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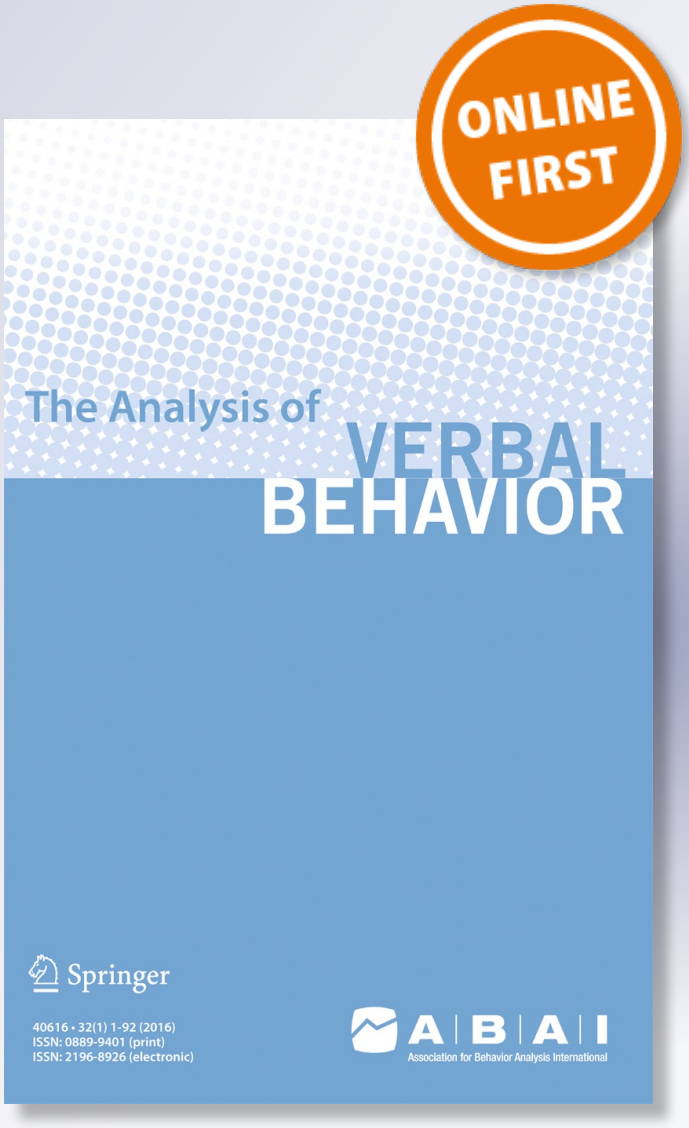

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BRIEF REPORT

Teaching Children with Autism to Follow Rules Specifying a Behavior and Consequence

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Abstract Rule-governed behavior (RGB) results from contact with a verbal description of a contingency as opposed to prior contact with that contingency. Despite its importance, research on the establishment of RGB with learners who do not display the skill is limited. Tarbox, Zuckerman, Bishop, Olive, and O'Hora (*The Analysis of Verbal Behavior*, *27*, 125-139, 2011) used multiple-exemplar training (MET) to teach children with autism spectrum disorder to follow rules specifying an antecedent and a behavior. We conducted a systematic replication of the Tarbox et al. study with three boys diagnosed with autism spectrum disorder and extended those methods to rules specifying a behavior and either a preferred or nonpreferred consequence (e.g., "If you clap, then you get candy"). In baseline, participants typically followed a given instruction regardless of whether the consequence was preferred or nonpreferred. Following MET, all participants responded accurately to novel rules, indicating that MET may be an effective method to establish basic RGB repertoires.

Keywords Autism spectrum disorder · Multiple-exemplar training · Rule following · Rule-governed behavior

Rule-governed behavior (RGB) is behavior that is evoked by a verbal stimulus specifying contingencies as opposed to direct contact with those contingencies (Skinner, 1969). RGB is an essential skill and offers enormous advantages to those

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who engage in it. It allows individuals to respond effectively in situations without a history of contacting the contingencies. A large portion of human society relies on the use of rules, as rules allow individuals to benefit from the experiences of other people instead of only learning through direct contact with contingencies (Skinner, 1969, 1974). In short, rules allow humans to move forward cumulatively by building upon the past experiences of other humans. Without RGB, humanity would, quite literally, need to "reinvent the wheel" with each new generation.

Despite the importance of RGB, only one published study on establishing RGB in learners who do not already have an established repertoire exists. Tarbox et al. (2011) taught children with autism spectrum disorder (ASD) to respond to simple rules specifying an antecedent and behavior (e.g., "If this is a dog, then clap your hands") through multiple-exemplar training (MET). Participants were directly trained on a number of rules, and after each set of rules was mastered, generalization probes were conducted. Although all participants eventually demonstrated accurate responding across a large variety of untrained rules, some participants required extensive training and modifications to both the format of the rules and the generalization probes. Tarbox and colleagues hypothesized that some participants may have lacked prerequisite skills to readily master novel rules.

Tarbox et al. (2011) provided an initial investigation on teaching RGB but only investigated rules describing antecedents and behaviors. While such rules are important, rules that describe consequences are equally, if not more, important in everyday life. For example, parents and teachers may often ask children to engage (or not engage) in particular behaviors and will state the relevant consequence that the child will then contact or not contact. In such cases, if the rule describes a nonpreferred or aversive consequence, the child with an intact rule-following repertoire would not follow the instruction. If the consequence described is preferred, however, the child should engage in the behavior. For example, if a child is told, "Go line up if you want to play kickball," whether the child should line up or not depends on whether the consequence (e.g., playing kickball) is momentarily preferred or not preferred. Therefore, research is needed to determine whether the multiple-exemplar procedure evaluated by Tarbox and colleagues is effective for establishing RGB when rules that describe behaviors and consequences are provided.

The primary purpose of the current study was to extend the Tarbox et al. study by teaching rules describing behaviors and consequences. We also extended the Tarbox et al. study by including stricter inclusion criterion for prerequisite skills and including treatment fidelity data collection and analysis.

Method

Participants, Setting, and Materials

Three boys diagnosed with ASD participated. Jack was 5 years old and Ben and Bailey were 4-year-old identical twins. All three children attended an intensive language intervention program, and clinicians working with the children reported that the participants were unable to follow if/then rules. All participants were given the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) upon

admission to the program, and each demonstrated most of the skills in the 18–30-month range, with emerging skills in the 30–48-month range. The inclusion criteria included demonstration of emergence of untrained responses following tact and/or listener training during the participants' regular clinical programming. That is, if the child was taught to tact a picture, the child also identified as a listener (i.e., receptively) the picture without additional training, and vice versa (also referred to as generalized symmetry or naming; Greer, Stolfi, & Pistoljevic, 2007). This criterion was a modification from the Tarbox et al. (2011) study and was used because generalized derived symmetry has been proposed as a prerequisite and component skill of other more complex relational skills, such as rule-following (Hayes, Barnes-Holmes, & Roche, 2001).

Experimental Design

A nonconcurrent, multiple-baseline design across participants (Kazdin, 2011) was used to evaluate the effects of the independent variable. Following mastery of a set of rules in training, generalization probes were conducted.

Response Measurement, Interobserver Agreement, and Treatment Fidelity

The primary dependent measure was the percentage of correct independent responses, defined as engaging in the specified behavior when the consequence was preferred or engaging in any behavior except for the one specified when the consequence was nonpreferred.

A second, independent observer collected data to assess interobserver agreement (IOA) and treatment fidelity during all phases of the study across all participants. To calculate IOA, the number of trials with an agreement between observers was divided by the number of agreements plus disagreements and multiplied by 100 %. To calculate treatment fidelity, each step of each phase was listed, and the observer used the list of steps to record and calculate the total percentage of correct implementation. For baseline sessions, IOA and treatment fidelity data were collected for 33.33, 40.00, and 42.85 % of sessions for Jack, Ben, and Bailey, respectively, with an average agreement of 100 % and an average percentage of correct implementation of 99.2 %. For treatment sessions, data were collected for 33.33, 50.00, and 33.33 % of sessions for Jack, Ben, and Bailey, respectively, with an average agreement of 100 % and an average percentage of correct implementation of 99.6 %. For generalization probes, data were collected for 50.00, 50.00, and 33.33 % of sessions for Jack, Ben, and Bailey, respectively, with an average agreement of 100 % and an average percentage of correct implementation of 98.8 %.

Procedures

Pre-assessments All rules across all phases were presented in the format of "If you *instruction*, then *consequence*" (e.g., If you *clap*, then you get the *ball*). Prior to baseline, each listener instruction and the identification of each consequence were probed in isolation, and the participant was required to respond correctly three consecutive times in order to include the instruction or consequence. Items to be used as consequences were identified through therapist and parent report in addition to vocal requests from participants. Table 1 displays a list of all instructions and consequences used during the study.

General Procedures Prior to each session and across all phases, the therapist presented each of the preferred and nonpreferred stimuli to the child in order to identify preferred and nonpreferred items to use during that session. Items that were consumed

Table 1 Listener instructions and preferred (P) and nonpreferred (NP) consequences for each participant

Instruction	Participant(s)	Consequence	Participant(s)
Stand up	Jack, Ben, Bailey	Ball toy	Jack (P) , Bailey (P)
Stick out tongue	Jack, Bailey	Batman toy	Ben (P) , Bailey (P)
Stomp feet	Jack, Ben	Book	Jack (P)
Thumbs up	Bailey	Broccoli	Jack (NP)
Tickle the table	Jack, Ben, Bailey	Brush teeth	Bailey (NP)
Touch head	Jack, Ben, Bailey	Bubbles	Ben (P)
Touch tummy	Jack, Ben	Carrots	Jack (NP)
Touch arm	Bailey	Cars	Ben (P), Bailey (P)
Touch chair	Bailey	Celery	Jack (NP)
Touch ear	Ben, Bailey	Chips	Jack (P)
Touch feet	Jack	Chocolate	Ben (P), Bailey (P)
Touch floor	Ben, Bailey	Draw shapes	Bailey (NP)
Touch hair	Ben	Drum	Bailey (P)
Touch mouth	Bailey	Elmo guitar	Jack (P), Bailey (P)
Touch nose	Jack, Ben, Bailey	Envelope	Bailey (NP)
Touch shirt	Bailey	Fruit snacks	Jack (P), Ben (P) , Bailey (P)
Touch shoes	Jack, Ben	Goldfish	Jack (P), Ben (P), Bailey (P)
Touch shoulders	Jack, Bailey	Green beans	Jack (NP), Ben (NP), Bailey (NP)
Touch teeth	Jack	Gummy bears	Jack (P), Bailey (P)
Wave	Jack, Ben, Bailey	iPad	Ben (P)
Wiggle fingers	Bailey	M&Ms	Jack (NP), Ben (P), Bailey (P)
Wiggle your arms	Jack, Ben	Oreos	Jack (P)
Stand up	Jack, Ben, Bailey	Paper	Bailey (NP)
Stick out tongue	Jack, Bailey	Paper towel	Ben (NP) Bailey (NP)
Stomp feet	Jack, Ben	Peas	Jack (NP), Ben (NP), Bailey (NP)
Thumbs up	Bailey	Pete the Cat	Jack (P)
Tickle the table	Jack, Ben, Bailey	Plate	Ben (NP), Bailey (NP)
Touch head	Jack, Ben, Bailey	Play doh	Ben (P), Bailey (P)
Touch tummy	Jack, Ben	Reese's	Jack (NP)
Touch arm	Bailey	Sort silverware	Ben (NP), Bailey (NP)
Touch chair	Bailey	Spin toy	Bailey (P)
		Spoon	Ben (NP)
		Tomato	Jack (NP)
		Trace letters	Ben (NP)
		Trace numbers	Bailey (NP)
		Trash	Ben (NP) , Bailey (NP)
		Vegetable juice	Jack (NP), Ben (NP), Bailey (NP)

and/or interacted with were included as preferred consequences for that session, whereas items that were not consumed or interacted with were included as nonpreferred consequences for that session. It was planned that, if a participant did not consume/interact with any potential preferred items presented on a given day (or did consume/interact with potential nonpreferred items presented), then no sessions would be conducted that day. This never occurred for nonpreferred items and occurred once each for Ben and Bailey for preferred items. Prior to starting a session, the therapist pointed to and vocally tacted each item and then stated "You can have the (*nonpreferred item name)* or the (*preferred item name)*" while pointing to the items. Across all phases, the order of rule presentation was randomized prior to the session.

Baseline Each session consisted of six trials with three rules describing preferred consequences and three rules describing nonpreferred consequences. Each consequence was paired with one of six instructions. At the outset of each trial, a rule such as "If you clap, then you get the broccoli" was presented. If the child engaged in the specified behavior, the therapist provided the specified consequence. If the child engaged in another behavior or did not respond, the therapist did not provide the specified consequence and ended the trial. The therapist periodically interspersed trials of mastered tasks and reinforced compliance with those tasks using preferred items not used in the study.

Training Each session consisted of eight trials. One preferred consequence and one nonpreferred consequence were used for each set of training rules and were paired with four instructions. For each trial, the therapist presented the rule and the opportunity to respond independently.

If the child engaged in the specified behavior, the therapist provided the specified consequence. If the child did not engage in the specified behavior, the therapist did not provide the specified consequence. If a participant responded incorrectly, he was given specific feedback (e.g., "You didn't want broccoli, so you shouldn't have clapped.") in a neutral voice. If the child engaged in an incorrect response on the initial independent opportunity, the therapist then implemented an error correction procedure. The error correction procedure included physically prompting the specified behavior when the consequence was preferred and physically prompting an alternative behavior, such as putting the participant's hands on the table, when the consequence was nonpreferred. The rule was repeatedly presented with prompts faded after each presentation (see Figs. 1 and 2 for prompt fading steps). Mastery criteria consisted of correct responding on seven out of eight trials on the initial independent opportunity across two sessions.

Generalization Probes Following mastery of a set of rules, generalization probes were conducted to determine whether participants could respond correctly to novel rules. Sessions consisted of six rule presentations, with no behaviors or consequences described in the rules used at any previous time in the study. Therapist responses were identical to those in baseline. If a participant responded correctly to fewer than five out of six trials, the participant returned to training with a new set of rules. If the participant responded correctly to five or six trials, another probe was conducted. If the participant responded correctly to at least five trials, their participation was completed. If the participant responded correctly to four or fewer trials, the participant returned to training with a new set of rules.

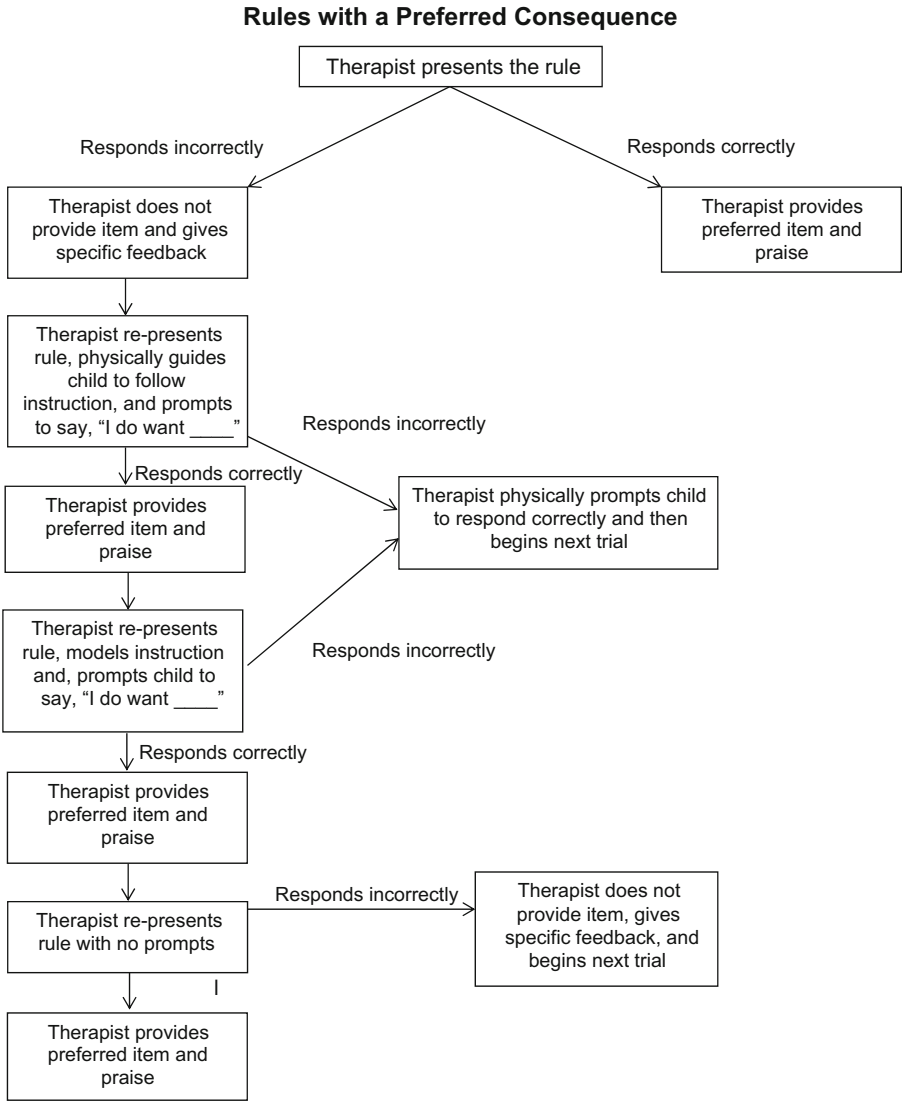

Fig. 1 The training procedures when the specified consequence was preferred

Results

Results for all three participants are displayed in Fig. 3. During baseline, all three participants responded correctly during approximately 50 % of sessions (i.e., chance level). Following the introduction of training, Jack and Ben met mastery criteria following three and four training sessions, respectively. Jack and Ben responded correctly to all trials (specifying novel rules) during two consecutive generalization probe sessions. Bailey met mastery criteria for the first set of rules following 15

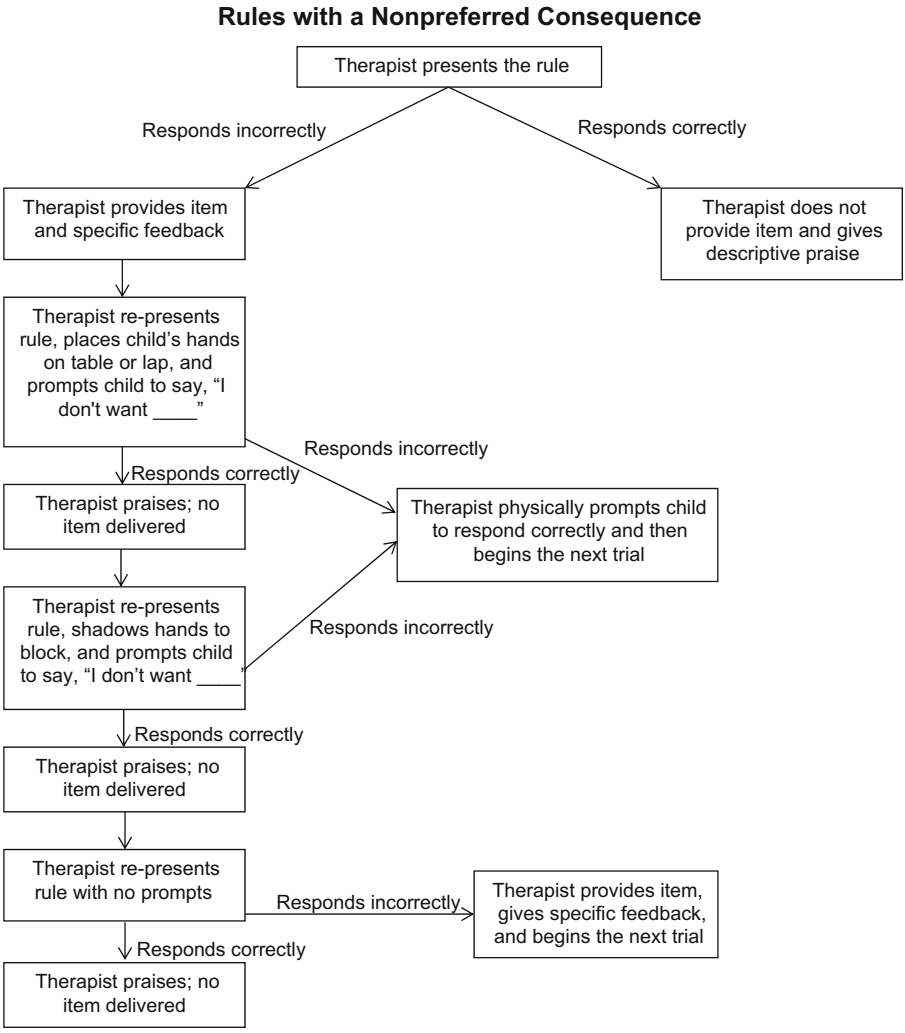

Fig. 2 The training procedures when the specified consequence was nonpreferred

sessions of training. During generalization probes, Bailey responded correctly to only four of six trials, after which he returned to training with a new set of training rules. An additional three sessions were conducted until he mastered the second set of rules. Following mastery, generalization probes were repeated (with novel rules), and Bailey responded correctly to all trials across two consecutive sessions.

Discussion

Results from the current study suggest that MET was effective at establishing a generalized repertoire of following untrained rules that describe behaviors and consequences. Generalization of rule following to novel rules was observed after mastery of only one (Jack and Ben) or two (Ben) sets of rules, in contrast with participants in

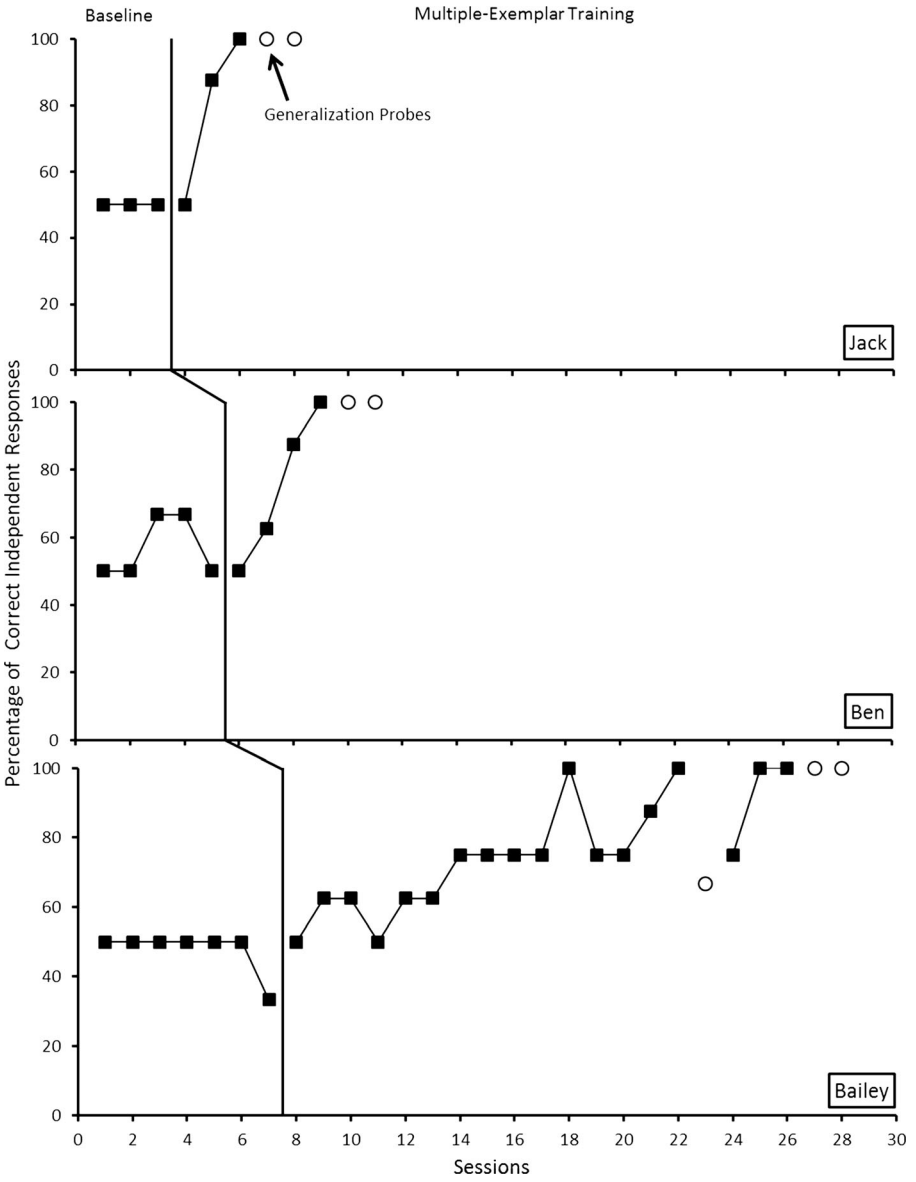

Fig. 3 The percentage of correct responses on independent opportunities to respond to a rule across participants

Tarbox et al. (2011), who required up to 11 sets of exemplars. It is possible that the relatively quicker acquisition compared to some of the participants in the Tarbox et al. study may be the result of participant selection procedures. Tarbox et al. noted that there were no formal inclusion criteria for their study participants. In the current study, all participants demonstrated generalized symmetry or naming, suggesting that generalized symmetry may be a prerequisite for the establishment of RGB.

One noteworthy aspect of the study is that in baseline, participants contacted the contingencies described by the rules but did not begin to respond accurately to the rules until prompting procedures and praise were added during training. It was anticipated that some participants would acquire the skill during baseline. However, this never occurred despite repeated contact with the contingencies described in the rule, possibly because the participants had a long history of reinforcement for compliance with the specified instructions. Additionally, it may have been difficult to respond correctly due to the need to *avoid* engaging in a behavior stated by a therapist, perhaps requiring a self-control repertoire (Kanfer & Karoly, 1972). The prompting of alternative responses during treatment may have helped the participants respond effectively by providing an appropriate response to engage in instead of avoiding the named behavior.

Although the results from the current investigation were positive across all three participants, four main limitations may provide avenues for future investigation. First, novel rules used during generalization probes were not probed prior to intervention, and therefore, no data on the level of responding to those rules are available. This method of generalization probes was used to assess for truly RGB (the participants had no exposure to the rules prior to the probe), to allow for reinforcement of instances of generalization (Stokes & Baer, 1977), and to prevent repeated presentations of a rule to which responding was never reinforced from serving as an S^{Δ} (Tarbox et al., 2011). Future researchers may correct this limitation by probing rules used for generalization probes a limited number of times in order to have data on the level of responding prior to intervention while still minimizing exposure to the rules.

Second, preferred and nonpreferred stimuli were not tested for reinforcing effectiveness prior to inclusion in the study, but brief preference assessments were conducted prior to each session (Pace, Ivancic, Edwards, Iwata, & Page, 1985). It is worth noting that sessions only needed to be cancelled on two occasions because of a participant's lack of stimulus consumption. No session was ever halted due to consumption of nonpreferred items. However, to ensure that stimuli were (or were not) reinforcing, future researchers could confirm whether stimuli functioned as reinforcers prior to including them as consequences in rules.

Third, although the rules taught are likely analogous to those presented by parents and teachers in everyday life, they remained arbitrary in nature, and an assessment of generalization of RGB to completely natural environments was not included. Although the inclusion of only arbitrary rules limits the extent to which broader practical implications can be drawn regarding effectiveness, the current procedure was selected in order to maintain a high degree of control over the procedure and to exclude the possible influence of participant reinforcement history. Future research could focus on more naturalistic rules and test for generalization outside of the clinical environment.

Fourth, it is unclear whether Jack and Ben required exposure to multiple exemplars prior to acquiring the skill, or if fewer examples would have been sufficient. The initial training set for both participants included eight exemplars, and both participants acquired the generalized repertoire after MET. Future research could consider probing for generalization after a smaller number of rules are acquired.

The current study successfully replicated the findings of Tarbox et al. (2011) that MET can be used to establish a basic repertoire of RGB in children with ASD and extended this finding to if/then rules specifying a behavior and consequence. The results also support Skinner's (1969) analysis of rule following, which suggests that

individuals engage in RGB due to a history of reinforcement for following rules. Future research should focus on more complex rules, rules encountered in the natural environment, and teaching the ability to derive rules.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained for all individual participants included in the study from their parents.

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