts at removal) for a specified duration. The criterion duration of passive compliance to wearing a medical bracelet was increased incrementally in a pre-programmed changing-criterion design. All attempts to remove the bracelet were blocked and resulted in the resetting of the DNRO interval. The DNRO intervals were faded from 5 s to 7 hr. Similarly, Wheatley et al. (2020) used a DNRO procedure to increase compliance with wearing an antistrip suit for one participant diagnosed with ASD. The participant was required to tolerate the suit for increasing amounts of time without challenging behavior. Instances of challenging behavior reset the DNRO interval timer and all attempts to remove the suit were blocked. Compliance resulted in access to a preferred item and brief break from the suit. Mastery-level compliance was achieved following the fading of DNRO intervals from 2 s to 6 hr in a pre-programmed sequence.

Procedures that incorporate response blocking for escape-maintained behavior introduce elements of escape extinction whereby an individual continues to contact an aversive stimulus despite emitting escape behaviors with lengthy learning histories. As such, escape extinction may produce deleterious side effects (e.g., extinction bursts, response variability, emotional responding, aggression) that increase the likelihood of injury, especially in the context of medical procedures (Athens & Vollmer, 2010; Fisher et al., 1993; Hagopian et al., 1998; Hagopian & Toole, 2009). Although a review of the literature may suggest that extinction bursts or extinction-induced aggression may not be as prevalent as previously assumed (Katz & Lattal, 2020; Lerman & Iwata, 1995; Lerman et al., 1999), it must still be taken into consideration when creating socially significant and ecologically valid interventions for increasing tolerance to medical devices or procedures.

Recently, Sivaraman et al. (2020) evaluated the use of Telehealth technologies to teach caregivers of children with ASD methods to increase compliance to wearing a facemask. The researchers were successful in coaching caregivers to implement standard procedures to increase compliance (e.g., graduated exposure, shaping, and contingent reinforcement) such that participants wore a facemask for 10 consecutive minutes. Despite the success of Sivaraman et al., additional research is needed to identify the necessary training components to promote efficient and efficacious interventions for passive compliance to wearing a facemask. As such, the current study replicated and extended previous research evaluating the efficacy of using a resetting DRO without escape extinction for increasing passive compliance to the novel task of wearing a facemask for 30 min in six participants with ASD. Further, we measured the extent to which the intervention effects generalized across contexts. Finally, we evaluated the necessity of the DRO fading steps using terminal probes prior to each fading step.

Method

Participants, Materials, and Setting

Six participants were recruited from a local applied behavior analytic (ABA) day-treatment center. All participants' treatment goals included increasing passive compliance to wearing a facemask and decreasing mask removal behaviors. Participants had no history of direct training for passive compliance with wearing a facemask. All participants had an ASD diagnosis and received one-on-one ABA services for 12 - 20 hr per week. Participants were between 4 and 14 years old. Further demographic information is displayed in Table 1. Parents or guardians provided consent for participation prior to the start of the study. Per the medical

Table 1

Participant Demographics, Type of Mask, and Preference Assessment Results

Participant	Age (years)	Duration of ABA Services	Sex	Ethnicity	VB-MAPP Score	Type of Mask	High-Preferred Item(s)	Low-Preferred Items
Otis	5	3 years	Male	White	116	Loop Mask	Jiffy® PB Balls iPad®	Books ABC V-Tech® toy Squishy toy
Lucy	7	2.5 years	Female	White	127	Loop Mask	Hershey's Kisses®	Building blocks Books Coloring materials
Roman	7	3 years	Male	Hispanic	89	Loop Mask / Tie Mask	Swiss Roll®	Slinky® Alphabet toy Ball
Rhett	14	5 years	Male	White	18	Loop Mask	iPad®	See N' Say® Fischer Price® Music Toy Fischer Price® Letter Toy
Luke	4	1 year	Male	White	134	Loop Mask / Tie Mask	iPad®	Spinyo® Books Puzzles
Silas	7	3 years	Male	White	149	Loop Mask	Skittles®	Mr. Potato Head® Play-Doh® Books

Note. The duration of ABA services corresponds to the duration of daily one-on-one applied behavior analytic services at the time of the study. The *Verbal Behavior Milestone Assessment Placement Program* (VB-MAPP; Sundberg, 2008) value corresponds to participants' overall VB-MAPP scores. The underlined type of mask corresponds to the mask used throughout training following brief exposure to different types of masks. Items listed under the high-preferred (HP) and low-preferred (LP) columns were derived from two multiple stimulus without replacement preference assessments (Luke, Silas, Roman, Otis, and Lucy) or free operant preference assessments (Rhett).

guidelines of national and international agencies (CDC, 2020; WHO, 2020), participants were required to be 2 years of age or older and demonstrate the ability to remove the mask without assistance to be included in the study. For each participant recruited into the study, researchers asked caregivers to provide a mask or a variety of masks they preferred the participant to wear. During training, each participant was assigned a single mask or multiple identical masks (i.e., disposable masks). Facemasks were either made of cloth or were manufactured, medical grade masks. Masks were either washed or replaced weekly or once there were visible signs of wear.

Training sessions were conducted within a private 3 m x 3 m padded therapy room with a one-way window, a table, two chairs, and three low-preferred tangible stimuli identified via a preference assessment (see below for additional details). The experimenter scored instances of challenging behavior using a pen and a paper data sheet. One participant was present at a time. Generalization session locations varied but remained in the center (e.g., hallways, other therapy rooms, outside play areas, etc.).

Response Measurement and Interobserver Agreement

Each session was conducted in a trial-based format in which participants were required to tolerate a facemask for varying durations of time. Sessions were terminated contingent on any of the following criteria: (a) Five consecutive trials were completed, (b) following the first successful trial after a 30-min session duration (session timer was paused for the reinforcement intervals), (c) a trial resulted in passive compliance for the terminal mastery criteria (i.e., compliance for 30 min), or (d) the duration of a single trial exceeded 60 min. A terminal goal of 30 min was selected based on caregiver report of the mean predicted duration of time that their child would need to wear their facemask. Across participants, the occurrence of aggression, self-injurious behavior, negative vocalizations, and removal of facemask were measured and were operationally defined for each participant. *Facemask removal* was scored when the participant inserted any number of fingers below the fabric of the mask or pulled the mask more than 2.5 cm away from their face. *Passive compliance* was scored when the participant omitted challenging behavior (including facemask removal) for the entire duration of the trial. *Errors* were scored when the participant engaged in any challenging behavior, including facemask removal, at any point during the trial. For each trial, the latency to engage in challenging behavior and the total trial duration (see resetting DRO contingencies below) were recorded. Full session responding (i.e., percentage of trails with passive compliance) was calculated by taking the number of trials with passive compliance and dividing by the total number of trials. This was then converted to a percentage by multiplying by 100.

To assess interobserver agreement (IOA), a second observer independently reviewed sessions either live or using recorded videos. Across participants, 43.3% (range, 33.3% - 50%) of sessions were reviewed for IOA measures. IOA was scored on a trial-by-trial basis. For passive compliance, exact agreement measures were used. For latency to error and trial duration, agreement was scored if the values were within ± 2 s of one another. To calculate IOA, the number of trials in agreement was divided by the total number of trials within a session and the resulting quotient was converted into a percentage. IOA scores for each session were then combined to determine the overall IOA for the dependent variable. The IOA scores were 100% for passive compliance, 98.6% for latency to error (range, 95.0% - 100%), and 98.8% for trial duration (range, 96.2% - 100%). IOA measures were completed across all treatment phases (baseline, fading sessions, terminal probes, and generalization probes) for a mean of 56.8% (range, 38.5% - 100%), 36.7% (range, 30.8% - 41.0%), 54.1% (range, 40.0% - 66.7%), and 100% of sessions, respectively.

Treatment Integrity

Experimenters were trained based on the WHO (2020) and CDC (2020) guidelines for properly wearing a facemask (e.g., the mask must be covering the nose and mouth and secured against the cheeks). During all sessions, experimenters were scored on saying, “It’s time to wear your facemask,” correctly placing the mask on the participant, starting the trial duration timer, removing the facemask contingent on either (a) an error or (b) compliance for criterion duration, stopping the timer to record the data, and providing the appropriate consequence based on responding. Treatment integrity was scored trial-by-trial based on adherence to the components previously mentioned (i.e., each component within a trial received a score of 0 or 1). Following completion of a session (see session termination criteria above), a treatment integrity score was calculated for the entire session by dividing the total number of correct components across trials by the total number of possible components; the resulting quotient was converted into a percentage. Treatment integrity data were collected for an average of 43.9% of sessions across participants and averaged 99.7% across all participants (range, 91.9% - 100%).

General Procedures and Experimental Design

The current study used a changing-criterion design embedded within a nonconcurrent multiple baseline design across participants to evaluate the effects of DRO without escape extinction procedures. Five trials were conducted per session unless the termination criteria were met (see above), at which point the session was terminated once the trial ended. One to two sessions were conducted per day, up to 5 days per week. Terminal probes were conducted following two training sessions with 100% passive compliance.

Preference Assessments

For five of the six participants, multiple-stimulus-without-replacement (MSWO) preference assessments (DeLeon & Iwata, 1996) were conducted to identify both high-preference (HP) and low-preference (LP) stimuli. During MSWO procedures, the participant was instructed to attend to five or six selected stimuli. The experimenters said, "Pick one." Following a selection response, the participant was permitted access to the stimulus for 20 s while the unselected stimuli were removed. If the participant did not engage in a selection response, the experimenter continued to deliver the discriminative stimulus ("Pick one") every 5 s until a selection response occurred. The remaining unselected stimuli were then re-presented until all stimuli were selected. The experimenter repeated this assessment at least three times per participant and rank-ordered stimuli based on the order in which they were selected. Two separate multiple-stimulus preference assessments with tangible and/or edible stimuli were conducted for each participant to identify (a) three LP stimuli to include in the room during trials and (b) one HP stimulus for use as a potential reinforcer for passive compliance (see Table 1).

LP Preference Assessment. Tangible stimuli were used in the first preference assessment to identify three LP stimuli. Stimuli were included in the assessment based on therapist report of low engagement with items during free operant periods from the preceding 2 weeks. Assessment procedures followed those described above. Following three replications of the preference assessment, the lowest three items were selected as LP stimuli. The purpose of this preference assessment was to identify three low-preferred stimuli to have present in the room throughout baseline and training sessions. LP stimuli were included in the room to simulate the relative level of stimulation and/or availability of preferred stimuli present in the context that the participant would be expected to wear their facemask (e.g., community settings).

HP Preference Assessment. Tangible and edible stimuli were used in the second preference assessment to identify one HP stimulus to present contingent on satisfying criteria for passive compliance. Stimuli were included within the assessment based on caregiver report of putative reinforcers to which they would have access in the contexts that their child would have to wear their facemask. Assessment procedures followed those discussed above. Following three replications of the preference assessment, the highest ranked item was identified as the HP stimulus.

Free-Operant Preference Assessment. A free-operant preference assessment (Roane et al., 1998) was used to identify target LP and HP stimuli for one participant, Rhett. We used a free-operant preference assessment with Rhett because he had not yet acquired a selection response (e.g., point, grasp) at the time of the study. The participant was placed in the room with six different stimuli and experimenters recorded the duration of engagement with each stimulus during a 5-min observation period. This process was repeated three times and the mean duration of engagement was calculated by adding the duration of engagement for each stimulus from each observation and then dividing by the total number of observations. The three stimuli with the lowest mean engagement (Fisher-Price® Letter Toy: < 1 s; See N' Say®: 1 s; Fisher-Price® Music Toy: 1.7 s) and the stimulus with the highest mean engagement (iPad®: 289 s) were selected as LP and HP stimuli for the study.

Mask Preference Assessment. For Roman, experimenters completed a concurrent chains preference assessment (see Fulton et al., 2020) for mask type before each experimental session following forced-exposure sessions during the initial baseline phase. For all experimental sessions, the experimenter initiated the session by presenting both mask types (loop mask or tie mask) on the table in front of Roman and saying, "Pick one." Roman completed the initial link response by touching one of the presented masks. The therapist then removed the non-selected mask type, and the session was conducted using only the selected mask. This process was reset such that the choice opportunity was presented before each session. We opted to use this procedure with Roman as he previously demonstrated high levels of problematic behavior when his ears were touched. The option to select a mask prior to each training session was designed to mitigate establishing operations for avoiding or escaping sensory events (e.g., loop around ear vs. strap around head and neck).

Baseline

Baseline sessions were identical for all participants. Participants were allowed access to LP items during the DRO interval, as well as during reinforcement intervals. The experimenter brought the participant into the room, instructed the participant to sit in a chair near the table, said, "It's time to wear your mask," and fitted the facemask over the participant's nose and mouth. The experimenter then immediately started the timer for the session. Experimenters interacted with the participant as little as possible, only responding to mands for assistance or to place or remove the facemask. Participants were able to move freely around the experimental room and interact with the LP items. Contingent on any instances of challenging behavior or attempts to remove the facemask, the experimenter removed the mask, and the trial was terminated. The latency to error was recorded, and the participant was given a 30-s break from wearing the mask without access to the LP tangible items before the experimenter initiated the next trial. These synchronous reinforcement procedures using the LP items were included during all phases of the study (see Diaz de Villegas et al., 2020).[1] If the participant engaged in passive compliance for the entire 30-min DRO interval, the experimenter stopped the timer, removed the mask, provided excited descriptive praise, a 30-s break, and access to the HP tangible or edible item as indicated by the preference assessment. Regardless of reinforcer type, the duration of reinforcement (i.e., intertrial interval) was held constant at 30 s. The experimenter recorded the total duration of the trial on the data sheet.

Fading Plus Differential Reinforcement of Other Behavior without Escape Extinction

The DRO without escape extinction condition was similar to the baseline condition, with two exceptions. First, praise and access to the HP stimulus were contingent on passive compliance for varying DRO interval lengths. Second, challenging behavior during the DRO interval resulted in the removal of the facemask for 10 s without access to LP items (see synchronous reinforcement procedures described above). Following the 10-s break, the DRO interval timer was reset, the experimenter restated the vocal discriminative stimulus (i.e., "It's time to wear your facemask"), the facemask was reapplied, and participants could resume interacting with LP items. This sequence of events continued until the participant tolerated the facemask for the target DRO interval. One session conducted with Rhett exceeded the 60-min trial duration criteria and

[1]This procedure was included in baseline and subsequent phases resemble contingencies in the natural environment based on anecdotal observation. For example, caregivers, contingent on removal of a facemask, will remove access to alternate items to reapply the facemask.

was terminated before passive compliance was achieved.

Initial fading steps were identified by taking the mean latency to error over the last three baseline sessions (two sessions for Otis) and rounding down to the nearest 5-s interval. Subsequent fading steps were identified via the same calculations using terminal probes. If more than one terminal probe session was conducted, the fading step was determined from the last terminal probe (see below for more detail). A fading step was targeted until a participant completed two consecutive sessions with 100% passive compliance on each trial. The only exception was with Rhett, who did not demonstrate mastery within six training sessions during his first fading step of 190 s. Following the sixth training session, a terminal probe was conducted to identify a shorter fading step.

Terminal Probes

Terminal probes were identical to baseline procedures and were conducted following mastery of each fading step. Probes were continued until the participant had zero trials with passive compliance for 30 min and the mean latency to error was greater than the previous fading step. Subsequently, a new fading interval was calculated based on the criteria described above. Experimenters calculated a new fading step for Lucy and Roman following their second terminal probe despite not satisfying the previously mentioned criteria. This decision was made in error; subsequent baseline probes should have been conducted until participants had zero trials with passive compliance for 30 min.

Generalization Probes

Generalization probes were identical to terminal probes, with one exception. Sessions were conducted in various places outside the experimental room. Locations were selected by the experimenters to simulate common situations in which participants would need to wear their facemasks (e.g., walking around in the community, working at a table within a classroom, etc.).

Walking Generalization Probe. Probe sessions were conducted while the experimenter and participant walked around the treatment center. While walking, the experimenter provided basic directions (e.g., "turn here," "stop").

Working Generalization Probe. Probe sessions were conducted in the participant's regular therapy room while the experimenter completed other treatment programs with the participant.

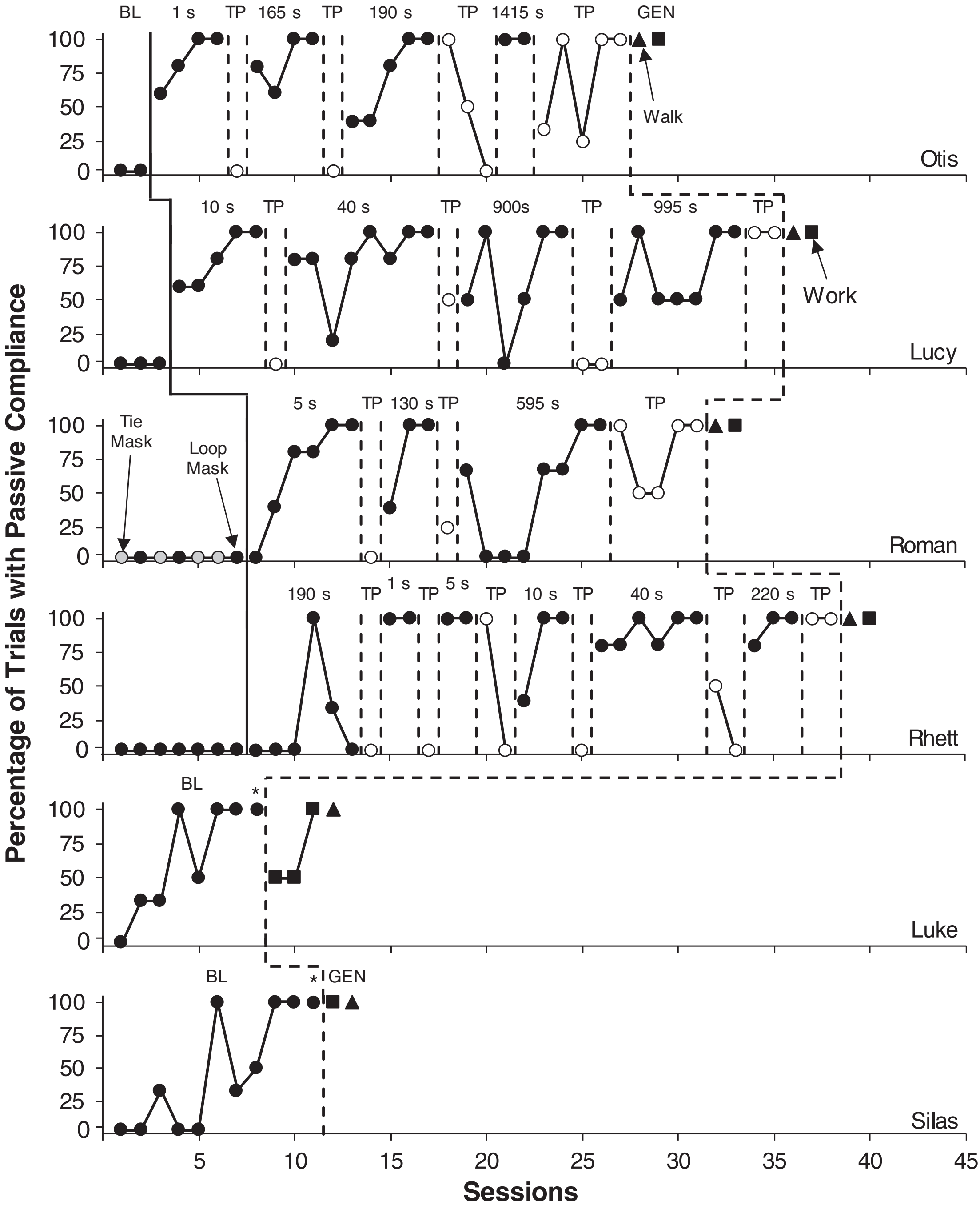
Results

Figure 1 shows the percentage of trials per session with passive compliance for all six participants. Four of six participants required between three and six fading steps to meet the terminal goal of 30 min of passive compliance. The number of sessions within those fading steps ranged from two to eight sessions to meet progression criteria (e.g., two consecutive sessions at 100% passive compliance). Specific to Rhett, we conducted a terminal probe following training at DRO 190 s despite not meeting the progression criteria for the fading step. We opted to do this as passive compliance was emitted at low levels across six training sessions at the DRO 190 s. Following this terminal probe and the calculation of a new fading step, Rhett demonstrated high levels of passive compliance. All four participants met the 30-min terminal goal following two to five sessions under terminal probe procedures in their final stage of treatment. Further, all four participants responded with 100% passive compliance for both generalization probes (work and walk probes).

The remaining two participants, Luke and Silas, required seven and 10 baseline sessions respectively to meet the terminal goal. For Luke, the type of mask was changed from a tie

Figure 1

Percentage of Trials with Passive Compliance



Note. Data correspond to the percentage of trials with passive compliance. Data points with asterisks correspond to maintenance probes conducted 8 weeks (Luke) and 4 weeks (Silas) following fulfillment of mastery criteria. TP corresponds to terminal probe sessions.

mask to a loop mask between sessions 2 and 3 based on parent preference and availability. This change in mask coincided with an increase in passive compliance. Following mastery, 4- and 8-week maintenance probes were conducted for Silas and Luke respectively. For both participants, passive compliance maintained at mastery levels. Silas continued to respond with 100% passive compliance during both generalization probes (work and walk probes). Luke initially tolerated the facemask for 50% of trials during the first two work generalization probes. The mean latency to error during the first two probes, however, indicated near-mastery levels of compliance (1293.5 s and 1719.0 s, respectively; see Figure 2). As such, multiple generalization probes were conducted. Compliance increased to 100% during the third work generalization probe. Passive compliance maintained at 100% during the first walk generalization probe. Table 2 shows a summary of sessions across all participants, including the individual number of fading steps required and sessions to achieve mastery-level passive compliance for all participants. Additionally, Table 2 depicts the total training time across all six participants (excluding baseline and generalization probes).

Figure 2 depicts the mean latency to error per session across participants. Figure 3 provides a reduced y-axis to aid in the visual analysis of smaller fading steps for the first four participants. The gray dotted lines depict the changing criteria to satisfy the DRO interval. In general, for those that required fading, participants' average latency to error increased and closely approximated the fading step's criterion within one to two training sessions. Further, all four participants' mean responding during terminal probes sequentially increased following fading steps.

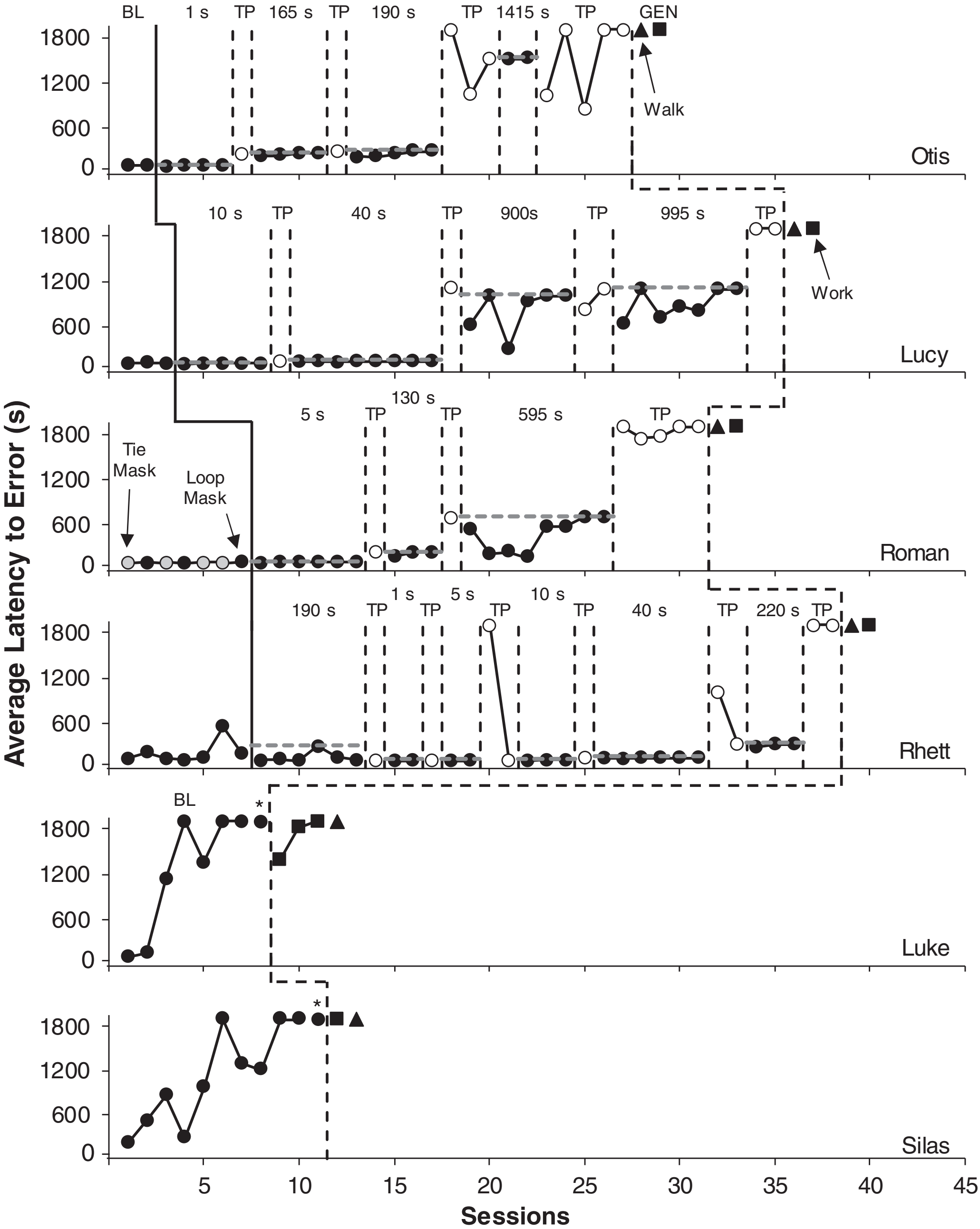
In sum, this intervention required seven to 38 training sessions and between 216.6 and 848.6 min of direct training to reach the terminal goal of 30 min of passive compliance for all six participants. Two participants acquired mastery level passive compliance without fading procedures following repeated exposure to baseline contingencies while the remaining four participants acquired mastery level passive compliance following fading steps using DRO contingencies. Fading steps ranged from 1 s to 1415 s and were based on terminal probes conducted following mastery of each DRO fading step.

Discussion

At the conclusion of this study, six participants engaged in passive compliance to wearing a facemask for 30 min. Although two participants did not require DRO fading steps to reach the terminal goal, the remaining four participants required between three and six fading steps to meet mastery. For all participants, the DRO intervention did not require the introduction of response blocking (i.e., escape extinction procedures). This study replicates and extends previous literature supporting the effectiveness of differential reinforcement with and without fading and without the use of response blocking to increase compliance (Dufour & Lanovaz, 2020; Hagopian & Thomson, 1999; Lalli et al., 1999; Piazza et al., 1997; Shabani & Fisher, 2006; Slifer et al., 1993).

That two participants in the current study achieved mastery-level passive compliance without the use of fading steps warrants further discussion. There are two possible explanations for these results. First, it is possible that mastery-level passive compliance was achieved primarily through a process of habituation and respondent extinction to an aversive stimulus. For these participants, repeated exposure to the facemask resulted in increases in passive compliance. This is similar to Steusser and Roscoe (2020) in which repeated exposure to medical procedures resulted in decreases in elicited responses to conditioned aversive

Figure 2
Average Latency to Error



Note. Data correspond to the average latency across trials for each session to engage in challenging behavior or facemask removal. Data points with asterisks correspond to maintenance probes conducted 8 weeks (Luke) and 4 weeks (Silas) following fulfillment of mastery criteria. Dotted gray lines indicate the phase-specific mastery criteria for passive compliance. TP corresponds to terminal probe sessions.

Table 2

Session Summary Across Participants

Participant	Sessions to Mastery	Number of DRO Fading Steps	DRO Fading Durations (s)	Total Duration of Sessions (min)
Otis	27	4	1, 165, 190, 1415	848.6
Lucy	35	4	10, 40, 900, 995	709.7
Roman	31	3	5, 130, 595	634.6
Rhett	38	6	190, 1, 5, 10, 40, 220	531.4
Luke	7	N/A	N/A	216.6
Silas	10	N/A	N/A	302.2

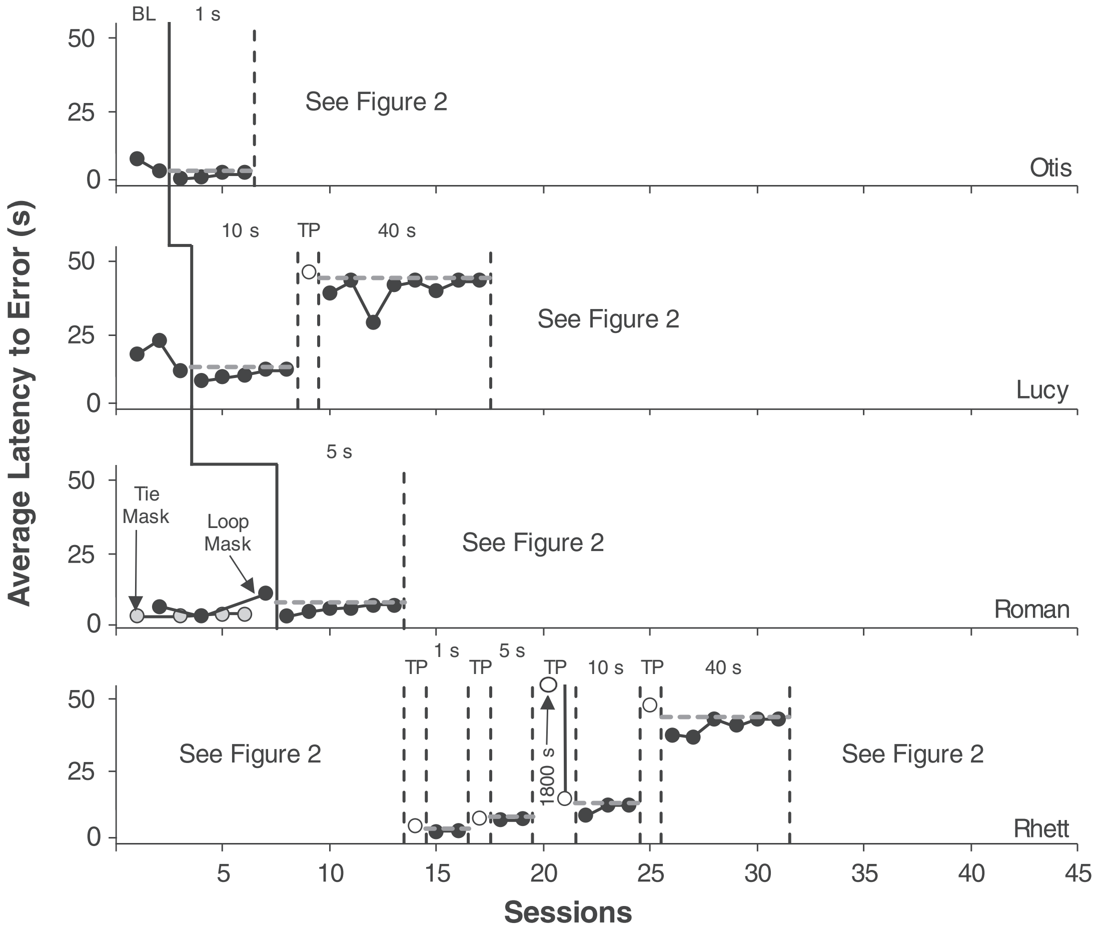
Note. Sessions to mastery refers to the total number of sessions required to achieve the mastery criterion for passive compliance (maintenance and generalization sessions are not included). The number of DRO fading steps (column three) and DRO fading duration (column four; seconds) refer to the DRO training intervals necessary to achieve passive compliance during two consecutive terminal probe sessions. The total duration of training is based on the aggregated session durations until the mastery criterion for passive compliance was achieved (maintenance and generalization sessions are not included).

stimuli and decreases in escape-maintained behaviors. As such, for Luke and Silas, delayed reinforcement contingencies (i.e., removal of facemask, delayed access to high-preferred reinforcers and enthusiastic praise) potentially controlled passive compliance to a greater degree than the immediate reinforcement contingencies for facemask removal (i.e., a 30 s break from wearing facemask). The second possibility is that the LP items provided during baseline sessions may have served to enrich the environment and reduced the aversiveness of the overall context, including wearing a facemask (see noncontingent reinforcement [NCR] procedures; Richling et al., 2011). Further, due to the synchronous reinforcement schedule in place throughout the study (i.e., LP stimuli were only available while the participant was appropriately wearing their mask; Diaz de Villegas et al., 2020), these items may have served as reinforcing stimuli for passive compliance. However, anecdotally, participants never or rarely engaged with the LP items. Half of the participants engaged with the LP items to a greater extent under low compliance requirements (e.g., durations below approximately 10 min), whereas the other half rarely engaged with the LP items under any response requirements. Future research should investigate the relative reinforcement value of LP items as a function of increases in response requirements (e.g., duration of time of passive compliance).

For the remaining four participants, DRO interval fading was required to meet the terminal criteria of 30 min. That is, a majority of participants required exposure to systematic approximations of the terminal criterion to achieve mastery level passive compliance with wearing a facemask. Though the fading intervals and number of fading steps varied across participants, all participants achieved mastery level passive compliance within 40 experimental sessions. This finding is consistent with previous research in that for some participants, additional intervention beyond that of NCR procedures may be needed to meet terminal levels of passive compliance (DeLeon et al., 2008). There are at least two areas that warrant further discussion as it concerns these findings.

First, our results demonstrate that a resetting DRO contingency can be effective at promoting passive compliance even in the absence of response blocking or escape extinction. This finding underscores the social validity of implementing passive compliance training outside

Figure 3
Average Latency to Error, Reduced Y-Axis



Note. Data correspond to the average latency across trials for each session to engage in challenging behavior or facemask removal. Dotted gray lines indicate the phase-specific mastery criteria for passive compliance. TP corresponds to terminal probe sessions.

of ideal contexts (e.g., at school, in the community). That is, caregivers and educators may be more likely to implement training procedures with high fidelity, as interventions that are relatively low response effort and limit exposure to aversive stimuli are often perceived as more acceptable treatments (Diller et al., 2013; Kazdin, 1980; Miltenberger, 1990). Nonetheless, previous research has demonstrated that response blocking is indeed necessary under some conditions (e.g., Cook et al., 2015). Future research should investigate preliminary assessment methods to more readily identify conditions under which response blocking is and is not necessary. More expeditious identification of such conditions may reduce the local learning histories for escape-maintained challenging behavior (i.e., decrease instances of automatic negative reinforcement for removal of facemask) as response blocking could be introduced immediately, thus increasing the efficacy and efficiency of this training procedure.

Second, we incidentally identified a negative correlation between participants' overall VB-MAPP scores and sessions to mastery-level passive compliance. Participants with higher overall scores (e.g., Luke and Silas; see Table 1) required a fewer number of sessions compared to participants with lower VB-MAPP scores (e.g., Rhett). This finding potentially highlights the relevance of participants' developing verbal repertoires. That is, advanced listener and rule-governed repertoires may increase the efficiency of training procedures. This relationship is certainly speculative and subject to future investigation. Specifically, future research should investigate the extent to which differences in participants' listener and rule-governed repertoires correspond to differences in training duration, fading steps, and generalization across contexts. Findings from this type of research may promote the development of preliminary training assessments to determine the most efficient and effective training package based on participants' current behavioral repertoires (Bosch & Fuqua, 2001).

Some limitations were present in the current study. First, all training sessions and programmed generalization sessions took place in a controlled clinical context. Due to accessibility, training sessions did not take place in socially valid community locations, which is ultimately where it would be most important to wear one's facemask for extended periods of time. Anecdotally, five of six participants' parents reported that participants did wear their facemasks without removing them in various community locations (e.g., the grocery store, at school, on the bus) for varying lengths of time (reported compliance for approximately 45 min to 4 hrs in these settings). Though safety and logistical details may hinder the possibility of training passive compliance in a variety of contexts, future research should investigate training methods or experimental designs devised to directly promote and measure generalization of skills across different contexts.

Second, participants' duration of passive compliance with wearing a facemask could never exceed the criterion duration, as is typical in a changing-criterion design (Roane et al., 2011), because experimenters removed the facemask and terminated the trial contingent on meeting the criterion duration. Nonetheless, the changing criteria yielded systematic increases in the average latency to error across fading steps and resulted in the participants achieving the terminal goal of 30 min of passive compliance. Further, the terminal probes enhanced the demonstration of experimental control by functioning as brief reversals (see Drifke et al., 2020).

Additionally, a more precise definition of facemask removal may need to be considered in future research studies. Due to the novelty of this behavior, we created an operational definition for facemask removal that was somewhat arbitrary (i.e., did not necessarily conform with either medical recommendations or community standards). Anecdotally, individuals in the community often adjust their mask by briefly removing the mask or inserting fingers under the mask, and thus it may be unreasonable to ask participants to not adjust their mask at all for increasing intervals of time. Future research may better define what is or is not appropriate behavior when wearing a facemask by asking stakeholders via a social validity survey and consulting with medical experts.

As other researchers have discussed (e.g., Dufour & Lanovaz, 2020), we did not conduct a functional analysis to identify the maintaining reinforcement contingencies of mask removal. Due to the novel nature of the target behavior, participants most likely did not have any previous experience wearing or removing a facemask. Therefore, a functional analysis was not an appropriate tool for this target behavior, as facemask removal most likely did not have a previous reinforcement history to identify (Iwata et al., 1982/ 1994). This does assume, however, that facemask removal functions as its own response class and is not part of a larger functional response class. Nonetheless, throughout the course of training and through repeated exposures in community settings, participants may develop a history of reinforcement other than a negative reinforcement contingency for facemask removal (i.e., social positive reinforcement or positive tangible reinforcement functions). Future research may evaluate the use of a functional analysis of facemask removal for individuals with lengthier histories of reinforcement for the behavior.

Finally, for four of the six participants, preferred edibles were used as positive reinforcement for passive compliance. Once this skill is generalized to community settings, the removal of the facemask following a 30-min interval to consume an edible item while still in a public setting could result in a health risk to other community members. Though we demonstrated intervention efficacy without edible reinforcers for two participants, future research should investigate the extent to which edible reinforcement exerts a controlling relationship on passive compliance. Future research should also investigate the effects of providing an array of high-preferred reinforcers to participants contingent on passive compliance, as opportunities to make choices between reinforcing events may be more valuable and may decrease the likelihood of satiation (Fisher et al., 1997; Tiger et al., 2013).

Beyond those previously mentioned, this study highlights additional areas in need of further research. First, although preference for facemask type was evaluated for one participant in this experiment, future research may want to expand upon preference for facemask color or pattern as well as material type and its potential effects on the rate of mastery for passive compliance (Dunlap et al., 1994). Additionally, in the current study, participants were not taught how to don a facemask on their own (see Sivaraman et al., 2020). This may have resulted in a missed opportunity to promote independence when wearing a mask (Code 4.0; BACB, 2014) and thus, limits the ecological validity of our findings. Future research may consider including a behavioral skills training (BST) component to directly teach the skills for independently donning a facemask (e.g., Neef et al., 1989). Further, for individuals with advanced verbal repertoires and/or rule-governed behavior, it may be beneficial to introduce a rule, such as, "If you wear the mask, you will get to play," as part of the treatment package, as a contingency-specifying stimulus may result in decreased training times or fading steps for all participants (e.g., Falcomata et al., 2008; Wheatley et al., 2020). Researchers should also consider the utility of discrimination training to help individuals discriminate when they should or should not be wearing a facemask (e.g., "If other people are around you, you need to wear the mask."). For example, Hood et al. (2017) used BST and within-session corrective feedback to teach conversation skills to individuals with ASD based on subtle nonverbal discriminative stimuli (e.g., conversation partner yawning). Similar strategies could be adopted to teach individuals to discriminate between contexts in which wearing a facemask is required and not required. Although the inclusion of facemask preference assessments, a BST component for donning a facemask, rules for compliance, and discrimination training for wearing a facemask in appropriate contexts may increase response effort and training time, it would enhance the ecological validity of passive compliance of wearing a facemask and enhance the extent to which individuals appropriately don a facemask in relevant conditions outside of the training context.

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