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Rule-Governed Behavior: Teaching a Preliminary Repertoire of Rule-Following to Children with Autism

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Abstract

Rule-governed behavior is generally considered an integral component of complex verbal repertoires (Skinner, 1974) but has rarely been the subject of empirical research. In particular, little or no previous research has attempted to establish rule-governed behavior in individuals who do not already possess the repertoire. This study consists of two experiments which evaluated multiple exemplar training procedures for teaching a simple component skill which may be necessary for developing a repertoire of rule-governed behavior. In both experiments, children with autism were taught to respond to simple rules which specified antecedents and the behaviors which should occur in their presence. In the first study, participants were taught to respond to rules containing “if/then” statements, where the antecedent was specified before the behavior. The second experiment was a replication and extension of the first. It involved a variation on the manner in which rules were presented. Both experiments eventually demonstrated generalization to novel rules for all participants, however variations to the standard procedure were required for several participants. Results suggest that rule-following can be analyzed and taught as generalized operant behavior and implications for future research are discussed.

DESCRIPTORS: rule-governed behavior, rule-following, instructional control, conditionality, autism, relational frame theory
Rule-Governed Behavior:

Teaching a Preliminary Repertoire of Rule-Following to Children with Autism

Applied behavior analysis is a science which endeavors to solve problems involving socially important behavior by identifying the variables of which such behavior is a function, thereby allowing for its prediction and control. Behavior may be easiest to control when the environmental variables of which it is a function are readily apparent and/or are to be found in the recent history of the person. A special class of behavior, however, defies efforts at the identification of immediately apparent environmental contingencies which are responsible for its occurrence, namely, that of rule-governed behavior (RGB). RGB is behavior which occurs due to contact with rules that describe contingencies, and not due to prior contact with the contingencies the rule describes (Skinner, 1968). For example, one can respond effectively to the rule “If you drink bleach, you will die,” without ever having to directly contact the contingencies, that is, without ever having to engage in the behavior of drinking bleach or of contacting the consequence of dieing. One can “follow” the rule, even though one has never contacted the contingencies which it describes.

Skinner described RGB as particularly crucial for the existence and maintenance of human civilization (YEAR). RGB is important because it allows humans to respond effectively in life without having to directly contact contingencies which would be destructive or inefficient to contact. Rules allow one to avoid dangerous consequences for behavior (e.g., the rule “Look both ways before crossing the street”). Rules also allow one to profit from the experience of previous generations by contacting rules that previous generations have derived through their contact with contingencies.
science are one such example (Skinner, YEAR). For example, the principle of reinforcement can be taught to a university student or clinician and it can be applied immediately. It is not necessary for each new person to discover the principle of reinforcement through random contact with natural contingencies. The same may be said of the laws of physics, biology, chemistry, and engineering. Each new engineer need not discover through direct contact with the consequences of their behavior how to build a bridge that will not fall down. RGB is therefore among the most important, foundational classes of behavior for human civilization and modern life as we know it would be impossible without it.

Despite the importance of RGB, relatively little attention has been paid to it in the behavior analytic literature. Skinner was the first in the behavioral community to allocate a significant degree of attention to RGB (YEAR, EARLIEST REFERENCE). Skinner’s conceptual analyses of RGB vary somewhat across his various writings but Skinner generally suggested that RGB was behavior that occurred due to contact with rules, not due to contact with the contingencies which the rules describe (REFERENCE). Generally speaking, Skinner suggested that people engage in RGB, i.e., follow rules, because they have a history of reinforcement for doing so (REFERENCE). Generally, then, it might be stated that rule-following can be conceptualized as a class of behavior, in itself. Further, rules were defined as “contingency-specifying stimuli” (REFERENCE). However, the concept of specification was deliberately excluded from Skinner’s general analysis of verbal behavior because it overlapped very much with the concepts of understanding and reference, both of which Skinner clearly stated were unnecessary in the analysis of behavior (REFERENCE, PARROT SUBSTITUTION AND REFERENCE).
The rejection of reference as an independent, hypothetical causal construct was important, but the issue of what a rule “means” and whether a person can “understand” a rule was not resolved. In an early treatment of the topic, Parrott (YEAR) pointed out that the behavior of simply complying with a rule is not equivalent with understanding the rule. A person may hear a rule and not understand it (as in hearing a rule in a foreign language) or may hear a rule, understand it, and not comply for other reasons (e.g., the consequence described in the rule was not relevant, the person has no history of complying with the rules stated by that particular speaker, etc.). In either case, the person behaving does not comply with the rule, but clearly something different is occurring in the two cases. In the first case, the person does not understand the rule, in the second case, he does. Put another way, in the first case, the rule specifies nothing, while in the second case, the contingencies specified by the rule are clear (albeit, not potent).

Early empirical research on RGB generally did not address the functional relations involved in how one can “understand” a rule, and therefore how one can follow it, despite never having contacted the contingencies which it describes. Research on RGB was active in the 1980’s, centering around the work of Charles Catania and colleagues. The research conducted in that period generally involved studying the differences among the properties of rule-governed and contingency shaped behavior, such as differences in resistance to extinction (REFERENCE), differences in the speed of acquisition (REFERENCE), and differences in XXXXX (REFERENCE). This body of research was an important first step in identifying the properties that distinguish contingency-shaped behavior and RGB but conceptual and empirical research generally had still had not
addressed what, exactly, rules are, and how repertoires of RGB are acquired (HAYES RFT INTRO??).

Conceptual work in recent years has analyzed RGB from the perspective of Relational Frame Theory (RFT). Space does not permit a full conceptual treatment of an RFT analysis of RGB (see O’Hora CHAPTER IN RFT; Tarbox, Tarbox, & O’Hora, 2009), but a brief overview will be provided here. The foundation of an RFT analysis of RGB is perfectly consistent with Skinner’s basic position, namely, that rule-following can be conceptualized as an operant. However, RFT allows for a refinement of the conceptual analysis of what rules are and how a repertoire of RGB can be acquired. To start with, RFT allows for a functional analysis of what it means that a rule “specifies” a contingency. The elements that a rule “specifies” for any given person are the elements which participate in relational frames with the stimuli in the rules, for that particular person. For example, in the case of a rule stated in a foreign language, the foreign words do not participate in any relational frame whatsoever, so the rule means nothing. Rules that contain words that participate in relational frames with other events or stimuli “specify” those events or stimuli for the person hearing the rule. Consider the rule “If it’s raining, then take an umbrella, and you won’t get wet.” The stimulus “raining” participates in an equivalence relation (or frame of coordination) with the actual sights and sounds of rain, the stimulus “take an umbrella” participates in an equivalence relation with the actual behavior of taking an umbrella, and the stimulus “won’t get wet” participates in an equivalence relation with avoidance of the aversive condition of wetness. These equivalence relations account for specification of the three terms contained in the contingency but not the contingency itself. In other words, if the rule
consisted simply of “raining take an umbrella won’t get wet,” the rule would not make sense – it would not specify that rain is the antecedent in the presence of which one should take the umbrella (the behavior), nor that avoiding wetness would be the consequence of taking it. According to an RFT analysis, the stimuli “If / then” and the placing of them with respect to the other stimuli contained in the rule, are contextual cues for a relational frame of conditionality, which controls how one interacts with the equivalence relations involving the three terms of the contingencies (REFERENCE O’HORA CHAPTER 2001).

Relational frames of conditionality are said to be established, like all other relational frames, via a history of reinforcement of multiple exemplars of such frames (REFERENCE 2001, FAMILIES OF FRAMES CHAPTER). After a sufficient history of reinforcement of compliance with rules which state antecedents, behaviors, and consequences, arranged around a contextual cue (e.g., “if/then”), a generalized relational operant emerges, such that one acquires the ability to respond to novel rules that one has never contacted, if the contextual cues present during previous reinforcement are currently present. For example, a parent may say “First clean your room, then you can go play,” “First finish your dinner, then you can have dessert,” “First do your homework, then you can play video games,” and so on, for many exemplars, all of which vary, except that they all contain the contextual cues “First / then.” After a sufficient history of reinforcement for complying with many such exemplars, the contextual cues come to have antecedent control over responding to the rule by engaging in the behavior described, so long as the consequence described is sufficiently potent. It should be noted that the topography of the contextual cue is irrelevant, so long as a particular topography
is present when sufficient exemplars are trained. Indeed, such a history is what makes certain contextual cues “mean something.” A fully developed repertoire of RGB presumably contains many such contextual cues, all of which set the occasion for relating events conditionally.

The RFT functional analysis of rule-following and the history of multiple exemplar training which likely establishes it is inherently practical and empirically testable. Despite the potential utility of the RFT analysis, no research has yet been done which has attempted to establish such a repertoire in someone who does not have it. Most or all RFT research on RGB has examined its properties in people who already readily demonstrate it, e.g., college students (O’Hora, Barnes-Holmes, Roche, & Smeets, 2004).

Clinical populations which are characterized by difficulties in language development, such as autism and other developmental disorders, would presumably benefit from the development of behavioral intervention programs which can establish RGB. However, no previous studies have been published which have attempted to establish RGB in individuals in these populations. One study on RGB in individuals with developmental disabilities evaluated the effects of self-generated rules on computer tasks (Arntzen, Halstradtro, & Halstradtro, 2009). Using the “silent dog” strategy, they assessed the control of self-instructions on the behavior of a boy with autism. The participant successfully learned several computer tasks and it seemed that these tasks were under the control of covert self-instruction. Further, rules created from the participant’s overt self-talk were sufficient in teaching computer skills to another child with autism. This study represents an important first step in evaluating rule-governed
behavior in children with developmental delays but research is needed on procedures for establishing rule-governed behavior in these populations.

The purpose of this study was to investigate a procedure for establishing a generalized ability to respond to simple rules in children with autism who displayed no evidence of a rule-following repertoire. In specific, a multiple exemplar training procedure was investigated for training children with autism to respond to rules specifying antecedents and behaviors. The critical outcome of the study was to demonstrate generalization of the ability to follow rules for which participants had never contacted the specified contingencies, the defining characteristic of RGB.

Experiment One

Method

A concurrent multiple probe (Kazdin, 1982) across participants design was used. In order to assess the number of exemplars required to produce generalization, generalization probes were included after each trained rule was mastered.

Participants and Setting

Three boys with autism participated. All children were clients of a community-based agency which provided home-based early intensive behavioral intervention services, which addressed all deficit skill areas (e.g., language, social skills, play, independent living skills, motor, academics). David was five years old and had been receiving 40 hours of therapy a week for 25 months at the start of the study. Frank was three years old and had been receiving therapy for 25 hours a week for 19 months. Joey was five years old and had been receiving therapy for 18 hours a week for 17 months. All participants had significantly developed repertoires of tacts, mands, and basic one-step
instructions. Caregivers of all participants reported that they could not follow simple rules and that the establishment of this ability was a clinical priority. All procedures were implemented as a part of the child’s regularly scheduled behavioral intervention program in his/her home.

Response Measurement and Interobserver Agreement

A correct response to the “if/then” rule was defined as engaging in the behavior specified in the rule when the stimulus described was presented and not engaging in the specified behavior when the described stimulus was not present. Interobserver agreement (IOA) was assessed by having two independent observers collect data simultaneously during 21%, 32%, and 74% of sessions for David, Frank, and Joey, respectively. Mean IOA for David was 98% (range = 83-100%), 98% for Frank (range = 80-100%), and 98% for Joey (range = 92-100).

Procedures

Baseline. During baseline, a picture card and “If/then” rule were presented. A presumably neutral consequence (e.g., “Okay”) was given for any response. In half of the trials, the stimulus described in the rule was presented. In the other half of the trials, a stimulus that was not described in the rule was presented. Trials of mastered items were interspersed and the child received reinforcement for correct responses to mastered items in order to maintain compliance. Prior to the study, probes were run to confirm that the participants could correctly tact and receptively identify each of the stimuli used in the study. Probes were also conducted to ensure that the participants could correctly respond to the simple instructions used in the study such as, “Clap your hands.”
Training. During training, the picture card and “If/then” rule were presented. Correct responses were reinforced. The therapist stated “no” in a neutral tone of voice contingent on an incorrect response and descriptive feedback was provided such as, “No, I said if this is a carrot then clap but look that’s not a carrot so don’t clap.” If a participant began to respond before the entire rule was stated, therapists used partial physical guidance to prompt the participant to place their hands on their lap. Prompts for engaging or not engaging in the behaviors specified in the rules were faded out, within-session, according to the following most-to-least prompt fading hierarchy: 1) full physical, 2) partial physical, 3) model, 4) vocal, and 5) no prompt. Each time a new rule was introduced, the prompt-fading hierarchy was initiated at the highest level of prompting and prompts were faded within-session. Most-to-least prompt fading was continued on subsequent sessions, until a participant demonstrated correct independent responding on one trial where the specified stimulus was present and one where it was absent. On subsequent sessions where the same rule was continuing to be trained, the same prompting hierarchy was used, but was implemented in reverse order, according to a within-session, least-to-most sequence.

During half of the training trials the stimulus described in the rule was presented. In the other half of the trials a different stimulus was presented. After the first rule was acquired, new training rules were interspersed with previously learned rules so that three different rules (two mastered and one acquisition) were presented each session. Criterion for mastery of a particular rule was set at 80% or more correct across two consecutive sessions. To reach criteria the participant also had to respond correctly the first time the
stimulus in the rule was present and the first time the stimulus in the rule was not present, during each session. Once criteria had been met, a generalization probe was conducted.

*Altered rule presentation format.* This phase was identical to the training phase, except in how rules were stated. Rules were presented so that the behavior was described before the antecedent was specified as in “Clap if this is a carrot,” instead of “If this is a carrot, then clap.”

*Generalization probes.* Generalization probes were identical to baseline and included only rules which had not been trained. If the participant scored below 80% correct on the generalization probe, training continued with the next rule. If the participant scored over 80% on the generalization probe, training was discontinued and follow-up probes were conducted after one and two weeks. The two week follow-up probe was conducted by a different therapist to show generalization across time (maintenance) and generalization across people.

*Altered generalization probe format.* This phase was identical to the generalization probes, except that rules were stated with the behavior specified before the antecedent, as in the *altered rule presentation format* phase, described above.

**Results**

Figure 1 depicts the results of Experiment 1 and the top panel depicts results for David. During baseline, correct responding was consistently low. David acquired the first rule in the training phase after 15 sessions. Generalization was then probed and found to be absent. Additional rules were then trained and generalization was again probed after each rule was acquired. Generalization was not clearly demonstrated until David acquired
11 rule exemplars. Correct responding maintained at the one and two week follow-up
generalization probes.

The middle panel of Figure 1 depicts the results for Frank. Frank met criteria for
generalization after three exemplars were directly trained but maintenance was not
demonstrated at the one week follow up. A second follow-up probe was then conducted
and correct responding remained low, so Frank was trained in additional exemplars. After
Frank was trained on four additional exemplars and still did not demonstrate
generalization, his clinical supervisor expressed dissatisfaction with the lack of progress
and requested that something be changed. Therefore, the altered rule presentation format
phase was initiated. In addition, after each rule exemplar was mastered, generalization
probes were conducted according to the altered generalization probe format. Frank met
criteria for generalization after two additional exemplars were trained and correct
responding remained high at the one and two week follow-up probes, therefore
demonstrating maintenance and generalization to another therapist.

The third panel of Figure 1 depicts the results for Joey. Joey demonstrated high
percentages of correct responding during generalization probes after only two rule
exemplars had been trained. These results maintained at a one-week follow-up probe and
a two-week follow-up probe with another therapist.

Discussion

Experiment 1 demonstrated that multiple exemplar training can establish the
generalized ability to respond to novel rules, consisting of basic contingency statements
which specify an antecedent and a behavior, in young children with autism. However, the
initial procedure only produced generalization in two of three participants and a
modification of the procedure appeared to be necessary for Frank. The *altered rule presentation format* was designed based on the observation that participants generally engaged in the behavior specified in the rule immediately after the rule was stated, regardless of whether the specified antecedent was present. The behavior specified in the rule was the last word stated in the rule so it was hypothesized that, due to the lengthy history of reinforcement for engaging in an action when asked to do so, the antecedent which was specified in the rule was not salient because it occurred earlier in the rule statement. In addition, in the standard rule presentation format, the contextual cue “if” occurred at the beginning of the rule and may have also been less salient for that reason. Therefore, the *altered rule presentation format* was designed to specify the behavior at the beginning of the rule, so that the word specifying the antecedent and the contextual cue “if” occurred closer in time to when the participant had the opportunity to respond. However, the *altered rule presentation format* was only implemented with one participant, and could not be evaluated in the context of an experimental design, so further research was needed to evaluate its effectiveness. This was the purpose of Experiment 2.

Experiment Two

*Method*

The experimental design was identical to that used in Experiment 1.

*Participants and Setting*

Three boys with autism participated in the experiment, none of which had participated in Experiment 1. James was five years old and had been receiving therapy 20 hours a week for 17 months. Tim was seven years old and had been receiving treatment
for 13 hours a week for 10 months at the start of the study. Greg was six years old at the start of the study and had been receiving treatment for 25 months for 30 hours a week. As in Experiment 1, all participants were reported to possess significant repertoires of tacting, manding, and following one-step instructions but none could reportedly follow simple rules. All procedures were implemented as a part of the child’s regularly scheduled behavioral intervention program in his/her home.

Response Measurement and Interobserver Agreement

A correct response to a rule was defined as engaging in the behavior specified in the rule when the stimulus described was presented and not engaging in the specified behavior when the described stimulus was not present. In addition, a correct response required that the participant emit a vocal response that specified whether or not he should engage in the behavior (e.g., “That’s not a carrot, so I shouldn’t clap”). IOA was assessed by having two independent observers collect data simultaneously during 67%, 58%, and 49% of sessions for James, Tim, and Greg, respectively. Mean IOA for James was 100%, 99% for Tim (range = 92-100%), and 99% for Greg (range = 92-100).

Procedures

Baseline. This condition was identical to the baseline condition of Experiment 1, with the exception that rules were presented with the behavior specified before the antecedent (e.g., “Clap if this is a carrot”), as was done in the altered rule presentation format and the altered generalization probe format conditions of Experiment 1.

Training. This condition was identical to the training condition of Experiment 1, with the exception that rules were presented with the behavior specified before the antecedent, as was done in the altered rule presentation format. The number of
exemplars presented in each training session also differed from that in Experiment 1.
Instead of an individual training rule with a single behavior and stimulus (e.g., “Stomp if
this is a hat”) a single behavior was paired with 3 different stimuli during the session
(e.g., “Stomp if this is a hat,” “Stomp if this is a cookie,” and “Stomp if this is a bike”). In
addition, participants were prompted to engage in a vocal response describing the
antecedent present and the appropriate response (e.g., “That’s not a carrot, so I shouldn’t
clap”). Prompting for the vocal response was identical to that for the motor response (i.e.,
within-session most-to-least, followed by within-session least-to-most), except that the
following hierarchy was used: 1) full vocal model, 2) partial vocal model, 3) no prompt.

*Generalization probes.* This phase was identical to the altered generalization
probe condition of Experiment 1.

*First trial generalization probes.* During these probes, a single trial of an
untrained rule was probed. These new rules included behaviors and stimuli that were
never included in any previous training sessions or probes. Consequences were identical
to the Training phase. Because differential consequences were delivered for correct and
incorrect responding, each rule could only be probed once (i.e., after one trial of a
particular rule occurred and consequences were provided for correct or incorrect
responding, that rule could not be presented again in the future, if generalization was to
be assessed). Generalization was demonstrated if and when a participant consistently
responded correctly to many successive trials of novel rules.

*Results*

Figure 2 depicts the results of Experiment 2. The top panel of Figure 2 depicts
James’s data. James met criteria for generalization (83%) after two sets of rules were
trained (two behaviors and six stimuli). Maintenance was demonstrated at the one and two week follow-up probes.

The middle panel of Figure 2 depicts Tim’s data. Tim did not demonstrate generalization after eight sets of training rules had been acquired. Additional sets of rules continued to be trained, but *first trial generalization probes* were instituted, rather than the standard generalization probes. Tim never responded incorrectly to *first trial generalization probes*. After 14 *first trial generalization probes*, a standard generalization probe session was implemented and Tim’s correct responding returned to low levels. Additional *first trial generalization probes* were then conducted and Tim’s correct responding returned to 100%.

The third panel of Figure 2 depicts Greg’s data. Greg reached criteria for generalization following one set of training rules (one behavior and three stimuli). Maintenance was demonstrated at the one week follow-up probe. However, correct responding decreased at the two week follow-up when another person administered the probe. Two additional sets of rule exemplars were then trained and Greg continued to demonstrate low levels of correct responding. One *first trial generalization probe* was then conducted and RS responded incorrectly. An additional set of rule exemplars were then trained and Greg subsequently responded correctly to 8 *first trial generalization probes*, after which time, a standard generalization probe was conducted, during which Greg continued to respond correctly. An additional 12 novel rules were then probed in *first trial generalization probes* and Greg’s correct responding remained at 100%.

Discussion
The results of Experiment 2 demonstrated that multiple exemplar training, as initially implemented, established the generalized ability to follow rules containing if/then statements in only one out of three participants. Specifically, Tim and Greg continued to respond incorrectly on generalization probes, despite exposure to training of many rule exemplars. However, experimenters hypothesized that low levels of correct responding to generalization probes may have been influenced by the lack of differential consequences for correct or incorrect responding during those probes. That is, if and when correct responding did occur, it was on extinction. Since the same stimuli were used each time a generalization probe was conducted, and many generalization probes were conducted throughout the course of the study, this essentially amounted to a multiple schedule, in which correct responding during training produced reinforcement and correct responding during generalization probes produced extinction. When analyzed as a multiple schedule, it follows that correct responding would be low in the generalization probes. This potential analysis was supported by the fact that correct responding was high during several training sessions in which a new exemplar was first introduced, despite the fact that correct responding was low in an immediately preceding generalization probe. The first trial of a new exemplar during a training session essentially amounted to a generalization probe, in that the participant had the opportunity to independently respond to a novel rule which had not been previously trained and correct responding on that first trial, therefore, amounted to a demonstration of generalization. Such correct responding was frequently observed during training trials, leading experimenters to hypothesize that generalization was indeed occurring, but that
the stimuli used during generalization probes (which had been associated with extinction for many previous trials) functioned as S deltas for correct responding.

The *first trial generalization probe* procedure was developed to address this potential problem. These probes allowed experimenters to test generalization without using stimuli which were previously associated with extinction and to allow experimenters to reinforce occurrences of generalization, a procedure which has been previously recommended (Stokes & Baer, 1977). Tim’s data support the interpretation that the original generalization stimuli may have been functioning as S deltas because Tim’s responding increased to 100% correct immediately upon the introduction of the *first trial generalization probes*. The initial *first trial generalization probe* conducted with Greg produced incorrect responding but all subsequent probes, following the training of an additional set of exemplars, produced 100% correct responding.

**General Discussion**

The results of the current two experiments demonstrate that basic behavioral procedures, including prompting and reinforcement, in the context of multiple exemplar training, can establish a generalized repertoire of responding correctly to simple rules. All six children with autism in the two experiments successfully demonstrated a generalized ability to follow novel rules which contained if/then contingency statements that specified behaviors and the antecedent conditions under which they should occur. This is the first study to establish any form of RGB in individuals with developmental disabilities who do not have it.

These results have significant implications for an analysis of RGB as generalized operant behavior. A generalized operant analysis of RGB is congruent with Skinner’s
suggestion that people follow rules because they have received reinforcement for doing so in the past and it is congruent with the RFT interpretation that RGB consists of generalized relational operants under antecedent contextual control. The RFT analysis, that RGB may be acquired through reinforcement of multiple exemplars of following individual rules, appears to be supported by the current results.

In addition to the potential conceptual implications of the current data, the results of the two experiments offer promising applied implications. Virtually no intervention programs currently exist for establishing RGB in people who do not have it in their repertoires. The current two experiments are only initial forays into developing procedures for establishing RGB, but they may represent a basic foundation from which to proceed. Future research will be needed which continues to evaluate multiple exemplar training procedures for establishing more complex repertoires of rule-following, eventually extending into something resembling a fully developed adult repertoire of RGB. The rules included in the current two experiments were among the simplest possible examples of rules, in that they specified only the antecedent and the behavior. Future research will need to investigate multiple exemplar training for establishing the ability to respond to rules which specify all three terms of the three term contingency. The complexity of the rules could be further expanded by including additional terms (e.g., more than one antecedent condition or more than one behavior) and/or by requiring participants to respond to antecedents or consequences in terms of additional relations (including other relational frames). For example, “Clap if the circle is bigger than the triangle” or “Clap if you put on your pants before you put on your shirt this morning” (Tarbox, Tarbox, & O’Hora, 2009).
Eventually, research on establishing RGB must move beyond teaching the most basic forms of RGB in children with developmental disabilities, to investigating procedures for establishing repertoires of RGB which typically developed adults posses. For example, little or no published studies have attempted to teach individuals the ability to derive rules and follow them or to respond to long-delayed (e.g., death, cancer, retirement, career advancement) or non-existent consequences (e.g., going to hell, going to heaven, etc.).

Several limitations of the current two experiments are worthy of discussion. A significant limitation of the first trial generalization probe procedure is the fact that none of the stimuli used in it were probed prior to intervention and therefore low levels of correct responding were not demonstrated during the baseline phase. That is, it is possible that Tim and Greg would have responded correctly to these rules prior to the multiple exemplar training intervention. However, this possibility appears highly unlikely, given the multitude of trials to which they responded incorrectly to similar rules specifying similar stimuli during baseline and throughout intervention. Nevertheless, future studies should include one trial of each stimulus to be later used in a first trial generalization probe, with no programmed consequence for correct or incorrect responding, during the baseline phase.

An additional limitation of the two experiments is that the results obtained were significantly idiosyncratic across participants. One participant in each experiment readily demonstrated generalization to novel rules after being trained on a small number of exemplars. However, the other four participants either required training on many exemplars across a long period of time (David) or required a modification to the basic
procedure (Frank, Tim, and Greg). It is not possible to determine the cause of the idiosyncratic results from the current data but it was likely due to differences among reinforcement histories and current repertoires of the participants at the time the studies were initiated. For example, there are likely prerequisite skills which are necessary before multiple exemplar training in rule-following is likely to be successful. Future research should attempt to empirically identify what these skills are.

Another potential strategy for avoiding participant variables which may prevent the acquisition of RGB may be to include typically developing children as participants, rather than children with developmental disabilities. Typically developing children generally do not require explicit intervention in order to develop repertoires of RGB, so such research may be less socially valid, but it may provide a more convenient research context in which to study the basic processes involved in the establishment of rule-following repertoires.

A significant limitation to the current study is the fact that, although generalization to novel rules was demonstrated for all participants, no attempt was made to assess generalization of rule-following to rules that participants contacted in the course of their day-to-day life. That is, generalization of the basic ability to understand and respond to if-then contingency statements was demonstrated but it is not known if generalization occurred on a broader basis. The purpose of the current two experiments was to conduct an initial evaluation of whether establishing a basic component skill of rule-following was possible via multiple exemplar training, not to assess real-life generalization, however future research should attempt to ensure that treatment gains are applied across participants’ everyday lives.
The two experiments in the current study demonstrated that multiple exemplar training can be used to establish the generalized ability to follow simple rules, containing if/then contingency statements that describe antecedents and behaviors. This is the first study, of which the authors are aware, where the primary purpose of the study was to establish RGB in individuals who do not possess it in their repertoire. Further, the results of this study demonstrate that such a repertoire can be established in children with autism. However, this study is not without its limitations and future research is needed to identify prerequisite skills so that participants can be appropriately matched to training procedures and more consistently positive results can be obtained with particular procedures.
References


O’Hora chapter (2001)

Families of Frames Chapter (2001)
Author Note

The authors would like to thank Ben Craighead for his contributions to the study.
Table 1.

*Rules Presented During Baseline, Training, and Generalization Probes in Experiment 1.*

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<thead>
<tr>
<th>Baseline and Generalization probes</th>
<th>Directly Trained</th>
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<tr>
<td>If this is orange then touch your head</td>
<td>If this is a carrot then clap</td>
</tr>
<tr>
<td>If this is a pig then arms up</td>
<td>If this is a triangle then turn around</td>
</tr>
<tr>
<td>If this is a shoe then touch the floor</td>
<td>If this is a ball then stomp</td>
</tr>
<tr>
<td>If this is a chair then knock</td>
<td>If this is a cookie then jump</td>
</tr>
<tr>
<td>If this is a spoon then stand up</td>
<td>If this is a hat then stick out your tongue</td>
</tr>
<tr>
<td>If this is a car then wave</td>
<td>If this is a bike then touch your nose</td>
</tr>
<tr>
<td></td>
<td>If this is a cup then show me laughing</td>
</tr>
<tr>
<td></td>
<td>If this is an apple then touch your ears</td>
</tr>
<tr>
<td></td>
<td>If this is a square then clap</td>
</tr>
<tr>
<td></td>
<td>If this is a motorcycle then stomp</td>
</tr>
<tr>
<td></td>
<td>If this is a cracker then turn around</td>
</tr>
</tbody>
</table>
Figure Captions

*Figure 1.* Percentage of correct responses across all conditions for David, Frank, and Joey.

*Figure 2.* Percentage of correct responses across all conditions for James, Tim, and Greg.