This is a post-peer-review, pre-copyedit version of a chapter published in the *Handbook of treatments for autism spectrum disorder* edited by J. L. Matson. The final authenticated version is available online at: https://doi.org/10.1007/978-3-319-61738-1_10

Comorbid Challenging Behaviors

Marc J. Lanovaz

Université de Montréal

John T. Rapp

Auburn University

Alexie Gendron, Isabelle Préfontaine, & Stéphanie Turgeon

Université de Montréal

Author Note

The literature review and analyses presented in the chapter were funded in part by a grant and a salary award from the Fonds de recherche du Québec – Santé to the first author.

Introduction

Researchers have shown that individuals with autism spectrum disorders (ASD) engage in higher levels of challenging behaviors than individuals with other developmental disabilities (Arron, Oliver, Moss, Berg, & Burbidge, 2011; Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; McClintock, Hall, & Oliver, 2003; Rojahn, Wilkins, Matson, & Boisjoli, 2010). Individuals with ASD also present the highest prevalences for specific forms of challenging behaviors including self-injury, aggression, and stereotypy (Chebli, Martin, & Lanovaz, 2016; Emerson et al., 2001; Farmer & Aman, 2011; Matson & Shoemaker, 2009; Rojahn et al., 2009). These results indicate that challenging behaviors are clearly a significant issue in children, adolescents, and adults with ASD that practitioners must take into consideration when developing treatment plans.

Characteristics of Challenging Behaviors

Although the research literature contains multiple definitions of challenging behaviors, researchers generally agree that a behavior is challenging when it poses a threat to the development, health or security of the individual with ASD or others (e.g., caregivers, educators, siblings), and when functional abilities are compromised (Dunlap et al., 2006; Minshawi, Hurwitz, Morris, & McDougle, 2014; Rojahn, Matson, Lott, Esbensen, & Smalls, 2001). As part of the current chapter, we will use this broad definition when referring to challenging behaviors. Usually described by their observable properties, challenging behaviors vary in terms of nature, frequency, duration, and intensity (McGill, Hughes, Teer, & Rye, 2001). Frequently reported topographies of challenging behaviors are self-injurious behaviors (SIB), aggression and destruction, and stereotypy (Baghdadli, Pascal, Grisi, & Aussilloux, 2003; Chebli et al. 2016; Emerson et al., 2001; Matson & Nebel-Schwalm, 2007; McTiernan, Leader, Healy, & Mannion,

2011; Rojahn et al., 2001). The occurrence of each topography is not mutually exclusive: The behavioral profiles of individuals with ASD often include occurrences of multiple different forms of challenging behaviors (Mazurek, Kanne, & Wodka, 2013; McClintock et al., 2003).

Researchers typically define SIB as self-directed behaviors that may inflict physical harm to one's own body (Carr, 1977; Iwata, Dorsey, Slifer, & Bauman, 1982/1994). Commonly observed forms of SIB include head banging, hair pulling, biting, eye poking, scratching, self-punching, self-slapping, and self-pinching (Baghdadli, et al., 2003; Carr, 1977; Iwata, Pace et al., 1994; Matson & LoVullo, 2008). Cases involving intake of inedible items (pica) or fluids and the use of objects or furniture to harm one's self have also been reported in the research literature (Kahng, Hausman, & Jann, 2011; Luiselli, Cochran, & Huber, 2005; Mitter, Romani, Greer, & Fisher, 2015).

A second common category of challenging behaviors is aggression and destruction, which are often associated with high risks of injuries to one's self and others (Matson, Boisjoli, Rojahn, & Hess, 2009). Aggression is a challenging behavior that is directed towards somebody else that causes, or has the potential to cause, physical or psychological harm. Some prevailing topographies of aggression are shouting, cursing, insulting, threatening, hitting, pinching, biting, kicking, and hair pulling (Roane & Kadey, 2011). On the other hand, destruction is the act of damaging property by throwing, breaking, knocking over or tearing objects or furniture apart (Mitter et al., 2015; Roane & Kadey, 2011). Destruction is similar in form to aggression, but it is directed towards objects rather than other individuals.

A third common category of challenging behaviors is stereotypy, which is generally defined as repetitive and invariant behaviors, activities, or interests that have no apparent social function (MacDonald et al., 2007; Rapp & Vollmer, 2005). At a young age, stereotypy is

common among typically developing children (Thelen, 1979). Its frequency tends to stay stable or to decrease between the ages of 2 and 4 in children without disabilities while it generally increases in children with ASD (MacDonald et al., 2007). Manifestations of stereotypy can include motor or vocal behaviors that vary across individuals, time, and settings. Examples of repetitive motor movements include hand flapping, body rocking, pacing, head rolling or weaving, object spinning, and twirling (Chebli et al., 2016; Crosland, Zarcone, Schroeder, Zarcone, & Fowler, 2005). Examples of vocal stereotypy involve any repetitive sounds and non-contextual phrases that happen without apparent intention to interact such as unrecognizable words or vocalizations, non-contextual laughing, giggling, and repetition of words or phrases (Lanovaz & Sladeczek, 2012; MacDonald et al., 2007).

Challenging behaviors can take other forms that have not been discussed previously such as noncompliance (Plumet & Veneziano, 2014; Wilder, Harris, Reagan, & Rasey, 2007). Noncompliance can be generalized to all people and environments, or it can be specific to one person, a type of demand or a location. Other examples of challenging behaviors reported in the research literature include elopement or running away, stripping, inappropriate touching, and food stealing (Luiselli et al., 1999; Newman, Summerhill, Mosley, & Tooth, 2003; Olive, Lang, & Davis, 2008; O'Reilly, Edrisinha, Sigafoos, Lancioni, & Andrews, 2006; Schmidt, Drasgow, Halle, Martin, & Bliss, 2014; Vaughn, Wilson, & Dunlap, 2002).

Prevalence of Challenging Behaviors

Identifying the exact prevalence of challenging behaviors in individuals with ASD is problematic due to the diverse methodologies used across studies. These differences in methodologies include the use of small or heterogeneous samples in respect to diagnosis (i.e., ASD, autism, PDD-NOS), sex and age, and variations in operational definitions of challenging

behaviors. Other issues are the adoption of a single data collection method or of a single informant as well as the use of non-psychometrically validated data collection instruments. That said, we will offer a general overview of prevalence using specific studies to provide an estimate for each topography.

Multiple studies have evaluated the overall prevalence of challenging behaviors in individuals with ASD. Parents and caregivers have reported prevalences of challenging behaviors ranging from 36% to 94% in multiple samples of individuals with ASD (Baghdadli, et al., 2003; Bodfish, Symons, Parker, & Lewis, 2000; Murphy, Healy, & Leader, 2009). In a more recent study, McTiernan et al. (2011) reported that 94% of their sample presented one or more topographies of challenging behaviors using staff members as informants. Some authors have studied the risk factors associated with high prevalences of challenging behaviors within clinical populations. High levels of impulsivity, low levels of communication skills, and high severity of ASD characteristics were found to predict higher prevalences and severity of challenging behaviors (Arron et al., 2011; Matson & Shoemaker, 2009; Mazurek et al., 2013; Rojahn et al., 2009).

Regarding more specific forms of challenging behaviors, studies of SIB have reported prevalences from 20% to 69% in individuals with ASD (Baghdadli et al., 2003; Bodfish et al., 2000; Matson & Rivet, 2008; Mazurek et al., 2013; McTiernan et al., 2011; Richards, Oliver, Nelson, & Moss, 2012; Rojahn et al., 2009). In a recent study by Rattaz, Michelon and Baghdadli (2015), parents of 152 adolescents with ASD completed the Aberrant Behavior Checklist. The analysis of the results indicated that 36% of the sample engaged in at least one form of SIB. The severity of autistic symptomatology was found to be the most important risk

factor for displaying SIB. As with other studies, low levels of communication skills and impulsivity were also identified as predictors for engagement in the behavior.

Prevalence estimates for aggression and destruction also vary considerably across studies. Tyrer et al. (2006) found that 29% of the adults with autism presented aggressive behaviors while Mazurek et al. (2013) reported prevalence of 54% in their sample of 1,584 of children aged 2 to 17 years old. The latter study also noted age as being significantly associated with aggression. In fact, the researchers found that the highest prevalence was in children aged from 5 to 7 years old. McTiernan et al. (2011) reported a prevalence similar to the one found by Mazurek et al. (2013). According to their results, 56% of their sample of 174 participants with ASD aged from 3 to 14 years exhibited aggressive or destructive behaviors. When considering destruction alone, Matson and Rivet (2008) indicated that at least 29% of their sample of adults with ASD engaged in this type of behavior. Finally, stereotypy appears to have the highest prevalence, which is expected given that it is a defining feature of ASD. In a recent systematic review, Chebli et al. (2016) reported that 88% of individuals with ASD engaged in at least one form of stereotypy. Chebli et al. found that sensory stereotypy (e.g., gazing at lights, rubbing or sniffing objects) was the highest recorded type of stereotypy, followed by object stereotypy (e.g., spinning toys), locomotion (e.g., pacing), hand/finger movement (e.g., hand flapping), and vocal stereotypy (e.g., echolalia).

Impact of Challenging Behaviors

Engagement in challenging behaviors may have serious consequences on individuals with ASD and those around them (e.g., caregivers, instructors). This section highlights some of the potential impacts of untreated challenging behaviors. Regardless of form, one of the main collateral effects of engaging in challenging behaviors is increased levels of parental stress

(Lecavalier, Leone, & Wiltz, 2006). A study conducted by Tomanik, Harris, and Hawkins (2004) found that communication difficulties, limited interaction with others, and restricted abilities to care for one's self were also highly correlated with maternal stress. Increased levels of stress may result in higher psychological distress, more mental health issues, and marital conflicts.

The topography of challenging behaviors with the most obvious impact on the individual is SIB. Engaging in SIB may produce bruises, swelling, lacerations, fractures, induced blindness, physical malformations, and infections (Carr, 1977; Luiselli et al., 2005; Minshawi, Hurwitz, Morris, & McDougle, 2014; Underwood, Figueroa, Thyer, & Nzeocha, 1989). In extreme cases, self-injury can lead to medical interventions, hospitalization, and even death (Baghdadli et al., 2003; Mandell, 2008; Minshawi, Hurwitz, Morris, & McDougle, 2014). In addition to physical harm, SIB reduces an individual's well-being as it negatively affects social skills, leads to social stigmatization, increases isolation, limits educational and vocational opportunities, and restricts one's access to community-based activities (Luiselli et al., 2005; Minshawi, Hurwitz, Morris, & McDougle, 2014).

Given their consequences for others, aggression and destructive behaviors may also interfere with opportunities to be included in learning environments and community activities. Moreover, individuals who exhibit aggression and their caregivers are at risk of suffering from physical and emotional distress (Matson et al., 2009; Roane, & Kadey, 2011). For individuals with ASD, untreated aggressive behaviors may result in their removal from school settings, residential settings, and work environments (Marcus, Vollmer, Swanson, Roane, & Ringdahl, 2001). Mandell (2008) also found that aggressiveness towards others poses a considerable risk of hospitalization in psychiatric facilities for children diagnosed with ASD. Additionally,

aggression and destruction can induce social impairments, high financial costs, and exposure to harmful substances (Roane & Kadey, 2011).

Stereotypy is a time consuming and invasive behavior that typically interferes with engagement in functional activities. As a result, engaging in stereotypy may compromise interactions with peers, adaptive functioning, and learning (Cunningham & Schreibman, 2008; Lanovaz, Robertson, Soerono, & Watkins, 2013). The individual's abilities to execute daily living tasks, to communicate appropriately, and to engage in functional activities may also be affected (Matson, Kiely, & Bamburg, 1997). Furthermore, individuals who engage in stereotypy may suffer from prejudices, restricted learning opportunities, and limited social integration (Jones, Wint, & Ellis, 1990). Cunningham and Schreibman (2008) also noted that social stigmatization is associated with a feeling of discomfort in parents of children who engage in stereotypy in public environments. Consistent with studies on other forms of challenging behaviors displayed by individuals with ASD, Harrop, McBee, and Boyd (2016) found that preschoolers' engagement in restricted and repetitive behaviors was correlated with increased caregiver stress.

Assessment

When aiming to reduce engagement in challenging behaviors in individuals with ASD, the first step is to identify the stimuli that evoke and maintain the behavior in the individual's environment. That is, the practitioner should identify antecedent events that may trigger or evoke engagement in the challenging behaviors as well as the reinforcers that maintain their occurrence. The following sections examine common antecedent and consequent events associated with challenging behaviors and methods to identify them.

Antecedent Events

Antecedents are generally defined as events or stimuli that immediately precede the occurrence of a behavior (Smith & Iwata, 1997). Various environmental and intrinsic stimuli such as objects, settings, time, type of activities, persons, and sensations can function as setting events for challenging behaviors (McGill, Teer, Rye, & Hughes, 2003; Simó-Pinatella et al., 2013). Their identification is an important step in the reduction of challenging behaviors as it emphasizes the circumstances in which the behaviors occur. With this in mind, two types of antecedent events should be acknowledged when analyzing challenging behaviors: discriminative stimuli and motivating operations (MO).

Discriminative stimuli are precise events or stimulus changes that signal the availability or non-availability of reinforcement (Langthorne & McGill, 2009; Simó-Pinatella et al., 2013). This differential availability of the reinforcer results from the relationship between a stimulus condition, a given behavior, and the subsequent outcome (Michael, 1993). To be considered discriminative, the presence of the stimulus condition must have previously preceded a specific behavior that resulted in reinforcement. Second, in the absence of the stimulus condition, the same behavior must not have produced reinforcement (Michael, 2000). As a result, the frequency of the behavior is modified according to the availability of reinforcement. The behavior is more frequent in the presence of the discriminative stimuli because of the concomitant possibility of reinforcement while the frequency of the behavior is decreased in the absence of the discriminative stimuli since no reinforcement is expected (Langthorne & McGill, 2009; Michael, 1982). Several variables can serve as discriminative stimuli for challenging behaviors such as the characteristics of the environmental context, the presence or absence of a preferred item, and the presence of a specific individual (e.g., Conners et al., 2000; Kang et al., 2010; O'Reilly et al., 2000).

A second type of antecedent events is the MO. The presence of MO sets the capacity of an event to serve as reinforcer or punisher by triggering two interrelated phenomena termed value-altering and behavior-altering effects (Langthorne, McGill, & Oliver, 2014; Laraway, Snycerski, Michael, & Poling, 2003; Laraway, Snycerksi, Olson, Becker, & Poling, 2014). The value-altering effect alters the effectiveness of reinforcers or punishers (Langthorne et al., 2014). The value of reinforcement or punishment is either increased (i.e., established) or decreased (i.e., abolished) in the presence of the MO. In contrast, the behavior-altering effect involves the impact of the MO on the actual behavior. The latter is either encouraged (evoked) or discouraged (abated; Laraway et al., 2003). Taken together, value-altering and behavior-altering effects have considerable impact on the frequency of challenging behaviors. Some potential MO for challenging behaviors include sleep deprivation (Horner, Day & Day, 1997; O'Reilly, 1995; Reed, Dolezal, Cooper-Brown, & Wacker, 2005), menstrual discomfort (Carr & Smith, 1995; Carr, Smith, Giacin, Whelan, & Pancari, 2003; Douglas, 2004; Hamilton, Marshal, & Murray, 2011) as well as certain drugs and illnesses (Kennedy & Meyer, 1996; Luiselli, et al. 2005; Mello, Mendelson, & Kuehnle, 1982; Nickels et al., 2009; O'Reilly, 1997; Rapp, Swanson, & Dornbush, 2007; Valdovinos & Kennedy, 2004). For practitioners, identifying both discriminative stimuli and MO is important as they will have an impact on the selection of an intervention and its effect on challenging behaviors.

Functions of Challenging Behaviors

The development of challenging behaviors can be fully appreciated through the observation of their function, which is described as the reinforcement contingency maintaining the behaviors (Hanley, Iwata, & McCord, 2003). Challenging behaviors are generally followed by environmental and internal consequences. These consequences maintain, reinforce or

discourage the reoccurrence of challenging behaviors. If an individual's response to the antecedent is followed by desirable consequences, the probability of this behavior reoccurring increases. Therefore, the function of the behavior is to access the targeted consequence. A behavior can either occur in order to gain access to something desirable or to terminate an unwanted situation or stimulus event (Horner & Carr, 1997; Iwata, Dorsey et al., 1982/1994). These two effects, embodied by social positive, social negative and automatic reinforcement, serve as a description for the maintenance of challenging behaviors.

Positive social reinforcement is a type of reinforcement that is mediated by another person and is associated with the addition of a stimulus event. In practical settings, challenging behaviors maintained by social positive reinforcement are generally categorized within one of two functions: attention and tangible. Attention-maintained challenging behaviors are reinforced by the social response of others to the behavior. This response may be either motor (e.g., facial expressions, physical contact) or verbal (e.g., comforting words, maintenance of conversation). Forms of attention that may seem less desirable (e.g., reprimands) may also maintain engagement in challenging behaviors (Olive et al., 2008). A common indicator of the attention function is that an individual will seek eye contact while engaging in challenging behaviors. The individual may also react when attention of others is diverted or provided to someone else. As an example, Schmidt et al. (2014) showed that the aggression, inappropriate touching, and cursing of an adolescent with ASD occurred most often when an adult entered the room and began a conversation with the therapist.

Access to tangible items is also a type of social reinforcement that maintains challenging behaviors (Vollmer, Marcus, Ringdahl, & Roane, 1995). When a challenging behavior has a tangible function, engaging in the behavior results in the delivery of a tangible item, an edible, or

an activity (e.g., watching a movie). In these cases, challenging behaviors may occur when access to a preferred item or activity is restricted, refused, or withdrawn. For example, researchers have shown that children with ASD who exhibit ritualistic behavior might engage in challenging behaviors if their routine is interrupted or blocked (e.g., Rispoli, Camargo, Machalicek, Lang, & Sigafoos, 2014).

Negative social reinforcement involves the removal of a stimulus by another individual. It is generally associated with the escape (termination or attenuation of a putatively unpleasant stimulus event) or avoidance function (prevention of a putatively unpleasant stimulus event). Challenging behaviors maintained by negative social reinforcement are followed by escape or avoidance of an aversive event (Carr, 1977) such as the termination of an instruction, task, demand or routine, or the withdrawal of an individual or stimulus (e.g., loud sounds, bright lights). Schindler and Horner (2005) provide an example of challenging behaviors maintained by escape. The researchers found that the high pitch and frequent screaming of a young girl with ASD was maintained by escaping components of an activity, which were subjectively rated as difficult.

Finally, automatic reinforcement, also referred to as nonsocial reinforcement, involves contingencies that are independent from the social environment (Vollmer, 1994). Researchers hypothesize that challenging behaviors maintained by nonsocial reinforcement generate their own sensory consequences, such as visual stimulation, vestibular stimulation, tactile input, and auditory stimulation (Lovaas, Newsom, & Hickman, 1987; Rapp, 2008). As for behavior maintained by social consequences, challenging behaviors serving a nonsocial function can be described as positively or negatively reinforced, but the technology to differentiate between the two is not well developed (Minshawi, Hurwitz, Fodstad et al., 2014; Rapp & Vollmer, 2005). A

behavior is considered as nonsocially reinforced when it persists in the absence of social reinforcement (Querim et al., 2013). For example, Dominguez, Wilder, Cheung, and Rey (2014) found that engagement in rumination was independent of social consequences in a child with ASD. Researchers have also shown that various forms of stereotypy are generally, albeit not always, maintained by nonsocial reinforcement (Beavers, Iwata, & Lerman, 2013; Matson, Bamburg, Cherry, & Paclawskyj, 1999; Rapp & Vollmer, 2005; Wilke et al., 2012).

Functional Assessment

Assessment of challenging behaviors should be viewed as a generative, multiple-step process. The first step often involves the use of indirect or anecdotal assessment to gather general information about the conditions during which the challenging behavior occurs. The second step is for trained practitioners to conduct direct observations of the challenging behavior during "high probability" conditions (presumably identified via indirect or informant assessment) in order to (a) determine the baseline rate or level of the challenging behavior and (b) identify antecedents (i.e., potential MO or discriminative stimuli) and consequent (i.e., potential reinforcers) events for the challenging behavior. Results of recent survey studies suggest that many practitioners often rely, perhaps to a fault, on the findings from basic descriptive assessments to develop behavioral interventions for challenging behaviors (Oliver, Pratt, & Normand, 2015; Roscoe, Phillips, Kelly, Farber, & Dube 2015). The third step of the assessment process should involve a functional analysis (FA) of one or more probable operant functions of the challenging behavior. At a minimum, the FA should involve direct, systematic manipulation of one or more antecedent events, consequent events, or both (Hanley et al., 2003).

Indirect or anecdotal assessment. Informant-based assessments typically involve structured questionnaires that are delivered by a practitioner to a caregiver of the individual

referred for the treatment of challenging behaviors. Two structured questionnaires with varying degrees of empirical support are the Questions About Behavior Function (QABF), which is a 25-item questionnaire (Matson & Vollmer, 1995), and the Functional Analysis Screening Tool (FAST), which is a 16-item questionnaire (Iwata, DeLeon, & Roscoe, 2013). In general, the QABF has been evaluated in studies with a wider range of participants and challenging behaviors (e.g., Applegate, Matson, & Cherry,1999; Lanovaz, Argumedes, Roy, Duquette, & Watkins, 2013; Paclawskyj, Matson, Rush, Smalls, & Vollmer, 2000, 2001; Smith, Smith, Dracobly, & Peterson-Pace, 2012; Watkins & Rapp, 2013) than the FAST. Nevertheless, the results of either assessment should be used primarily to develop one or more hypotheses about the operant function of challenging behaviors. Practitioners can also acquire qualitative information about events surrounding challenging behavior via parent-conducted ABC narratives; however, the reliability and validity of those observations have been mixed (e.g., Lerman, Hovanetz, Strobel, & Tetreault, 2009; Lanovaz, Argumedes et al., 2013)

Direct assessment. On the continuum of direct assessment tools, practitioners can utilize a low-effort descriptive assessments or a high-effort structured descriptive assessment. At the most basic level, a practitioner conducting a descriptive assessment may simply collect data on common consequent events for engaging in challenging behaviors. At a more complex level, a descriptive assessment may include data collection on various antecedent events (e.g., demands, tangibles restricted) and consequent events (e.g., escape provided, tangible provided). This intensive data collection allows the practitioner to calculate conditional and unconditional (sometimes referred to as background probabilities) probabilities of challenging behaviors in relation to various antecedent and consequent events; however, the intensive analysis does not necessarily increase the probability of identifying the correct function of challenging behaviors

(e.g., Pence, Roscoe, Bourret, & Ahearn, 2009). Except in cases when relations between antecedent events, consequent events and challenging behaviors are evident, results from this level of assessment should be used primarily to further develop specific conditions to be tested in a FA.

Structured descriptive assessments are conducted in a manner that is similar to descriptive assessments with conditional and unconditional probabilities with the exception that practitioner directly manipulates the antecedent events (consequences are left to vary). Because the antecedent conditions are controlled by the practitioner, the observations can be organized into sessions with equivalent durations (e.g., 10 min) containing specific antecedent changes (e.g., demands provided or attention withheld). The results from each session can then be plotted into multielement design graphs and visually inspected for elevated data paths (e.g., Anderson & Long, 2002; English & Anderson, 2006). Even though structured descriptive assessments do not offer a clear time saving compared to a typical FA, this approach may be better suited to evaluating the stimulus events that evoke challenging behaviors in classroom settings or other contexts that are difficult to simulate with a standard or modified FA.

Functional analysis. Functional analytic procedures (Iwata, Dorsey et al., 1982/1994), have been used to assess the operant function of a wide range of challenging behaviors by individuals with ASD and other neurodevelopmental disorders (Hanley et al., 2003; Beavers et al., 2013). As previously noted, standard FA procedures involve conditions that test for (a) social positive reinforcement in the form of contingent attention, contingent access to activities, or both; (b) social negative reinforcement in the form of escape or termination of subjectively unpleasant environmental events such as academic or vocational demands; and (c) nonsocial reinforcement whereby challenging behaviors persist without changes to the individual's external

environment. The standard FA with multiple test conditions provided during 10-min sessions are generally recognized as the gold standard for assessing the operant function of challenging behaviors, but many practitioners lack the resources needed to conduct the standard conditions (e.g., Oliver et al., 2015; Roscoe et al., 2015). As alternatives, practitioners may opt to use a brief FA or alternative methodologies.

In general, practitioners should use the results of the indirect assessment and direct observations to develop a hypothesis that can be directly evaluated with a brief FA methodology. Some these brief FA variations have been used widely in the treatment literature whereas others have only preliminary support. It is important to recognize that specific types of challenging behaviors lend themselves to one or more of these FA approaches. Iwata and Dozier (2008) outlined the relative merits of brief FA variations and illustrated hypothetical results for each variation. As outlined by Iwata and Dozier, each approach can be fit to one or more single-case experimental designs (with minor exceptions) and each has relative advantages (e.g., time saving, good contextual fit) and disadvantages (e.g., limited scope of function).

Consecutive no-interaction sessions. This FA variation should be used when the practitioner suspects that the challenging behavior in question is nonsocially reinforced (Iwata & Dozier, 2008; Querim et al., 2013). This practice was initially part of the third phase of a progressive model proposed by Vollmer et al. (1995) to verify the persistence of behavior in the absence of social consequences. When applied, a practitioner may verify that an individual's challenging behavior is maintained by a nonsocial consequence by showing that the behavior persists across three or more consecutive no-interaction 10-min sessions. Challenging behaviors that decrease markedly across sessions are presumed to be socially reinforced and should be subjected to further assessment with other FA variations. The primary advantage of this approach

is the substantial time savings for practitioners. By contrast, the primary limitation is that the outcome does not directly inform practitioners of indicated interventions. That is, behaviors that persist across such conditions are likely to be maintained by automatic positive reinforcement (Rapp & Vollmer, 2005), but more refined analyses are required to develop a functionally-matched intervention. Descriptions of such analyses are beyond the scope of this section, but we refer readers to Lanovaz, Rapp, and Fletcher (2010) and Rapp and Lanovaz (2016) for one comprehensive option.

Single-function test. For this FA format, the practitioner consolidates information obtained from the indirect and descriptive assessments to develop a specific hypothesis about the operant function of the challenging behavior. Based on the hypothesis, the practitioner develops a specific test condition to assess the effects of one specific antecedent or consequent event. The control condition is then developed to control the event that is manipulated in the test condition. The practitioner then conducts three or more sessions for each condition in an alternating format.

Latency analysis of standard conditions. Using this format, practitioners arrange to conduct standard FA conditions of 5 min or 10 min in duration; however, the dependent variable is the latency to engagement in the challenging behavior and the respective session is terminated following an occurrence of the said behavior. Because the dependent variable differs from a standard FA, the visual analysis differs slightly as well. The practitioner identifies the stimulus event maintaining the challenging behavior based on the data path with the shortest latency to engagement. When aptly implemented, the control condition yields an elevated data path (indicating the absence of the target behavior for the duration of the session) and the test condition that contains the functional reinforcer for the challenging behavior produces a lower-level data path. The primary advantages of using this method are the potential time savings and

its suitability for specific forms of challenging behaviors such as elopement or pica (Neidert, Iwata, Dempsey, & Thomason-Sassi, 2013; Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011). A potential disadvantage of this FA variation is that it may produce false negatives (i.e., failure to detect a true function for the challenging behavior) due to the heavy reliance on antecedent control.

Trial-based conditions. This FA format share features of the latency analysis (i.e., a trial ends with engagement in the challenging behavior) and single-function pairwise analyses (i.e., specific control trials are designed for each individual test-trial condition). The dependent measure is the percentage of trials with challenging behaviors across control and test trials for each potential function. The primary advantage of this FA variation is that it is well-suited to classroom and other instructional formats (Bloom, Iwata, Fritz, Roscoe, & Carreau, 2011; Rispoli et al., 2014; Sigafoos & Saggers, 1995). Nonetheless, due to the number of trials that must be conducted for each test-specific control condition, this FA variation is unlikely to save time for practitioners.

Analysis of precursor behaviors. This FA variation, which is not intended to be a briefer iteration, can be particularly useful for practitioners when (1) provided consequences for high intensity challenging behaviors (e.g., some forms of SIB) is undesirable and (2) the target behavior is consistently preceded by less intensive behavior (Dracobly, & Smith, 2012; Fritz, Iwata, Hammond, & Bloom, 2013; Herscovitch, Roscoe, Libby, Bourret, & Ahearn, 2009; Najdowski, Wallace, Ellsworth, MacAleese, & Cleveland, 2008; Smith & Churchill, 2002). Because this analysis requires a detailed descriptive assessment with conditional and unconditional probabilities to identify a behavior that reliably precedes more intensive challenging behavior, it may actually require more time than a standard FA that is based only on

the primary topography of challenging behaviors. This approach does allow practitioners to evaluate the function of potentially harmful challenging behaviors without having to directly reinforce instances of such behavior.

Empirically-Supported Treatments

When developing treatment plans to reduce challenging behaviors in individuals with ASD, practitioners must identify empirically-supported treatments. Multiple criteria have been developed to define the quality and quantity of research support necessary to consider an intervention as empirically-supported (e.g., Briss et al., 2000; Chambless et al., 1998; Kratochwill et al., 2010). The current chapter will focus on criteria for single-case experiments because most published studies on reducing challenging behaviors in ASD have made use of single-case experimental designs (Brosnan & Healy, 2011; Carr, Severtson, & Lepper, 2009; DiGennaro Reed, Hirst & Hyman, 2012). Chambless et al. (1998) propose a minimum of 9 well-designed single-case experiments in their definition of empirically-supported whereas Kratochwill et al. (2010) recommend a minimum of 20 single-case studies fitting specific criteria. To address this discrepancy, Lanovaz and Rapp (2016) recently proposed reporting the success rate of a treatment to determine whether it is empirically-supported. Specifically, a treatment is considered as empirically-supported when the success rate can be estimated within a range of 40% or less and the treatment produces an acceptable success rate, which we set at 50% or more for the current chapter. The number of successful experiments necessary is thus dependent on the success rate; treatments with higher success rates necessitate fewer replications than treatments with success rates closer to 50% when identifying those with empirical support.

To identify empirically-supported treatments for the chapter, we first conducted a literature search of PsycInfo® using the following search terms (Keywords: autis* OR asd OR

pdd or Asperg* OR "pervasive development*") AND (Keywords: agress* OR "problem behav*" OR "challenging behav*" OR "self-injur*" OR "repetitive behave* OR opposition OR noncompliance OR stereotyp*) AND (Any Field: treatment OR intervention). We also hand searched the references of a series of systematic reviews on challenging behaviors in individuals with developmental disabilities (Brosnan & Healy, 2011; Carr et al., 2009; Chowdhury & Benson, 2011; Kurtz, Boelter, Jarmolowicz, Chin, & Hagopian, 2011; Lanovaz, Robertson et al., 2013; Petscher, Rey & Bailey, 2009). Then, the last three authors read the titles and abstracts (and article if necessary) to identify those that tested the effects of a treatment for reducing challenging behaviors in individuals with ASD.

For each study, we collected data for each participant individually (i.e., design, function, treatment, and effect). For our analyses, we excluded datasets that used quasi-experimental designs (e.g., AB, ABC) or that did not specify the function of challenging behaviors. Furthermore, we only included datasets that tested the effects of interventions individually. Multi-component treatments were not included in our analyses with the following exceptions. First, the interventions could include an extinction component. Second, we included self-management treatments that involved a differential reinforcement component as the former were rarely implemented without the latter. Similarly, response interruption and redirection (RIRD) was included in punishment-based procedures even though it included a reinforcement component. Finally, we did not exclude studies that involved minor additions (e.g., fading, prompting, schedule thinning).

We considered a treatment effective (i.e., a success) when (a) engagement in the challenging behavior decreased and (b) the researchers demonstrated experimental control over the challenging behavior (based on our visual analysis or the visual analysis of the authors when

the graphs were unavailable). If an individual was subjected to minor variations of an intervention (e.g., with different reinforcers, with varied schedules), we only included the participant once in the analysis of the target intervention and we counted the experiment as a success if reductions and experimental control were demonstrated with at least one treatment parameter. As discussed previously, one of the main factors that guide practitioners in selecting a treatment is the function of the challenging behavior. Thus, we separately identified treatments that met the single-case design criteria for empirically-supported treatments for socially reinforced challenging behaviors and nonsocially reinforced challenging behaviors. In the following sections, we describe the treatments that met the criteria to be considered empirically-supported based on the number of studies that we found for each broad function category.

Socially Reinforced Challenging Behaviors

Functional communication training (FCT). According to our search and our analysis, FCT is the treatment with the most empirical support for reducing socially reinforced challenging behaviors. The treatment consists of teaching the individual who engages in challenging behaviors an alternative communicative response that serves the same function (Tiger, Hanley, & Bruzek, 2008). This response can involve exchanging a picture, signing, activating a microswitch, using a speech-enhancement device, or vocally requesting (Heath, Ganz, Parker, Burke, & Ninci, 2015). Regardless of the form of the communicative response, researchers generally agree that FCT is most effective when combined with extinction, which involves the withholding of reinforcement when challenging behaviors occur (Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997; Wacker et al., 1990). When conducting our literature search, we found a total of 29 studies,

including 54 participants with ASD, for a success rate of 98% CI [90%, 99%] when using FCT to reduce socially reinforced challenging behaviors.

In an example of FCT, Hanley, Jin, Vanselow, and Hanratty (2014) reduced challenging behaviors in four children with ASD by teaching a communicative response while implementing an extinction component. Interestingly, the researchers also conducted a denial and delay tolerance procedure to facilitate the implementation of the treatment in practical settings. Schmidt et al. (2014) taught three boys with ASD to sign for the reinforcer maintaining challenging behaviors (i.e., edible or attention), which produced reductions in aggression and increases in appropriate demands in all participants. Two of the participants also showed subsequent generalization and maintenance of the learned responses.

The main advantage of using FCT is that the practitioner teaches the individual a novel communicative response, which can be pivotal in the reduction of other challenging behaviors with the same function and in the development of prosocial behaviors. The implementation of FCT also has its challenges. Notably, the individual may engage in the communicative responses (a) when the parent or staff is unavailable to provide the reinforcer, or (b) at high frequencies which make the communicative behavior as disruptive to the routine as the initial challenging behavior. To address these concerns, researchers have recommended using a multiple schedule wherein a FCT condition is alternated with an extinction condition (Hanley, Iwata, & Thomson, 2001; Jarmolowicz, DeLeon, & Kuhn, 2009; Kuhn, Chirighin, & Zelenka, 2010). Initially, the FCT condition is longer than the extinction condition, but the duration of each is modified until the FCT is implemented for durations that are realistic within the applied setting. Another limitation is that teaching the initial communicative response may be time consuming, especially

for individuals with severe to profound intellectual disability. As such, the treatment may fail to produce short-term changes.

Differential reinforcement of alternative behavior (DRA). Another reinforcement-based procedure with empirical support for reducing engagement in socially reinforced challenging behaviors is DRA. During DRA, the individual receives a reinforcer contingent on engaging in an alternative appropriate behavior (Petscher et al., 2009). This alternative behavior may take on many forms such as playing, following instructions, or being on-task (McClean & Grey, 2012; Piazza, Moes, & Fisher, 1996; Ringdahl et al., 2002). As with FCT, research suggests that DRA is typically more effective when combined with extinction (Richman, Wacker, Asmus, & Casey, 1998). The main difference with FCT is that the appropriate behavior is not necessarily a communicative response. Based on 14 studies with 20 participants with ASD, the success rate of DRA for reducing challenging behaviors maintained by social reinforcement was 100% CI [84%, 100%].

In a recent example of DRA, Slocum and Vollmer (2015) found that providing access to preferred edible items contingent on compliance reduced aggression behaviors in four children with ASD. The results also indicated that using 30-s breaks as reinforcers was only effective in reducing challenging behaviors in two of these four participants, underlining the importance of identifying potent reinforcers prior to treatment. Similarly, Piazza et al. (1996) reduced multiply controlled destructive behaviors in 11-year-old boy with ASD by implementing DRA for compliance with instructions. The intervention reduced challenging behaviors to near-zero levels while maintaining increasingly higher expectations for task completion.

In the same vein as FCT, the main advantage of DRA is that the intervention simultaneously strengthens an appropriate behavior. The individuals may thus benefit from

learning new responses (e.g., play, compliance, on task) that could improve their adaptive functioning. On the other hand, one concern with DRA is that the alternative response may not necessarily be incompatible with engagement in challenging behaviors. Therefore, there is the risk that the individual may access reinforcement following both the alternative behavior and the challenging behavior if an extinction component is not implemented concurrently. Practitioners may also face challenges when attempting to identify an alternative behavior, especially if the challenging behavior occurs in multiple settings.

Noncontingent reinforcement (NCR). Noncontingent reinforcement consists of providing access to a preferred stimulus on a regular or continuous basis, independently of the occurrence of challenging behaviors (Carr et al., 2009). Generally, the preferred stimulus is matched to the function of the challenging behavior and is provided on a schedule equal or more frequent than that received for engaging in challenging behaviors (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). However, stimuli unrelated to function have also been shown to be effective at reducing socially reinforced challenging behaviors (Fischer, Iwata, & Mazaleski, 1997; Fisher, DeLeon, Rodriguez-Catter, & Keeney, 2004; Lalli, Casey, & Kates, 1997). In a recent meta-analysis, Richman, Barnard-Brak, Grubb, Bosch, and Abby (2015) showed that unrelated stimuli are less effective than functional stimuli and that thinning the schedule reduces the effectiveness of NCR. Furthermore, NCR can be effective even when reinforcement remains available for engagement in challenging behaviors (Hagopian, Crockett, Stone, Deleon, & Bowman, 2000). Our literature search indicates that NCR was effective at reducing socially reinforced challenging behavior in 100 % CI [77%, 100%] of 13 individuals with ASD from 10 studies with whom the procedures were implemented.

Hagopian, Fisher and Legacy (1994) provide an interesting example of NCR to reduce attention-maintained challenging behaviors. Specifically, they provided access to noncontingent social interactions to 5-year-old quadruplets with ASD and showed that the intervention was effective at the reducing destructive behaviors in all four participants. The researchers also showed that denser schedules produced larger reductions than leaner schedules. In a study on multiply controlled challenging behaviors (i.e., tangible and escape function), Ingvarsson, Kahng, and Hausman (2008) found that providing access to edible items on a fixed-time schedule reduced engagement in aggression, disruption, and SIB. Notably, the study also showed that the implementation of NCR was associated with an increase in compliance in the participant.

From a practical standpoint, NCR has the advantage of being easy to implement; the parent or trainer only has to provide the stimuli on a time-based or continuous schedule. This ease of use makes it possible to implement the procedures with multiple individuals who engage in challenging behaviors in group settings (Hagopian et al., 1994). Another benefit of NCR is that it generally produces immediate reductions in engagement in challenging behaviors. The treatment may also produce some negative side-effects. The implementation of NCR may occasionally result in a temporary increase in the frequency or intensity of the challenging behaviors and the delivery of stimuli on a time-based schedule may adventitiously reinforce challenging behaviors (Vollmer, Ringdahl, Roane, & Marcus, 1997). To address this issue, one simple solution is to implement a hold, wherein the stimulus is never delivered within a certain period of time (e.g., 5 s) following engagement in challenging behaviors.

Nonsocially Reinforced Challenging Behaviors

Punishment contingencies. Punishment involves the addition of an aversive stimulus or the removal of a preferred stimulus (or reinforcer) contingent on the occurrence of challenging

behaviors. The use of punishment has been the topic of the most studies for reducing engagement in nonsocially reinforced challenging behaviors (e.g., Ahearn, Clark, MacDonald, & Chung, 2007; Anderson & Le, 2011; Cook, Rapp, Gomes, Frazer, & Lindblad, 2014; Doughty, Anderson, Doughty, Williams, & Saunders, 2007; Peters & Thompson, 2013). The punishment contingencies that have been implemented for nonsocially reinforced behaviors include: reprimands, overcorrection, response blocking, and RIRD. The success rate for punishment-based procedures for treating nonsocially reinforced behaviors currently stands at 87% [77%, 93%] for 63 individuals with ASD who participated in 27 different studies.

Ahearn et al. (2007) examined the effects of RIRD on engagement in vocal stereotypy in four children with ASD. The intervention consisted of presenting three consecutive demands contingent on engagement in challenging behaviors. In their initial study, RIRD reduced vocal stereotypy to near-zero levels in all four participants and increased appropriate vocalizations in three of them. In a study of positive practice overcorrection, Peters and Thomson (2013) examined its effects on the stereotypy of three individuals with ASD. During overcorrection, the trainer prompted the individual to stop and practice appropriate engagement for 30 s contingent on the occurrence of stereotypy. Their results indicated that the procedures reduced motor stereotypy for the three participants while increasing engagement for two of three participants.

Punishment contingencies are often used in applied settings as the intervention produces rapid reductions in challenging behaviors. However, clinicians should be wary of the challenges associated with the implementation of punishment-based interventions as well as of its multiple side-effects (see Lerman & Vorndran, 2002 for detailed discussion). First, punishment contingencies must be applied on a continuous schedule in order to be effective in reducing engagement in challenging behaviors. Second, all topographies must be targeted by the

punishment contingency; if not, engagement in other forms of challenging behaviors may continue or increase (Lanovaz, Robertson et al., 2013; Rapp, Vollmer, St. Peter, Dozier & Cotnoir, 2004). Third, the implementation of punishment-based interventions may produce an escalation of the target behavior or the emergence of aggressive behaviors, which can be counterproductive. Given the side-effects of punishment and its aversive nature, professionals have an ethical obligation to limit its use and prioritize the least restrictive intervention procedures (Vollmer et al., 2011). Punishment-based procedures should always be combined with other interventions and be used only when alternatives are unavailable or ineffective. An additional limitation specific to RIRD should also be noted. In two recent studies, researchers have shown that the success of punishment-based RIRD may be an artifact of the measurement procedures (Carroll & Kodak, 2014; Wunderlich & Vollmer, 2015). That is, uninterrupted measurement of stereotypy suggests that RIRD does not necessarily reduce overall levels of stereotypy. Thus, practitioners should carefully monitor its effects or consider other types of punishment contingencies to reduce engagement in nonsocially reinforced challenging behaviors.

NCR. Based on our literature search, NCR is one of the treatments with the most empirical support for the treatment of nonsocially reinforced challenging in individuals with ASD (e.g., Britton, Carr, Landaburu, & Romick, 2002; Luiselli, Ricciardi, Zubow, & Laster, 2004; Rapp et al., 2013; Reid, Parsons, & Lattimore, 2010; Saylor, Sidener, Reeve, Fetherston, & Progar, 2012). For nonsocially reinforced behaviors, a preferred item is generally provided on a continuous basis. This preferred stimulus may either be matched or unmatched to the stimulation generated by the nonsocially reinforced behavior (Rapp, 2007). An example of matched stimulus for vocal stereotypy is music as both the challenging behavior and music produce auditory stimulation. In contrast, an unmatched stimulus using the same example would

be a toy that produces visual and tactile stimulation. The success rate of NCR for nonsocially reinforced behaviors for 66 individuals from 25 different studies is 74% [63%, 83%].

Britton et al. (2002) examined the effects of introducing prompting within a NCR treatment for a 26-year-old woman with ASD and intellectual disability. The results indicated that the prompting produced higher rates of engagement with a preferred stimulus during treatment while being associated with lower levels of nonsocially reinforced face touching. In a comprehensive study of NCR, Rapp et al. (2013) compared the effects of matched and unmatched stimuli on the vocal stereotypy of 21 children with ASD. In their sample, providing matched stimuli noncontingently reduced vocal stereotypy in 8 of 11 participants whereas unmatched stimuli produced reductions in only 1 of 10 participants. Moreover, NCR produced increases in collateral forms of motor stereotypy in 8 of 14 participants.

The implementation of NCR with nonsocially reinforced challenging behaviors has similar advantages to those maintained by social reinforcement: the treatment produces rapid reductions in the target behavior and is easy to implement. The intervention also has some different disadvantages when it comes to challenging behaviors maintained by nonsocial reinforcement. The preferred stimulus is generally provided on a continuous basis, which may interfere or be incompatible with engagement in other important behaviors (e.g., completing tasks). As indicated previously, even when NCR reduces one form of nonsocially reinforced challenging behaviors, it may be replaced by other untargeted forms (Rapp et al., 2013). To address this limitation while also increasing interactions with the preferred stimulus, some researchers recommend combining the intervention with a prompting procedure for appropriate behaviors (Britton et al., 2002; Lanovaz et al., 2014).

Self-management. Individuals with ASD may also manage their own intervention to reduce engagement in challenging behaviors. Self-management procedures generally consist of a combination of awareness training, self-recording of the challenging behaviors, and delivery of reinforcement for meeting preset goals (Crutchfield, Mason, Chambers, Wills, & Mason, 2015; Fritz, Iwata, Rolider, Camp, & Neidert, 2012; Shabani, Wilder, & Flood, 2001; Stahmer & Schreibman, 1992; Tiger, Fisher, & Bouxsein, 2009). For the differential reinforcement component, a preferred stimulus is typically provided for not engaging in challenging behaviors for specific periods of time (as in a DRO schedule) or for accurate recording (as in a DRA schedule). The reinforcer may be self-managed (i.e., self-delivered by the individual with ASD) or delivered by someone else. Based on data from 19 individuals with ASD from 11 different studies, self-management was effective with 95% [75%, 99%] of individuals with ASD with whom it was attempted.

Fritz et al. (2012) compared the effects of differential reinforcement for self-recording and for not engaging in nonsocially reinforced stereotypy in two adults and one boy with ASD. Their results indicated that the reinforcement of self-recording was effective for only one participant whereas reinforcement needed to be provided for not engaging in challenging behaviors for the remaining two participants to produce reductions to near-zero levels. In a recent study, Crutchfield et al. (2015) used the I-Connect, a self-monitoring app, to reduce stereotypy in two adolescents with ASD in a school setting. The use of the app produced reductions in stereotypy despite the absence of planned reinforcement. It should be noted that albeit less frequent, the challenging behaviors still occurred on a regular basis.

One of the strengths of self-management is that the practitioner is encouraging the individual to manage his or her own behavior, which promotes independence and self-

determination for individuals with ASD. The intervention does not always require a trainer, which may facilitate and increase the frequency of its implementation. In contrast, one of the limitations of the treatment is that some studies suggest that the delivery of reinforcers by an external individual may be necessary (Fritz et al., 2012). A second limitation is that most studies have been conducted with individuals with a mild or no intellectual disability. Given the complexity of teaching the recording procedures, self-management may not be an option for most individuals with an associated moderate, severe or profound intellectual disability.

Differential reinforcement of other behavior (DRO). Researchers have repeatedly shown that DRO may be an effective treatment for reducing engagement in nonsocially reinforced challenging behaviors (e.g., Lanovaz & Argumedes, 2010; Rozenblat, Brown, Brown, Reeve, & Reeve, 2009; Taylor, Hoch, & Weisman, 2005; Vollmer, Marcus et al., 1995). In general, DRO consists of providing a reinforcer contingent on the absence of challenging behaviors. The schedule can be either momentary or based on an interval. During momentary DRO, the reinforcer is provided if the challenging behavior is not occurring at a specific point in time whereas, during interval-based DRO, the behavior must not occur during an entire interval of a specified duration in order to provide the reinforcer. If the behavior occurs during the latter, the time interval is reset by the trainer. Minimally, the interval of the reinforcement schedule must be equal or shorter than the average time between two occurrences of the challenging behavior. The success rate of DRO in the research literature currently stands at 81% [57%, 93%] for 16 participants with ASD, but the 10 studies used varied interval durations.

Taylor et al. (2005) provided access to a preferred musical toy in the absence of vocal stereotypy to a 6-year-old girl with ASD within a classroom setting. The intervention reduced the challenging behaviors to near-zero levels even when the interval schedule was gradually

increased to 5 min. In another study, Rozenblat et al. (2009) compared two DRO schedules on the nonsocially reinforced repetitive vocalizations of three children with ASD. Their results indicated that the denser schedule reduced challenging behavior to near-zero levels in all three participants and that it was systematically more effective than the leaner schedule.

Although DRO is a relevant option when other treatments (e.g., NCR) have failed to produce reductions in the target behavior, practitioners should remain aware of two challenges when implementing the intervention in applied settings with individuals with ASD. First, the DRO schedule may need to be very dense (e.g., 5 s or less) for the treatment to initially reduce challenging behaviors with high frequencies (Rozenblat et al. 2009); the treatment may thus be too time consuming, complex or impractical to implement. Second, the implementation of DRO for challenging behaviors that do not have a high frequency may be a challenge with individuals who also have an intellectual disability. As an example, if the reinforcer is only provided once every 5 min and the trainer cannot explain the contingency through the use of rules, the DRO schedule may have no impact on the behavior targeted for reduction.

Physical exercise. An antecedent-based procedure with support to reduce engagement in nonsocially reinforced challenging behaviors is physical exercise. Researchers have examined the effects of multiple forms of physical exercise including walking, jogging, swinging, cycling, and jumping on a trampoline (Celiberti, Bobo, Kelly, Harris, & Handleman, 1997; Cuvo, May, & Post, 2001; Morrison, Roscoe, & Atwell, 2011; Neely, Rispoli, Gerow, & Ninci, 2015). Vigorous exercises (e.g., jogging) may produce larger reductions than less rigorous exercises (e.g., walking; Celiberti et al., 1997). Our review identified 5 studies with 14 participants with ASD using exercise for reducing nonsocially reinforced challenging behaviors; the success rate was 93% [69%, 99%].

For example, Morrison et al. (2011) examined the effects of engaging in preferred exercises for 10 min in four individuals with ASD. The results of their study indicated that the intervention reduced both immediate and subsequent levels of challenging behaviors in three of the four participants. In a more recent study, Neely et al. (2015) compared the effects of jumping on a trampoline for brief periods of time or until indicators of behavioral satiation were observed. The longer periods of exercises (i.e., until satiation) not only reduced engagement in stereotypy but also increased academic engagement for the two participants. The results of both these studies suggest that physical exercise can maintain some its suppressive effect following its termination.

Engaging in physical exercises produces multiple benefits beyond the reduction of challenging behaviors, which makes it an interesting option to consider (Bremer, Crozier, & Lloyd, 2016; Sorensen & Zarrett, 2014). Notably, the intervention may improve both the physical and mental health of individuals who engage in moderate-to-vigorous exercises. From a practical standpoint, one of the main challenges is finding extra time to implement the intervention prior to other activities. The intervention generally reduces nonsocially reinforced challenging behaviors to near-zero levels during the exercises, but practitioners should note that the subsequent reductions are not generally as large (e.g., Celiberti et al., 1997; Cuvo et al., 2001; Morrison et al., 2011). Combining physical exercise with other empirically-supported interventions may address this concern.

Practical Considerations

To improve the effectiveness and maintenance of behavior changes, practitioners should consider multiple factors when planning interventions to reduce engagement in challenging behaviors. Specifically, preference assessment, stimulus control, thinning the reinforcement

schedule, and combining interventions are factors that practitioners should keep in mind when implementing most behavioral interventions. Thus, the current section outlines important points to consider when practitioners design their treatment plans.

Prior to implementing any intervention that involves a preferred stimulus or reinforcer (e.g., NCR, DRA, DRO), practitioners should first conduct a preference assessment. The purpose of a preference assessment is to identify the preferred stimuli that will be used as part of treatment. Researchers have shown that experimentally identified preferred stimuli produced better outcomes than less preferred stimuli (Kang et al., 2013). Providing a full description of the multiple preference assessment procedures is beyond the scope of this chapter. Nonetheless, practitioners should note that the most popular methods, according to a survey conducted by Graff and Karsten (2012), are the paired-choice method (Fisher et al., 1992), the multiple stimulus with replacement method (DeLeon & Iwata, 1996) and the free-operant method (Roane, Vollmer, Ringdahl, & Marcus, 1998). These methods have also been adapted to assess preference for stimuli other than edible and tangible items such as music (Horrocks & Higbee, 2008), video recordings (Chebli & Lanovaz, 2016), and social interactions (Nuernberger, Smith, Czapar, & Klatt, 2012; Smaby, MacDonald, Ahearn, & Dube, 2007).

In certain settings, it may not be possible for practitioners to implement interventions that require dense schedules of reinforcement or punishment across the entire day. A solution to this issue is implementing the intervention for only short periods of time during the day. In these cases, the intervention should include a stimulus that signals that the intervention contingencies are currently in place (i.e., a discriminative stimulus). For individuals with an associated intellectual disability, this signal is typically a visual cue (e.g., a colored poster or card, a bracelet) that the intervention is or is not being implemented. Practitioners should consider

including such cues within any intervention that they recommend as these may make the intervention more effective at maintaining lower levels of challenging behaviors (Doughty et al., 2007; Hanley et al., 2001). These stimuli can be gradually faded, which can facilitate the maintenance and generalization of behavior changes (Cooper, Heron, & Heward, 2007)

To make an intervention easier to maintain in the long term, practitioners generally aim to reduce the amount of reinforcement provided once an intervention has been shown to be effective. To this end, researchers have showed that practitioners may gradually delay reinforcement or thin the reinforcement schedule to make the intervention more manageable (Hanley et al., 2014; Taylor et al., 2005). Delaying reinforcement involves waiting for increasingly longer periods of time prior to providing the reinforcer contingent on an appropriate behavior whereas schedule thinning consists of providing the reinforcer on a leaner schedule as the clients make progress. Practitioners should consider these options when attempting to facilitate the implementation of their interventions in applied settings.

As part of the chapter, we reviewed each empirically-supported intervention individually for clarity. That said, treatments consisting of multiple interventions are amongst the most reported in the research literature (DiGennaro Reed et al., 2012). We encourage practitioners to consider implementing multi-component treatments when planning and designing interventions to reduce engagement in challenging behaviors in individuals with ASD. Practitioners should remember that adding components may also make the treatment more complex and time consuming, and should thus carefully weigh the benefits and drawbacks.

Conclusions

Multiple treatments can be considered as empirically-supported for the reduction of challenging behaviors in individuals with ASD. We provided a description and a value of

success rate for each intervention in the current chapter. Interestingly, we identified more empirically-supported interventions for nonsocially reinforced challenging behaviors than for socially reinforced behaviors. One potential explanation for this discrepancy is that the presence of repetitive behaviors, which are generally nonsocially reinforced, is a diagnostic criterion for ASD. Therefore, it should not be surprising that researchers have conducted more studies on this topic within the ASD population. Another noteworthy observation is that success rates for interventions for socially reinforced challenging behaviors were on average higher than those for nonsocially reinforced behaviors. The lack of direct control over the maintaining consequence may explain part of the lower success rates for challenging behaviors maintained by nonsocial reinforcement. Our literature search also underlines the importance of conducting additional research on standardized treatments for reducing challenging behaviors using controlled trials.

Our success rates should be considered as estimates rather than absolute values. Our search was limited to the PsycInfo database and to a handful of systematic reviews; a search of other databases or using the specific names of intervention may have yielded more studies. It should also be noted that we did not assess the quality of the single-case designs as proposed by Kratochwill et al. (2013). Instead, we considered all studies that used a single-case experimental design. Finally, our definition of success was based on the demonstration of experimental control; however, some treatments may have produced relatively small changes. Nevertheless, we believe that our results should serve as general guidelines to support practitioners in the selection of treatments to reduce engagement in challenging behaviors in individuals with ASD. As importantly, we emphasize that a systematic, rigorous, and functional approach to treatment is key to success in the reduction of challenging behaviors in this population.

References

Ahearn, W. H., Clark, K. M., MacDonald, R. P., & Chung, B. I. (2007). Assessing and treating vocal stereotypy in children with autism. *Journal of Applied Behavior Analysis, 40,* 263-275. doi: 10.1901/jaba.2007.30-06

Anderson, J., & Le, D. D. (2011). Abatement of intractable vocal stereotypy using an overcorrection procedure. *Behavioral Interventions, 26,* 134-146. doi: 10.1002/bin.326

Anderson, C. M. & Long, E. S. (2002). Use of a structured descriptive assessment methodology to identify variables affecting problem behavior. *Journal of Applied Behavior Analysis, 35*, 137–154. doi: 10.1901/jaba.2002.35-137

Applegate, H. J. E., Matson, J. L., & Cherry, K. E. (1999). An evaluation of functional variables affecting severe problem behaviors in adults with mental retardation by using the Questions about Behavioral Function Scale (QABF). *Research in Developmental Disabilities, 20,* 229–237. doi:10.1016/S0891-4222(99)00005-0

Arron, K., Oliver, C., Moss, J., Berg, K., & Burbidge, C. (2011). The prevalence and phenomenology of self-injurious and aggressive behaviour in genetic syndromes. *Journal of Intellectual Disability Research, 55,* 109-120. doi: 10.1111/j.1365-2788.2010.01337.x

Baghdadli, A., Pascal, C., Grisi, S., & Aussilloux, C. (2003). Risk factors for self-injurious behaviours among 222 young children with autistic disorders. *Journal of Intellectual Disability Research, 47,* 622-627. doi: 10.1046/j.1365-2788.2003.00507.x

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46,* 1-21. doi: 10.1002/jaba.30

Bloom, S. E., Iwata, B. A., Fritz, J. N., Roscoe, E. M., & Carreau, A. B. (2011). Classroom application of a trial- based functional analysis. *Journal of Applied Behavior Analysis, 44*, 19-31. doi: 10.1901/jaba.2011.44-19

Bodfish, J. W., Symons, F. J., Parker, D. E., & Lewis, M. H. (2000). Varieties of repetitive behavior in autism: Comparisons to mental retardation. *Journal of Autism and Developmental Disorders, 30*, 237-243. doi: 10.1023/a:1005596502855

Bremer, E., Crozier, M., & Lloyd, M. (2016). A systematic review of the behavioural outcomes following exercise interventions for children and youth with autism spectrum disorder. *Autism*. Advanced online publication. doi: 10.1177/1362361315616002

Briss, P. A., Zaza, S., Pappaioanou, M., Fielding, J., Wright-De Agüero, L., Truman, B. I., ... & Harris, J. R. (2000). Developing an evidence-based guide to community preventive services--methods. *American Journal of Preventive Medicine, 18*, 35-43. doi: 10.1016/S0749-3797(99)00119-1

Britton, L. N., Carr, J. E., Landaburu, H. J., & Romick, K. S. (2002). The efficacy of noncontingent reinforcement as treatment for automatically reinforced stereotypy. *Behavioral Interventions, 17*, 93-103. doi: 10.1002/bin.110

Brosnan, J., & Healy, O. (2011). A review of behavioral interventions for the treatment of aggression in individuals with developmental disabilities. *Research in Developmental Disabilities, 32*, 437-446. doi: 10.1016/j.ridd.2010.12.023

Carr, E. G. (1977). The motivation of self-injurious behavior: A review of some hypotheses. *Psychological Bulletin, 84*, 800-816. doi: 10.1037/0033-2909.84.4.800

Carr, E. G. & Smith, C.E. (1995). Biological setting events for self-injury. *Mental retardation and developmental disabilities, 1*, 94-98. doi: 10.1002/mrdd.1410010204

Carr, E. G., Smith, C. E., Giacin, T. A., Whelan, B. M., & Pancari, J. (2003). Menstrual discomfort as a biological setting event for severe problem behavior: Assessment and intervention. *American Journal on Mental Retardation, 108,* 117-133. doi: 10.1352/0895-8017(2003)108<0117:MDAABS>2.0.CO;2

Carr, J. E., Severtson, J. M., & Lepper, T. L. (2009). Noncontingent reinforcement is an empirically supported treatment for problem behavior exhibited by individuals with developmental disabilities. *Research in Developmental Disabilities, 30,* 44-57. doi: 10.1016/j.ridd.2008.03.002

Carroll, R. A., & Kodak, T. (2014). An evaluation of interrupted and uninterrupted measurement of vocal stereotypy on perceived treatment outcomes. *Journal of Applied Behavior Analysis, 47,* 264-276. doi: 10.1002/jaba.118

Celiberti, D. A., Bobo, H. E., Kelly, K. S., Harris, S. L., & Handleman, J. S. (1997). The differential and temporal effects of antecedent exercise on the self-stimulatory behavior of a child with autism. *Research in Developmental Disabilities, 18,* 139-150. doi: 10.1016/S0891-4222(96)00032-7

Chambless, D. L., Baker, M. J., Baucom, D. H., Beutler, L. E., Calhoun, K. S., Crits-Christoph, P., ... & Woody, S. R. (1998). Update on empirically validated therapies II. *The Clinical Psychologist, 51,* 3-16.

Chebli, S. S., & Lanovaz, M. J. (2016). Using computer tablets to assess preference for videos in children with autism. *Behavior Analysis in Practice. 9,* 50-53. doi: 10.1007/s40617-016-0109-0

Chebli, S. S., Martin, V., & Lanovaz, M. J. (2016). Prevalence of stereotypy in individuals with developmental disabilities: A systematic review. *Review Journal of Autism and*

Developmental Disorders. Advanced online publication. doi: 10.1007/s40489-016-0069-x

Chowdhury, M., & Benson, B.A., (2011). Use of differential reinforcement to reduce behavior problems in adults with intellectual disabilities: A methodological review. *Research in Developmental Disabilities, 32*, 383-394. doi: 10.1016/j.ridd.2010.11.015

Conners, J., Iwata, B. A., Kahng, S. W., Hanley, G. P., Worsdell, A. S., & Thompson, R. H. (2000). Differential responding in the presence and absence of discriminative stimuli during multielement functional analyses. *Journal of Applied Behavior Analysis*, *33*, 299-308. doi:10.1901/jaba.2000.33-299

Cook, J. L., Rapp, J. T., Gomes, L. A., Frazer, T. J., & Lindblad, T. L. (2014). Effects of verbal reprimands on targeted and untargeted stereotypy. *Behavioral Interventions*, *29*, 106-124. doi: 10.1002/bin.1378

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, NJ: Pearson.

Crosland, K., Zarcone, J. R., Schroeder, S., Zarcone, T., & Fowler, S. (2005). Use of antecedent analysis and a force sensitive platform to compare stereotyped movements and motor tics. *American Journal on Mental Retardation,110*, 181-192. doi: 10.1352/08958017(2005)110<181:UOAAAA>2.0.CO;2

Crutchfield, S. A., Mason, R. A., Chambers, A., Wills, H. P., & Mason, B. A. (2015). Use of a self-monitoring application to reduce stereotypic behavior in adolescents with autism: A preliminary investigation of I-Connect. *Journal of Autism and Developmental Disorders, 45*, 1146-1155. doi: 10.1007/s10803-014-2272-x

Cunningham, A. B., & Schreibman, L. (2008). Stereotypy in autism: The importance of function. *Research in Autism Spectrum Disorders, 2*, 469-479. doi: 10.1016/j.rasd.2007.09.006

Cuvo, A. J., May, M. E., & Post, T. M. (2001). Effects of living room, Snoezelen room, and outdoor activities on stereotypic behavior and engagement by adults with profound mental retardation. *Research in Developmental Disabilities, 22,* 183-204.

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*, 519-533. doi: 10.1901/jaba.1996.29-519

DiGennaro Reed, F. D., Hirst, J. M., & Hyman, S. R. (2012). Assessment and treatment of stereotypic behavior in children with autism and other developmental disabilities: A thirty year review. *Research in Autism Spectrum Disorders, 6*, 422-430. doi: 10.1016/j.rasd.2011.07.003

Dominguez, A., Wilder, D. A., Cheung, K., & Rey, C. (2014). The use of verbal reprimand to decrease rumination in a child with autism. *Behavioral Interventions, 29*, 339-345. doi: 10.1002/bin.1390

Dominick, K. C., Davis, N. O., Lainhart, J., Tager-Flusberg, H., & Folstein, S. (2007). Atypical behaviors in children with autism and children with a history of language impairment. *Research in Developmental Disabilities, 28,* 145-162. doi: 10.1016/j.ridd.2006.02.003

Doughty, S. S., Anderson, C. M., Doughty, A. H., Williams, D. C., & Saunders, K. J. (2007). Discriminative control of punished stereotyped behavior in humans. *Journal of the Experimental Analysis of Behavior, 87*, 325-336. doi: 10.1901/jeab.2007.39-05

Douglas, O. L. (2004). Menstrually related self-injurious behavior in adolescents with autism. *Journal of the American Academy of Child & Adolescent Psychiatry, 43*, 1193. doi: 10.1097/01.chi.0000135624.89971.d1

Dracobly, J. D., & Smith, R. G. (2012). Progressing from identification and functional analysis of precursor behavior to treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 45*, 361–374. doi: 10.1901/jaba.2012.45-361

Dunlap, G., Strain, P. S., Fox, L., Carta, J. J., Conroy, M., Smith, B. J., ... & Sailor, W. (2006). Prevention and intervention with young children's challenging behavior: Perspectives regarding current knowledge. *Behavioral Disorders, 32*, 29-45.

Emerson, E., Kiernan, C., Alborz, A., Reeves, D., Mason, H., Swarbrick, R., . . . Hatton, C. (2001). The prevalence of challenging behaviors: A total population study. *Research in Developmental Disabilities, 22*, 77-93. doi: 10.1016/S0891-4222(00)00061-5

English, C. L. & Anderson, C. M. (2006). Evaluating the treatment utility of the analog functional analysis and the structured descriptive assessment. *Journal of Positive Behavior Interventions, 8*, 212-229. doi:10.1177/10983007060080040401

Farmer, C. A., & Aman, M. G. (2011). Aggressive behavior in a sample of children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*, 317-323. doi: 10.1016/j.rasd.2010.04.014

Fischer, S. M., Iwata, B. A., & Mazaleski, J. L. (1997). Noncontingent delivery of arbitrary reinforcers as treatment for self-injurious behavior. *Journal of Applied Behavior Analysis, 30*, 239-249. doi: 10.1901/jaba.1997.30-239

Fisher, W. W., DeLeon, I. G., Rodriguez-Catter, V., & Keeney, K. M. (2004). Enhancing the effects of extinction on attention-maintained behavior through noncontingent delivery of

attention or stimuli identified via a competing stimulus assessment. *Journal of Applied Behavior Analysis, 37,* 171-184. doi: 10.1901/jaba.2004.37-171

Fisher, W.W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491-498. doi: 10.1901/jaba.1992.25-491

Fritz, J. N., Iwata, B. A., Hammond, J. L., & Bloom, S. E. (2013). Experimental analysis of precursors to severe problem behavior. *Journal of Applied Behavior Analysis, 46,* 101-129. doi: 10.1002/jaba.27

Fritz, J. N., Iwata, B. A., Rolider, N. U., Camp, E. M., & Neidert, P. L. (2012). Analysis of self-recording in self-management interventions for stereotypy. *Journal of Applied Behavior Analysis, 45,* 55-68. doi: 10.1901/jaba.2012.45-55

Graff, R. B., & Karsten, A. M. (2012). Assessing preferences of individuals with developmental disabilities: a survey of current practices. *Behavior Analysis in Practice, 5,* 37-48.

Hagopian, L. P., Crockett, J. L., Stone, M., Deleon, I. G., & Bowman, L. G. (2000). Effects of noncontingent reinforcement on problem behavior and stimulus engagement: The role of satiation, extinction, and alternative reinforcement. *Journal of Applied Behavior Analysis, 33,* 433-449. doi: 10.1901/jaba.2000.33-433

Hagopian, L. P., Fisher, W. W., & Legacy, S. M. (1994). Schedule effects of noncontingent reinforcement on attention-maintained destructive behavior in identical quadruplets. *Journal of Applied Behavior Analysis, 27,* 317-325. doi: 10.1901/jaba.1994.27-317

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and

punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31,* 211-235. doi: 10.1901/jaba.1998.31-211

Hamilton, A., Marshal, M. P., & Murray, P. J. (2011). Autism spectrum disorders and menstruation. *Journal of Adolescent Health, 49*, 442-445. doi: 10.1016/j.jadohealth.2011.01.015

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavioral Analysis, 36*, 147-185. doi: 10.1901/jaba.2003.36-147

Hanley, G. P., Iwata, B. A., & Thompson, R. H. (2001). Reinforcement schedule thinning following treatment with functional communication training. *Journal of Applied Behavior Analysis, 34*, 17-38. doi: 10.1901/jaba.2001.34-17

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis, 47*, 16-36. doi: 10.1002/jaba.106

Harrop, C., McBee, M., & Boyd, B. A. (2016). How are child restricted and repetitive behaviors associated with caregiver stress over time? A parallel process multilevel growth model. *Journal of Autism and Developmental Disabilities*. Advance online publication. doi: 10.1007/s10803-016-2707-7

Heath, A. K., Ganz, J. B., Parker, R., Burke, M., & Ninci, J. (2015). A Meta-analytic Review of Functional Communication Training Across Mode of Communication, Age, and Disability. *Review Journal of Autism and Developmental Disorders, 2*, 155-166. doi: 10.1007/s40489-014-0044-3

Herscovitch, B., Roscoe, E. M., Libby, M. E., Bourret, J. C., & Ahearn, W. H. (2009). A procedure for identifying precursors to problem behavior. *Journal of Applied Behavior Analysis, 42*, 697-702. doi: 10.1901/jaba.2009.42-697

Horner, R. H., & Carr, E. G. (1997). Behavioral support for students with severe disabilities: Functional assessment and comprehensive intervention. *The Journal of Special Education, 31*, 84-104. doi: 10.1177/002246699703100108

Horner, R., Day, M. H., & Day, J. R. (1997). Using neutralizing routines to reduce problem behaviors. *Journal of Applied Behavior Anlaysis, 30*, 601-614. doi: 10.1901/jaba.1997.30-601

Horrocks, E., & Higbee, T. S. (2008). An evaluation of a stimulus preference assessment of auditory stimuli for adolescents with developmental disabilities. *Research in Developmental Disabilities, 29*, 11-20. doi: 10.1016/j.ridd.2006.09.003

Ingvarsson, E. T., Kahng, S., & Hausman, N. L. (2008). Some effects of noncontingent positive reinforcement on multiply controlled problem behavior and compliance in a demand context. *Journal of Applied Behavior Analysis*, *41*, 435-440. doi: 10.1901/jaba.2008.41-435

Iwata, B. A., DeLeon, I. G., & Roscoe, E. M. (2013). Reliability and validity of the functional analysis screening tool. *Journal of Applied Behavior Analysis, 46*, 271-284. doi: 10.1002/jaba.31

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197-209. doi:10.1901/jaba.1994.27-197. (Reprinted from *Analysis and Intervention in Developmental Disabilities*, 2, 3-20, 1982).

Iwata, B. A., & Dozier, C. L. (2008). Clinical application of functional analysis methodology. *Behavior Analysis in Practice, 1,* 3–9.

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., Rodgers, T. A., …Willis, K. D. (1994). The functions of self-injurious behavior: An experimental epidemiological analysis. *Journal of Applied Behavior Analysis, 27,* 215-240. doi: 10.1901/jaba.1994.27-215

Jarmolowicz, D. P., DeLeon, I. G., & Kuhn, S. A. C. (2009). Functional communication during signaled reinforcement and/or extinction. *Behavioral Interventions, 24,* 265-273. doi: 10.1002/bin.288

Jones, R. S. P., Wint, D., & Ellis, N. C. (1990). The social effects of stereotyped behavior. *Journal of Intellectual Disability Research, 34,* 261-268. doi: 10.1111/j.1365-2788.1990.tb01537.x

Kahng, S., Hausman, N. L., & Jann, K. E. (2011). Self-injurious behavior. In J. K. Luiselli (Ed.), *Teaching and behavior support for children and adults with autism spectrum disorders: A practitioner's guide* (pp. 136-142). New York, NY: Oxford University Press.

Kang, S., Lang, R. B., O'Reilly, M. F., Davis, T. N., Machalicek, W., Rispoli, M. J., & Chan, J. M. (2010). Problem behavior during preference assessments: an empirical analysis and practical recommendations. *Journal of Applied Behavior Analysis, 43,* 137-141. doi: 10.1901/jaba.2010.43-137

Kang, S., O'Reilly, M., Lancioni, G., Falcomata, T. S., Sigafoos, J., & Xu, Z. (2013). Comparison of the predictive validity and consistency among preference assessment procedures: A review of the literature. *Research in Developmental Disabilities, 34,* 1125-1133. doi: 10.1016/j.ridd.2012.12.021

Kennedy, C. H., & Meyer, K. A. (1996). Sleep deprivation, allergy symptoms, and negatively reinforced problem behavior. *Journal of Applied Behavior analysis, 29,* 133-135. doi: 10.1901/jaba.1996.29-133

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). *Single-case designs technical documentation.* Retrieved from http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education, 34*, 26-38. doi: 10.1177/0741932512452794

Kuhn, D. E., Chirighin, A. E., & Zelenka, K. (2010). Discriminated functional communication: A procedural extension of functional communication training. J*ournal of Applied Behavior Analysis, 43,* 249-264. doi: 10.1901/jaba.2010.43-249

Kurtz, P.F., Boelter, E.W., Jarmolowicz, D.P., Chin, M.D., & Hagopian, L.P. (2011). An analysis of functional communication training as an empirically supported treatment for problem behavior displayed by individuals with intellectual disabilities. *Research in Developmental Disabilities, 32,* 2935-2942. doi: 10.1016/j.ridd.2010.11.015

Lalli, J. S., Casey, S. D., & Kates, K. (1997). Noncontingent reinforcement as treatment for severe problem behavior: Some procedural variations. *Journal of Applied Behavior Analysis*, *30*, 127-137. doi: 10.1901/jaba.1997.30-127

Langthorne, P., & McGill., P. (2009). A tutorial on the concept of the motivating operation and its importance to application. Behavior Analysis in Practice, 2, 22-311.

Langthorne, P., McGill, P., & Oliver, C. (2014). The motivating operation and negatively reinforced problem behavior : A systematic review. *Behavior Modification, 38,* 107-159. doi: 10.1177/0145445513509649

Lanovaz, M. J., & Argumedes, M. (2010). Immediate and subsequent effects of differential reinforcement of other behavior and noncontingent matched stimulation on stereotypy. *Behavioral Interventions, 25*, 229-238. doi: 10.1002/bin.308

Lanovaz, M. J., Argumedes, M., Roy, D., Duquette, J. R., & Watkins, N. (2013). Using ABC narrative recording to identify the function of problem behavior: A pilot study. *Research in Developmental Disabilities, 34,* 2734-2742. doi: 10.1016/j.ridd.2013.05.038

Lanovaz, M. J., & Rapp, J. T. (2016). Using single-case experiments to support evidence-based decisions: How much is enough? *Behavior Modification.* Advanced online publication. doi: 10.1177/0145445515613584

Lanovaz, M. J., Rapp, J. T. & Fletcher, S. M. (2010). Expanding functional analysis of automatically reinforced behavior using a three-component multiple schedule. *European Journal of Behavior Analysis, 11*, 17-27.

Lanovaz, M. J., Rapp, J. T., Maciw, I., Prégent-Pelletier, E., Dorion, C., Ferguson, S., & Saade, S. (2014). Effects of multiple interventions for reducing vocal stereotypy: Developing a sequential intervention model. *Research in Autism Spectrum Disorders, 8*, 529-545. doi: 10.1016/j.rasd.2014.01.009

Lanovaz, M. J., Robertson, K. M., Soerono, K., & Watkins, N. (2013). Effects of reducing stereotypy on other behaviors: A systematic review. *Research in Autism Spectrum Disorders, 7*, 1234-1243. doi: 10.1016/j.rasd.2013.07.009

Lanovaz, M. J., & Sladeczek, I. E. (2012). Vocal stereotypy in children with autism spectrum disorders: A review of behavioral interventions. *Behavior Modification, 36,* 146-164. doi: 10.1177/0145445511427192

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36*, 407-414. doi: 10.1901/jaba.2003.36-407

Laraway, S., Snycerksi, S., Olson, R., Becker, B., & Poling, A. (2014). The motivating operations concept: Current status and critical response. The Psychological Record, 64, 601-623. doi. 10.1007/s40732-014-0080-5

Lecavalier, L., Leone, S., & Wiltz, J. (2006). The impact of behaviour problems on caregiver stress in young people with autism spectrum disorders. *Journal of Intellectual Disability Research, 50,* 172-183. doi: 10.1111/j.1365-2788.2005.00732.x

Lerman, D. C., Hovanetz, A., Strobel, M., & Tetreault, A. (2009). Accuracy of teacher-collected descriptive analysis data: A comparison of narrative and structured recording formats. *Journal of Behavioral Education, 18*, 157-172. doi: 10.1007/s10864-009-9084-7

Lerman, D. C., & Vorndran, C. M. (2002). On the status of knowledge for using punishment: Implications for treating behavior disorders. *Journal of Applied Behavior Analysis, 35,* 431-464. doi: 10.1901/jaba.2002.35-431

Lovaas, I., Newson, C., & Hickman, C. (1987). Self-stimulatory behavior and perceptual reinforcement. *Journal of Applied Behavior Analysis, 20,* 45-68. doi: 10.1901/jaba.1987.20-45

Luiselli, J. K., Cochran, M. L., & Huber, S. A. (2005). Effects of otitis media on a child with autism receiving behavioral intervention for self-injury. *Child & Family Behavior Therapy, 27*, 51-56. doi: 10.1300/J019v27n02_05

Luiselli, J. K., Ricciardi, J. N., Zubow, M., & Laster, K. (2004). Practice of an alternative behavior as intervention for object stereotypy: Comparison of contingent and noncontingent implementation across evoking stimuli. *The Behavior Analyst Today, 5*, 304-312. doi: 10.1037/h0100037

Luiselli, J. K., Wolongevicz, J., Egan, P., Amirault, D., Sciaraffa, N., & Treml, T. (1999). The Family Support Program: Description of a preventive, community-based behavioral intervention for children with pervasive developmental disorders. *Child & Family Behavior Therapy, 21*, 1-18. doi: 10.1300/J019v21n01_01

MacDonald, R., Green, G., Mansfield, R., Geckeler, A., Gardenier, N., Anderson, J., Holcomb, W., & Sanchez, J. (2007). Stereotypy in young children with autism and typically developing children. *Research in Developmental Disabilities, 28*, 266-277. doi: 10.1016/j.ridd.2006.01.004

Mandell, D. S., (2008). Psychiatric hospitalization among children with autism spectrum disorders. *Journal of Autism and Developmental Disabilities, 38*, 1059-1065. doi: 10.1007/s10803-007-0481-2

Marcus, B. A., Vollmer, T. R., Swanson, V., Roane, H. R., & Ringdahl, J. E. (2001). An experimental analysis of aggression. *Behavior Modification, 25*, 189-213. doi: 10.1177/0145445501252002

Matson, J. L., Bamburg, J. W., Cherry, K. E., & Paclawskyj, T. R. (1999). A validity study on the questions about behavioral function (QABF) scale: Predicting treatment success for

self-injury, aggression, and stereotypies. *Research in Developmental Disabilities, 20,* 163-175. doi: 10.1016/S0891-4222(98)00039-0

Matson, J. L., Boisjoli, J., Rojahn, J., & Hess, J. (2009). A factor analysis of challenging behaviors assessed with the Baby and Infant Screen for Children with Autism Traits (BISCUIT-Part 3). *Research in Autism Spectrum Disorders, 3,* 714-722. doi: 10.1016/j.rasd.2009.01.008

Matson, J. L., Kiely, S., & Bamburg, J. (1997). The effect of stereotypies on adaptive skills as assessed with the DASH-II and Vineland Adaptive Behavior Scales. *Research in Developmental Disabilities, 18,* 471-476. doi: 10.1016/S0891-4222(97)00023-1

Matson, J. L., & LoVullo, S. V. (2008). A review of behavioral treatment for self-injurious behaviors of persons with autism spectrum disorders. *Behavior Modification, 32*, 61-76. doi: 10.1177/0145445507304581

Matson, J. L., & Nebel-Schwalm, M. (2007). Assessing challenging behaviors in children with autism spectrum disorders: A review. *Research and Developmental Disabilities, 28*, 567-579. doi: 10.1016/j.ridd.2006.08.001

Matson, J. L., & Rivet, T. T. (2008). Characteristics of challenging behaviours in adults with autistic disorder, PDD-NOS, and intellectual disability. *Journal of Intellectual & Developmental Disability, 33,* 323-329. doi : 10.1080/13668250802492600

Matson, J. L., & Shoemaker, M. (2009). Intellectual disability and its relationship to autism spectrum disorders. *Research in Developmental Disabilities, 30*, 1107-1114. doi: 10.1016/j.ridd.2009.06.003

Matson, J. L., & Vollmer, T. R. (1995). The Questions about Behavioral Function (QABF) user's guide. Baton Rouge, LA: Scientific Publishers.

Mazurek, M. O., Kanne, S. M., & Wodka, E. L. (2013). Physical aggression in children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*, 455-465. doi: 10.1016/j.rasd.2012.11.004

McClean, B., & Grey, I. (2012). An evaluation of an intervention sequence outline in positive behaviour support for people with autism and severe escape-motivated challenging behaviour, *Journal of Intellectual and Developmental Disability, 37*, 209-220. doi: 10.3109/13668250.2012.704982

McClintock, K., Hall, S., & Oliver, C. (2003). Risk markers associated with challenging behaviours in people with intellectual disabilities: A meta-analytic study. *Journal of Intellectual Disability Research, 47*, 405-416. doi: 10.1046/j.1365-2788.2003.00517.x

McGill, P., Hughes, D., Teer, K., & Rye, L. (2001). Variability in staff reports of the frequency of challenging behavior. *Research in Developmental Disabilities*, *22*, 221-231. doi: 10.1016/S0891-4222(01)00069-5

McGill, P., Teer, K., Rye, L., & Hughes, D. (2003). Staff reports of setting events associated with challenging behavior. *Behavior Modification, 27*, 265-282. doi: 10.1177/0145445503251604

McTiernan, A., Leader, G., Healy, O., & Mannion, A. (2011). Analysis of risk factors and early predictors of challenging behavior for children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 5*, 1215-1222. doi: 10.1016/j.rasd.2011.01.009

Mello, N. K., Mendelson, J. H., & Kuehnle, J. C. (1982). Buprenorphine effects on human heroin self administration: An operant analysis. *Journal of Pharmacology and Experimental Therapeutics, 223*, 30-39.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior, 37,* 149-155. doi: 10.1901/jeab.1982.37-149

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16,* 191-206

Michael, J. (2000). Implications and refinements of the establishing operation concept. *Journal of Applied Behavior Analysis, 33,* 401-410. doi: 10.1901/jaba.2000.33-401

Minshawi, N. F., Hurwitz, S., Fodstad, J. C., Biebl, S., Morris, D. H., & McDougle, C. J. (2014). The association between self-injurious behaviors and autism spectrum disorders. *Psychology Research and Behavior Management, 7,* 125-136. doi: 10.2147/PRBM.S44635

Minshawi, N. F., Hurwitz, S., Morris, D., & McDougle, C. J. (2014). Multidisciplinary assessment and treatment of self-injurious behavior in autism spectrum disorder and intellectual disability: Integration of psychological and biological theory and approach. *Journal of Autism and Developmental Disorder, 45,* 1541-1568. doi: 10.1007/s10803-014-2307-3

Mitter, D. R., Romani, P. W., Greer, B. D., & Fisher, W. W. (2015). Assessment and treatment of pica and destruction of holiday decorations. *Journal of Applied Behavior Analysis, 48,* 912-917. doi: 10.1002/jaba.255

Morrison, H., Roscoe, E. M., & Atwell, A. (2011). An evaluation of antecedent exercise on behavior maintained by automatic reinforcement using a three-component multiple schedule. *Journal of Applied Behavior Analysis, 44,* 523-541. doi: 10.1901/jaba.2011.44-523

Murphy, O., Healy, O., & Leader, G. (2009). Risk factors for challenging behaviors among 157 children with autism spectrum disorder in Ireland. *Research in Autism Spectrum Disorders, 3*, 474-482. doi: 10.1016/j.rasd.2008.09.008

Najdowski, A. C., Wallace, M. D., Ellsworth, C. L., MacAleese, A. N., & Cleveland, J. M. (2008). Functional analyses and treatment of precursor behavior. *Journal of Applied Behavior Analysis, 41*, 97–105. doi: 10.1901/jaba.2008.41-97

Neely, L., Rispoli, M., Gerow, S., & Ninci, J. (2015). Effects of antecedent exercise on academic engagement and stereotypy during instruction. *Behavior Modification, 39*, 98-116. doi: 10.1177/0145445514552891

Neidert, P. L., Iwata, B. A., Dempsey, C. M. & Thomason-Sassi, J. L. (2013). Latency of response during the functional analysis of elopement. *Journal of Applied Behavior Analysis, 46*, 312–316. doi: 10.1002/jaba.11

Newman, D. W., Summerhill, L., Mosley, E., & Tooth, C. (2003). Working with an adult male with Down's syndrome, autism and challenging behaviour: Evaluation of a programme of staff support and organizational change. *British Journal of Learning Disabilities, 31*, 85-90. doi: 10.1046/j.1468-3156.2003.00227.x

Nickels, K. C., Katusic, S. K., Colligan, R. C., Weaver, A. L., Voigt, R. G., & Barbaresi, W. J. (2009). Stimulant medication treatment of target behaviors in children with autism: A population-based study. *Journal of Developmental and Behavioral Pediatrics, 29*, 75-81. doi: 10.1097/DBP.0b013e31815f24f7

Nuernberger, J. E., Smith, C. A., Czapar, K. N., & Klatt, K. P. (2012). Assessing preference for social interaction in children diagnosed with autism. *Behavioral Interventions, 27*, 33-44. doi: 10.1002/bin.1336

Olive, M. L., Lang, R. B., & Davis, T. N. (2008). An analysis of the effects of functional communication and a voice output communication aid for a child with autism spectrum disorder. *Research in Autism Spectrum Disorders, 2,* 223-236. doi: 10.1016/j.rasd.2007.06.002

Oliver, A. C., Pratt, L. A., & Normand, M. P. (2015). A survey of functional behavior assessment methods used by behavior analysts in practice. *Journal of Applied Behavior Analysis,* 48, 817–829. doi: 10.1002/jaba.256

O'Reilly, M. F. (1995). Functional analysis and treatment of escape-maintained aggression correlated with sleep deprivation. *Journal of Applied Behavior Analysis, 28,* 225-226. doi: 10.1901/jaba.1995.28-225

O'Reilly, M. F. (1997). Functional analysis of episodic self-injury correlated with recurrent otitis media. *Journal of Applied Behavior Analysis, 20,* 165-167. doi: 10.1901/jaba.1997.30-165

O'Reilly, M. F., Edrisinha, C., Sigafoos, J., Lancioni, G., & Andrews, A. (2006). Isolating the evocative and abative effects of an establishing operation on challenging behavior. *Behavioral Interventions, 21,* 195-204. doi: 10.1002/bin.215

O'Reilly, M. K., Richman, D. M., Lancioni, G., Hilery, J., Lindauer, S., Crosland, K., & Lacey, C. (2000). Using brief functional assessments to identify specific contexts for problem behavior maintained by positive and negative reinforcement. *European Journal of Behavior Analysis, 1,* 135-142. doi: 10.1080/15021149.2000.11434164

Paclawskyj, T. R., Matson, J. L., Rush, K. S., Smalls, Y. & Vollmer, T. R. (2000). Questions about Behavioral Function (QABF): A behavioral checklist for functional assessment of

aberrant behavior. *Research in Developmental Disabilities, 21*, 223–229. doi:10.1016/S0891-4222(00)00036-6

Paclawskyj, T. R., Matson, J. L., Rush, K. S., Smalls, Y. & Vollmer, T. R. (2001). Assessment of the convergent validity of the Questions about Behavioral Function (QABF) Scale with analogue functional analysis and the Motivation Assessment Scale. *Journal of Intellectual Intellectual Disability Research, 45*, 484–494. doi:10.1046/j.1365–2788.2001.00364.x

Pence, S. T., Roscoe, E. M., Bourret, J. C., & Ahearn, W. H. (2009). The relative contributions of three descriptive methods: Implications for behavioral assessment. *Journal of Applied Behavior Analysis, 42*, 425-446. doi: 10.1901/jaba.2009.42-425

Peters, L. C., & Thompson, R. H. (2013). Some indirect effects of positive practice overcorrection. *Journal of Applied Behavior Analysis, 46*, 613-625. doi: 10.1002/jaba.63

Petscher, E. S., Rey, C., & Bailey, J. S. (2009). A review of empirical support for differential reinforcement of alternative behavior. *Research in Developmental Disabilities, 30*, 409-425. doi: 10.1016/j.ridd.2008.08.008

Piazza, C. C., Moes, D. R., & Fisher, W. W. (1996). Differential reinforcement of alternative behavior and demand fading in the treatment of escape-maintained destructive behavior. *Journal of Applied Behavior Analysis, 29*, 569-572. doi: 10.1901/jaba.1996.29-569

Plumet, M.-H., & Veneziano, E. (2014). Typical and atypical pragmatic functioning of ASD children and their partners: A study of oppositional episodes in everyday interactions. *Journal of Autism and Developmental Disorders, 45*, 53-67. doi: 10.1007/s10803-014-2164-0

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Ortega, J. V., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 46,* 47-60. doi: 10.1002/jaba.26

Rapp, J. T. (2007). Further evaluation of methods to identify matched stimulation. *Journal of Applied Behavior Analysis, 40,* 73-88. doi: 10.1901/jaba.2007.142-05

Rapp, J. T. (2008). Conjugate reinforcement: A brief review and suggestions for applications to the assessment of automatically reinforced behavior. *Behavioral Interventions, 23,* 113-136. doi: 10.1002/bin.259

Rapp, J. T., & Lanovaz, M. J. (2016). Stereotypy. In N. N. Singh (Ed.), *Clinical handbook of evidence-based practices for individuals with intellectual and developmental disabilities*. New York, NY: Springer.

Rapp, J. T., Swanson, G., & Dornbusch, K. (2007). Temporary increases in problem behavior and sleep disruption following decreases in medication: A descriptive analysis of conditional rates. *Behavior Modification, 31,* 825-846. doi: 10.1177/0145445507301653

Rapp, J. T., Swanson, G., Sheridan, S., Enloe, K., Maltese, D., Sennott, L., …Lanovaz, M. J. (2013). Immediate and subsequent effects of matched and unmatched stimuli on targeted vocal stereotypy and untargeted motor stereotypy. *Behavior Modification, 37,* 543-567. doi: 10.1177/0145445512461650

Rapp, J. T., & Vollmer, T. R. (2005). Stereotypy I: A review of behavioral assessment and treatment. *Research in Developmental Disabilities, 26,* 527-547. doi: 10.1016/j.ridd.2004.11.005

Rapp, J. T., Vollmer, T. R., St. Peter, C., Dozier, C. L., & Cotnoir, N. M. (2004). Analysis of response allocation in individuals with multiple forms of stereotyped behavior. *Journal of Applied Behavior Analysis, 37,* 481-501. doi: 10.1901/jaba.2004.37-481

Rattaz, C., Michelon, C., & Baghdadli, A. (2015). Symptom severity as a risk factor for self-injurious behaviours in adolescents with autism spectrum disorders. *Journal of Intellectual Disability Research, 59,* 730-741. doi: 10.1111/jir.12177

Reed, G. K., Deloezal, D. N., Cooper-Brown, L. J., & Wacker, D. P. (2005). The effects of sleep disruption on the treatment of a feeling disorder. *Journal of Applied Behavior Analysis, 38,* 243-245. doi: 10.1901/jaba.2005.42-04

Reid, D. H., Parsons, M. B., & Lattimore, L. P. (2010). Designing and evaluating assessment-based interventions to reduce stereotypy among adults with autism in a community job. *Behavior Analysis in Practice, 3,* 27.

Richards, C., Oliver, C., Nelson, L., & Moss, J. (2012). Self-injurious behaviour in individuals with autism spectrum disorder and intellectual disability. *Journal of Intellectual Disability Research, 56,* 476-489. doi: 10.1111/j.1365-2788.2012.01537.x

Richman, D. M., Barnard-Brak, L., Grubb, L., Bosch, A., & Abby, L. (2015). Meta-analysis of noncontingent reinforcement effects on problem behavior. *Journal of Applied Behavior Analysis, 48,* 131-152. doi: 10.1002/jaba.189

Richman, D. M., Wacker, D. P., Asmus, J. M., & Casey, S. D. (1998). Functional analysis and extinction of different behavior problems exhibited by the same individual. *Journal of Applied Behavior Analysis, 31,* 475-478. doi: 10.1901/jaba.1998.31-475

Ringdahl, J. E., Kitsukawa, K., Andelman, M. S., Call, N., Winborn, L., Barretto, A., & Reed, G. K. (2002). Differential reinforcement with and without instructional fading. *Journal of Applied Behavior Analysis, 35*, 291–294. doi: 10.1901/jaba.2002.35-291

Rispoli, M., Camargo, S., Machalicek W., Lang, R., & Sigafoos, J. (2014). Functional communication training in the treatment of problem behavior maintained by access to rituals. *Journal of Applied Behavior Analysis, 47,* 580-593. doi: 10.1002/jaba.130

Roane, H. S., & Kadey, H. J. (2011). Aggression and destruction. In J. K. Luiselli (Ed.), *Teaching and behavior support for children and adults with autism spectrum disorders: A practitioner's guide* (pp. 143-150). New York, NY: Oxford University Press.

Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A. (1998). Evaluation of a brief stimulus preference assessment. *Journal of Applied Behavior Analysis*, *31*, 605-620. doi: 10.1901/jaba.1998.31-605

Rojahn, J., Matson, J. L., Lott, D., Esbensen, A. J., & Smalls, Y. (2001). The Behavior Problems Inventory: An instrument for the assessment of self-injury, stereotyped behavior, and aggression/destruction in individuals with developmental disabilities. *Journal of Autism and Developmental Disorders, 31,* 577-588. doi: 10.1023/A:1013299028321

Rojahn, J., Matson, J. L., Mahan, S., Fodstad, J. C., Knight, C., Sevin, J. A., & Sharp, B. (2009). Cutoffs, norms, and patterns of problem behaviors in children with an ASD on the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT-Part 3). *Research in Autism Spectrum Disorders, 3,* 989-998. doi: 10.1016/j.rasd.2009.06.002

Rojahn, J., Wilkins, J., Matson, J. L., & Boisjoli, J. (2010). A comparison of adults with intellectual disabilities with and without ASD on parallel measures of challenging behaviour: The Behavior Problems Inventory-01 (BPI-01) and Autism Spectrum

Disorders-Behavior Problems for Intellectually Disabled Adults (ASD-BPA). *Journal of Applied Research in Intellectual Disabilities, 27,* 179-185. doi: 10.1111/j.1468-3148.2009.00519.x

Roscoe, E. M., Phillips, K. M., Kelly, M. A., Farber, R., & Dube, W. V. (2015). A statewide survey assessing practitioners' use and perceived utility of functional assessment. *Journal of Applied Behavior Analysis*, *48,* 830–844. doi: 10.1002/jaba.259

Rozenblat, E., Brown, J. L., Brown, A. K., Reeve, S. A., & Reeve, K. F. (2009). Effects of adjusting DRO schedules on the reduction of stereotypic vocalizations in children with autism. *Behavioral Interventions, 24,* 1-15. doi: 10.1002/bin.270

Saylor, S., Sidener, T. M., Reeve, S. A., Fetherston, A., & Progar, P. R. (2012). Effects of three types of noncontingent auditory stimulation on vocal stereotypy in children with autism. *Journal of Applied Behavior Analysis*, *45,* 185-190. doi: 10.1901/jaba.2012.45-185

Schindler, H. R., & Horner, R. H. (2005). Generalized reduction of problem behavior of young children with autism: Building trans-situational interventions. *American Journal of Mental Retardation, 110,* 36-47. doi: 10.1352/0895-8017(2005)110<36:GROPBO>2.0.CO;2

Schmidt, J. D., Drasgow, E., Halle, J. W., Martin, C. A., & Bliss, S. A. (2014). Discrete-trial functional analysis and functional communication training with three individuals with autism and severe problem behavior. *Journal of Positive Behavior Interventions*, *16*, 44-55. doi: 10.1177/1098300712470519

Shabani, D. B., Wilder, D. A., & Flood, W. A. (2001). Reducing stereotypic behavior through discrimination training, differential reinforcement of other behavior, and self-monitoring. *Behavioral Interventions*, *16*, 279-286. doi: 10.1002/bin.96

Shirley, M. J., Iwata, B. A., Kahng, S., Mazaleski, J. L., & Lerman, D. C. (1997). Does functional communication training compete with ongoing contingencies of reinforcement? An analysis during response acquisition and maintenance. *Journal of Applied Behavior Analysis, 30,* 93-104. doi: 10.1901/jaba.1997.30-93

Sigafoos, J., & Saggers, E. (1995). A discrete-trial approach to the functional analysis of aggressive behaviour in two boys with autism. *Journal of Intellectual and Developmental Disabilities, 20*, 287-297.

Simó-Pinatella, D., Font-Roura, J., Planella-Morató, J., McGill, P., Alomar-Kurz, E., & Giné C. (2013). Types of motivating operations in interventions with problem behavior: A systematic review. *Behavior Modification, 37,* 3-38. doi: 10.1177/0145445512448096

Slocum, S. K., & Vollmer, T. R. (2015). A comparison of positive and negative reinforcement for compliance to treat problem behavior maintained by escape. *Journal of Applied Behavior Analysis, 48,* 563-574. doi: 10.1002/jaba.216

Smaby, K., MacDonald, R. P., Ahearn, W. H., & Dube, W. V. (2007). Assessment protocol for identifying preferred social consequences. *Behavioral Interventions, 22*, 311-318. doi: 10.1002/bin.242

Smith, R. G., & Churchill, R. M. (2002). Identification of environmental determinants of behavior disorders through functional analysis of precursor behaviors. *Journal of Applied Behavior Analysis, 35,* 125–135. doi: 10.1901/jaba.2002.35-125

Smith, R. G., & Iwata, B. A. (1997). Antecedent influences on behavior disorders. *Journal of Applied Behavior Analysis, 30,* 343-375. doi: 10.1901/jaba.1997.30-343

Smith, C. M., Smith, R. G., Dracobly, J. D., & Peterson-Pace, A. (2012). Multiple-respondent anecdotal assessments: An analysis of interrater agreement and correspondence with

analogue assessment outcomes. *Journal of Applied Behavior Analysis, 45*, 779-795. doi: 10.1901/jaba.2012.45-779

Sorensen, C., & Zarrett, N. (2014). Benefits of physical activity for adolescents with autism spectrum disorders: A comprehensive review. *Review Journal of Autism and Developmental Disorders, 1*, 344-353. doi: 10.1007/s40489-014-0027-4

Stahmer, A. C., & Schreibman, L. (1992). Teaching children with autism appropriate play in unsupervised environments using a self-management treatment package. *Journal of Applied Behavior Analysis*, *25*, 447-459. doi: 10.1901/jaba.1992.25-447

Taylor, B. A., Hoch, H., & Weissman, M. (2005). The analysis and treatment of vocal stereotypy in a child with autism. *Behavioral Interventions, 20*, 239-253. doi: 10.1002/bin.200

Thelen, E. (1979). Rhythmical stereotypies in normal human infants. *Animal Behavior, 27,* 699-715. doi: 10.1016/0003-3472(79)90006-X

Thomason-Sassi, J. L., Iwata, B. A., Neidert, P. L., & Roscoe, E. M. (2011). Response latency as an index of response strength during functional analysis of problem behavior. *Journal of Applied Behavior Analysis*, *44*, 51-67. doi: 10.1901/jaba.2011.44-51

Tiger, J. H., Fisher, W. W., & Bouxsein, K. J. (2009). Therapist- and self-monitored DRO contingencies as a treatment for the self-injurious skin picking of a young man with Asperger syndrome. *Journal of Applied Behavior Analysis, 42,* 315-319. doi: 10.1901/jaba.2009.42-315

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1,* 16-23.

Tomanik, S., Harris, G. E., & Hawkins, J. (2004). The relationship between behaviours exhibited by children with autism and maternal stress. *Journal of Intellectual and Developmental Disability, 29*, 16–26. doi: 10.1080/13668250410001662892

Tyrer, F., McGrother, C. W., Thorp, C. F., Donaldson, M., Bhaumik, S., Watson, J. M., & Hollin, C. (2006). Physical aggression towards others in adults with learning disabilities: Prevalence and associated factors. *Journal of Intellectual Disability Research, 50*, 295-304. doi: 10.1111/j.1365-2788.2005.00774.x

Underwood, L. A., Figueroa, R. G., Thyer, B. A., & Nzeocha, A. (1989). Interruption and DRI in the treatment of self-injurious behavior among mentally retarded and autistic self-restrainers. *Behavior Modification, 13*, 471-481. doi: 10.1177/01454455890134006

Valdovinos, M. G., & Kennedy, C. H. (2004). A behavior-analytic conceptualization of the side effects of psychotropic medication. *The Behavior Analyst, 27*, 231-238.

Vaughn, B. J., Wilson, D., & Dunlap, G. (2002). Family-centered interventions to resolve problem behaviors in a fast-food restaurant. *Journal of Positive Behavior Interventions, 4*, 38-45. doi: 10.1177/109830070200400107

Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities, 15*, 187-207. doi: 10.1016/0891-4222(94)90011-6

Vollmer, T. R., Hagopian, L. P., Bailey, J. S., Dorsey, M. F., Hanley, G. P., Lennox, D., ... & Spreat, S. (2011). The association for behavior analysis international position statement on restraint and seclusion. *The Behavior Analyst, 34*, 103-110.

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: Noncontingent

reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26,* 9-21. doi: 10.1901/jaba.1993.26-9

Vollmer, T. R., Marcus, B. A., Ringdahl, J. E., & Roane, H. S. (1995). Progressing from brief assessments to extended experimental analyses in the evaluation of aberrant behavior. *Journal of Applied Behavior Analysis, 28,* 561-576. doi: 10.1901/jaba.1995.28-561

Vollmer, T. R., Ringdahl, J. E., Roane, H. S., & Marcus, B. A. (1997). Negative side effects of noncontingent reinforcement. *Journal of Applied Behavior Analysis, 30,* 161-164. doi: 10.1901/jaba.1997.30-161

Wacker, D. P., Steege, M. W., Northup, J., Sasso, G., Berg, W., Reimers, T., ... & Donn, L. (1990). A component analysis of functional communication training across three topographies of severe behavior problems. *Journal of Applied Behavior Analysis, 23,* 417-429. doi: 10.1901/jaba.1990.23-417

Watkins, N. & Rapp, J. T. (2013). The convergent validity of the questions about behavioral function scale and functional analysis for problem behavior displayed by individuals with autism spectrum disorder. *Research in Developmental Disabilities, 34,* 11-16. http://dx.doi.org/10.1016/j.ridd.2012.08.003

Wilder, D. A., Harris, C., Reagan, R., & Rasey, A. (2007). Functional analysis and treatment of noncompliance by preschool children. *Journal of Applied Behavior Analysis, 40,* 173-177. doi: 10.1901/jaba.2007.44-06

Wilke, A. E., Tarbox, J., Dixon, D. R., Kenzer, A. L., Bishop, M. R., & Kakavand, H. (2012). Indirect functional assessment of stereotypy in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6,* 824-828. doi: 10.1016/j.rasd.2011.11.003

Wunderlich, K. L., & Vollmer, T. R. (2015). Data analysis of response interruption and redirection as a treatment for vocal stereotypy. *Journal of Applied Behavior Analysis*, *48*, 749-764. doi: 10.1002/jaba.227