Published in final edited form as:

J Appl Behav Anal. 2021 June ; 54(3): 1013–1031. doi:10.1002/jaba.824.

Sustaining Behavior Reduction by Transitioning the Topography of the Functional Communication Response

Kayla R. Randall[1], **Brian D. Greer**[2,3], **Sean W. Smith**[1,2], **Ryan T. Kimball**[4]

[1]Munroe-Meyer Institute, University of Nebraska Medical Center

[2]Severe Behavior Program, Children's Specialized Hospital–Rutgers University Center for Autism Research, Education, and Services (CSH–RUCARES)

[3]Department of Pediatrics, Rutgers Robert Wood Johnson Medical School

[4]Department of Counseling and Applied Behavioral Studies, University of Saint Joseph

Abstract

When a functional communication response (FCR) can be reliably occasioned, destructive behavior tends to be lower. However, the form of FCR may affect the durability of functional communication training, as missing FCR materials may promote resurgence. Experiment 1 demonstrated that resurgence of target responding was lower when a vocal FCR remained available but was placed on extinction compared to when a card-based FCR was unavailable. Experiment 2 replicated the finding that initiating treatment with a card FCR produced less target responding than when initiating treatment with a vocal FCR. We then evaluated a set of procedures for transitioning the card FCR to the previously unlearned vocal FCR. These findings suggest benefits of training different types of FCRs at different stages of treatment and provide a preliminary set of procedures for transitioning between FCR topographies while occasioning minimal target responding.

Keywords

functional communication response; functional communication training; resurgence; sustained behavior reduction; translational research

Functional communication training (FCT; Carr & Durand, 1985) entails teaching a communication response to individuals whose destructive behavior is reinforced by changes in the social environment (e.g., access to adult attention). When FCT is combined with extinction for destructive behavior, the newly trained functional communication response (FCR) alone produces reinforcement; thus, the FCR replaces destructive behavior (e.g., Fisher et al., 1993; Hagopian et al., 1998). FCT has shown to be efficacious across many FCR topographies, including vocal responses, manual signs, communication cards, microswitches, and voice-output devices (Durand, 1999; Greer et al., 2016; Marcus & Vollmer, 1995; Richman et al., 2001; Wacker et al., 1998). As such, some studies have

Correspondence concerning this article should be addressed to Brian D. Greer, CSH–RUCARES, 888 Easton Ave., Somerset, NJ 08873. brian.greer@rutgers.edu.

focused on identifying the optimal FCR topography to accommodate individuals who use more than one communication topography (e.g., Richman et al., 2001). Other studies have determined the training conditions that ensure proficient use of the FCR while maintaining low-to-zero rates of destructive behavior (e.g., Horner & Day, 1991). Finally, more recent studies have combined these two goals (e.g., Ringdahl et al., 2018). Findings from these lines of research suggest that behavior analysts should select FCRs that are less effortful, more preferred, and that produce reinforcement immediately and often (Horner & Day, 1991; Richman et al., 2001; Ringdahl et al., 2009; Ringdahl et al., 2018; Winborn-Kemmerer et al., 2009).

Another important factor to consider when initiating FCT is selecting an FCR that minimizes exposure to the establishing operation (EO) for destructive behavior (DeRosa et al., 2015; Fisher et al., 2018). DeRosa et al. (2015) initiated FCT using two different FCR topographies—a card-based FCR (card FCR) and a vocal FCR. The key distinction between these topographies was whether the therapist could physically guide the response and whether the response was retractable (i.e., a response that becomes physically impossible by restricting access to materials). In this case, the card FCR could be physically guided and was retractable because the card could be withheld; whereas the vocal FCR could not be physically guided and was unretractable, as the vocal response could not be ethically prevented. As the card FCR allowed the therapist to physically guide the FCR and immediately deliver the reinforcer maintaining destructive behavior, individuals experienced shorter exposures to the EO, and less destructive behavior occurred. The authors hypothesized that the difference in EO exposure across the two FCR topographies (and not the topographies themselves) was responsible for the differential efficacy of the two FCT procedures. This effect was replicated by Fisher et al. (2018), who demonstrated that shorter EO exposure produced less destructive behavior than longer EO exposure during otherwise identical FCT treatments. These findings provide support for selecting an initial FCR topography that allows therapists to minimize exposure to the EO for destructive behavior.

Most FCRs that can be physically guided and, thus, made to ensure that EO exposure is minimized, require response materials (e.g., card touch, card exchange). However, there are a few potential limitations to such treatments. One limitation is that retractable FCRs may have limited universal recognition and acceptance, which may decrease social validity (Ghaemaghammi et al., 2018; Tiger et al., 2008). Additionally, already stressed caregivers (Baker et al., 2002; Baker et al., 2003; Dumas et al., 1991) may view treatments that require response materials to be more burdensome than those that do not. Finally, continued access to response materials is necessary for treatment to remain effective. If response materials are misplaced, even temporarily, EO exposure for destructive behavior is likely to increase in a manner similar to the extended-EO condition in Fisher et al. (2018). Such conditions often precipitate the recurrence of destructive behavior (Briggs et al., 2018), called resurgence. *Resurgence* is the recurrence of target responding (e.g., destructive behavior) following a worsening of reinforcement conditions (Epstein, 1983; Lattal et al., 2017).

Previous investigations on retractable FCRs have produced mixed results when it comes to resurgence. Early applied research showed little resurgence when alternative response

materials were absent (Wacker et al., 2011) and little difference in resurgence when alternative response materials were partially present (e.g., a microswitch without affixed FCR card) or absent altogether (Wacker et al., 2013). However, more recent basic and translational research demonstrated clear differences in resurgence when alternative response materials were present or absent (Kimball et al., 2018; Podlesnik & Kelley, 2014). For example, Kimball et al. (2018) showed higher response rates of target behavior in four of five comparisons when the alternative response was unavailable as compared to when it was available but placed on extinction, replicating the results of Podlesnik and Kelley (2014). Thus, treatment relapse is likely more robust if the individual is unable to emit the alternative response altogether (e.g., if a caregiver misplaces communication materials).

The studies reviewed present conflicting suggestions for practice. On the one hand, behavior analysts should select retractable FCRs that can be quickly prompted during the initial stages of FCT to minimize exposure to the EO. FCR topographies that are material based, including card-touch and card-exchange FCRs, seem well suited for this requirement. On the other hand, a modest but growing body of research now suggests that resurgence may be more likely if materials become misplaced or lost. One potential solution to these conflicting suggestions is to conduct FCT in a manner that capitalizes on the benefits of both types of FCRs. That is, initially teach individuals a retractable FCR (e.g., card FCR) that can be physically guided during the early stages of FCT to mitigate resurgence during exposure to the EO for destructive behavior. After establishing a treatment effect, teach the individual an unretractable FCR (e.g., a vocal FCR) so that continued availability of the FCR may mitigate resurgence associated with the FCR being unavailable. However, a necessary first step is to ensure that the unretractable FCR mitigates resurgence when compared to a condition in which a retractable FCR becomes unavailable.

In the present study, a translational-research approach was used to evaluate whether an unretractable, vocal FCR better mitigated resurgence when compared to a retractable, card FCR during a simulated period when the communication card was unavailable (Experiment 1). In Experiment 2, a proof-of-concept procedure for transitioning the card FCR to a previously unlearned vocal FCR was evaluated.

General Method

Participants, Setting, and Materials

Twelve participants were recruited for Experiment 1, and one participant was recruited for Experiment 2. All participants were fully ambulatory and could imitate one-word utterances. Individuals who engaged in destructive behavior (e.g., aggression, self-injurious behavior) at a rate or intensity that would have interfered with participation were excluded. Table 1 provides participant demographics and experiment information.

Sessions were conducted in an early intervention classroom or in a padded treatment room at a center-based treatment facility for individuals with autism spectrum disorder. Session rooms included relevant session materials, including a 20.3-cm x 20.3-cm training pad for the target response, a 7.6-cm by 7.6-cm laminated and colored FCR card, and preferred tangible items for reinforcement. A training pad and FCR card (when available)

were located to the left and right of the participant, and the locations of each were counterbalanced across participants and conditions. Sessions were conducted either at a table or on the floor of the session room. In Experiment 2, each condition was correlated with a specific color using colored poster boards that matched the color of the experimenter's shirt.

Response Measurement, Interobserver Agreement, and Procedural Fidelity

Response Measurement—Participants were taught an arbitrary target response to serve as a surrogate for destructive behavior. The *target* response was defined as touching the top of the training pad with at least 50% of the participant's hand. If the participant picked up their hand and touched the pad again, this was considered a second target response. The alternative response during FCT was either a card FCR or a vocal FCR. An *independent card FCR* was defined as touching the top of the FCR card with at least 50% of the participant's hand. A *prompted card FCR* was defined as the experimenter guiding the participant to touch the top of the FCR card. An *independent vocal FCR* was defined as a vocal phrase that specified the reinforcer. The specific vocal FCR varied across participants (see Table 1) and was selected based on how reliably the participant imitated vocal targets during a vocal-imitation screening (described below). A *prompted vocal FCR* was defined as the participant emitting the vocal FCR within 5 s of a vocal prompt by the experimenter.

In Experiment 2, data collectors recorded *EO exposure*, which was defined as the percentage of session duration in which the participant did not have access to the reinforcer. EO exposure was calculated by subtracting the total amount of time with access to the reinforcer from the total session duration, then dividing this number by the session duration, and multiplying by 100 to produce a percentage. Across all experimental phases, data were collected on laptop computers using the data collection program DataPal, which is a beta-version of BDataPro (Bullock et al., 2017). The frequency of target responses and all independent and prompted card and vocal FCRs were measured. The rate of each dependent variable was later calculated by dividing the total count by the session duration.

Interobserver Agreement—Reliability data were collected for all participants by having an independent second observer score a portion of each participant's sessions (M = 40.2%; range, 23.1%–53.3%) either in-vivo or from a video recording. Interobserver agreement was calculated by dividing each 5-min session into 10-s intervals and scoring an agreement for each interval in which both data collectors recorded the same number of responses (i.e., exact agreement within the interval) for target responses, card FCRs, and vocal FCRs. Agreement was calculated on a session-by-session basis by summing the number of agreement intervals, dividing by the total number of intervals, and then multiplying the quotient by 100 to obtain a percentage. Agreement averaged between 92% and 100% for all participants across all dependent variables (i.e., target responses, card and vocal FCRs). Agreement for each participant and dependent variable can be found in Supporting Information.

Procedural Fidelity—Procedural fidelity was collected on at least 33% (M = 36%; range, 33%–38%) of sessions across participants. A consequence was delivered correctly

if a reinforcer was provided within 5 s of its programmed delivery or withheld as programmed. Procedural fidelity was calculated per session by summing the number of correct consequence deliveries, dividing by the total number of opportunities to deliver the consequences correctly, and multiplying the quotient by 100 to obtain a percentage. Procedural fidelity averaged between 97% and 100% across participants. Procedural fidelity for each participant can be found in Supporting Information.

Experimental Design

A three-phase resurgence arrangement consisting of baseline, FCT, and extinction was used in Experiment 1. A between-subjects design was used for Experiment 1 to compare rates of target behavior between two experimental groups (i.e., a card group and a vocal group). For the card group, a card FCR was trained during the FCT phase and then removed during the extinction phase to simulate a situation when response materials are missing. For the vocal group, a vocal FCR was trained during the FCT phase and then placed on extinction in the final phase.

After participants met the inclusion criteria described below for the vocal-imitation screening, they were randomized across the two groups in pairs such that group membership never became unbalanced by more than one participant. For the final four participants in Experiment 1, a within-subject evaluation was conducted, such that these participants experienced both experimental arrangements (i.e., card FCR and vocal FCR). Similarly, condition order was randomized and counterbalanced across participants in the within-subject evaluation to identify potential sequence effects.

In Experiment 2, rates of target behavior and FCRs were compared in a combined multielement and reversal design using color-correlated contexts for each condition. A set of procedures were evaluated for systematically transitioning the card FCR to a vocal FCR in a new context.

General Procedures

Preference Assessment and Inclusion Screening

All participants experienced either a paired-stimulus (Fisher et al., 1992) or free-operant (Roane et al., 1998) preference assessment to identify highly preferred tangible items for use as reinforcers in the experimental evaluation (data available upon request). If more than one highly preferred item was identified or if a participant's motivation to engage with a single item was fleeting (e.g., participant transitioned between items after short durations), several items were included and delivered simultaneously as reinforcers throughout the experiment. This occurred with Abigail, Alana, Andrea, Jack, Joanna, Lilly, and Selena. Therapists delivered the same unique combination of reinforcers throughout the experiment for these participants.

A trial-based, vocal-imitation screening was conducted to ensure that participants could imitate single words or short phrases to request preferred items. This screening occurred before participants were randomized for group assignment. Four vocal targets that were progressively more complex (e.g., Ghaemmaghami et al., 2018) were used to identify the

most complex vocal FCR with which each participant was proficient. Targets minimally consisted of the name of the reinforcing stimulus (e.g., “Tablet”) and were as complex as a four-word phase (e.g., “I want tablet, please”). The four targets were randomly presented three times each for a total of 12 trials. Eleven of the 12 participants in Experiment 1 imitated the targets with 75% or greater accuracy. Lilly was noncompliant with the vocal-imitation screening but emitted full sentences spontaneously outside of the vocal-imitation screening. In a 10-min sample, she emitted 17, one- to six-word sentences while she played with an experimenter. This information suggested Lilly had the repertoire necessary to participate in Experiment 1. Only one participant (Joanna, Experiment 2) failed to demonstrate the repertoire necessary to participate in Experiment 1.

Target Response Pretraining

For Experiments 1 and 2, target response pretraining was conducted with all participants to teach the surrogate for destructive behavior prior to baseline. At the beginning of the trial, the experimenter (a) provided brief access to the reinforcer, (b) removed the reinforcer, (c) immediately prompted the target response using physical guidance, and (d) immediately thereafter provided access to the reinforcer for 20 s. After the reinforcement interval elapsed, the experimenter removed the reinforcer until the participant emitted a subsequent target response. The experimenter increased the prompt delay to 2, 5, 10, and then 20 s after blocks of 10 trials, regardless of performance. The experimenter continued to conduct pretraining until each participant emitted the target response independently for 10 consecutive trials.

The FCR card was available during target response pretraining and baseline for participants who would later experience FCT with the card FCR. As all participants in Experiment 1 could emit the vocal FCR at any point, the FCR card was provided during pretraining and baseline to equate the availability of the vocal FCR and card FCR. This allowed for similar histories of extinction for the alternative responses, mitigating a potential confound (cf. Greer & Shahan, 2019). The experimenter made no statements about the presence of the card and did not reinforce card or vocal FCRs during either of these phases.

Experiment 1

Baseline

The procedures for baseline were the same as target response pretraining except that the experimenter did not provide prompts to emit the target response, and sessions lasted 5 min. At least five baseline sessions were conducted, and baseline continued until responding was stable, as determined by both visual inspection and a stability criterion (i.e., a standard deviation of less than 50% of the mean target response rate for the last five sessions).

FCT Pretraining

The procedures for FCT pretraining were conducted using the same procedures as target pretraining except that the target response was placed on extinction, and the experimenter prompted the FCR corresponding to that condition (i.e., vocal or card FCR for participants in the vocal or card group, respectively). If the participant emitted a target response, the experimenter waited 3 s and prompted the participant to emit an FCR without a co-occurring

target response (i.e., a 3-s changeover delay). Depending on the condition, the experimenter prompted either the card FCR using physical guidance or the vocal FCR by stating, "Say, (vocal FCR)." Similar to target response pretraining, this phase continued until the participant emitted the relevant FCR independently for 10 consecutive trials without a target response.

FCT

The procedures for FCT were the same as FCT pretraining except that the experimenter did not provide prompts to emit the FCR, and sessions lasted 5 min. At least five FCT sessions were conducted, and FCT continued until the rate of independent FCRs was stable while the rate of target responding remained below an 85% reduction from baseline rates for two consecutive FCT sessions.

Card Group—The experimenter reinforced only card FCRs during FCT for the card group.

Vocal Group—The experimenter reinforced only vocal FCRs during FCT for the vocal group. Like target response pretraining and during baseline for this group, no FCR card was present during these FCT sessions.

Extinction

The procedures for extinction began with the experimenter providing access to the reinforcer prior to the first session of the phase for both groups. The first session began with the experimenter removing the reinforcer and withholding it for both target responding and FCRs such that neither response produced the reinforcer. For participants in the card group, the experimenter removed the FCR card at the outset of the extinction phase. Sessions occurred consecutively such that the participant did not gain access to the reinforcer between sessions of the extinction phase. Extinction sessions continued until (a) two or more consecutive sessions occurred with at least an 85% reduction in target responding from baseline rates, (b) a maximum of five sessions occurred, or (c) the scheduled research appointment ended.

Data Analysis

A proportion of baseline calculation was used to account for differences in baseline responding between participants. To calculate proportion of baseline for each participant, we first calculated mean target response rate across all baseline sessions. We then divided the response rate of each extinction session by the mean baseline response rate for that participant. We considered target responding during any extinction session that exceeded target responding during the preceding phase to be an instance of resurgence (Briggs et al., 2018).

A randomization test helped determine whether participants' responding across the two groups differed significantly. Randomization tests employ a method of resampling by selecting random pairs of data points and redistributing those pairs across groups to evaluate the probability that the randomly sampled data would produce a distribution as or more extreme than the obtained distribution (Craig & Fisher, 2019). The statistical software $R_{3.6.1}$

(R Core Team, 2017) performed the randomization test using the obtained target response rates expressed as a proportion of baseline responding and included data from the first session of extinction for all participants due to detecting no sequence effects for participants who experienced both the card and vocal FCT conditions. The randomization test conducted 100,000 repetitions.

Results and Discussion

Figure 1 depicts proportion of baseline responding during extinction and the last two sessions of FCT across all participants and conditions of Experiment 1. Six of eight participants displayed resurgence in the card group, and proportional response rates were highly variable. Four participants (Taylor, Abigail, Blake, and Jack) displayed resurgence that approached or exceeded baseline response rates (i.e., a proportion of 1.0 or higher). For the vocal group, four of eight participants displayed resurgence; however, resurgence never approached or exceeded baseline response rates. The overall magnitude and variability of resurgence was lower for the vocal group than for the card group both across and within participants. Only three of eight participants (38%) in the card group maintained an 85% reduction in baseline levels of target responding. In contrast, seven of eight participants (88%) in the vocal group maintained this same reduction. Individual data for each participant in Experiment 1 can be found in the Supporting Information.

Figure 2 depicts target response rates during the initial session of extinction for each participant in the card and vocal groups, as well as rates of vocal FCRs for each participant in the vocal group. Target behavior was considerably more variable in the card group compared to the vocal group. Vocal FCRs for the vocal group appeared to compete with target responding, and the total amount of responding across response topographies in the vocal group approximated those of target responding in the card group. Differences in target responding across groups were statistically significant ($p = 0.02$). That is, the randomly sampled data produced a distribution as or more extreme than the obtained distribution in only 2% of the 100,000 repetitions.

The results of Experiment 1 suggest that vocal FCRs and other FCR topographies that cannot be easily restricted may help mitigate resurgence compared to situations when a material-based FCR (e.g., card touch, card exchange) is unavailable. These findings replicate those of Kimball et al. (2018) and Podlesnik and Kelley (2014) by showing that the continued availability of an alternative response mitigates resurgence. The present findings extend earlier work on this topic by showing that such an increased likelihood of resurgence can depend on the topography of the alternative response—a finding that would appear to have implications for FCT in practice.

Incorporating the present findings with those on best practices for initiating FCT (DeRosa et al., 2015; Fisher et al., 2018) suggests that initially targeting a retractable mand topography (e.g., a card-touch FCR) and later transiting that response to an unretractable mand topography (e.g., a vocal FCR) may help mitigate resurgence in the early and later stages of FCT. Successfully transitioning an established FCR of one modality to a different, unlearned

FCR of a different modality is likely to require multiple training procedures, including shaping, prompting, and response restriction.

Researchers have used shaping procedures to establish FCR topographies of greater complexity and precision while maintaining generally low levels of destructive behavior during FCT (Ghaemmaghami et al., 2018, Hanley et al., 2014). For example, after establishing the mand, “My way, please,” Ghaemmaghami et al. placed this response on extinction while simultaneously prompting and reinforcing successive approximations to the terminal mand, “Excuse me? May I have my way, please?” Destructive behavior remained low throughout the shaping process for this participant.

Although such procedures have not been applied for the purposes of transitioning between mand topographies (e.g., from a card-touch FCR to a vocal FCR), they seem to be a reasonable component of such a strategy, particularly once an approximation to the vocal FCR is established and occurring reliably. Another seemingly necessary component is the continuous initial access to the already established FCR topography (e.g., an FCR card) while simultaneously prompting and reinforcing approximations to the terminal vocal FCR. We also believed that another necessary component was to include initially brief, but gradually increasing, periods of time when the already established FCR topography (e.g., touching the FCR card) was unavailable while simultaneously prompting and reinforcing approximations to the terminal vocal FCR. Therefore, we evaluated a set of procedures designed for transitioning between FCRs that differed across topographies in Experiment 2.

Experiment 2

One participant (Joanna) imitated a lower percentage of targets in the vocal-imitation screening than the other participants in Experiment 1. Although Joanna could imitate some phrases, she did not demonstrate generalized vocal imitation. Thus, her limited vocal-verbal behavior and poor echoic repertoire made her a good candidate for evaluating FCR-transition procedures in Experiment 2. Additionally, Joanna failed to accurately imitate the vocal target, “May I have toy?” during the vocal-imitation screening. The research team selected this vocal target as the terminal vocal FCR in Experiment 2 because Joanna could say each individual word within the full sentence even though she was unable to imitate the full sentence.

Baseline

Baseline was identical to Experiment 1 except that sessions were conducted in two contexts, each associated with a unique color of shirt worn by the experimenter and a matching poster board displayed in the room. These two contexts would later be associated with the card and vocal conditions of FCT pretraining. Similar to Experiment 1, the FCR card was present across both contexts to equate the availability of both FCR topographies. For baseline and the following phase of FCT pretraining, sessions were conducted across these two contexts in a multielement design. Condition order was randomized except that no more than two sessions of the same condition type occurred consecutively. Baseline sessions continued until there were at least five sessions in each context and until independent responding was stable.

FCT Pretraining

Across both contexts, FCT pretraining was implemented by placing target behavior on extinction and providing access to the functional reinforcer following each instance of the FCR during 5-min sessions. The participant had brief access to the reinforcer prior to the start of the session, and then the experimenter (a) restricted access to the reinforcer, (b) prompted the appropriate FCR according to a 0-s prompt delay, and (c) immediately thereafter delivered reinforcement for 20 s. If the participant emitted a target response, the experimenter waited 3 s and prompted the participant to emit an FCR without a co-occurring target response (i.e., a 3-s changeover delay). The experimenter did not increase the prompt delay beyond 0 s during FCT pretraining.

Card Condition—The experimenter prompted and reinforced only the card FCR in this condition. A 3-s changeover delay remained in place for the vocal FCR and target response.

Vocal Condition—The experimenter reinforced only the vocal FCR (“May I have toy?”) in this condition and prompted this response at the beginning of the session and every 5 s thereafter until the participant emitted the vocal FCR. A 3-s changeover delay remained in place for the card FCR and target response.

Transition of FCR Topography

FCT Baseline—This phase established independent use of the card FCR before transitioning the card FCR to a vocal FCR. Following the recent history with a 0-s prompt delay for the card FCR during FCT pretraining, the therapist increased the prompt delay for the card FCR following two consecutive sessions in which the participant did not engage in target behavior. The prompt delay increased to 2, 5, 10, and then 20 s or until the participant consistently emitted independent card FCRs. This phase ended after three sessions in which the participant engaged in independent card FCRs for 80% or more of the programmed opportunities and no target behavior.

FCR Transition—The goal of the FCR transition was to promote independent use of the terminal vocal FCR (i.e., “May I have toy?”) while ensuring that target responding remained low by systematically manipulating response effort (i.e., vocal response complexity) and EO exposure (i.e., response restriction and prompt delays). The card remained present throughout the FCR-transition phase until Joanna acquired the terminal vocal FCR. If Joanna engaged in a card FCR at any point when the reinforcer was not already available, the experimenter reinforced this communication response.

Response Effort.: To ensure minimal EO exposure during the FCR transition and to promote rapid and independent use of the vocal FCR, the experimenter differentially reinforced vocal FCRs of increasing complexity because Joanna could independently emit each portion of the full vocal FCR in isolation but was unable to emit the full sentence accurately and fluently. Response effort was minimized initially by differentially reinforcing a one-word vocal FCR (i.e., “May?”) until the participant emitted this response independently for two consecutive sessions. Response effort increased by adding one additional word (i.e., progressing from “May?” to “May I?”) after the participant emitted the

partial vocal FCR independently for two consecutive sessions with 80% or greater accuracy. This process continued until the participant emitted the terminal vocal FCR (i.e., “May I have toy?”) independently for two consecutive sessions with 80% or greater accuracy.

Response Restriction and Progressive Prompt Delay.: The experimenter simultaneously used procedures similar to those described by Goh et al. (2000) to transition Joanna’s use of the card FCR to the vocal FCR while controlling exposure to the EO for target behavior. This was accomplished by restricting the availability of the FCR card for progressively longer durations (i.e., fading exposure to the EO for target responding) while simultaneously increasing the delay to the prompt for the vocal FCR. Reinforcement remained available for the independent or prompted vocal FCR eligible for reinforcement, as well as any independent card FCRs.

The experimenter began with a 0-s prompt delay for the vocal FCR and a 2-s response-restriction interval. At the beginning of the session, the experimenter restricted the FCR card and reinforcer while simultaneously prompting the vocal FCR. If the participant did not emit the vocal FCR immediately after the prompt, the experimenter prompted the vocal FCR every 2 s until either (a) the response-restriction interval ended or (b) the participant emitted the vocal FCR eligible for reinforcement. When the response-restriction interval ended, the experimenter returned the FCR card but continued to withhold reinforcement until either FCR occurred, at which point the experimenter terminated the EO for target responding by delivering the reinforcer.

The experimenter increased the prompt delay for the vocal FCR while simultaneously increasing the response-restriction interval such that the first prompt always occurred 2 s prior to the end of the response-restriction interval. The prompt delay and the response-restriction interval increased by 2 s after the participant emitted at least 80% of FCRs that were vocal (independent or prompted but always specific to the topography currently eligible for reinforcement) or independent card FCRs for two consecutive sessions with less than 85% of target responding relative to baseline. Response effort increased by introducing the next approximation of the terminal vocal FCR after observing two consecutive sessions with 80% or greater independent vocal FCRs currently eligible for reinforcement and less than 85% of target responding relative to baseline.

For each new approximation of the vocal FCR (e.g., progressing to “May I?” from “May?”), the experimenter reverted to immediately prompting the new vocal FCR and reinstituted the 2-s response-restriction interval to minimize EO exposure to target responding given the increase in response effort. This process described above repeated for each approximation of the vocal FCR until the participant emitted the terminal vocal FCR consistently.

Results and Discussion

Figure 3 displays Joanna’s responding across baseline and FCT pretraining of Experiment 2. During baseline across both contexts, Joanna displayed high and generally stable rates of target responding. She did not engage in any vocal or card FCRs during baseline. During FCT pretraining phases in the vocal context (top panel), Joanna engaged in zero prompted

vocal FCRs and moderate to low rates of target behavior. Although the card FCR was not prompted or reinforced in this context, she engaged in high to moderate rates of independent card FCRs. During FCT pretraining phases in the card context (bottom panel), Joanna displayed high and stable rates of prompted card FCRs and low to zero rates of target responding.

Figure 4 displays the FCT baseline and FCR transition. During FCT baseline, Joanna displayed a high and stable rate of card FCRs. When the FCR transition began and the experimenter prompted the initial portion of the vocal FCR (i.e., “May?”), Joanna had a high rate of prompted vocal FCRs and near-zero rates of independent card FCRs. Following the increased delay to the vocal prompt and the response-restriction interval, Joanna had a high rate of independent vocal FCRs. There were zero rates of independent card FCRs and target behavior. After progressing to the next vocal FCR (i.e., “May I?”), when the experimenter also reverted to an immediate prompt and shorter response-restriction interval, there was an increase in prompted vocal FCRs. Low and stable independent card FCRs occurred until increasing the delay to the vocal prompt and the response-restriction interval, at which point Joanna engaged in a high rate of independent vocal FCRs, zero card FCRs, and zero target responding.

Joanna engaged in low rates of prompted vocal FCRs and high, variable rates of independent card FCRs when the experimenter progressed to the next vocal FCR (i.e., “May I have?”). When the delay to the prompt and the response-restriction interval increased to 4 s and 6 s, respectively, independent vocal FCRs increased whereas independent card FCRs and prompted vocal FCRs decreased. Target responding was zero. With the terminal vocal FCR (i.e., “May I have toy?”), Joanna had high and stable vocal FCRs with decreasing independent card FCRs and zero target responding. Finally, when the card FCR was removed and only the vocal FCR was reinforced, Joanna produced high and stable independent terminal vocal FCRs and zero target responding.

Figure 5 displays the percentage of session duration with EO exposure across baseline, FCT pretraining, FCT baseline, and the FCR transition (corresponding to the data across Figures 3 and 4). There were similarly low-to-moderate percentages of EO exposure in baseline across the card and vocal conditions. However, during the FCT pretraining phases, there was a high and stable percentage of EO exposure during the vocal condition and a low and stable percentage of EO exposure during the card condition. During FCT baseline and FCR transition, EO exposure was reasonably well controlled and minimized across sessions as Joanna learned increasingly more effortful approximations of the terminal vocal FCR.

Experiment 2 replicates prior research on the importance of controlling prompts when initiating FCT by showing better suppression of target responding when therapists could physically guide the alternative (card-touch) response than when therapists were unable to reliably occasion the alternative (vocal) response (Figure 3). Furthermore, large differences in the percentage of session duration with EO exposure across the card- and vocal-FCR conditions in Figure 5 suggest this effect was due to differences in EO exposure and not necessarily FCR topography, also replicating prior research by DeRosa et al. (2015) and Fisher et al. (2018).

A novel contribution of Experiment 2 was the evaluation of a set of procedures for transitioning a mastered card FCR to a previously unlearned vocal FCR. The experimenter systematically transitioned the topography of the FCR from a card FCR to a vocal FCR by manipulating response effort while also adjusting exposure to the EO for target responding. When targeting each approximation of the terminal vocal FCR, there was a reliable pattern of increased card FCRs and prompted vocal FCRs, followed by a decrease of both of these responses with a corresponding increase in independent vocal FCRs eligible for reinforcement. This pattern continued until establishing the terminal vocal FCR.

Throughout the FCR transition, levels of EO exposure remained low, similar to those measured during FCT pretraining with the card FCR. Controlling and minimizing EO exposure during the FCR transition appeared important for maintaining the low rates of target responding observed throughout the FCR transition. Such transition procedures that control and minimize EO exposure appear promising for clinical use.

General Discussion

Two interrelated experiments demonstrated the problem produced by unavailable, retractable communication materials (Experiment 1) and a potential solution to this problem by transitioning responding to an unretractable response for one participant (Experiment 2). Translational research of this sort can be referred to as “use-inspired” (cf. Mace & Critchfield, 2010)—a form of reverse translation that originates from an applied problem but is studied under a more basic arrangement.

In Experiment 1, we compared responding in a condition in which an unretractable alternative response (i.e., a vocal FCR) was continuously available but placed on extinction to responding in a condition in which materials necessary to engage in the alternative response (i.e., the FCR card) were unavailable. Resurgence was greater and more variable for the card-FCR condition than for the vocal-FCR condition, suggesting that loss of an alternative response may be more detrimental in terms of treatment relapse than simply arranging extinction for the alternative response.

A number of steps were taken to enhance the internal validity of Experiment 1. For example, the baseline- and FCT-phase durations were equated across the card- and vocal-FCR groups to minimize the possibility that differences in phase duration affected the results. Identical schedules of reinforcement were programmed across the two groups, and we obtained highly similar rates of reinforcement as a result (*M*[Card (Baseline)] = 2.5 reinforcers per min; range, 2.1–2.8; *M*[Vocal(Baseline)] = 2.5 reinforcers per min; range, 2.1–2.8; *M*[Card (FCT)] = 2.6 reinforcers per min; range, 2.5–2.7; *M*[Vocal(FCT)] = 2.5 reinforcers per min; range, 2.2–2.8). However, the results were both divergent from and convergent with clinical investigations of resurgence when the alternative response was removed.

Wacker et al. (2011) showed little resurgence of destructive behavior when alternative response materials (i.e., an FCR card and microswitch) were restricted. In a related study, Wacker et al. (2013) showed little difference in the resurgence of destructive behavior when alternative response materials were either partially or fully restricted. However, both

studies are difficult to interpret with respect to the question of whether continued access to alternative response materials affects resurgence. In the former study, the test condition of interest occurred following many treatment sessions in which destructive behavior resulted in extinction with or without extinction also arranged for alternative responding. Because repeated exposure to extinction decreases resurgence (e.g., Shahan et al., 2020), the ability to detect changes resulting from this specific experimental manipulation may have also diminished. In the latter study, partial access to alternative response materials (i.e., a microswitch without affixed FCR card) may have appeared sufficiently different than in training, thus limiting stimulus generalization. Despite these interpretive difficulties in relating prior applied research on this topic, findings from Experiment 1 of the present study are consistent with recent basic and translational investigations that have directly compared resurgence with and without the alternative response (Kimball et al., 2018; Podlesnik & Kelley, 2014).

The current results were convergent with prior clinical research in that several participants in the card condition did not display resurgence. Previous research has shown that resurgence does not always occur (e.g., Briggs et al., 2018; Craig & Shahan, 2016; Fisher et al., 2019). For example, resurgence occurred reliably for only four of seven participants in the study by Fisher et al. (2019). Thus, the variability observed in terms of the prevalence and magnitude of resurgence both across and within participants is generally consistent with other studies on resurgence that employ a small number of participants. However, use of continuous schedules of reinforcement likely increased the discriminability of transitioning from FCT to extinction, which likely hampered the resurgence effect for some participants (see Nevin & Grace, 2000 for relevant discussion).

Removal of the FCR card during extinction for participants who experienced the card condition may have signaled the unavailability of reinforcement for some participants but not others, which may have contributed to the mixed results across participants within this experimental group. In a departure from traditional resurgence tests, the alternative response was removed at the beginning of extinction for the card condition. This procedure may have functioned as an extinction cue for some participants, which prior research has shown to mitigate resurgence (e.g., Fuhrman et al., 2016; Fisher et al., 2020). However, in these prior investigations, extinction cues were stimuli correlated explicitly with extinction (i.e., S-). Therefore, important procedural differences across the present study and prior research on extinction cues should be considered when interpreting this possibility.

Another, and perhaps more likely interpretation of how removal of the FCR card may have affected target-response variability across participants in the card group during extinction is that FCR card removal may have functioned as a new stimulus context for some participants. It seems reasonable that this new stimulus context, unassociated with reinforcer deliveries, may have been sufficiently distinct from the preceding baseline phase for some participants that target responding failed to generalize to the extinction phase.

There is an implied limitation to Experiment 1 in this explanation of the findings—removal of the FCR card for the card group may have entailed both a change in context (i.e., removal of the FCR card), as well as the omission of reinforcers from the environment by way of

removal of the alternative response. Relapse preparations that combine tests for multiple forms of relapse (e.g., renewal and resurgence) often produce higher levels of relapse (i.e., super resurgence; Kincaid et al., 2015; Liggett et al., 2018; Wathen & Podlesnik, 2018), suggesting another potential interpretation of Experiment 1. Because the purpose of Experiment 1 was to compare levels of resurgence when communication materials were lost (i.e., a card FCR) to a condition in which the FCR topography could not be restricted (i.e., a vocal FCR), such a context change was a necessary component for the applied question driving Experiment 1. Although including a third condition in which a trained card FCR remains available during the resurgence test could be informative for parsing out the group differences in Experiment 1, it is not immediately clear how one would disentangle the independent roles of context change from the unavailability of the alternative response when designing a different experiment or when interpreting the present results. Ultimately, these issues need to be further researched by conducting a similar study in the context of ongoing care for individuals with destructive behavior.

The data from Figure 2 suggest that response competition likely played an important role in the results of Experiment 1. We found a high rate of vocal FCRs and a lower rate of target behavior during extinction for the vocal group across all participants, and the total amount of measured behavior (i.e., target plus alternative responding) for the vocal group closely approximated the amount of target responding for the card group. The continuous availability of the vocal FCR during extinction for the vocal group likely competed with target responding for the vocal group, whereas the card FCR was unavailable to compete with target responding for the card group. This interpretation of response competition impacting relapse is consistent with the results of similar investigations (e.g., Kimball et al., 2018). Additionally, shorter latencies to resurgence occurred for the card group compared to the vocal group. On average, individuals in the card group who emitted a target response did so after 7 s (range, 4 s–13 s) of exposure to extinction, and individuals in the vocal group who emitted a target response did so after 32 s (range, 3 s–50 s) of exposure to extinction. Thus, it seems likely that the unretractable vocal FCR helped mitigate both the frequency and latency of target behavior relapse. Training an unretractable FCR (e.g., a vocal- or manual-sign FCR) may be beneficial when treating destructive behavior with FCT because it ensures continuous availability of an alternative to destructive behavior, as well as continued access to the associated reinforcement contingency.

The logic that response competition likely impacted the findings for the vocal group in Experiment 1 also serves as a reasonable account for the varied levels of target responding in the card group during the resurgence test. Although we did not measure participant responding outside those dependent variables described above, the varying degrees to which participants engaged in other, non-target behavior (e.g., playful, exploratory, stereotypic responding) may help account for discrepant levels of target responding in the card group, similar to the measured vocal FCR for the vocal group. Future research on this topic should include measures of such other behavior (see Sullivan et al., 2020 for a related example).

Experiment 2 replicated the results of DeRosa et al. (2015) and Fisher et al. (2018) by showing more target responding and greater EO exposure in the FCT-pretraining condition in which the experimenter trained a response that could not be physically guided (i.e.,

the vocal FCR) compared to a response that the experimenter could reliably occasion (i.e., the card FCR). The experimenter then implemented a set of transition procedures that manipulated response effort (i.e., vocal response complexity) and EO exposure (i.e., response restriction and prompt delays) with the goal of establishing closer approximations of the terminal vocal FCR while controlling and minimizing EO exposure and thus, target responding (see Bishop et al., 2020 and Gevarter et al., 2016 for related but different approaches for transitioning to a novel mand in the absence of problem behavior or its surrogate). These procedures resulted in low rates of target responding as the topography of the FCR transitioned from a card FCR to a terminal vocal FCR. To the authors' current knowledge, this is the first study to transition alternative responding across topographically distinct responses after first demonstrating a lack of acquisition of the terminal FCR with typical pretraining procedures (i.e., prompting, reinforcement only for the targeted FCR).

Conclusions about the generality of the FCR-transition procedures and the optimal conditions under which to select these procedures are limited because we had only one participant and evaluated the transition procedures in a translational arrangement. However, the success of any such FCR-transition procedures is likely to be impacted by participant variables (e.g., vocal repertoire, compliance) which may slow or hasten the acquisition of a given terminal vocal FCR. For Joanna, forward chaining seemed like a suitable strategy for establishing the terminal vocal FCR because she could emit each word in isolation correctly but could not emit the full sentence. We suggest using screening tests like the one described herein as a means of selecting developmentally appropriate vocal FCRs. Simple, low-effort manual signs may be more appropriate for some individuals.

The present experiments collectively suggest benefits of training different types of FCRs at different stages of treatment with FCT. The exploratory results of Experiment 2 serve as a proof of concept, suggesting a set of procedures for transitioning between FCRs while effectively treating destructive behavior. Future research that extends these procedures by evaluating the components necessary and sufficient to transition topographies effectively and efficiently is another possibility when extending these findings to the treatment of destructive behavior.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research fulfilled partial requirements for the first author's doctoral degree from the University of Nebraska Medical Center and was funded in part by grants 5R01HD079113, 5R01HD083214, and 5R01HD093734 from the National Institute of Child Health and Human Development.

References

Baker BL, Blacher J, Crnic KA, & Edelbrock C. (2002). Behavior problems and parenting stress in families of three-year-old children with and without developmental delays. American Journal of Mental Retardation, 107(6), 433–444. 10.1352/0895-8017(2002)107<0433:BPAPSI>2.0.CO;2 [PubMed: 12323068]

Baker BL, McIntyre LL, Blacher J, Crnic K, Edelbrock C, & Low C. (2003). Pre-school children with and without developmental delay: Behaviour problems and parenting stress over time. Journal of Intellectual Disability Research, 47(4–5), 217–230. 10.1046/j.1365-2788.2003.00484.x [PubMed: 12787154]

Bishop SK, Moore JW, Dart EH, Radley K, Brewer R, Barker LK, Quintero L, Litten S, Gilfeather A, Newborne B, & Toche C. (2020). Further investigation of increasing vocalizations of children with autism with a speech-generating device. Journal of Applied Behavior Analysis, 53(1), 475–483. 10.1002/jaba.554 [PubMed: 30900254]

Briggs AM, Fisher WW, Greer BD, & Kimball RT (2018). Prevalence of resurgence of destructive behavior when thinning reinforcement schedules during functional communication training. Journal of Applied Behavior Analysis, 51(3), 620–633. 10.1002/jaba.472 [PubMed: 29774545]

Bullock CE, Fisher WW, & Hagopian LP (2017). Description and validation of a computerized behavioral data program: "BDataPro". The Behavior Analyst, 40(1), 275–285. 10.1007/s40614-016-0079-0 [PubMed: 31976934]

Carr EG, & Durand VM (1985). Reducing behavior problems through functional communication training. Journal of Applied behavior Analysis, 18(2), 111–126. 10.1901/jaba.1985.18-111 [PubMed: 2410400]

Craig AR, & Fisher WW (2019). Randomization tests as alternative analysis methods for behavior-analytic data. Journal of the Experimental Analysis of Behavior, 111(2), 309–328. 10.1002/jeab.500 [PubMed: 30706944]

Craig AR, & Shahan TA (2016). Behavioral momentum theory fails to account for the effects of reinforcement rate on resurgence. Journal of the Experimental Analysis of Behavior, 105(3), 375–392. 10.1002/jeab.207 [PubMed: 27193242]

DeRosa NM, Fisher WW, & Steege MW (2015). An evaluation of time in establishing operation on the effectiveness of functional communication training. Journal of Applied Behavior Analysis, 48(1), 115–130. 10.1002/jaba.180 [PubMed: 25420612]

Dumas JE, Wolf LC, Fisman SN, & Culligan A. (1991). Parenting stress, child behavior problems, and dysphoria in parents of children with autism, down syndrome, behavior disorders, and normal development. Exceptionality, 2(2), 97–110. 10.1080/09362839109524770

Durand VM (1999). Functional communication training using assistive devices: Recruiting natural communities of reinforcement. Journal of Applied Behavior Analysis, 32(3), 247–267. 10.1901/jaba.1999.32-247 [PubMed: 10513023]

Epstein R. (1983). Resurgence of previously reinforced behavior during extinction. Behaviour Analysis Letters, 3(6), 391–397.

Fisher WW, Fuhrman AM, Greer BD, Mitteer DR, & Piazza CC (2020). Mitigating resurgence of destructive behavior using the discriminative stimuli of a multiple schedule. Journal of the Experimental Analysis of Behavior, 113(1), 263–277. 10.1002/jeab.552 [PubMed: 31621919]

Fisher WW, Greer BD, Mitteer DR, Fuhrman AM, Romani PW, & Zangrillo AN (2018). Further evaluation of differential exposure to establishing operations during functional communication training. Journal of Applied Behavior Analysis, 51(2), 360–373. 10.1002/jaba.451 [PubMed: 29512153]

Fisher WW, Piazza CC, Bowman LG, Hagopian LP, Owens JC, & Slevin I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. Journal of Applied Behavior Analysis, 25(2), 491–498. 10.1901/jaba.1992.25-491 [PubMed: 1634435]

Fisher W, Piazza C, Cataldo M, Harrell R, Jefferson G, & Conner R. (1993). Functional communication training with and without extinction and punishment. Journal of Applied Behavior Analysis, 26(1), 23–36. 10.1901/jaba.1993.26-23 [PubMed: 8473256]

Fisher WW, Saini V, Greer BD, Sullivan WE, Roane HS, Fuhrman AM, Craig AR, & Kimball RT (2019). Baseline reinforcement rate and resurgence of destructive behavior. Journal of the Experimental Analysis of Behavior, 111(1), 75–93. 10.1002/jeab.488 [PubMed: 30499107]

Fuhrman AM, Fisher WW, & Greer BD (2016). A preliminary investigation on improving functional communication training by mitigating resurgence of destructive behavior. Journal of Applied Behavior Analysis, 49(4), 884–899. 10.1002/jaba.338 [PubMed: 27449566]

Gevarter C, O'Reilly MF, Kuhn M, Mills K, Ferguson R, Watkins L, Sigafoos J, Lang R, Rojeski L, & Lancioni GE (2016). Increasing the vocalizations of individuals with autism during intervention with a speech-generating device. Journal of Applied Behavior Analysis, 49(1), 17–33. 10.1002/jaba.270 [PubMed: 26640163]

Ghaemmaghami M, Hanley GP, Jessel J, & Landa R. (2018). Shaping complex functional communication responses. Journal of Applied Behavior Analysis, 51(3), 502–520. 10.1002/jaba.468 [PubMed: 29761485]

Goh HL, Iwata BA, & DeLeon IG (2000). Competition between noncontingent and contingent reinforcement schedules during response acquisition. Journal of Applied Behavior Analysis, 33(2), 195–205. 10.1901/jaba.2000.33-195 [PubMed: 10885527]

Greer BD, Fisher WW, Saini V, Owen TM, & Jones JK (2016). Functional communication training during reinforcement schedule thinning: An analysis of 25 applications. Journal of Applied Behavior Analysis, 49(1), 105–121. 10.1002/jaba.265 [PubMed: 26482103]

Greer BD, & Shahan TA (2019). Resurgence as choice: Implications for promoting durable behavior change. Journal of Applied Behavior Analysis, 52(3), 816–846. 10.1002/jaba.573 [PubMed: 31049954]

Hagopian LP, Fisher WW, Sullivan MT, Acquisto J, & LeBlanc LA (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. Journal of Applied Behavior Analysis, 31(2), 211–235. 10.1901/jaba.1998.31-211 [PubMed: 9652101]

Hanley GP, Jin CS, Vanselow NR, & Hanratty LA (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. Journal of Applied Behavior Analysis, 47(1), 16–36. 10.1002/jaba.106 [PubMed: 24615474]

Horner RH, & Day HM (1991). The effects of response efficiency on functionally equivalent competing behaviors. Journal of Applied Behavior Analysis, 24(4), 719–732. 10.1901/jaba.1991.24-719 [PubMed: 1839157]

Kimball RT, Kelley ME, Podlesnik CA, Forton A, & Hinkle B. (2018). Resurgence with and without an alternative response. Journal of Applied Behavior Analysis, 51(4), 854–865. 10.1002/jaba.466 [PubMed: 29749053]

Kincaid SL, Lattal KA, & Spence J. (2015). Super-resurgence: ABA renewal increases resurgence. Behavioural Processes, 115, 70–73. 10.1016/j.beproc.2015.02.013 [PubMed: 25712040]

Lattal KA, Cançado CR, Cook JE, Kincaid SL, Nighbor TD, & Oliver AC (2017). On defining resurgence. Behavioural Processes, 141(1), 85–91. 10.1016/j.beproc.2017.04.018 [PubMed: 28487201]

Liggett AP, Nastri R, & Podlesnik CA (2018) Assessing the combined effects of resurgence and reinstatement in children diagnosed with autism spectrum disorder. Journal of the Experimental Analysis of Behavior, 109(2) 408–421. 10.1002/jeab.315 [PubMed: 29485763]

Mace FC, & Critchfield TS (2010). Translational research in behavior analysis: Historical traditions and imperative for the future. Journal of the Experimental Analysis of Behavior, 93(3), 293–312. 10.1901/jeab.2010.93-293 [PubMed: 21119847]

Marcus BA, & Vollmer TR (1995). Effects of differential negative reinforcement on disruption and compliance. Journal of Applied Behavior Analysis, 28(2), 229–230. 10.1901/jaba.1995.28-229 [PubMed: 16795864]

Nevin JA, & Grace RC (2000). Behavioral momentum and the law of effect. Behavioral and Brain Sciences, 23(1), 73–130. 10.1017/S0140525X00002405

Podlesnik CA, & Kelley ME (2014). Resurgence: Response competition, stimulus control, and reinforcer control. Journal of the Experimental Analysis of Behavior, 102(2), 231–240. 10.1002/jeab.102 [PubMed: 25125267]

Richman DM, Wacker DP, & Winborn L. (2001). Response efficiency during functional communication training: Effects of effort on response allocation. Journal of Applied Behavior Analysis, 34(1), 73–76. 10.1901/jaba.2001.34-73 [PubMed: 11317991]

Ringdahl JE, Berg WK, Wacker DP, Crook K, Molony MA, Vargo KK, Neurnberger JE, Zabala K, & Taylor CJ (2018). Effects of response preference on resistance to change. Journal of the Experimental Analysis of Behavior, 109(1), 265–280. 10.1002/jeab.308 [PubMed: 29319190]

Ringdahl JE, Falcomata TS, Christensen TJ, Bass-Ringdahl SM, Lentz A, Dutt A, & Schuh-Claus J. (2009). Evaluation of a pre-treatment assessment to select mand topographies for functional communication training. Research in Developmental Disabilities, 30(2), 330–341. 10.1016/j.ridd.2008.06.002 [PubMed: 18672344]

Roane HS, Vollmer TR, Ringdahl JE, & Marcus BA (1998). Evaluation of a brief stimulus preference assessment. Journal of Applied Behavior Analysis, 31(4), 605–620. 10.1901/jaba.1998.31-605 [PubMed: 9891397]

Shahan TA, Browning KO, & Nall RW (2020). Resurgence as choice in context: Treatment duration and on/off alternative reinforcement. Journal of the Experimental Analysis of Behavior, 113(1), 57–76. 10.1002/jeab.563 [PubMed: 31777091]

Sullivan WE, Saini V, DeRosa NM, Craig AR, Ringdahl JE, & Roane HS (2020). Measurement of nontargeted problem behavior during investigations of resurgence. Journal of Applied Behavior Analysis, 53(1), 249–264. 10.1002/jaba.589 [PubMed: 31219177]

Tiger JH, Hanley GP, & Bruzek J. (2008). Functional communication training: A review and practical guide. Behavior Analysis in Practice, 1(1), 16–23. 10.1007/BF03391716 [PubMed: 22477675]

Wacker DP, Berg WK, Harding JW, Derby KM, Asmus JM, & Healy A. (1998). Evaluation and long-term treatment of aberrant behavior displayed by young children with disabilities. Journal of Developmental and Behavioral Pediatrics, 19(4), 260–266. 10.1097/00004703-199808000-00004 [PubMed: 9717135]

Wacker DP, Harding JW, Berg WK, Lee JF, Schieltz KM, Padilla YC, Nevin JA, & Shahan TA (2011). An evaluation of persistence of treatment effects during long-term treatment of destructive behavior. Journal of the Experimental Analysis of Behavior, 96(2), 261–282. 10.1901/jeab.2011.96-261 [PubMed: 21909168]

Wacker DP, Harding JW, Morgan TA, Berg WK, Schieltz KM, Lee JF, & Padilla YC (2013). An evaluation of resurgence during functional communication training. The Psychological Record, 63(1), 3–20. 10.11133/j.tpr.2013.63.1.001. [PubMed: 34276071]

Wathen SN, & Podlesnik CA (2018). Laboratory models of treatment relapse and mitigation techniques. Behavior Analysis: Research and Practice, 18(4), 362–387. 10.1037/bar0000119

Winborn-Kemmerer L, Ringdahl JE, Wacker DP, & Kitsukawa K. (2009). A demonstration of individual preference for novel mands during functional communication training. Journal of Applied Behavior Analysis, 42(1), 185–189. 10.1901/jaba.2009.42-185 [PubMed: 19721740]

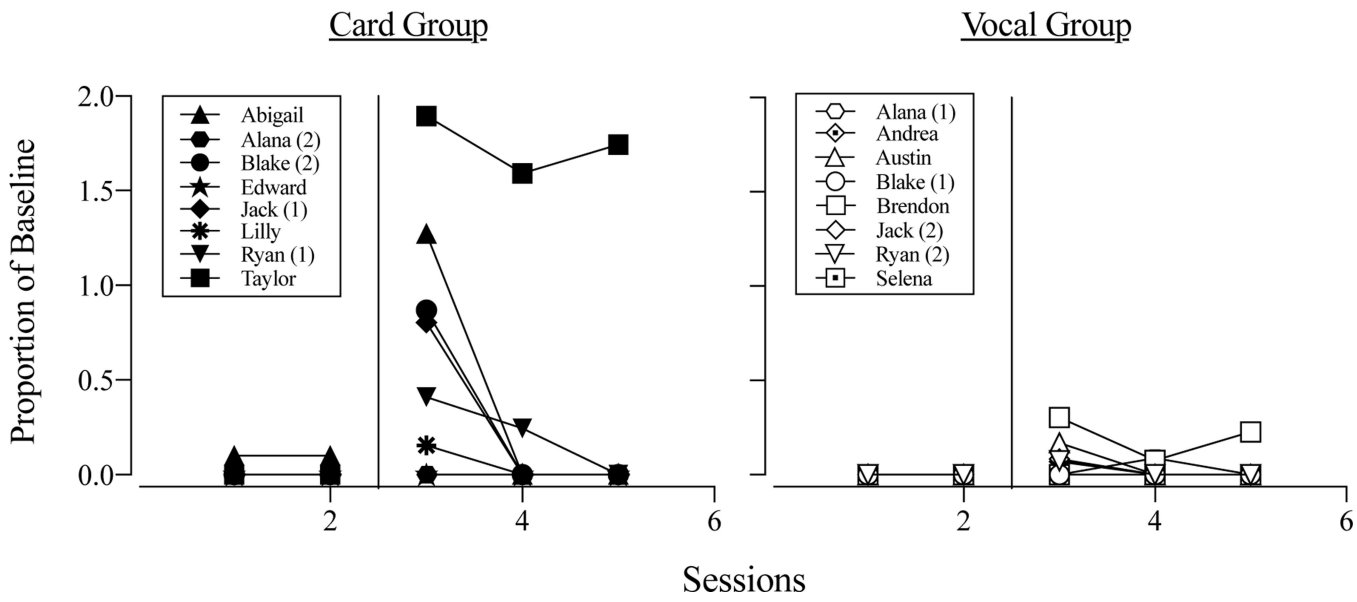

Figure 1. Proportion of Baseline Target Responding During FCT and Extinction Phases by Group

Note. The parenthetical number beside participants' names indicates condition order for those participants who experienced the card and vocal conditions. FCT = functional communication training.

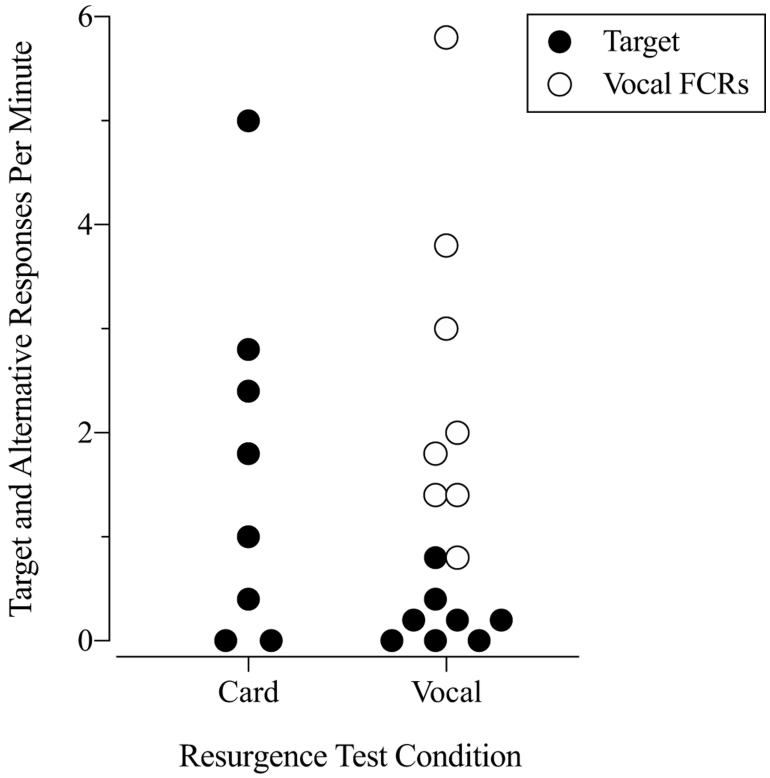

Figure 2. Target and Alternative Response Rates During First Extinction Session
Note. FCR = functional communication response.

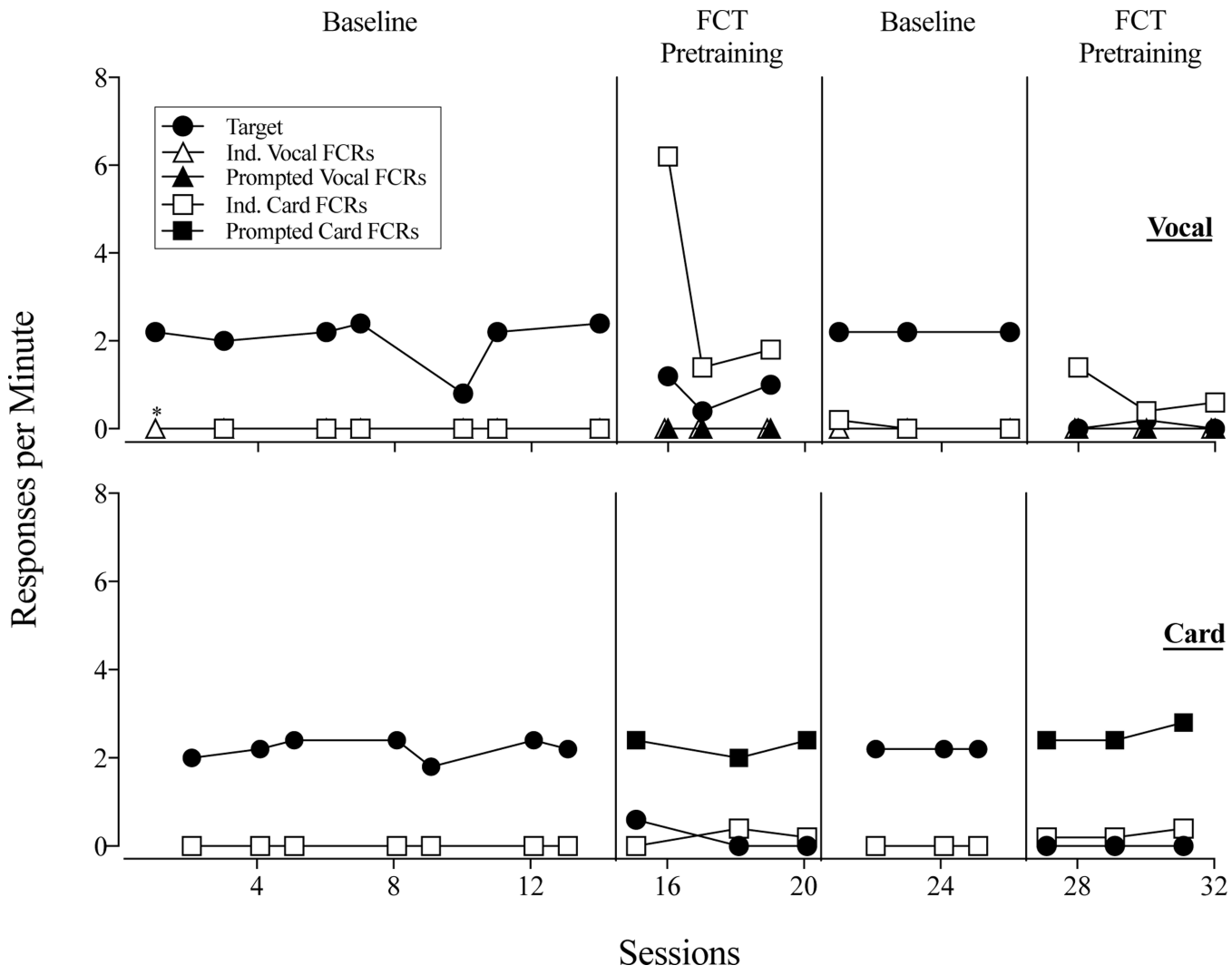

Figure 3. Target, Independent FCR, and Prompted FCR Rates Across Conditions for Joanna

Note. Ind. = independent; FCT = functional communication training; FCR = functional communication response. *FCR card missing from first session.

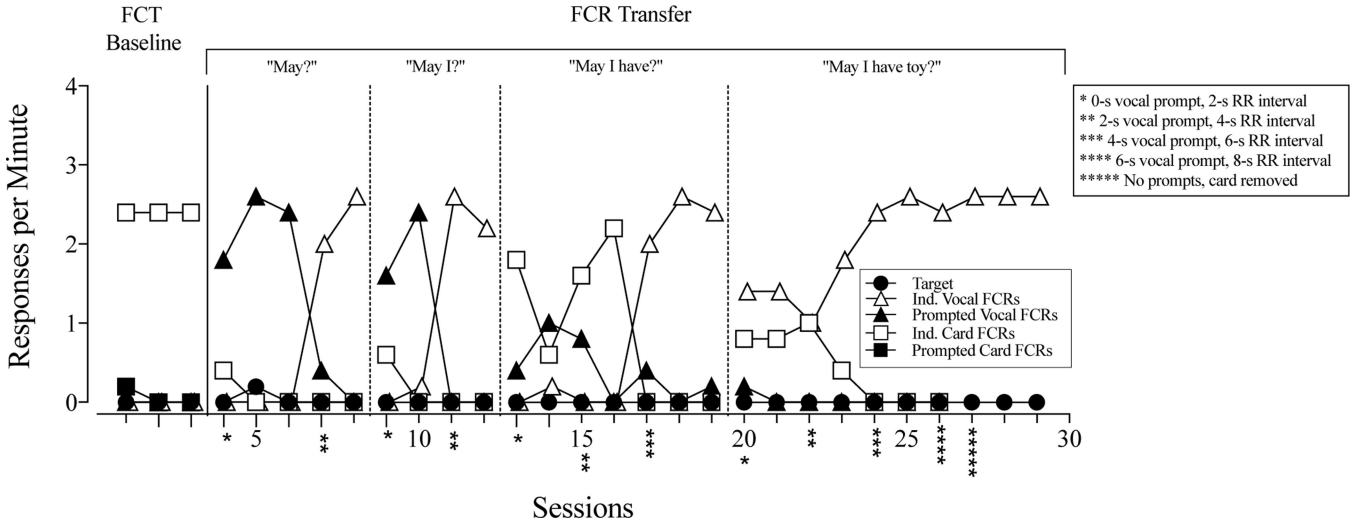

Figure 4. FCR Transition

Note. Asterisks denote when and how prompt delays changed, as well as the duration of the response restriction (RR) interval. Ind. = independent; FCT = functional communication training; FCR = functional communication response.

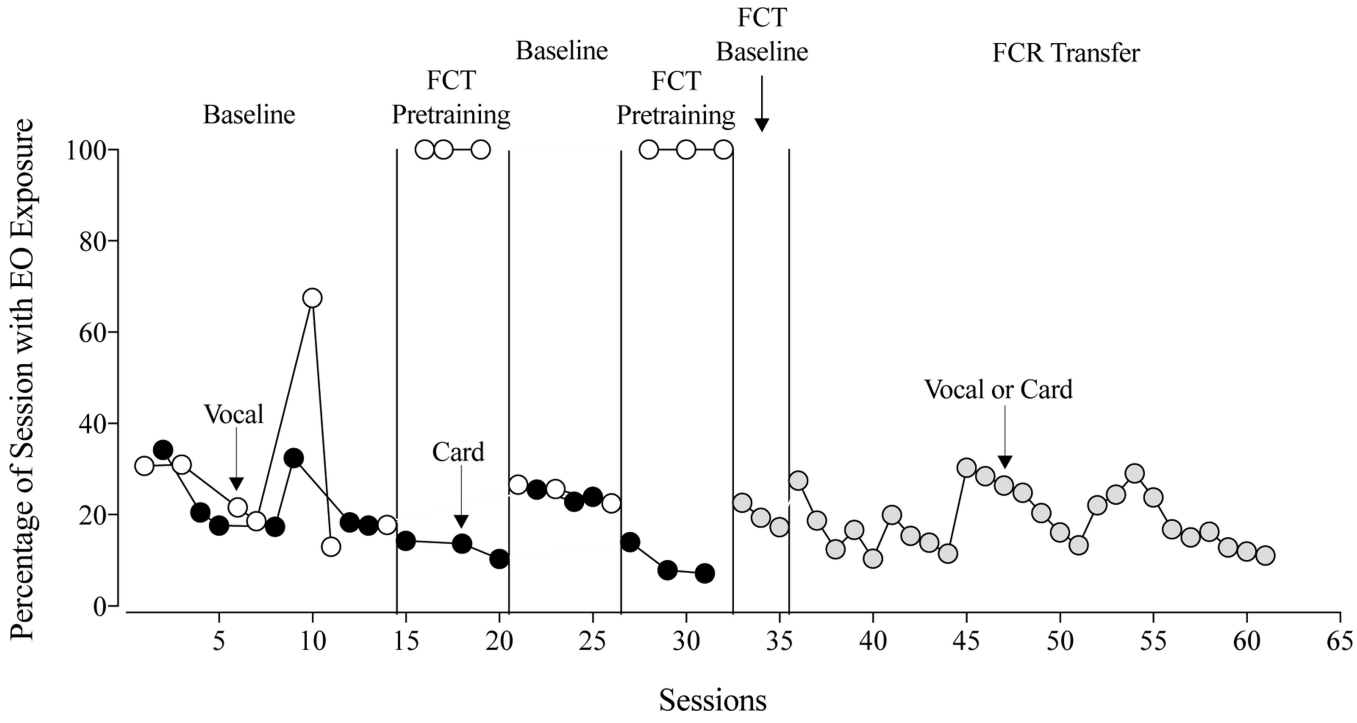

Figure 5. EO Exposure During FCR Transition

Note. FCT = functional communication training; FCR = functional communication response.

Table 1

Participant Demographics and Experiment Information

Participant	Age (in Years)	ASD Diagnosis	Experiment	Vocal FCR
Abigail	4	No	1	—
Alana	5	No	1	“I want toys, please.”
Andrea	7	No	1	“May I have the iPad?”
Austin	6	No	1	“Can I have toys, please?”
Blake	3	Yes	1	“Toys, please.”
Brendon	6	Yes	1	“I want iPad, please.”
Edward	6	Yes	1	—
Jack	3	No	1	“Can I have toys, please?”
Joanna	4	Yes	2	“May I have toy?”
Lilly	3	No	1	—
Ryan	7	Yes	1	“Toys, please.”
Selena	3	No	1	“May I have toys, please?”
Taylor	7	Yes	1	—

Note. ASD = autism spectrum disorder; FCR = functional communication response.