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FUNCTIONAL ANALYSIS OF CHALLENGING BEHAVIOR IN PEOPLE WITH SEVERE INTELLECTUAL DISABILITIES[1, 2]

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Summary.—Challenging behaviors exhibited by individuals with developmental disabilities often hinder the acquisition of academic, social, and life skills. Functional analysis has been useful for assessing challenging behavior in various settings. The purpose of this study was to implement an operant methodology for recognizing the functional properties of challenging behavior in people with intellectual disabilities. Four adults diagnosed with profound intellectual disability received assessment under several experimental conditions using a functional analysis methodology: social attention as positive reinforcement, negative reinforcement such as the termination of demands, positive tangible reinforcements, absence of social contingencies, and escape from noisy stimuli. Results showed that different types of reinforcement or avoiding contingencies affected the rate of aggression, self-injury, disruption, stereotypy, or socially offensive behaviors, and functional analysis may potentially be a viable alternative for identifying challenging behaviors.

Challenging behavior is common among individuals with autism spectrum disorders and with other intellectual disabilities. Educators and parents of children with Autism Spectrum Disorder often identify the treatment of challenging behavior as a primary intervention priority (Rispoli, Lang, Neely, Camargo, Hutchins, Davenport, *et al*., 2013) because challenging behavior is a major impediment to the delivery of educational services. Challenging behavior exhibited by individuals with Autism Spectrum Disorder or developmental disabilities often hinder the acquisition of essential academic, social, and life skills, and they present a significant challenge to parents, educators, and other care providers (Bat-haee, 2001; Falcomata, Roane, Muething, Stephenson, & Ing, 2012).

The notion of challenging behavior (including tantrums, self-injury, aggression, excessive stereotypy, and/or elopement) as functional operants represented a change in the way that challenging behaviors are understood and in the way that interventions for challenging behavior are developed (Iwata, Dorsey, Slifer, Bauman, & Richman, 1994; Ramasamy, Taylor, & Ziegler, 1996; Dunlap & Fox, 2011). Challenging behavior frequently functions as a way for the patient to escape or avoid task demands

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(Iwata, *et al*., 1994) or are maintained by automatic reinforcement (persistence of responding in the absence of social contingencies; Roscoe, Iwata, & Zhou, 2013). Carr (1977) indicated that challenging behavior may be reinforced through extrinsic sources (e.g., attention, termination of demands), or that the behavior itself may produce some form of intrinsic reinforcement (e.g., sensory stimulation, pain reduction). Carr suggested that one means of selecting a potentially effective treatment would consist of first determining what is currently maintaining the behavior.

Functional analysis has been useful for assessing challenging behavior under a variety of conditions (Lehardy, Lerman, Evans, O'Connor, & Lesage, 2013). Most challenging behaviors are linked to a set of predictable consequences (e.g., obtaining attention, avoiding demands); understanding these specific consequences enables the design of more effective, individualized interventions. It also delineates the consequences (functions) that have been shown to maintain the behavior and the antecedent stimuli (Hanley, Iwata, & McCord, 2003).

Precursors of challenging behavior are defined as behaviors that may predict occurrences of the target problem behavior (Fritz, Iwata, Hammond, & Bloom, 2013). Assessment of precursors of challenging behavior may predict occurrences of the target problem behavior (Smith & Churchill, 2002). Recent studies have shown that precursors and severe problem behavior can be maintained by the same reinforcement and that placing reinforcement contingencies on precursors may decrease the rate of severe problem behavior (Herscovitch, Roscoe, Libby, Bourret, & Ahearn, 2009; Fritz, *et al*., 2013). Therefore, assessing the function of precursors can reduce the rates of severe behavior observed during assessment (Dracobly & Smith, 2012). For example, Borrero and Borrero (2008) used classroom observations followed by conditional probability and lag-sequential data analysis to conclude that loud vocalizations were predictive of property destruction, self-injury behaviors, or aggression. The applied benefit of a precursor evaluation is its potential as a basis for treatment. The study by Dracobly and Smith (2012) established that when a behavior can be inferred from its precursors, treatment for the most severe behavior might be established on assessment of less severe behavior.

A powerful inference of functional analysis is that when the specific consequences maintaining a challenging behavior are identified, they can be used to establish acceptable responses that become functionally equivalent replacements for the challenging behavior (Dunlap & Fox, 2011). Studies that included functional analysis to identify the function of challenging behavior also led to the formation of effective treatments (Cannella, O'Reilly, & Lancioni, 2006; Roscoe, *et al*., 2013). In those studies, the reinforcer that maintained the challenging behavior was withheld using differential reinforcement strategies (Schindler & Horner, 2005). The rein-

forcer was provided either non-contingently or contingently upon appropriate conduct (Tucker, Sigafoos, & Bushell, 1998; Lehardy, *et al*., 2013), or by changes in the instructional context (Schilling & Schwartz, 2004).

In recent years, researchers have been refining an operant methodology for identifying the functional properties of challenging behavior (Fritz, *et al*., 2013; Roscoe, *et al*., 2013), considering it is necessary to complete in a naturalistic setting (Chiang, 2008; Castonguay, Barkham, Lutz, & McAleavey, 2013). Therefore, the purpose of the current study was to extend previous research involving behavioral interventions for challenging behavior and to present the results obtained with a new assessment protocol. In this setting, the participants' behavior was repeatedly observed with a computerized procedure and controlled across several behavioral conditions in a natural setting. A new version of The Observer XT, a professional software package for the collection and analysis of observational data, was used. This new approach for assessing challenging behavior, rarely used in naturalistic contexts with autism spectrum disorders or other intellectual disabilities, allows the different topographies of problem behavior to be presented separately. Finally, the control conditions were modified in an effort to more directly match them to the test condition, using a pairwise experimental design.

Method

Participants

Four individuals ("Izco, Varo, Juan, and Jorge" used for reference) with severe developmental disabilities were recruited from a special education center for adults. Recruitment was based on staff and caregiver observations, clinical interviews, and results from the Inventory for Client and Agency Planning (Montero, 1996), which assesses five types of behavior problems: self-injury, aggression, stereotypy, socially offensive behaviors, and elopement. All participants engaged in two or more challenging behaviors. Participant characteristics, age (M=39.5 yr., SD=6.2), diagnostic classification, and definition of the target challenging behavior, are listed in Table 1.

Juan's IQ was evaluated with the Spanish version of the Wechsler Adult Intelligence Scale (Wechsler, 2008) (IQ=36). Because Izco, Varo, and Jorge had restricted communication skills, it was not possible to use the WAIS for assessment of IQ. Intellectual capability was estimated after clinical criteria by an expert psychologist, a staff member of the institution, following the DSM-IV–TR (American Psychological Association, 2000) standards. The psychologist was an expert in intellectual disability and had a deep knowledge of all participants.

Cognitive state for participants was assessed by Mini-Mental State Examination (Lobo, Esquerra, Gomez-Burgada, Sala, & Seva, 1979). All participants presented severe cognitive impairment: Juan: 07 (out of 35); Izco: 00; Varo: 00; and Jorge: 00.

TABLE 1
PARTICIPANTS' CHARACTERISTICS

Name	Classification	Target Problem Behaviors
Izco, Age 42	Autism Spectrum Disorder and profound intellectual disability	Self-injury: a1 (Hand hitting: hand banging against table), a2 (chest hitting: hand-to-chest), a3 (leg hitting: hand-to-leg), a4 (belly hitting: hand-to-belly), a5 (head banging: hand-to-head), a6 (arm hitting: hand-to-arm)
		Aggression: b1 (slapping other individuals), b2 (kicking other individuals)
		Disruptive behaviors: c1 (elopement: leaving a specific area without permission)
Varo, Age 33	Autism Spectrum Disorder and profound intellectual disability	Self-injury: a1 (head banging: hand-to-head), a2 (specific hand mouthing; contact between the thumb and the palate)
		Aggression: b1 (pulling other people's clothes), b2 (slapping other individuals), b3 (kicking other individuals), b4 (pulling other people's hair), b5 (pinching other individuals)
		Stereotypic behaviors: c1 (body rocking: engaging in repetitive body movements such as rocking), c2 (wandering: moving from place to place without a fixed plan)
Juan, Age 43	Autism Spectrum Disorder and severe intellectual disability	Self-injury: a1 (biting own clothes), a2 (hand mouthing; contact between the thumb and the mouth), a3 (mouthing objects: putting of non-food objects in his mouth), a4 (slapping himself: hand-to-face)
		Disruptive behavior: b1 (shouting: screaming with unknown reasons)
Jorge, Age 40	Down Syndrome, profound intellectual disability, and Obsessive Compulsive Disorder traits	Self-injury: a1 (leg hitting: hand-to-leg), a2 (chest hitting: hand-to-chest), a3 (slapping himself: hand-to-face), a4 (hand hitting: hand banging against table), a5 (hand banging against pad)
		Aggression: b1 (slapping other individuals), b2 (kicking other individuals)

Functional and communication skills were assessed by Inventory for Client and Agency Planning (Montero, 1996). All participants scored very low in all specific adaptive behaviors sub-test (motor skills, personal living abilities, social and communication skills, and community living abilities): Juan: 35 out of 100, Izco 01, Varo 13, and Jorge 33.

The participants were residents of severe mental disabilities Unit "Vista Hermosa AFANAS-Jerez." It is a non-government organization, an institution serving people with mental disabilities for 50 years. When this study was

TABLE 2
SPECIFIC DESCRIPTION OF EXPERIMENTAL AND CONTROL CONDITIONS

Test for	Control	Experimental	Functional Hypothesis
Positive automatic reinforcement (self-stimulation)	Participant received sensorial external stimulation: massage with a massage device, soothing music, flashing lights.	Participant was alone in an empty room, with no toys or other stimuli, and no specific activity was programmed.	If challenging behavior rate was higher under the experimental condition, then challenging behavior was a function of self-stimulation.
Social positive reinforcement (attention)	Participant was in the classroom with two caregivers implementing curriculum activities. Caregivers paid attention to the participant every 10 sec., disregarding any challenging behavior.	Participant received social positive reinforcement (attention) each time that a challenging behavior occurred.	If challenging behavior rate was higher under the experimental condition, then challenging behavior was a function of social positive reinforcement.
Negative reinforcement (escape/avoidance)	Participant was in a classroom with two caregivers implementing curriculum activities.	Participant was required to solve various curriculum activities of increasing difficulty (sticking pins on a corkboard, solving puzzles, storing tokens in a box, etc). If challenging behavior appeared, a 15-to-30-sec. break was allowed.	If challenging behavior rate was lower under the experimental condition, then challenging behavior was a function of social negative reinforcement.
Tangible positive reinforcement (access)	Participant was with the experimenter in an empty room, with several preferred toys. Participant was allowed to hold toys at any time.	Several preferred toys were available in the classroom, but the participant was not allowed to play with them. However, the participant was allowed to hold the toys for a short time when challenging behavior occurred.	If challenging behavior rate was higher under the experimental condition, then challenging behavior was a function of tangible positive reinforcement.

(continued on next page)

TABLE 2 (CONT'D)
SPECIFIC DESCRIPTION OF EXPERIMENTAL AND CONTROL CONDITIONS

Test for	Control	Experimental	Functional Hypothesis
Negative reinforcement (escape)	Participant was in a classroom with the caregiver implementing programmed curriculum activities.	Caregiver turned on loud music for approximately 30 sec. If challenging behavior appeared, the caregiver turned the volume off for approximately 1 min.	If challenging behavior rate was higher under the experimental condition, then challenging behavior was a function of negative reinforcement.
Negative reinforcement (escape)	Participant was in a classroom with a caregiver for three (15 min.) sessions. Participant was exposed to challenging behavior eliciting stimuli (open window, turn off radio, open a drawer). No blocking action was implemented by caregiver.	Participant was exposed for three (15 min.) sessions to eliciting challenging behavior stimuli. Caregiver blocked Jorge starting challenging behavior.	If challenging behavior rate was higher under the experimental condition, then challenging behavior was a function of positive automatic reinforcement.

carried out, a total of 39 adults were users of the Day Care Unit. This Unit grouped users in five classrooms, 5 to 7 people each. Clinical, rehabilitative, and educational services were provided by 12 experienced staff. All users had a specific and personal treatment program. All participants in this study were selected because they had persistent challenging behavior and a very weak response to treatment. They had been treated by behavior modification and/or special education training. This study was carried out after obtaining permission from both the parents and the institution.

Data Collection

All sessions were recorded on video, and the videos were analyzed with The Observer XT 10.0 (Noldus Information Technology, 2011) scoring and analysis software. The Observer XT is a professional and user-friendly software package for the collection, analysis, and presentation of observational data, and has been used in behavioral studies of people with Autism Spectrum Disorder or other disabilities (Talbott, Nelson, & Tager-Flusberg, 2013). The introduction of data requires a previous template, which includes topography details for each behavioral category and the contextual conditions (discriminative stimuli and consequences) that are considered relevant to be in-

cluded in the project. The data recording in the observation module displays the video; behaviors are coded manually. These video files enable researchers to check behaviors in a systematic way; to rigorously examine the frequency, duration, and intensity of each selected behavior; and to perform data entry and generate reports and statistical charts. For the current study, a template for the target problem behaviors was created (see specific target behaviors in Table 1), and then each session was videotaped with two cameras. Data collection was carried out by the authors with a total of 20 videotaping hours. The parents of participants in this study provided informed consent.

Procedure

Each participant was exposed to several experimental conditions to investigate five hypotheses of challenging behavior: (a) social attention reinforces challenging behavior, (b) negative reinforcement (such as the termination of task demands, considered unpleasant—Izco and Varo; or avoiding an obsessive compulsive ritual—Jorge) maintains challenging behavior, (c) self-stimulation maintains challenging behavior (automatic positive reinforcement), (d) tangible positive reinforcement maintains challenging behavior, and (e) escaping from noisy stimuli maintains challenging behavior. For each condition, 3 experimental and 3 control randomized sessions were planned. A 15 min. break between sessions was introduced. Izco and Juan received nine, 15 min. each, experimental and nine same-length control sessions; Varo received 12, 15 min. each, experimental and 12 control sessions because he was exposed to four conditions; and Jorge received three, 15 min. each, experimental and three same-length control sessions. Experimental sessions were carried out in the participants' classroom, keeping their daily routines. During experimental sessions, an observer recorded behaviors for Observer XT and another experienced caregiver introduced the experimental conditions.

Two observers independently scored responses during 50% of the video-recorded sessions (a total of 10 hr.). Both observers received specific training in using the Observer XT software and functional analysis. All videotaped sessions could be rechecked and slowed down, as often as necessary, improving observation accuracy. Occurrence reliability percentages were calculated on an interval-by-interval basis by dividing the number of agreements by the number of agreements plus disagreements, and multiplying by 100. Occurrence agreement averaged 91%, 99%, and 99% for each participant (Cohen's $\kappa = .92$; $p < .001$).

Results and Discussion

Izco's self-injury behaviors frequently occurred after he received some type of positive reinforcement (social attention or self-stimulation; Fig. 1). Izco's hand banging and arm hitting changed rates under negative reinforcement, but hand banging behavior increased in frequency only under

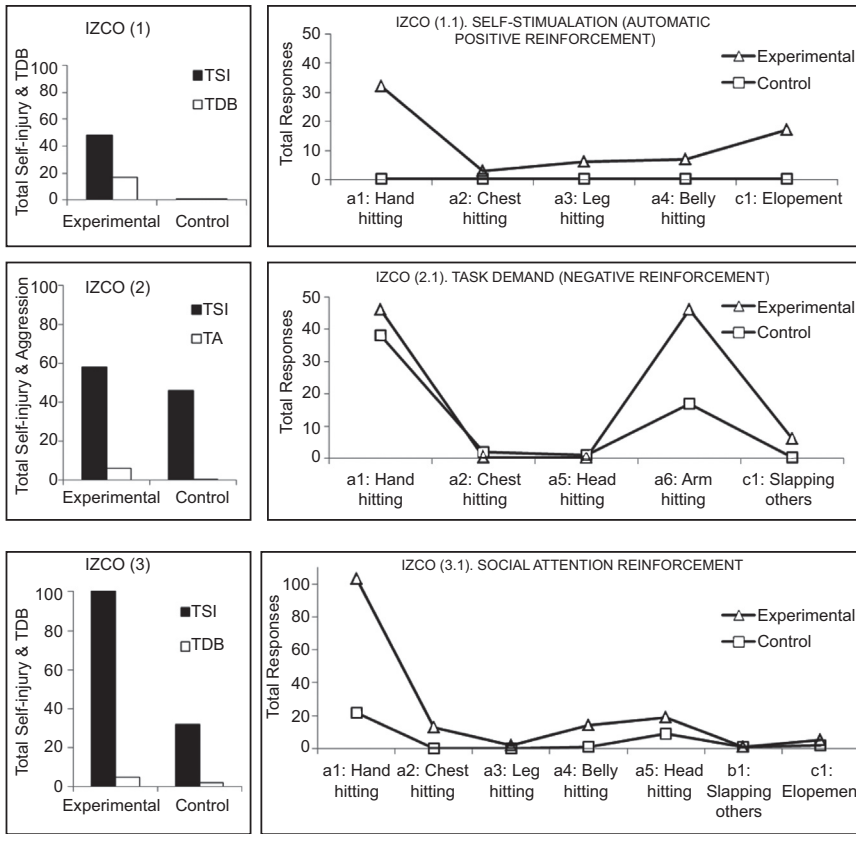

FIG. 1. Izco's challenging behaviors observed during the experimental and control sessions. Izco received three experimental conditions: self-stimulation (1.1), task demands (2.1), and social attention reinforcement (3.1). TSI, total self-injury; TA, total aggression; TDB, total disruptive behaviors.

automatic positive reinforcement. Izco's aggressive behavior allowed him to escape from task demands, rather than serving to provide self-stimulation. Elopement seemed to be maintained by positive reinforcement (self-stimulation and social attention). These relations of precursors-behavior-consequences were easily established by Observer XT data. The approach allowed a systematic following up of precursors and consequences of challenging behavior in naturalistic settings, increasing predictive validity. These findings provide further evidence for the utility of functional analysis as a viable method for identifying contingencies that maintain severe problem behavior (Smith & Churchill, 2002; Dracobly & Smith, 2012; Lehardy, *et al*., 2013). This functional relationship had particular impor-

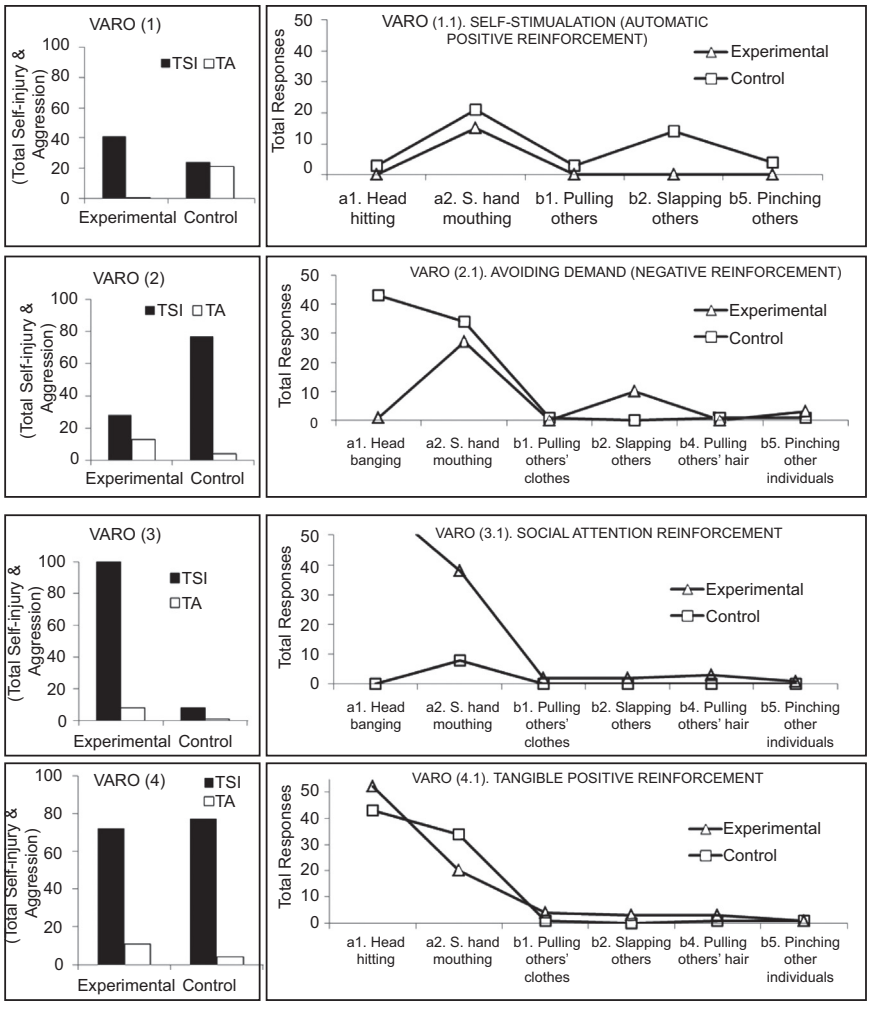

FIG. 2. Varo's challenging behaviors observed during the experimental and control sessions. Varo received four experimental conditions: self-stimulation (1.1), avoiding demand (2.1), social attention reinforcement (3.1), and tangible positive reinforcement (4.1). TSI, total self-injury; TA, total aggression.

tance in this study. The participants observed had severe intellectual disability, with a long history of challenging behaviors. In addition, they also had a wide range of severe communication skills restrictions.

Varo's challenging behavior was sensitive to different experimental conditions (Fig. 2). Self-injury behavior was more sensitive to self-stimulation. Aggression was more sensitive to negative reinforcement, so-

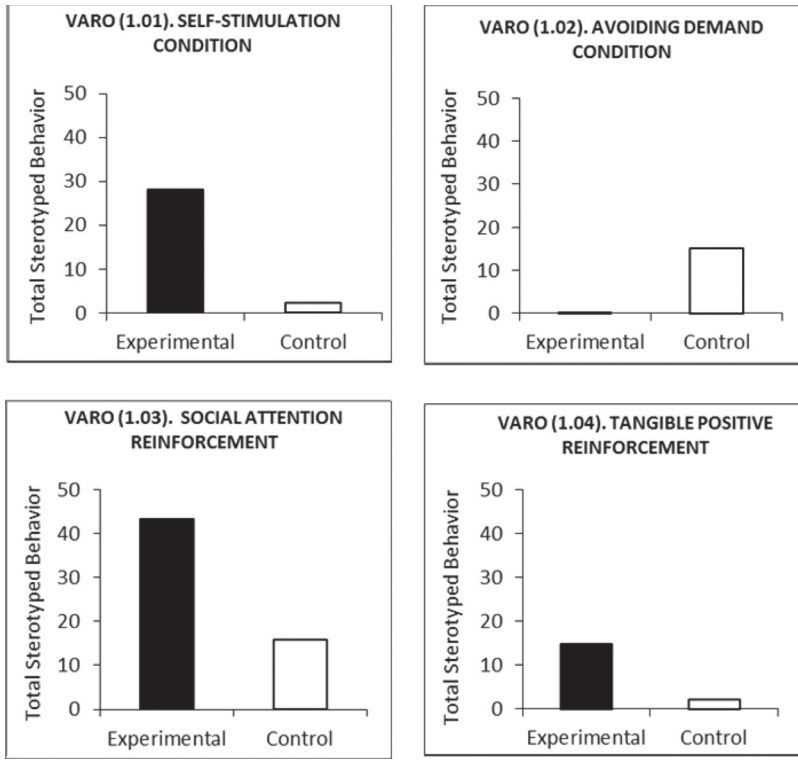

FIG. 3. Total time of Varo's stereotyped behaviors under four experimental conditions: self-stimulation (1.01), avoiding demands (1.02), social attention reinforcement (1.03), and tangible positive reinforcement (1.04).

cial attention, and tangible reinforcement acquisition than to avoiding task demands. These results were not expected, but suggested that under the self-stimulation condition Varo received 15 min. of sensorial external stimulation (massage, electric toothbrush, peanut butter, ice), a type of stimulus unusual for him. It is possible that proprioceptive stimulation tasks, offered during experimental sessions for assessing automatic positive reinforcement, were unusual events for this participant. They had not been experienced earlier. The short-term experimental sessions provoked avoiding behaviors rather than self-stimulation reinforcement. As Falcomata, *et al*. (2012) suggested, the participants' preferences for leisure activities may be responsible for challenging behavior. Varo's stereotyped behavior (body rocking) was more sensitive to social attention and tangible positive reinforcement than to automatic reinforcement. Antecedent (e.g.,

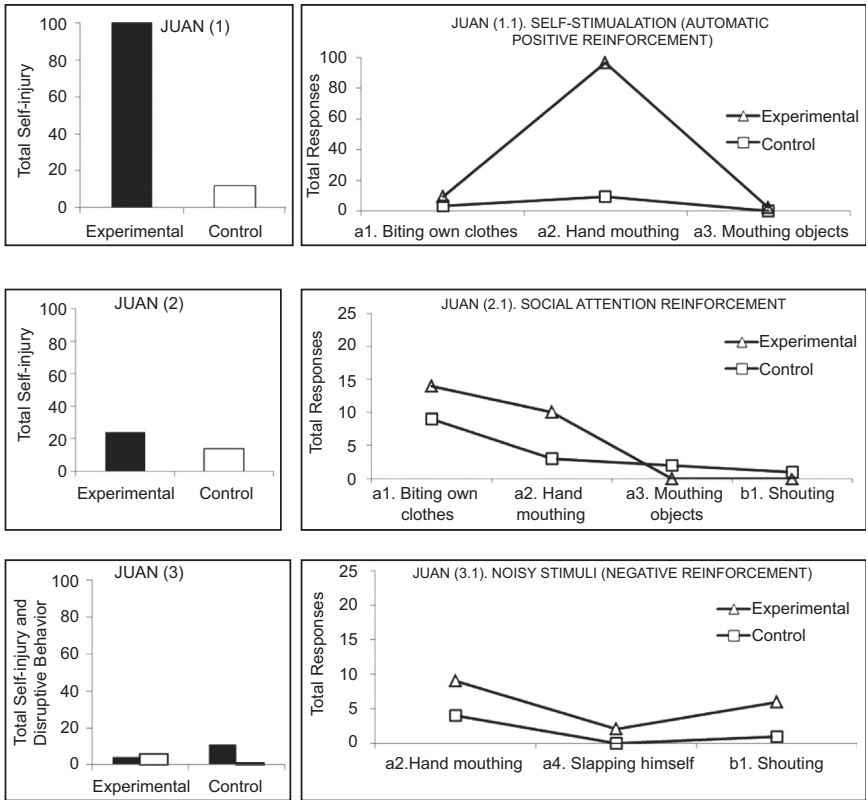

FIG. 4. Juan's challenging behaviors observed during the experimental and control sessions. Juan received three experimental conditions: self-stimulation (1.1), social attention reinforcement (2.1), and noisy stimuli (3.1).

environmental enrichment) and consequent (e.g., differential reinforcement of alternative behavior) interventions are known to produce at least short-term reductions in stereotypy (Hagopian & Toole, 2009).

Juan's challenging behavior was identified as self-injury and disruptive behavior (Fig. 3). He was exposed to three experimental conditions: social attention reinforcement, noisy stimuli (negative reinforcement), and self-stimulation (automatic positive reinforcement). Negative reinforcement was responsible for shouting, and automatic reinforcement and social reinforcement were responsible for self-injury. Shouting to escape from noisy stimuli always occurred, and sometimes Juan immediately engaged in self-injury behavior. This double reaction functionally explained

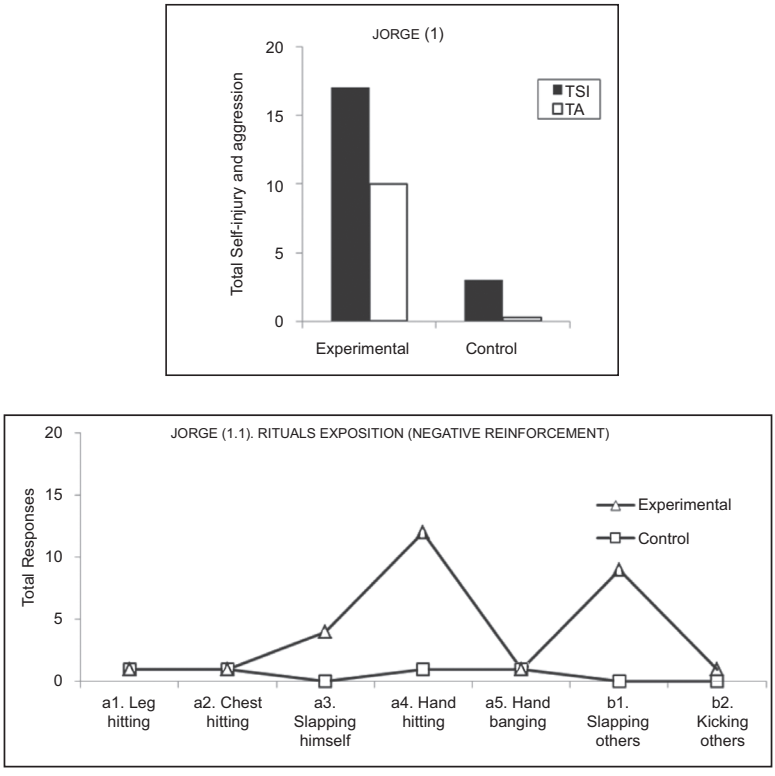

FIG. 5. Jorge's challenging behaviors observed during the experimental and control sessions. Jorge received one experimental condition: rituals exposure.

a previous observation that challenging behavior can be precursors of other severe behaviors (Matson & Wilkins, 2009).

Jorge was exposed to a single experimental condition: to inhibit obsessive convulsive rituals (closing a drawer or a window or turning on the radio). Under these experimental conditions, slapping himself, hand banging the table, and slapping others were more frequent (Fig. 5). For example, in the experimental condition the window was intentionally open. When Jorge tried to close it, he was blocked by the experimenter. Jorge then began to exhibit challenging behavior. However, when he was allowed to close the window (control condition), challenging behavior did not appear. One consequence of this process observed from the experimental sessions was to confirm Jorge's obsessive compulsive disorder.

The present investigation indicates that challenging behavior has multiple acquisition and maintaining factors. In light of the importance

of identifying all functions that maintain challenging behavior for an individual with intellectual disability, this functional analysis methodology appears to be useful. However, additional methods of accurately identifying multiple functions will most likely be needed. Several studies previously focused on various aspects of challenging behavior, including its topographical and functional characteristics (Lang, Davis, O'Reilly, Machalicek, Rispoli, Sigafoos, *et al*., 2010), both of which are critical issues when designing treatments. Although the approach illustrated in this study was both resource- and time-intensive, challenging behavior and other behavior disorders would benefit from this methodology. Several types of research (prevalence, descriptive, and experimental) are still needed to address challenging behavior, and hope that functional analysis directly answers several questions to promote the design of more efficient treatment procedures. Nonetheless, further research is needed to establish the utility and validity of this approach, focusing not only on the behaviors' frequency and duration, but also on the intensity of challenging behavior. Also, a larger number of participants would be included to increase the external validity of this study.

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