Functional Communication Training for Multiple Reinforcers: an Evaluation of Isolated Control Following a Synthesized Context

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Abstract

We evaluated the effectiveness of teaching 2 functionally and topographically dissimilar communication responses within the same sessions following a functional analysis with a synthesized contingency. We also conducted stimulus-control probes to determine the extent to which communication responses and problem behavior occurred when each contingency was presented in isolation. The child in the current study acquired communicative responses for both reinforcers, and problem behavior decreased during functional communication training (FCT). Further, relevant communication responses occurred in the respective stimulus-control probes. Results are discussed in terms of implications for research and practice regarding methods for conducting FCT following functional analyses with synthesized contingencies.

Keywords Functional analysis · Functional communication training · Synthesized contingency

Individuals who engage in problematic behavior (e.g., aggression, property destruction, self-injury) tend to struggle in many areas of life, including building relationships with peers, performing academically, and integrating into their communities (Howlin, Moss, Savage, & Rutter, 2013; Taylor & Seltzer, 2011; Whitaker, 2004). To improve the lives and outcomes of these individuals, applied behavior analysts have developed interventions to decrease their problem behavior, many of which rely on differential reinforcement. One specific intervention that has received much attention both in research and in practice is *functional communication training* (FCT; Carr & Durand, 1985; Tiger, Hanley, & Bruzek, 2008), which entails teaching or strengthening a communication response that is functionally equivalent to problem behavior.

Because the effectiveness of FCT relies on addressing the function of problem behavior (e.g., Lang et al., 2010), FCT is usually conducted following a functional behavior assessment (FBA), sometimes including a functional analysis (FA). FA in the context of FBA involves systematically manipulating antecedents and consequences for problem behavior across control and test conditions and has become the gold standard for identifying behavioral function (Hanley, Iwata, & McCord, 2003; Iwata, Dorsey, Slifer, Bauman, & Richman, 1994; Iwata & Dozier, 2008). Many published demonstrations of FA share common characteristics: They occur in highly controlled clinical settings, entail 10- to 15-min sessions, are arranged in a multielement design, and involve the manipulation of both antecedents and consequences, a format often referred to as “standard” or “traditional” (Beavers, Iwata, & Lerman, 2013). Test conditions (i.e., those that assess a particular function) are generally conducted by arranging an establishing operation (EO) for a putative reinforcer and delivering the corresponding putative reinforcer contingent on problem behavior.

Notwithstanding the strengths of FA, standard FA procedures sometimes yield ambiguous outcomes (e.g., undifferentiated responding across conditions; Hagopian, Rooker, Jessel, & DeLeon, 2013; Hanley et al., 2003; Kuhn, Hardesty, & Sweeney, 2009; Rooker, DeLeon, Borrero, Frank-Crawford, & Roscoe, 2014; Roscoe, Schlichenmeyer,

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& Dube, 2015). Accordingly, researchers have reported several modifications to the typical FA arrangement, including those that involve combining multiple EOs and consequences within the same test condition (a synthesized contingency; e.g., Slaton, Hanley, & Raftery, 2017; Strohmeier, Murphy, & O'Connor, 2017). For example, Hagopian, Bruzek, Bowman, and Jennett (2007) conducted FAs on the problem behavior of two adolescents with intellectual and developmental disabilities. Problem behavior in traditional FA conditions (demand, tangible, play, attention) occurred at low and undifferentiated levels for both participants. Interviews with staff and descriptive analyses were then conducted, which suggested that problem behavior occurred when demands were presented while the participants were engaging in a high-probability (i.e., highly preferred) activity. Next, test conditions were developed in which the therapist requested that the participants leave their ongoing preferred activity (a combination of demand and tangible conditions). Contingent on problem behavior, the therapist withdrew the demand and allowed the participants to continue to engage in the activity. Test sessions were alternated with control sessions, during which the participants had free access to engage in the preferred activity and did not receive demands. For both participants, problem behavior was consistently elevated in test sessions relative to control.

Although combining multiple EOs and consequences into a synthesized contingency in an FA can be useful, implications for treatment may be unclear, specifically regarding the need to address individual EOs and consequences in the synthesized contingency. One approach was illustrated by Ghaemmaghami, Hanley, Jin, and Vanselow (2016), who conducted FCT with a typically developing child following an FA that consisted of a synthesized contingency of escape, tangibles, and attention. The authors specifically sought to affirm control of each individual contingency by sequentially conducting FCT for each putative function in a multiple-baseline design. The request for escape was taught first, which decreased but did not eliminate problem behavior. Then, the child was taught to request tangibles during breaks, which further decreased but, again, did not eliminate problem behavior. Finally, the child was taught to request attention during breaks, which eliminated problem behavior.

In the current study, we conducted an FA that consisted of a synthesized contingency after problem behavior did not occur (and was undifferentiated) in isolated contingency conditions. We then evaluated the effectiveness of a procedure to address the contingencies in isolation during FCT. Specifically, we taught two topographically and functionally dissimilar communication responses within the same FCT sessions from the outset of treatment. We also added to the literature on methods of affirming stimulus control by individual contingencies (e.g., Ghaemmaghami et al., 2016) by conducting stimulus-control probes (SCPs) immediately following FCT.

Method

Participant and Setting

Jordy was a typically developing 6-year-old male and was referred for the treatment of problem behavior by a university-based laboratory school. Jordy was able to follow multiple-step instructions and demonstrated age-appropriate imitative and vocal-verbal repertoires (mands, tacts, and intraverbals). All sessions took place in a clinic room (2.7 × 2.9 m) equipped with a one-way mirror at a university-based clinic. The room contained a table and chairs, and the floor was covered in protective padding.

Measurement and Interobserver Agreement

All sessions were videotaped, and data collectors later scored data from video. All responses were scored using frequency recording and were converted into response rates (responses per minute).

Jordy engaged in property destruction (throwing objects) and inappropriate vocalizations (vocalizations above conversation level with a negative affect, such as crying or grimacing, or while engaging in property destruction). Functional communication responses (FCRs) were also scored for Jordy in his treatment analysis. The simple tangible FCR consisted of Jordy saying, “Can I have a turn on the iPad, please?” or an appropriate variation (e.g., “May I see the iPad, please?”) or touching the tangible therapist with a communication card with the printed words. The simple escape FCR consisted of Jordy saying, “Can I have a break, please?” or an appropriate variation (e.g., “May I please have a break?”) or touching the escape therapist with a communication card with the printed words. Complex FCRs (tangible and escape) consisted of Jordy saying, “excuse me” while making eye contact with the appropriate therapist prior to emitting a simple FCR.

A second observer independently scored Jordy’s problem behavior during FA and treatment sessions. Scored-interval interobserver agreement (IOA) was calculated during the FA by dividing each session into 10-s intervals and dividing the number of intervals with agreement with respect to the occurrence of problem behavior by the total number of intervals in which either observer scored an occurrence of problem behavior. Scored-interval IOA was calculated for all FA sessions in which problem behavior occurred.

Mean count-per-interval IOA was calculated for 30% of treatment sessions by dividing each session into 10-s intervals and comparing observers’ scores in each interval; the smaller scored frequency was divided by the larger, and the result was multiplied by 100 to yield a percentage-agreement score for each interval. The mean percentage agreement across intervals was then calculated to obtain the IOA score for each session.

Mean agreement for problem behavior during the FA was 92% (range 75–100%). Mean agreement during treatment was calculated for each topography separately: simple tangible FCR ($M = 100\%$), simple escape FCR ($M = 99\%$; range 93–100%), complex tangible FCR ($M = 99\%$; range 93–100%), complex escape FCR ($M = 98\%$; range 85–98%), and problem behavior ($M = 100\%$).

Design

The FA was conducted in an A-B-C arrangement with an embedded multielement design in Condition C. Conditions A and B consisted of exposures to escape and tangible EOs in isolation, and Condition C consisted of alternating synthesized control and synthesized test sessions. Treatment (FCT) was conducted in an A-B-C-A-C reversal design.

Functional Assessment

Open-Ended Interview Prior to the FA, we conducted an open-ended interview (adapted from Hanley, 2012) to identify potential antecedents and consequences that maintained Jordy's problem behavior and to develop operational definitions. Results from the open-ended interview with Jordy's mother suggested that problem behavior occurred in situations that involved academic demands (specifically those that involved writing) and that denied access to preferred items. These situations sometimes occurred in isolation (e.g., when Jordy's mother instructed him to complete his homework when the iPad was unavailable and out of sight, or when his requests for his iPad were denied in the absence of an EO for escape), but they also occurred simultaneously (e.g., when his requests for the iPad were denied or it was removed while an instruction was simultaneously presented). When problem behavior occurred during demands, Jordy's mother reported sometimes "waiting him out" and sometimes allowing him to choose to complete an alternative assignment (e.g., one that did not involve writing). When problem behavior occurred during denied-access situations, Jordy's mother reported that she redirected him to another toy or activity. Results from the open-ended interview suggested that Jordy's problem behavior was maintained by escape from demands and/or access to preferred items, or a combination of the two.

FA We then conducted an FA in which sessions lasted 5 min. Graduate students implemented all conditions. We began by investigating the escape function, as Jordy's mother and the referring agency indicated that compliance with demands was a primary concern. During the escape-only condition, a therapist delivered a continuous series of writing instructions to Jordy with three-step prompting. If Jordy had engaged in problem behavior, he would have received a 30-s break, although problem behavior did not occur; all other behavior was

ignored. Next, we arranged a tangible-only condition, during which the therapist withheld access to a high-preferred item (an iPad) identified by a multiple stimulus without replacement (DeLeon & Iwata, 1996) preference assessment prior to the FA. The therapist sat next to Jordy and interacted with the iPad herself, as Jordy's mother noted that Jordy was more likely to engage in problem behavior if another person (e.g., sibling, peer) was interacting with one of his preferred items. If Jordy had engaged in problem behavior, he would have received 30-s access to the item, although problem behavior did not occur; all other behavior was ignored. Finally, we evaluated a tangible plus escape condition in which the escape therapist again delivered writing demands and the tangible therapist again sat next to Jordy but interacted with the item herself. If Jordy engaged in problem behavior, he received a 30-s break from demands with access to the high-preferred item.

Treatment

Simple FCT Four therapists were present during simple and complex FCT: a tangible-prompt therapist who prompted Jordy to emit the tangible FCR, an escape-prompt therapist who prompted Jordy to emit the escape FCR, an iPad therapist who withheld access to the iPad, and a demand therapist who issued demands (writing tasks from the FA). Although Jordy had a sophisticated verbal repertoire, we used a communication card to ensure that our prompt would evoke the FCR. We could not have ensured his compliance with an echoic prompt (e.g., the therapist saying, "Ask for a break."), which would have prevented the reinforcement of the FCR.

A progressive time-delay prompt that increased across sessions by 5 s was used to teach Jordy to emit the escape FCR, after which he received a 30-s break from work. Next, and within the same sessions, Jordy was taught (also using a progressive time-delay prompt) to emit the tangible FCR, after which he received access to the iPad. Prompts consisted of the relevant prompting therapist vocally stating the request while physically guiding Jordy's hand to pick up a communication card (with the word "iPad" or "break") and make contact with the relevant therapist. Tangible FCRs were only reinforced if Jordy was on a break (i.e., the iPad was not available if Jordy had not yet asked for a break), which exemplified a chained reinforcement schedule (Ferster & Skinner, 1957). Because Jordy usually emitted the tangible FCR immediately following the escape FCR, he usually received about 30-s access to the iPad. Each response was considered mastered when Jordy emitted 80% independent FCRs across three consecutive sessions with the first FCR in the session occurring independently.

Complex FCT Jordy was then taught to emit complex FCRs using the same progressive time-delay prompt that was used

to teach the simple FCRs. Prompts in this condition were implemented for “excuse me” and eye contact only. In other words, once Jordy emitted those responses, prompts were no longer in place for the remainder of the response (i.e., the simple FCR). If Jordy began to emit the simple FCR prior to the programmed prompt for the complex FCR, the relevant prompting therapist immediately prompted him to say, “excuse me” and to look at the demand or tangible therapist but did not prompt the remainder of the response (i.e., the simple FCR).

SCPs To determine whether Jordy would emit each FCR in sessions in which only one of the two EOs (escape and tangible) was arranged, SCPs were conducted immediately following mastery of the simple FCRs. In the tangible SCP, only the tangible therapist and Jordy were in the clinic room, and he was not given any demands. The tangible therapist withheld the iPad and allowed Jordy 30-s access contingent on the tangible FCR. Escape FCRs in the tangible SCP received no consequences. In the escape SCP, only the escape therapist and Jordy were in the clinic room, and the escape therapist delivered the same demands as had been used throughout training. The iPad was situated next to Jordy’s writing materials and played a movie or show that he typically watched so that the only EO during the escape SCP was for escape. Tangible FCRs in the escape SCP resulted in the escape therapist stating, “We’re working” and resuming the three-step prompting sequence for compliance.

Altogether, at least four outcomes were possible during the SCPs: (a) similar levels of the relevant FCRs in respective SCPs as during synthesized FCT (e.g., rates of escape FCRs in the escape SCP comparable to those in synthesized FCT), (b) no or lower levels of FCRs in respective SCPs when compared to synthesized FCT (e.g., no escape FCRs during the escape SCP), (c) similar levels of irrelevant FCRs in respective SCPs when compared to synthesized FCT (e.g., escape FCRs in the tangible SCP), and (d) notwithstanding levels of FCRs, reemergence of problem behavior. Assuming problem behavior did not reemerge, data consistent with the first or second outcomes would be ideal. Data consistent with the first outcome would suggest either that problem behavior was indeed sensitive to isolated contingencies or that, if problem behavior were sensitive to the synthesized contingency, combining EOs and consequences during FCT would generalize to isolated contingencies. Data consistent with the second outcome would suggest either that problem behavior was not sensitive to isolated contingencies or that combining EOs and consequences during FCT would not generalize to the isolated contingencies. We specifically sought to ensure that the third and fourth outcomes did not occur—that is, that irrelevant FCRs would occur in respective SCPs and that problem behavior would reemerge.

Results

Results from Jordy’s FA and treatment evaluation are shown in Figs. 1 and 2, respectively. Jordy did not engage in problem behavior in the escape- or tangible-only conditions (Fig. 1, Sessions 1–13) of the FA. He did, however, engage in problem behavior in the synthesized (escape plus tangible) condition. Thus, we concluded that his problem behavior was sensitive to at least one of the contingencies included in the synthesized contingency. It is worth noting that Jordy did not emit any simple or complex FCRs during the FA (Fig. 2, second and third panels in baseline).

In the treatment evaluation (Fig. 2), Jordy acquired both (escape and tangible) simple and complex FCRs quickly and at about the same rate (second panel, Sessions 4–7; third panel, Sessions 10–16). For simplicity, only independent requests are shown. Following the first session of simple FCT (Session 4), all of Jordy’s FCRs were vocal (Jordy did not use the communication cards). In the simple FCT phase, Jordy only required prompting in the first two sessions: 86% of escape and 71% of tangible FCRs were prompted in Session 4; 14% of escape FCRs in Session 5 were prompted (all tangible FCRs were independent in Session 5). In the first complex FCT phase, Jordy similarly only required prompting in the first two sessions: 86% of escape and 43% of tangible FCRs were prompted in Session 10; 100% of escape and 67% of tangible FCRs were prompted in Session 11. Problem behavior immediately decreased to zero with the introduction of simple FCT, recovered in the return to baseline (top panel, Session 17), and decreased with the return to complex FCT (top panel, Sessions 18–21).

During the SCPs (Sessions 8–9), Jordy emitted higher levels of FCRs relevant to the EO in each session: tangible FCRs in the tangible SCP (Session 8) and escape FCRs in the escape SCP (Session 9). He did, however, emit problem behavior in the escape SCP prior to emitting the first FCR.

Discussion

We evaluated the effectiveness of teaching functionally and topographically dissimilar FCRs in the same FCT sessions following an FA with the synthesized contingency of escape and tangibles. Although the initially prompted FCRs for escape and tangibles were topographically similar (handing a communication card to the therapist for both FCRs), all of Jordy’s FCRs following the first session of FCT were vocal and were topographically dissimilar: The break request consisted of the word “break” and the tangible request consisted of the word “iPad.” Jordy acquired both FCRs quickly and emitted the relevant FCR in the presence of the respective isolated contingency only.

Fig. 1 Results of Jordy's FA; RPM responses per minute

Researchers have evaluated a variety of procedures with the aim of clarifying FA outcomes when problem behavior occurs in multiple test conditions (e.g., Falcomata, Wacker, Ringdahl, Vinquist, & Dutt, 2013; Lindauer, Zarcone, Richman, & Schroeder, 2002) or in a synthesized test condition (e.g., Ghaemmaghami et al., 2016, described earlier). For example, Lindauer et al. (2002) found that problem behavior of an adult with intellectual and developmental disabilities was elevated in both attention and tangible conditions in an FA, with higher rates occurring in attention. To determine the relative influence of each contingency, they arranged two concurrent-operant assessments: the first with problem

behavior, with different topographies resulting in either attention or access to tangibles, and the second with FCRs, with different FCRs (exchanging a communication card) resulting in either attention or access to tangibles. Although problem behavior during the FA was consistently elevated in the attention condition relative to the tangible, responding in both concurrent-operant assessments alternated between the attention and tangible response options.

Practitioners have also reported methods of affirming control in the context of communication-based interventions in general. For example, Frost and Bondy (2002) recommended presenting “desired” and “undesired” response options

Fig. 2 Results from Jordy's treatment evaluation. Problem behavior is shown on the top panel, and independent simple and complex FCRs are shown on the middle and bottom panels, respectively; *BL* baseline; *Tan* tangible; *Esc* escape; *RPM* responses per minute

simultaneously during communication training to ensure that card exchanges are in fact under the control of contingencies for preferred items. Although escape and tangibles technically were not designated in the current study as “desired” or “undesired,” we arranged abolishing operations (AOs) for one or the other depending on the SCP. An FCR that corresponded to the stimulus for which an AO was arranged might be characterized as incorrect. Our methods differed from Frost and Bondy, however, in that we specifically taught FCRs for each stimulus during FCT, and we did not conduct error correction during the SCPs (e.g., when Jordy requested the iPad during the escape SCP, we did not prompt him to emit the break FCR). Methods of evaluating stimulus control following communication training are important, although relatively infrequently reported, and may be promising future directions for research.

The purpose of our SCPs was to evaluate the extent to which FCRs acquired during sessions in which multiple EOs were presented and alternated would occur in sessions in which EOs were arranged in isolation. Technically, the escape FCR was taught in the presence of EOs for both escape and tangibles—Jordy was experiencing demands and did not have access to the iPad. During the escape SCP, only an EO for escape was arranged. Therefore, it was possible that the escape FCR would not generalize to stimulus conditions in which the EO for tangibles was absent (i.e., an AO). Conversely, the tangible FCR was taught in the presence of the EO for tangibles only and following a reinforced escape FCR. Therefore, it was possible that the tangible FCR would not generalize to stimulus conditions in which demands and reinforcement for the escape FCR did not precede the opportunity for reinforcement for the tangible FCR.

With the exception of one tangible FCR in the escape SCP (Session 9), Jordy never emitted an FCR in the absence of the relevant EO. Further, he emitted the tangible FCR in the tangible SCP. This is important to note, because during FCT, tangible FCRs were only reinforced immediately following either an escape FCR or compliance. Relatedly, relevant FCRs were emitted in respective SCPs at levels comparable to FCT. Together, these results suggest that the tangible FCR was only under the control of the contingency for tangibles and that it may be possible to teach two FCRs in the same session while avoiding development of a response chain. In this case, a response chain would be seen if tangible FCRs only occurred in non-SCP sessions, with the withdrawal of demands functioning as the discriminative stimulus for the tangible FCR. Avoiding such a chain is important, as the tangible FCR should be evoked by an EO for tangibles and not the removal of demands.

In addition to the development of a response chain, another potential concern with our procedures was stimulus control with respect to problem behavior. For example, it could be that the effects of treatment in the initial FCT sessions did

not generalize to SCP sessions, as problem behavior was initially suppressed in conditions in which both EOs were presented simultaneously. Indeed, problem behavior did not occur during treatment until Session 9, the first escape SCP, albeit at lower levels than in baseline. This does not necessarily reflect a lack of generalization, however, because problem behavior had not yet contacted extinction. In other words, problem behavior had not contacted the programmed extinction contingency during the initial treatment sessions. Thus, it may be useful to conduct SCPs if problem behavior does not contact extinction in initial treatment sessions to increase the likelihood that problem behavior continues to be suppressed when EOs are presented in isolation.

The present procedure may offer advantages over other methods of FCT following FAs with synthesized contingencies. For example, after FAs that included synthesized contingencies, Hanley, Jin, Vanselow, and Hanratty (2014) taught the omnibus mand “my way” to two children with autism. Each mand resulted in access to all reinforcers implicated in the FAs: for Bob, both escape and tangibles, and for Dale, escape, tangibles, attention, and request compliance. Although such a procedure is effective in decreasing problem behavior and teaching an appropriate communication response (e.g., Ghaemmaghami, Hanley, Jessel, & Landa, 2018; Hanley et al., 2014; Santiago, Hanley, Moore, & Jin, 2016), the extent to which the omnibus mand generalizes to situations in which EOs are presented in isolation is unclear. For example, if a child is not receiving demands and is deprived of tangibles, it is unclear whether the child will emit the omnibus mand evoked only by the EO for tangibles in the absence of demands. Further, from a verbal behavior point of view (Sundberg & Partington, 1998), it may be more desirable to teach mands that are as specific as possible, so that mands can specify the reinforcer that corresponds to a specific EO at any given time. For example, a child may have been taught the omnibus mand “my way” to access both escape and attention. An EO may only be in place for escape, resulting in the unnecessary delivery of attention, which could result in a caregiver diverting her attention from other tasks or siblings. In the current study, we taught two topographically and functionally unique FCRs (tangible and escape) within the same communication sessions, and the FCRs were acquired fairly quickly. However, the extent to which these procedures are more advantageous than other FCT methods (e.g., teaching functionally dissimilar FCRs in separate sessions or first teaching an omnibus FCR) is an empirical question. Future researchers may evaluate the relative pros and cons to teaching omnibus versus specific mands immediately during FCT, as well as participant characteristics that are associated with greater success of a particular approach (e.g., scores on language assessments).

Of course, it is possible that Jordy’s problem behavior was not maintained by the synthesized contingency of escape and

tangibles and that only one of the FCRs that we taught was functionally related to his problem behavior. Because we did not replicate the FA conditions of the isolated contingencies of escape and tangibles, it is unclear whether Jordy's problem behavior was in fact maintained by the synthesized contingency, or whether problem behavior would have occurred in one of the isolated-contingency conditions had additional sessions been conducted. For example, it could have been the case that Jordy's problem behavior was maintained only by access to the iPad, and the request for a break from instructions may have only initiated the behavior chain that ultimately resulted in access to the iPad. At worst, then, we taught two topographically and functionally dissimilar FCRs in the same FCT sessions, at least one of which was functionally equivalent to problem behavior.

In contrast, if Jordy's problem behavior were maintained by the synthesized contingency, it may have been unusual for the FCRs to occur in the SCPs. In other words, why would Jordy emit the isolated FCRs if his problem behavior were maintained by the synthesized contingency? It could have simply been the case that we developed two additional response classes, one each for tangibles and escape. For example, research on the use of tangible conditions in FAs (e.g., Rooker, Iwata, Harper, Fahmie, & Camp, 2011) has shown that it is possible to develop a tangible function for behavior in cases in which one previously did not exist. It could be that here, we did so with an appropriate response (the FCR), which certainly does not appear undesirable from a clinical point of view.

An additional caveat to this procedure is that its effectiveness with individuals with less sophisticated verbal repertoires is unknown. Jordy engaged in age-appropriate tacts, mands, and intraverbals. Individuals with deficits related to the main verbal operants may not acquire topographically and functionally dissimilar mands in the same treatment sessions, although this is an empirical question. In addition, four therapists were present during FCT, which is likely unreasonable in traditional clinical settings. We were able to arrange four therapists and did so to evaluate the effectiveness of our procedures when implemented in the ideal arrangement. The extent to which these procedures may be implemented with one or two therapists, or whether modifications could be made to increase their practicality, should be evaluated. Finally, we did not present data related to schedule thinning or response chaining (e.g., teaching Jordy to comply with instructions before escape FCRs would be reinforced), which would be an informative future direction for those conducting FCT in a synthesized context. In any case, this study presents a method that may be useful for at least some individuals who engage in problem behavior.

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Compliance with Ethical Standards

Conflict of Interest All authors declare they have no conflicts of interest.

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

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

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