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EFFECTS OF RESPONSE PREFERENCE ON RESISTANCE TO CHANGE

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Treatments based on differential reinforcement of alternative behavior, such as functional communication training, are widely used. Research regarding the maintenance of related treatment effects is limited. Nevin and Wacker (2013) provided a conceptual framework, rooted in behavioral momentum theory, for the study of treatment maintenance that addressed two components: (a) reemergence of problem behavior, and (b) continued expression of appropriate behavior. In the few studies on this topic, focus has been on variables impacting the reemergence of problem behavior, with fewer studies evaluating the persistence of appropriate behavior. Given the findings from applied research related to functional communication training, variables related to response topography, such as response preference, may impact this aspect of maintenance. In the current study, the impact of response preference on persistence was evaluated in the context of functional communication training for individuals who did not exhibit problem behavior (Experiment 1) and for individuals with a history of reinforcement for problem behavior (Experiment 2). High-preferred mands were more persistent than low-preferred mands. These findings suggest that response related variables, such as response preference, impact response persistence and further suggest that response related variables should be considered when developing interventions such as functional communication training.

Key words: resistance to change, mands, functional communication training, response preference

Few empirical investigations have focused on the long-term effectiveness of functional communication training (FCT; Carr & Durand, 1985) and the behavioral processes that affect maintenance of the treatment effects of this intervention. Wacker et al. (2011) provided one example of research in this area by demonstrating the effects of FCT on appropriate and destructive behavior over the course of 9 to17 months of evaluation for eight young children receiving in-home assessment and treatment of problem behavior (Wacker, Berg, & Harding, 2004). Results of their study suggested that following repeated exposures to the FCT treatment package, appropriate responses persisted when contacting various treatment challenges (e.g., extinction for communicative responses, concurrent schedules of reinforcement, and increased response requirement to gain reinforcement) and destructive behavior remained at low levels. However, Wacker et al. (2011) did not evaluate the specific treatment variables affecting maintenance, including persistence of appropriate communication responses (i.e., mands [requests]).

Nevin and Wacker (2013) described a conceptualization of treatment maintenance related to FCT and other differential reinforcement of alternative (DRA)-based interventions that include two aspects: (a) continued suppression of problem behavior, and (b) continued expression of appropriate, alternative responses. Thus, persistence of the target mand when treatment is discontinued or

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disrupted comprises one aspect of treatment maintenance related to FCT. Evaluating the persistence of the target mand can consist of implementing a disruptor to treatment and then comparing the occurrence of the mand during disruption to its occurrence during the preceding treatment (e.g., baseline condition).

The behavioral momentum literature provides a useful guide for this approach to assessing maintenance. Studies of behavioral momentum most often maintain responding on a multiple schedule of reinforcement (baseline). The components of the multiple schedule typically vary with respect to some characteristic of the reinforcer (e.g., rate, magnitude, or delay of reinforcement). Following the multiple-schedule baseline, a disruptor such as extinction of the target response, response-independent reinforcement, or access to the reinforcer immediately prior to sessions (e.g., prefeeding) is arranged and responding is measured. This arrangement allows for response persistence to be evaluated as a function of the parameters manipulated during the multiple-schedule baseline.

Research related to behavioral momentum theory has demonstrated the effects of different reinforcer characteristics on response persistence in the basic literature. These characteristics include reinforcer rate (Nevin, 1974), magnitude (Grimes & Shull, 2001; Nevin, 1974), and delay of reinforcement (Nevin, 1974). Specifically, greater rates and magnitudes of reinforcement result in relatively greater persistence, as do relatively smaller delays to reinforcement.

Basic and translational evaluations of resistance to extinction and other disruptors typically restrict the range of responses to one (e.g., key pecking, silverware sorting), while applied evaluations of resistance to extinction and other disruptors typically include more than one response (e.g., problem behavior and appropriate communication). Response characteristics, such as novelty and proficiency, related to the appropriate communicative response (i.e., mand) affect FCT-based treatment outcomes. In a study conducted with two children with developmental disabilities, Winborn, Wacker, Richman, Asmus, and Geier (2002) noted greater levels of appropriate communication during FCT if the communicative response existed in the individual's repertoire prior to FCT. However, this arrangement was also associated with higher levels of problem behavior occurring during treatment, perhaps due to a shared history of reinforcement of problem behavior and existing appropriate communication as members of the same response class. Conversely, FCT conducted with novel communicative responses (i.e., responses that were not in the individual's repertoire prior to treatment) resulted in lower levels of appropriate communicative responses and lower levels of problem behavior. Ringdahl et al. (2009) demonstrated greater effectiveness of FCT when the participant showed greater proficiency with the mand prior to the initial FCT sessions when compared to FCT conducted with less initially proficient mands. Functional communication training using mand modalities that occurred only following a higher level of prompting from the therapist (e.g., model prompts vs. vocal prompts) resulted in (a) lower rates of appropriate communication, and (b) higher rates of problem behavior in comparison to FCT that incorporated mands that occurred following minimal prompting (e.g., vocal prompts).

Collectively, the Winborn et al. (2002) and Ringdahl et al. (2009) studies showed that initial treatment effects for FCT programs may be influenced by the novelty of the communicative response and the participant's initial proficiency with that response. However, because FCT was not optimally effective with one of the two response-type conditions (novel vs. established; high-proficiency vs. low-proficiency) in the Winborn et al. and Ringdahl et al. studies, a comparison of the impact of such variables on maintenance was not possible. By contrast, Winborn-Kemmerer, Ringdahl, Wacker, and Kitsukawa (2009) demonstrated that FCT could be successfully implemented with two appropriate mands. Further, although equally effective, results of this study demonstrated that, when the responses were available concurrently, participants allocated responding to one mand over the other. Thus, participants displayed a preference for one of the mands, but the relation between preference and persistence of the mands was not evaluated.

Given findings in the literature demonstrating that individuals exhibit a preference for mands (Falcomata, Ringdahl, Christensen, & Boelter, 2010; Ringdahl et al., 2016; Winborn

Table 1

Participant description and target mands (preferred mand in **bold**); Experiment 1

Participant/Gender	Age	Diagnoses	Target Mands
Quinn/Male	4 years old	ASD; Severe ID	**Microswitch activation**, picture card touch
Milo/Male	68 years old	Severe ID	Microswitch activation, **picture card touch**
Cora/Female	49 years old	Down Syndrome; Severe ID	Microswitch activation, **picture card touch**

et al., 2009) and the relative similarity of initial treatment success of FCT, regardless of response preference, the purpose of the current study was to evaluate the effects of response preference on the maintenance of FCT treatment effects, specifically on the persistence of mands. Experiment 1 was conducted with three individuals who exhibited communication delays, but no clinically significant problem behavior. The purpose of Experiment 1 was to evaluate the impact of response preference on the persistence of mands outside of the context of treatment for severe problem behavior before determining if this variable was one that should be explored within that context. Experiment 2 was conducted with four individuals as a systematic replication of the findings from Experiment 1 in the context of treatment for problem behavior. Persistence (maintenance) evaluations were conducted to be analogous to basic studies on behavioral momentum. However, instead of manipulating a reinforcement parameter during baseline, reinforcement was made similar across the components of a multiple schedule and the impact of baseline response preference on persistence was examined.

General Method

Two experiments comprise this evaluation. The setting and materials, data collection procedures, item preference assessment, mand proficiency analysis, FCT, mand preference analysis, and extinction sessions were the same across both experiments. The methods for Experiment 1 include descriptions of all the procedures that were common to Experiments 1 and 2. The methods for Experiment 2 describe the measures (i.e., occurrence of problem behavior), assessment (i.e., functional analysis of problem behavior), and participants that were changed for or unique to Experiment 2.

Experiment 1

Participants. Three individuals, given the pseudonyms Quinn, Milo, and Cora, participated in Study 1[1]. Each individual was diagnosed with autism spectrum disorder (ASD) and/or intellectual disability (ID) and had a communication delay or deficit. None of the participants used vocal communication strategies and care providers for each were interested in identifying alternative and augmentative communication strategies for use by the participants. Table 1 lists relevant participant demographics and target mands included in the study.

Setting and materials: Experiments 1 and 2. All sessions were conducted in a 3 m by 4 m evaluation room. The room was equipped with various stimuli (toys and/or preferred activities), a mat, and a one-way mirror. A microswitch that played a message requesting a functional reinforcer as identified during the preference assessment, and a 10 cm by 10 cm card with a picture representing the same functional reinforcer were present in the room during all sessions except the preference assessment. To enhance discriminability, we assigned a unique stimulus to each mand modality (i.e., a green colored board, approximately 90 cm by 60 cm, for microswitch sessions; and a yellow board, approximately 90 cm by 60 cm, for card sessions) and placed it on a wall in the room during the FCT and extinction sessions for the relevant mand. During all sessions, a therapist, data collector, and third adult with a video camera were present in the room. During item preference assessments and mand proficiency analysis sessions, the data collector used a clipboard with a pen

[1]Cora and Milo served as participants in a study related to resurgence of communicative behavior (Berg et al., 2015). Some of the data presented here overlap, but the experimental question was different. All three participants' response preference data were summarized in Ringdahl et al. (2016).

and paper-based data collection system. During communication training and extinction sessions, the data were collected using a laptop computer.

Procedures, dependent variables, and design. ***Item preference assessment: Experiments 1 and 2.*** We conducted a paired choice preference assessment based on the procedures outlined by Fisher et al. (1992). At least six items, including items or activities identified by the participant's care provider or investigator as potentially preferred, were included in each participant's preference assessment. Each item was presented with one other item during one trial and selection of an item resulted in 30 s of access. Data collectors recorded item selection, defined as the participant making physical contact with or vocally requesting (e.g., saying "Play Doh™") only one of the two items or activities presented during each trial of the item preference assessment. The data collector scored selection by circling the number assigned to the stimulus selected during each trial of the assessment. The percent of trials that each item was selected was calculated for each stimulus, and the stimuli selected for the greatest number of trials were identified as preferred stimuli for that participant. Each item was paired against every other item, and the items or activities selected the most often were identified as preferred stimuli for that participant and were included in subsequent analyses. An item was considered high preference if it was selected on more than 70% of presentations. Based on the preference assessment, high-preference items included Play Doh™ and bubbles (Quinn), puzzles (Cora), blank paper and markers for drawing and a kazoo (Milo), bubbles (Horatio), Disney videos (Lawrence), iPad (Sheldon and Bernie).

Mand proficiency analysis: Experiments 1 and 2. We conducted the mand proficiency analysis to determine the participants' ability to use various communicative responses to request a preferred item or activity identified through the item preference assessment (Experiment 1) or functional analysis (Experiment 2). The data collector recorded the types of prompts (i.e., no prompt, vocal prompt, model prompt, or physical prompt) the therapist provided before the participant demonstrated the target mand for at least three of the following communication modalities: (a) participants making contact with a laminated communication card (10 cm by 10 cm) with their hand, (b) making contact with a BigMack® microswitch with their hand such that the microswitch played the recorded message or an audible "click" was noted, (c) making an approximation of the manual sign for please (i.e., touching the palm of their hand to their chest) or more (i.e., touching the closed fingertips of both hands together), and (d) vocal approximations of various words (e.g., more, bubbles). *Independent communication* was scored if the participant produced the response prior to the therapist providing any type of prompt. *Communication with a vocal prompt* was scored if the participant produced the response following the therapist's vocal prompt. *Communication with a model prompt* was scored if the participant produced the response following the therapist's model prompt. *Communication with a physical prompt* was scored if the participant required physical assistance to emit the target mand. Communicative responses were reported as percent of trials requiring each type of prompt. We defined proficiency based on the distribution of prompt level needed across trials (e.g., 90% independent communication).

A second, independent observer collected data for the purposes of obtaining interobserver agreement (IOA) during at least 20% (range, 20% to 100%) of sessions across all participants. An agreement was defined as both observers marking the same level of prompting required to emit the mand for a given trial. Interobserver agreement coefficients were calculated by conducting a trial-by-trial comparison of the data collectors' observation sheets. The number of trials with agreements for a session were summed and divided by the total number of trials for that session and multiplied by 100%. Interobserver agreement coefficients exceeded 90% for all dependent measures, and for reinforcer delivery.

The mand proficiency analysis procedures were based on those described by Ringdahl et al. (2009). Ten trials with one communication modality comprised a session. Each trial consisted of a four-step prompting procedure (no prompt, vocal, model, physical assistance) to guide the participant to make the communicative response associated with the mand modality tested during that session. Prior to each block of 10 trials associated with one

mand modality, the therapist provided the participant with about 30 s of access to the preferred item(s). Each trial began with the therapist removing the preferred item(s) and waiting for 5 to 10 s before providing a vocal prompt. If the participant independently emitted the target communicative response (i.e., before the vocal prompt was delivered), the therapist delivered the preferred item and allowed 30 s of access. The level of prompt was recorded as independent. If no response was emitted within 10 s of item removal, the therapist provided a vocal prompt (e.g., "Quinn, if you want the Play Doh™, touch the card"). If the participant emitted the target mand within 5 to 10 s of the vocal prompt, the therapist delivered the preferred item and allowed 30 s of access. The level of prompt was recorded as vocal. If no response was emitted within 5 to 10 s of the vocal prompt, the therapist provided a model prompt (e.g., "Cora, if you want the puzzle, touch the card like this" and therapist modeled the response). If the participant emitted the target mand within 5 to 10 s of the model prompt, the therapist delivered the preferred item and allowed 30 s of access, and a model prompt was recorded. If no response was emitted within 5 to 10 s of the model prompt, the therapist provided physical assistance (e.g., "Sheldon, if you want the iPad, touch the card like this" and the therapist physically assisted the response). Following physical assistance, the therapist delivered the preferred item and allowed 30 s of access, and the data coder recorded a physical prompt. When 10 trials had been conducted, a 5-min break was provided without access to the preferred item before moving on to the next block of 10 trials with a different communication modality. To control for proficiency level in the subsequent analysis, we included the two communication modalities performed with the most similar levels of proficiency for the remainder of the study. Thus, proficiency did not vary across modalities, within participants.

Functional communication training: Experiments 1 and 2. Functional communication training consisted of four phases: a) initial multiple schedule FCT; b) mand preference assessment; c) multiple schedule FCT with control of reinforcement rate; and d) multiple schedule extinction. Table 2 displays the phases, components for each phase, available responses, reinforcement schedules, and correlated stimuli for one participant from each experiment.

The data collector recorded mands, defined as the participant making contact with a laminated communication card (10 cm by 10 cm) with their hand or making contact with a BigMack® microswitch with their hand such that the microswitch played the recorded message or an audible "click" was produced. During this evaluation, responses occurring with and without vocal prompts were scored as independent mands. The therapist did not deliver model and physical prompts during these evaluations.

Data collectors recorded mands, problem behavior (Experiment 2), and therapist behavior (i.e., delivery of the requested item) using computer-based software. The software allowed for data to be collected using a frequency measure. Mands, problem behavior (Experiment 2), and reinforcer delivery were reported as a rate measure (responses per min). A second, independent observer collected data for the purposes of obtaining IOA. Interobserver agreement was calculated separately for problem behavior, mands, and reinforcement delivery all using the same calculation method. The primary data collector collected data in vivo while the second observer collected data either in vivo or from video recordings. We calculated IOA coefficients by dividing each session into 6-s intervals and then conducting an exact interval-by-interval comparison of the observers' records. Agreement was scored for an interval if both observers recorded the same number of responses. Interobserver agreement was then calculated by dividing the total number of intervals with exact agreement by the total number of intervals for that session, and multiplying the number by 100. Interobserver agreement coefficients exceeded 90% for all dependent measures and for reinforcer delivery across all phases.

Initial multiple schedule FCT. During this phase, we conducted FCT with the two identified mand modalities identified during the mand proficiency analysis using a two-component, multiple schedule design. Each component included one communication modality and a unique, schedule correlated stimulus (i.e., colored board) as described previously. During this phase, the therapist delivered the

Table 2

Phases, components, available responses, reinforcement schedule, and schedule correlated stimuli for each of the four phases of experiments 1 (Cora) and 2 (Horatio)

Phase	Component	Available Response(s)	Schedule	Correlated Stimulus
Experiment 1: Cora				
Initial multiple schedule FCT	Microswitch	Microswitch	FR 1	Green Board
	Picture Card	Picture Card	FR 1	Yellow Board
Mand preference assessment		Microswitch and Picture Card	Concurrent FR 1/FR 1	None
Multiple schedule FCT with control of reinforcement rate	High-preferred FCT	Picture Card	FR 1	Yellow Board
	Low-preferred FCT	Microswitch	FR 1	Green Board
Multiple schedule extinction	High-preferred FCT	Picture Card	Extinction	Yellow Board
	Low-preferred FCT	Microswitc	Extinction	Green Board
Experiment 2: Horatio				
Initial multiple schedule FCT	Microswitch	Microswitch	FR 1	Green Board
		Problem behavior	Extinction	
	Picture Card	Picture Card	FR 1	Yellow Board
		Problem behavior	Extinction	
Mand preference assessment		Microswitch and Picture Card	Concurrent FR 1/FR 1	None
		Problem behavior	Extinction	
Multiple schedule FCT with control of reinforcement rate	High-preferred FCT	Microswitch	FR 1	Green Board
		Problem behavior	Extinction	
	Low-preferred FCT	Picture Card	FR 1	Yellow Board
		Problem behavior	Extinction	
Multiple schedule extinction	High-preferred FCT	Microswitch	Extinction	Green Board
		Problem behavior	Extinction	
	Low-preferred FCT	Picture Card	Extinction	Yellow Board

preferred item(s) identified during the item preference assessment following the designated mand on a fixed ratio (FR) 1 schedule. Prior to each session, the participant had 1 to 2 min of access to the preferred item(s). After this time elapsed, the therapist restricted access to the reinforcer and the participant was directed to attend to the colored board paired with the mand targeted for that communication training session. Next, the therapist prompted the participant to emit the designated mand to gain reinforcement. After the mand occurred, 30 s of access to the preferred item or activity was provided. Only the designated mand resulted in reinforcement. The phase continued until behavior exhibited stability (independent use and no downward trend in the rate of mands) with use of both mands across at least four sessions per condition.

Mand preference assessment. This phase functioned as an evaluation of response allocation across the two mand modalities when both modalities were concurrently available. We conducted sessions in a similar manner as described in the initial multiple schedule FCT phase. However, the environment did not include the poster boards previously associated with each mand modality and both communication devices were available and placed equidistant in front of the participant and the therapist provided a general vocal prompt ("If you want the iPad, let me know."). Side placement of the communication devices alternated session-by-session. Contingent on the participant emitting either of the communication modalities, the therapist delivered the reinforcer (i.e., preferred item or activity) and allowed approximately 30-s access following an FR-1 reinforcement schedule. The therapist moved the communication devices out of reach during the reinforcement interval. At the end of the reinforcement interval, the therapist removed the preferred item while making the previously described vocal prompt, and returned the communication devices. If no target mand occurred for 30 s, the therapist repeated the vocal prompt. This phase continued until a participant exhibited differentiated responding across the two communication modalities for five consecutive sessions. We defined the high-preferred mand as the

one toward which the participant displayed greater allocation for these five consecutive sessions.

Multiple schedule FCT with control of reinforcement rate (FCT baseline). We conducted this phase similar to the initial multiple schedule FCT phase with the same two conditions used during that phase. The environment again included the colored boards during initial multiple schedule FCT, conditions were alternated on a session-by-session basis, and the therapist delivered reinforcers on a FR-1 schedule. Sessions consisted of five response–reinforcer trials. We made this change (from time based sessions to trial based sessions) to control for the number of response–reinforcer pairings prior to extinction. We calculated the obtained reinforcement rate for each condition and continued the phase until the obtained reinforcement rates were within 10% of each other across at least five sessions in each condition. We attempted to keep the reinforcement rates as similar as possible so that any differences in later persistence would not be a function of reinforcement rate differences experienced across the two mands.

Multiple schedule extinction. This phase was similar to the initial multiple schedule FCT phase (i.e., the sessions were 5 min), but the contingency for mands was discontinued. Conditions were alternated on a session-by-session basis. The colored board associated with each mand modality and the communication device (card or microswitch) were present during their respective extinction sessions. Communicative responses did not have any programmed consequence. This condition continued until clear differentiation was noted across conditions or response rates were zero for three consecutive extinction sessions for either mand.

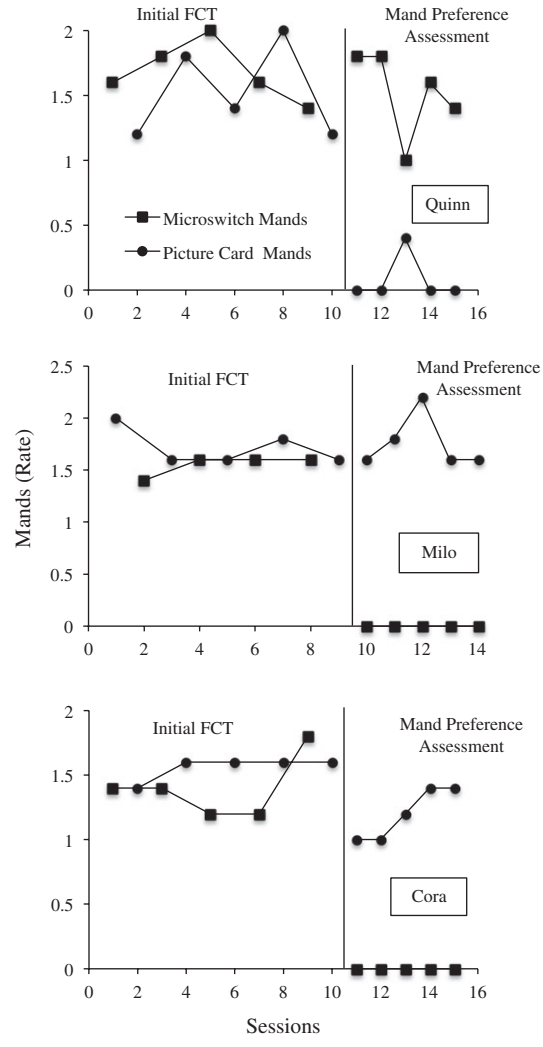

Fig. 1. Problem behavior and mands from Experiment 1 during initial FCT and the mand preference assessment, expressed as rate (responses/min).

Results and Discussion: Experiment 1

For each individual, we targeted use of the picture card and microswitch for reinforcement during FCT because each participant demonstrated similar proficiency with these strategies (data available from first author on request), and we judged their relative response efforts to be similar. Figure 1 displays the results of the initial multiple schedule FCT sessions followed by the mand preference assessment. All three individuals displayed both mand modalities during the initial FCT sessions. Average response rates (responses/min) were similar across modalities (Quinn, 1.7 for microswitch and 1.5 for picture card; Cora, 1.4 for microswitch and 1.6 for picture card; and Milo, 1.6 for microswitch and 1.8 for picture card). During the mand preference assessment, when both mand modalities were available and resulted in reinforcement on concurrent FR1/FR1 schedules, differential (Quinn) or exclusive (Milo and Cora) responding emerged within five sessions. Quinn exhibited a preference for the

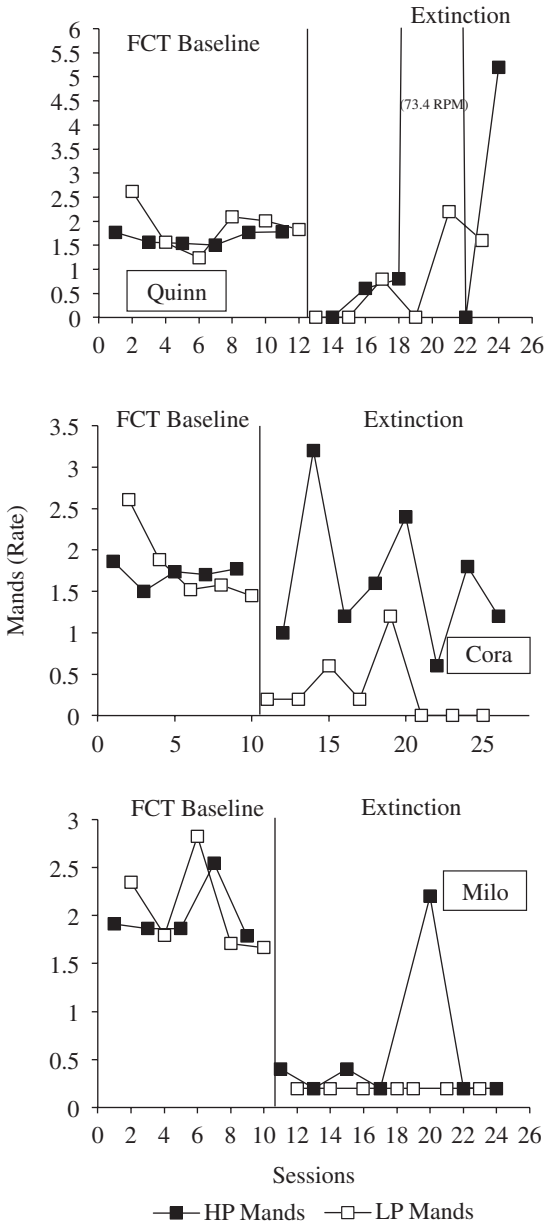

Fig. 2. Mands from Experiment 1 during FCT baseline and extinction, expressed as rate (responses/min).

microswitch response, while Milo and Cora exhibited a preference for the picture card response.

Figure 2 displays the result of the multiple-schedule FCT with control of reinforcement rate, referred to as baseline FCT, followed by disruption (extinction). Similar to initial FCT, each participant exhibited the two mands at similar rates across the FCT condition. Mean reinforcement rates (reinforcers per min) across FCT baseline sessions for the high-preferred and low-preferred mands were 1.56 and 1.54 (Quinn), 1.67 and 1.72 (Cora), and 1.72 and 1.85 (Milo). The results showed that Quinn's responding decreased to 0 for the first session of extinction for each mand. Subsequently, the high-preferred mand (microswitch) was exhibited during four of the next five extinction sessions, while the low-preferred mand (picture card) was exhibited during three of the next five extinction sessions. Milo's responding decreased in both mand extinction conditions. However, responding was relatively higher in the high-preferred mand (picture card) extinction condition. Responding decreased to 0 for both the last three sessions of the low-preferred mand (microswitch) extinction condition and the last two sessions of the high-preferred mand extinction condition. Cora continued to exhibit responding across both mand extinction conditions, with responding occurring at a higher rate during the high-preferred mand (picture card) extinction condition relative to the low-preferred mand (microswitch) extinction condition. The low-preferred mand decreased to 0 for the final three sessions of the extinction condition.

The overall results of Experiment 1 showed that the relatively more preferred mand persisted to a greater extent when we implemented extinction for each mand. Given that we controlled for rates and magnitudes of reinforcement during the phase preceding extinction, this finding suggested that a response variable, preference, impacted response persistence. Previous research (Mace, Mauro, Boyajian, & Eckert, 1997) demonstrated that responding maintained by relatively high-preferred reinforcers resulted in greater resistance to change in comparison to responding maintained by relatively less-preferred reinforcers. The current experiment held reinforcement parameters constant in the phase preceding disruption and evaluated the impact of response preference on resistance to change and yielded a similar outcome (i.e., greater resistance associated with the relatively high-preferred mand). This finding, that preference for a mand affects persistence, has implications for how to best program for maintenance of mands, and potentially has implications for clinical practice with FCT.

Table 3

Participant description, problem behavior, and target mands (preferred mand in **bold**); Experiment 2

Participant/Gender	Age	Diagnoses	Problem Behavior	Target Mands
Horatio/Male	4 years old	ASD; Severe ID	Disruptive behavior	**Microswitch activation**, picture card touch
Lawrence/Male	3 years old	ASD; Severe ID	Aggression, SIB	**Microswitch activation**, picture card touch
Sheldon/Male	8 years old	ASD; Moderate ID	Elopement, Disruptive behavior	**Microswitch activation**, picture card touch
Bernie/Male	2 years old	ASD; Developmental Delay; Speech Delay	Aggression, Property destruction	**Microswitch activation**, picture card touch

Experiment 2 was conducted to replicate Experiment 1, but do so in the context of FCT as an intervention for problem behavior. Thus, the purpose of Experiment 2 was to determine if a relatively more preferred mand would show greater response strength during disruption of a treatment following a history of reinforcement for an inappropriate response (e.g. problem behavior). To address this question, we used the same format and conditions used during Experiment 1 (i.e., FCT with a more preferred mand and FCT with a less preferred mand, followed by extinction), but with participants who had a history of receiving the same class of reinforcement for problem behavior.

Method: Experiment 2

Participants

Four individuals, given the pseudonyms Horatio, Lawrence, Sheldon, and Bernie, and diagnosed with ASD and/or ID and a communication deficit participated in Experiment 2[2]. None of the participants used vocal communication strategies. Care providers referred each individual for assessment and treatment of severe problem behavior. Table 3 lists relevant participant demographics, problem behavior, and target mands included in the study.

Dependent Variables, Procedures, and Design

We conducted Experiment 2 using the same general procedures as Experiment 1. This section describes differences only.

Functional analysis of problem behavior. A functional analysis based on the procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), with the addition of a tangible condition, was conducted to identify the variable(s) maintaining each participant's problem behavior. The data collector recorded problem behavior (as noted in Table 3), and communicative responses. Horatio engaged in aggression defined as climbing on others, hitting, hair pulling, and pinching. Lawrence engaged in aggression defined as grabbing, biting, scratching and hitting others. Sheldon engaged in elopement, defined as approaching the therapy door and touching the doorknob and/or opening the door. Sheldon's care provider reported that Sheldon also engaged in SIB (hitting head with his hand and biting himself on the arms and hands) and aggression (hitting and biting others), but he did not emit these behaviors during any observation. Bernie engaged in aggression (hitting others with an open hand, pushing and biting others), property destruction (throwing items), and screaming (high pitched noises lasting longer than 3 s). Data collectors coded each instance of problem behavior and each instance of a mand (targeted or nontargeted) using a frequency key, with separate keys for each dependent variable. We reported problem behavior and any mands that occurred as rate per min, calculated by dividing the number of occurrences of each dependent variable by the number of minutes for each session (i.e., 5 min). We collected interobserver agreement in the same manner as during the communication evaluation in Experiment 1. Interobserver agreement coefficients exceeded 90% for all dependent measures, and for reinforcer delivery.

2. Horatio, Lawrence, and Sheldon's response preference data were summarized in Ringdahl et al. (2016).

All sessions were 5 min in length, and the functional analyses were conducted using a multielement design and following the condition order described by Hammond, Iwata, Rooker, Fritz, and Bloom (2013). Specific conditions included control (all participants), attention (all participants), escape (all participants), tangible (all participants), and no interaction (Lawrence). During the *control* condition, the therapist provided the participants with preferred items and ongoing attention. The therapist did not present instructions and did not provide any programmed contingency for problem behavior. The *attention* condition began with the therapist removing attention while stating, "I'm busy. You can play with these toys" while providing access to moderately preferred items. Occurrences of the target problem behavior(s) resulted in 30 s of attention from the therapist. Prior to the *tangible* condition, the therapist allowed the participant to have 30 to 60 s of access to high-preferred items. To begin the session, the therapist stated, "It's my turn to play with the <item>" and removed the item from the participant. Attention continued throughout the session. Occurrences of the target problem behavior(s) resulted in 30 s of access to the preferred item. During the *escape* condition, the therapist presented academic (based on school plans or recommendations) or pre-academic tasks on an ongoing basis. The therapist used a three-step, least-to-most (vocal, model, physical) prompt sequence when delivering instructions. Compliance resulted in a brief praise statement in a neutral tone (e.g., "Good job"), followed by the next instruction. Occurrences of target problem behavior(s) resulted in a 30-s break from instructions. The therapist did not present attention or allow access to alternative items during these breaks. Because Lawrence engaged in SIB, we included a *no-interaction* condition for him. During this condition, the therapist sat in the corner of the therapy room, oriented away from Lawrence. Toys and instructional materials were not present in the room, and the therapist did not otherwise interact with Lawrence, except to block potentially injurious instances of SIB (i.e., responding that resulted in immediate redness). The therapist did not delivery instructions and did not implement any programmed reinforcement contingency following problem behavior.

Functional communication training: Experiment 2. We conducted FCT with the following changes for initial multiple schedule FCT, mand preference assessment, and multiple schedule FCT with control of reinforcement rate: (a) we placed problem behavior on extinction, and (b) if problem behavior occurred during a reinforcement interval, we removed the reinforcer and a new opportunity to mand was presented. Multiple schedule extinction included extinction for problem behavior.

Results and Discussion: Experiment 2

Based on the results of the functional analysis (available from the author upon request) and in combination with parent interviews, we selected the tangible condition as the target condition for the remaining phases of the experiment. For each individual, we targeted use of the picture card and microswitch for reinforcement during FCT based on the proficiency analysis because each participant demonstrated similar proficiency with these strategies (data available from first author on request), and we judged their relative response efforts to be similar.

Figure 3 displays the results of the initial FCT sessions, followed by the results of the mand preference assessment. All participants displayed both mand topographies during initial FCT. Horatio exhibited similar response rates (responses/min; microswitch, $M = 0.72$; picture card, $M = 0.74$) across mands. Lawrence exhibited higher response rates with the microswitch ($M = 2.4$) relative to the picture card ($M = 1.8$). Sheldon and Bernie each exhibited both mands at a rate of 1.0 responses/min across all sessions. Problem behavior dropped to zero for all participants across all initial FCT sessions across both mand conditions. When both mand topographies were available and resulted in reinforcement on conc FR 1/FR 1 schedules, (i.e., mand preference assessment) preference for the microswitch emerged within the first five sessions for Lawrence (differential) and Bernie (exclusive). Horatio and Sheldon demonstrated a preference for the microswitch after 11 and 15 sessions, respectively. Thus, for all participants, we identified the microswitch as the high-preferred mand and the picture card as the low-preferred mand.

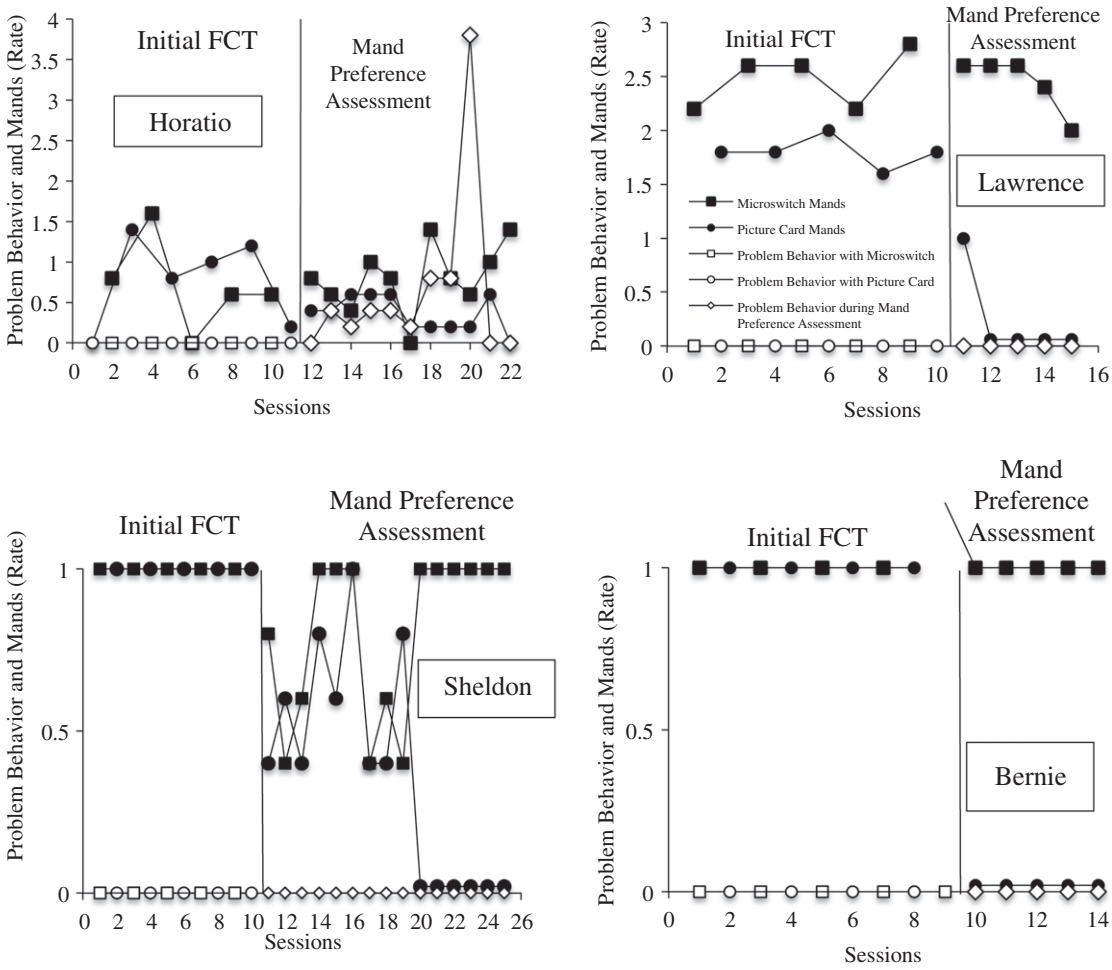

Fig. 3. Problem behavior and mands from Experiment 2 during initial FCT and the mand preference assessment, expressed as rate (responses/min).

Figure 4 displays the result of FCT baseline, followed by disruption (extinction). Horatio, Sheldon, and Bernie exhibited each mand at similar rates across the two components of baseline FCT. Lawrence engaged in more microswitch (high-preferred) than picture card (low-preferred) responses. Problem behavior was at or near zero for all sessions of baseline FCT across participants and across mand modalities. Mean reinforcement rates (reinforcers per min) across FCT baseline sessions for the high-preferred and low-preferred mands were 1.39 and 1.44 (Horatio), 1.42 and 1.51 (Lawrence), 1.1 and 1.1 (Sheldon), and 0.88 and 0.9 (Bernie).

When we implemented extinction, differentiation occurred across mands. Horatio's rates of the high-preferred mand use increased substantially over baseline levels at first, and then trended downward across sessions, while rates of the low-preferred mand decreased to near-zero rates almost immediately. Lawrence continued to exhibit both mands during the extinction sessions, and the low-preferred mand maintained at levels slightly higher than those observed during the baseline condition, while the high-preferred mand steadily decreased from baseline levels across the extinction sessions (only four sessions of extinction were conducted due to the high rates of problem behavior that reemerged during this phase across conditions). Sheldon's use of the high-preferred mand decreased below baseline levels during the first and fifth

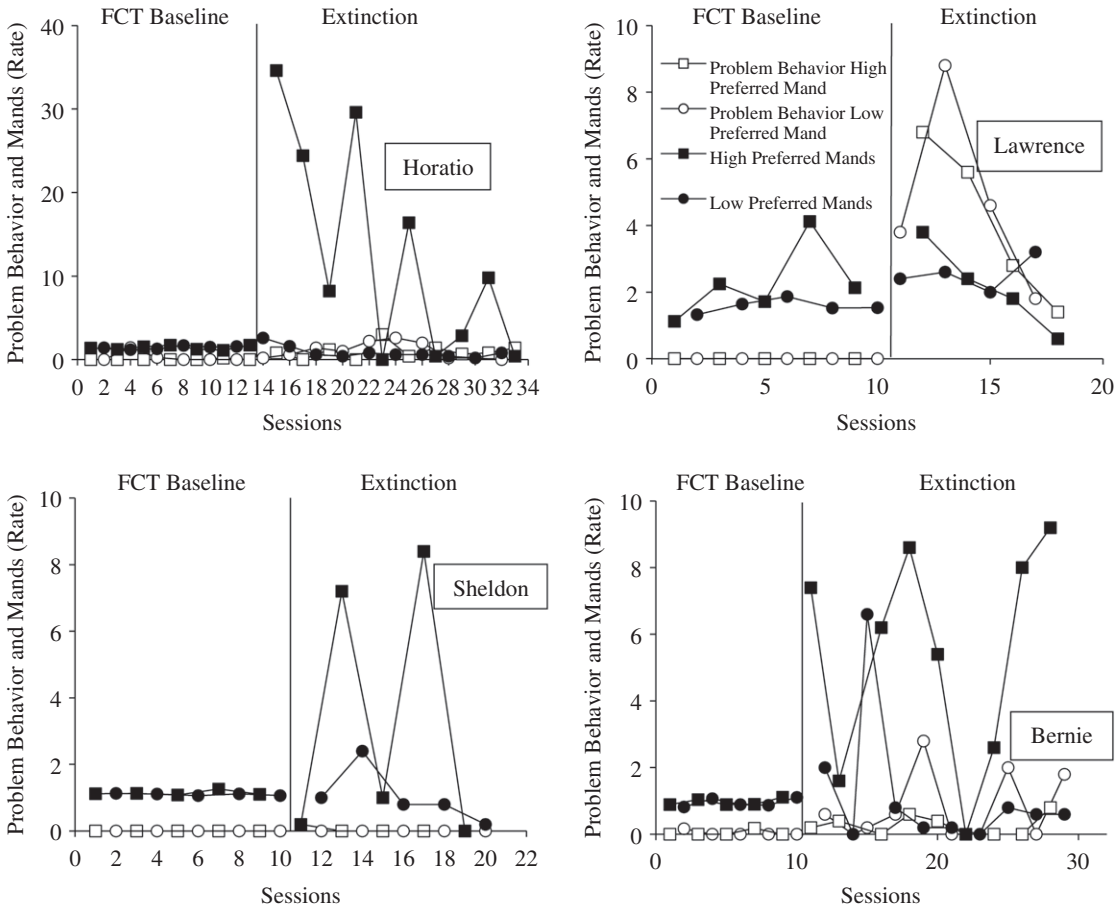

Fig. 4. Mands from Experiment 2 during FCT baseline and extinction, expressed as rate (responses/min).

(last) extinction session and varied between low and baseline levels during the remaining three extinction sessions (range, 0 to 8.4 responses/min). His use of the low-preferred mand remained at or above baseline levels for the first four extinction sessions and then decreased to below baseline levels for the final extinction session. Overall, the high-preferred mand occurred at a higher rate than the low-preferred mand. Bernie exhibited high and variable rates (range, 0 to 9.2 responses/min) for both mands, with the high-preferred mand continuing at higher rates than the low-preferred mand for seven of the nine extinction sessions. We noted resurgence of problem behavior at relatively low levels for Horatio, Sheldon, and Bernie. Lawrence showed high levels of problem behavior during both mand extinction sessions initially, which then decreased steadily for the remaining sessions of extinction.

The results of Experiment 2 systematically replicated the findings from Experiment 1, but in the context of FCT-based treatment for problem behavior. Results from Experiment 2 showed that the relatively higher preferred communicative response included in FCT displayed not only greater persistence than the less preferred mand for three of the four participants when we discontinued reinforcement, but also large increases in responding. Given that we controlled the rates and magnitudes of reinforcement in the phase preceding multiple schedule extinction, this finding suggested that a response variable, preference, impacted response persistence, and did so in a socially relevant context. In addition, the results of Experiment 2, like

those from Experiment 1, replicated previous findings with FCT such as showing preferences for mands when more than one mand was available for selection (Falcomata et al., 2010; Winborn-Kemmerer et al., 2009).

General Discussion

We conducted two experiments to evaluate the impact of relative preference among two responses on resistance to change for both responses during disruption to treatment. Seven participants showed a preference (i.e., greater allocation of responding to one mand relative to the other when both mands were available on a concurrent FR 1/FR 1 schedule) among mands. The more preferred mand showed higher response rates during challenges to treatment (i.e., extinction) following FCT for six of seven participants with ASD and/or IDD and limited communication skills across the two experiments. Several participants (Quinn, Experiment 1; Horatio, Sheldon, and Bernie, Experiment 2) also exhibited large increases of mands during extinction. The findings have both clinical and conceptual implications. From a clinical standpoint, they suggest that FCT-based treatment maintenance varies as a function of what response is selected as the alternative response to be reinforced. From a conceptual standpoint, the results suggest that response variables impact resistance to change, adding to the list of known variables affecting response strength.

There is one important alternative explanation for the findings to discuss before dealing with the specific clinical and conceptual implications of the findings. The majority (six out of seven) of participants' high-preferred mands displayed greater persistence. While care was taken to provide similar histories of reinforcement for each mand in the phase immediately preceding disruption (FCT baseline), the high-preferred mand received a greater rate of reinforcement during the mand preference assessment (second phase) relative to the low-preferred mand as a result of the concurrent schedule in place during that phase. This distant differential reinforcement history could, in part, explain the greater persistence. However, it is important to note that the behavioral momentum theory literature has identified stimulus–reinforcer (i.e., Pavlovian) contingencies as responsible for differences in response strength (Nevin, Tota, Torquato, & Shull, 1990). In the current experiments, the stimulus–reinforcer contingencies differed from the mand preference assessment, relative to FCT baseline and the subsequent disruption phase. Thus, it is unclear what contribution the history of reinforcement developed in that phase made to the observed differential persistence. Future, similar studies could address this potential confound by controlling reinforcer rates for the responses before moving on to the FCT baseline.

While FCT has long been established as an effective example of a DRA-based treatment for severe problem behavior, relatively few studies have evaluated variables that impact the maintenance of treatment effects. Mace et al. (2010) evaluated maintenance of treatment effects following DRA-based treatment. Findings from Mace et al. (2010) indicated that DRA resulted in increased rates of reinforcement and, subsequently, increased persistence of other responses (i.e., problem behavior) that were in the same response class when extinction for the alternative response was placed on extinction. While this study has important implications for DRA-based treatments, such as FCT, its findings were limited to the maintenance of treatment effects relative to problem behavior, as Mace et al. (2010) did not systematically evaluate maintenance of the alternative response. Wacker et al. (2011) also evaluated the maintenance of FCT-based treatment. However, although these authors tracked continued expression of appropriate communication across time and implementations of extinction and other disruptors, they did not manipulate or systematically evaluate variables affecting the persistence of appropriate communication. The current study adds to the small number of studies that have evaluated maintenance of appropriate behavior (i.e., communication) when disrupted by extinction. In addition, the current study identified a variable, response preference, which appeared to impact the persistence of mands.

The findings of the current study have implications for the implementation of FCT and other DRA-based interventions. To date, relatively little attention has been paid to the role the alternative response plays in intervention success or maintenance for this type of

intervention. Ringdahl et al. (2009) demonstrated that response proficiency affected the initial effectiveness of FCT; however, the impact of this variable on treatment maintenance was not evaluated because FCT was not effective with low proficiency alternative responses. Nonetheless, Ringdahl et al. (2009) suggested response selection impacted treatment success. Given the findings from the current set of experiments, response selection may not only impact initial treatment, but also appears to impact treatment maintenance. Thus, when implementing FCT, high-proficiency responses may be needed to quickly achieve initial treatment effects, and preferred responses appear to be beneficial for enhancing treatment maintenance relative to the continued expression of appropriate communication. Future research could focus on the impact of the variables on the outcomes of other, DRA-based interventions. For example, educational researchers could evaluate the impact of academic task format preference on treatment maintenance.

The selection of alternative responses that are more resistant to change has the potential to benefit the individual in the face of treatment challenges. For example, if a relatively high preference response is included in treatment, it may be more likely that this response will be exhibited in contexts where reinforcement for this response is temporarily interrupted. Continued expression may have at least two benefits. First, it may be easier to reestablish the response following a period of disruption. Second, continued expression may increase the likelihood that the response may encounter reinforcement, even in contexts where treatment is disrupted, similar to the findings reported by Durand (1999). Future research could investigate real world challenges to FCT, and other DRA-based treatments, across response preference to determine if the results found in the current study impact treatment in novel contexts.

From a conceptual standpoint, the collective findings from these two experiments add to the literature regarding variables that can impact response persistence. Much of the existing literature in this area has focused on how various reinforcement parameters (e.g., rate, magnitude, delay) impact response persistence. This literature base is robust and many of the findings have been replicated across species (e.g., pigeons, Nevin et al., 1990; rats, Mauro & Mace, 1996; goldfish, Igaki & Sakagami, 2004) and in both human operant (McComas, Hartman, & Jimenez, 2008) and applied (Romani et al., 2016) studies. In the current set of experiments, we took care to minimize the impact of reinforcer related variables, such as rate and magnitude, in the phase preceding extinction so that the impact of response preference could be isolated. In addition, we also minimized differences in other response related variables, such as proficiency and response effort, so that response preference could be isolated. Given these controls, and given the outcomes of the two experiments, the findings indicate that variables outside of reinforcement parameters impact response persistence. Specifically, response persistence varies as a function of the relative preference among alternative responses. Other response related variables and their impact on response persistence might also warrant investigation. For example, Winborn et al. (2002) demonstrated differences in FCT when novel and existing mands were incorporated into treatment and Ringdahl et al. (2009) demonstrated differences in FCT when mands that varied along the dimension of proficiency were incorporated into treatment. These variables might also impact response persistence.

One finding from the Experiment 2 that might have both clinical and conceptual implications was that resurgence of problem behavior was not uniformly inversely related to the differential levels of persistence noted for the high- and low-preferred responses. We noted resurgence of problem behavior for the Experiment 2 participants. When resurgence occurred, it occurred at higher levels during the extinction condition associated with the low-preferred mand relative to the extinction condition associated with the high-preferred mand. From an applied standpoint, these results suggest that incorporating a high-preferred mand into FCT may have the added clinical impact of mitigating resurgence when treatment challenges occur. From a conceptual standpoint, the impact of this response related variable, preference, yields outcomes that differ from the impact of reinforcer related variables, such as rate of reinforcement, on response persistence and resurgence of target behavior. Specifically, researchers

have demonstrated that higher rates of reinforcement correspond with greater persistence (Nevin et al., 1990). Similarly, researchers have demonstrated that higher rates of reinforcement for either target (Podlesnik & Shahan, 2009) or alternative (Leitenberg, Rawson, & Mulick, 1975) behavior correspond with greater resurgence of the target behavior. Our data from the current set of experiments suggests that mand preference impacts persistence in a manner similar to reinforcement rate. However, mand preference seems to affect resurgence of problem behavior in a manner contrary to reinforcement rate, because removal of reinforcement for the less preferred mand generated somewhat more resurgence of problem behavior. At present, quantitative models based on BMT do not account for response-related variables, such as preference or the potential effects of distant reinforcement histories (e.g., as occurred during the mand preference assessment in the current experiments) on response persistence or resurgence of target behavior. The Resurgence as Choice model (RaC; Shahan & Craig, 2017) provides an alternative quantitative model that can incorporate the effects of both response variables (i.e., bias) and distant reinforcement history into an account of response persistence and resurgence. Thus, future research might gainfully apply RaC to findings such as those generated by the current study.

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