Chapter 7
Functional Assessment of Problematic Forms of Prelinguistic Behavior

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Abstract Autism spectrum disorder is associated with communication impairment and problem behavior such as aggression and self-injury. Researchers have found an inverse relation between problem behavior and communicative competence, suggesting that some problem behavior might have a communicative basis. Additional support for this relation emanates from studies aimed at identifying variables that control problem behavior with experimental-functional analysis methodology. In this chapter, we review the results of current research that has used experimental-functional analyses of problem behavior among individuals with autism spectrum disorder. Results suggest that a substantial percentage of individuals with autism spectrum disorder present with problem behavior controlled by (a) attention from another person, (b) access to preferred objects/activities, and/or (c) escape from or avoidance of non-preferred objects/activities/people. Problem behavior controlled by these variables might be conceptualized as prelingusitic forms of intentional communication related to (a) recruiting attention, (b) requesting access to preferred objects/activities, and/or (c) rejecting non-preferred objects/activities/people. In such cases, intervention aimed at replacing the problematic forms by teaching appropriate communication alternatives has proven to be effective. Challenges in conducting experimental-functional analyses and interpreting their results are discussed, as are directions for future research related to replacing problematic prelinguistic forms with more acceptable alternatives.

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7.1 Introduction

Among the many developmental and behavioral characteristics associated with autism spectrum disorder (ASD), two are particularly relevant to this chapter. The first is that a significant percentage of individuals with ASD fail to develop any appreciable amount of speech or language. Osterling, Dawson, and McPartland (2001) estimated that 25 % of people with ASD lack speech and language and are likely to "remain mute their entire lives" (p. 437). Rowland (2009) reviewed evidence suggesting that up to 50 % of people with ASD will not develop sufficient speech to meet their everyday communication needs. While individuals in this latter group might develop some speech, they cannot rely on it as their primary mode of communication. Even when speech does develop, as is the case for the majority of people with ASD, communication is still impaired to some extent. For example, the individual might simply repeat words or phrases spoken by others, a phenomenon known as echolalia (Carr, Schreibman, & Lovaas, 1975; Sturmey, 2009). There appears to be another group of individuals with ASD who develop speech, as would be expected in the early developmental period (around 6–30 months of age), only to lose their acquired speech and language in a period of regression. Matson, Wilkins, and Fodstad (2010), for example, reported that 74 % of children with ASD who showed evidence of regression at about 28 months of age "lost previously developed speech or communication skills" (p. 43).

These figures support the well-established conclusion that severe communication impairment, defined as limited or no functional speech or language development, is common among individuals with ASD (American Psychiatric Association, 2013; Fitzer & Sturmey, 2009; Mirenda & Iacono, 2009). In the absence of a sufficient repertoire of speech and language — and without effective intervention to establish alternatives to speech (e.g., intervention to teach the person to use manual signs, picture exchange, or a speech-generating device) — such individuals are likely to rely primarily on more subtle or idiosyncratic prelinguistic forms of communication.

In terms of overall functioning, individuals with ASD who present with limited or no speech also tend to have comorbid intellectual disability and greater deficits in adaptive behavior functioning (Liss et al., 2001). Such individuals have been classified as functioning in the low range of the autism spectrum. Low-functioning autism has been characterized by (a) IQ less than 80, (b) significantly impaired social and communication abilities, and (c) higher levels of restricted/repetitive behavior (Stevens et al., 2000). As explained next, such individuals are at risk for developing a number of problematic forms of behavior.

The second most relevant characteristic in relation to this chapter is that a substantial percentage of individuals with ASD present with severe problem behavior. Emerson (2001) noted that behaviors are generally considered to be a severe problem when they occur with an intensity, frequency, or duration that is likely to (a) cause injury to the person or others, (b) disrupt the environment, and/or (c) restrict the person's participation in everyday activities and environments.

Problem behavior is often grouped into five main classes (Matson & Rivet, 2008). These are: (a) aggression (e.g., hitting, kicking, throwing objects at others, and/or biting others), (b) self-injury (e.g., hitting self, biting self, head banging, and ingesting inedible objects), (c) property destruction (e.g., ripping clothing and banging/kicking furniture, doors, and/or windows), (d) disruption (e.g., yelling, shouting, refusing to cooperate, and tantrums), and (e) stereotyped movements/ritualistic behavior (e.g., spinning, re-arranging, and/or mouthing objects, hand flapping, body rocking, and echolalia).

These types of problem behavior are common among individuals with ASD. Murphy, Healy, and Leader (2009), for example, found that 82 % of the children with ASD, in a sample of 157 children, engaged in one or more of these problematic forms of behavior. Other studies (e.g., Holden & Gitlesen, 2006; Matson, Wilkins, & Macken, 2009) have reported prevalence figures ranging from 35 % to more than 90 %. These prevalence estimates suggest that problem behavior is at least 2–3 times more common among individuals with ASD compared to other populations, including (a) typically developing individuals, and (b) people with intellectual disabilities (Holden & Gitlesen, 2006; Matson & Rivet, 2008; Rojahn, Matson, Lott, Esbensen, & Smalls, 2001).

In addition to documenting forms and prevalence, a number of investigators have sought to identify risk factors for problem behavior among individuals with ASD (Baghdadli, Pascal, Grisi, & Aussilloux, 2003; Murphy et al., 2009). Various potential risk factors have been explored, including: (a) age, (b) gender, (c) severity of autism symptoms, (d) level of intellectual disability, (e) adaptive behavior functioning, and (f) speech and language skills (see Lang et al., 2013 for a review). The findings of such studies have been mixed. For example, some investigators have identified a significant relation between age and gender with problem behavior (e.g., Baghdadli et al., 2003), while other investigators have found no such relations (e.g., Murphy et al., 2009). Lang et al. noted that these mixed findings could stem from differing composition of the sample groups and differences with respect to the specific types of problem behavior studied. Baghdadli et al., for example, focused on self-injury in a sample of preschool children (mean age = 5 years), whereas Murphy et al. studied a wider range of problematic forms in older children (mean age = 8.5 years).

Still, several authors have reported an inverse relation between communication ability and the frequency and severity of problem behavior (Beitchman & Peterson, 1986; Chamberlain, Chung, & Jenner, 1993; Lang et al., 2013). For example, Sigafoos (2000) assessed the frequency and severity of problem behavior and also changes in communication skills in a sample of 13 preschoolers with developmental disabilities. The sample consisted of 10 boys and 3 girls. When the study began, the children ranged from 33 to 55 months of age. These 13 children were assessed every 6 months over a 3-year period using standardized measures of communication development and problem behavior. The results indicated a strong inverse relation between the severity of problem behavior and children's communication ability. Specifically, children with more pronounced communication deficits were rated as having more severe problem behavior. These findings support a

general conclusion that people with more severe communication impairment tend to have more frequent and severe problem behavior, compared to those with better developed speech and language skills (see Didden et al., 2012 for a review).

Consideration of the high prevalence of problem behavior in light of the communication impairments associated with ASD has led to the hypothesis that some problematic forms might be viewed as communication behavior (Carr, 1977; Carr & Durand, 1985). Problem behavior might also have its etiology in communication impairment. That is, problem behavior might arise in part because the person has a purpose for communicating, but lacks the skills to do so in a socially acceptable manner (Weiss, 2003). Thus, problematic forms might emerge and persist because they often produce the intended outcome for the "speaker."

In keeping with this hypothesis, Sigafoos, O'Reilly, Drasgow, and Reichle (2002) outlined a learning/conditioning mechanism by which problematic forms of behavior might come to function as prelinguistic forms of communication. The process might unfold as follows: First, in the absence of speech — and in the absence of effective intervention to develop alternatives to speech — many individuals with ASD rely on prelinguistic acts to communicate their wants and needs. However, the prelinguistic forms used by individuals with ASD are often unconventional and idiosyncratic. This makes the communicative intent of the person's prelinguistic forms difficult for others to interpret and thus prone to frequent communication breakdowns (Brady & Halle, 2002). These breakdowns might, in turn, lead to changes in the force and/or topography of behavior due to the lack of reinforcement (i.e., extinction; Herrnstein, 1961; Keen, 2005) of the initial communication attempt. The change in force and topography could modify what initially was a rather benign prelinguistic request (e.g., leading an adult by the hand to an object) into a problematic form (e.g., forcibly grabbing or hitting the adult and screaming).

Imagine a hungry child with ASD attempting to request something to eat by leading an adult by the hand to a cookie jar. Now imagine the adult listener resisting the child's attempt. The child's initial attempt to request by leading would have been unsuccessful, which sets the occasion for an escalation of behavior. That is, in response to this extinction trial, the child escalates to forcibly grabbing the adult's hand and screaming. Being grabbed and screamed at has a tendency to secure one's attention and so the adult might then comply with the child's request, if for no other reason than to terminate the grabbing and screaming. If the adult reinforced the response by giving the requested item as described above, it would inadvertently teach the child that grabbing and screaming are more effective ways of communicating than leading. Grabbing and screaming could thus be conceptualized as problematic forms of prelinguistic requesting shaped by the adult's initial failure to attend to leading (i.e., extinction or a breakdown), and then reinforced by providing attention contingent on grabbing and screaming. It is plausible that through such an operant/learning mechanism, people with ASD might learn to engage in problem behavior to communicate. In essence, they could learn that certain (problematic) forms are more effective in recruiting a reinforcing response than attempting to use other existing and less intrusive forms. Problematic forms

might also become the default form because the person lacks other more conventional, socially appropriate, and sophisticated forms of either prelinguistic or linguistic communication that are equally effective. What makes the form effective is not its topography, but whether and how quickly listeners respond to it. Individuals with ASD are not purposely trying to anger or upset listeners with problem behavior; rather, they are simply engaging in behavior that they have found most functional in producing the outcomes they are seeking.

Durand (1990) argued that problem behavior could be conceptualized as functional communication when there was evidence that the behavior was, in fact, maintained by the resulting response of a listener. This conceptualization is consistent with Skinner's (1957) analysis of verbal behavior (i.e., communication) as a special type of operant behavior in the sense that it has an effect on the environment only through the mediation of a listener. For example, a window will not open simply by saying "Open the window." This request (or mand) will only be effective (from the speaker's perspective) if a listener, upon hearing the request, obliges the speaker by opening the window. Voluntary behavior of a speaker that occurs because of the resulting actions of the listener could be interpreted as intentional communication behavior (Durand, 1986).

Skinner (1957) noted that this definition of communication, or verbal behavior, includes not only the use of speech, but also the use of a wide variety of linguistic and prelinguistic forms. The critical variable is not the form of the behavior, but its function — whether or not the behavior occurs because of the resulting action (i.e., mediation) of the listener. It is thus possible that some behaviors viewed as problematic (e.g., hitting others, head banging, tantrums, throwing objects) could be conceptualized as instances of intentional communication in the sense that they are voluntary and functional (i.e., they produce the intended outcome through the mediation of a listener). Leading an adult by the hand to the cookie jar does not open the jar, but it just might cause the adult to do so. Similarly, grabbing and screaming does not open the cookie jar, but it just might cause the adult to do so.

In summary, there are correlational data suggesting a link between the communication impairments associated with ASD and increased risk of problem behavior (Beitchman & Peterson, 1986; Chamberlain et al., 1993; Didden et al., 2012; Lang et al., 2013; Sigafoos, 2000). There are also conceptual analyses (e.g., Skinner, 1957) that allow for an interpretation of some problem behavior as acts of intentional communication (Durand, 1986, 1990). And there is a plausible learning/conditioning mechanism by which problematic forms of behavior might come to function as prelingusitic forms of intentional communication (Sigafoos et al., 2004). But, an important question is whether there are any experimental data to support the hypothesis that some problem behaviors could be accurately defined as prelinguistic and intentional communication acts for individuals with ASD. Evidence bearing on this question emanates from studies that have undertaken experimental-functional analyses of problem behavior. In the next section, we describe this experimental-functional analytic approach and summarize the main findings of investigators who have employed it to examine the problem behavior of persons with ASD.

7.2 Experimental-Functional Analysis

A considerable amount of research has focused on assessing problem behavior among individuals with ASD and other developmental disabilities (Matson, 2012). Many studies in this area have been directed at providing an experimental-functional analysis of problem behavior (Vollmer, Roane, & Rone, 2012). The primary objective of such analysis is to identify the variables that control problem behavior. Control in this context refers to both the antecedent events that evoke, motivate, and/or set the occasion for problem behavior as well as the consequences that reinforce/maintain the behavior (Vollmer et al., 2012). From a behavioral psychology orientation, behavior is said to be "explained" when its controlling variables are identified (Skinner, 1953).

The gold standard for undertaking an experimental-functional analysis of problem behavior was developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982; Iwata et al. 1994). The approach involves observing the frequency of problem behavior under the following conditions: (a) attention, (b) demand, (c) alone, and (d) free play. Subsequent studies have often included another (tangible) condition (Mace & West, 1986). In the attention condition, the frequency of problem behavior is recorded when an adult is present and only attends to the person when the person engages in problem behavior. Consistently high rates of problem behavior in this condition, relative to other conditions, would indicate that problem behavior was occasioned by a non-attending adult and maintained by the reinforcing effects of attention from the adult. This attention-maintained problem behavior could be interpreted as a form of prelinguistic behavior for recruiting/requesting attention.

In the demand condition, the person is presented with a work task and the task is briefly removed when problem behavior occurs. Consistently high rates of problem behavior in this condition, relative to other conditions, could indicate that the behavior is occasioned by (evoked by) task demands and maintained by the resulting escape from those task demands, which is a type of negative reinforcement (Carr, Newsom, & Binkoff, 1976). This escape-maintained problem behavior could be interpreted as a form of prelingusitic behavior akin to protesting, rejecting, or requesting a break.

Another set of circumstances that is sometimes included in an experimental-functional analysis is a tangible condition. In this condition, the person might be required to wait before access to preferred objects or activities is allowed. However, the person is given immediate access to the items contingent upon occurrences of problem behavior. Again consistently higher rates of problem behavior in this condition, relative to the attention and demand conditions, would indicate the problem behavior is occasioned by preferred items and maintained by positive reinforcement in the form of gaining access to those items. Problem behavior that is maintained by access to preferred objects could be interpreted as a form of prelinguistic requesting. An everyday example of such tangible-maintained problem behavior is the common scenario of children who tantrum in the grocery store

because in the past this has been an effective means of coercing their parents to buy them a preferred item.

High rates of problem behavior in the attention, demand, and tangible conditions described above could be suggestive of a possible communicative function. That is, if problem behavior is maintained by socially-mediated attention, escape, and/or access to preferred objects/activities, then the problem behavior could be interpreted as functional/intentional communication (Carr & Durand, 1985; Durand, 1986, 1990). Another possibility, however, is that problem behavior might occur under conditions that suggest a non-social/non-communicative function. For example, it is possible that problem behavior could be self-stimulatory or largely biological in origin (Carr, 1977; Weiss, 2003). To test for these possibilities, experimental-functional analyses typically include an alone condition. Here the person is simply observed while alone. Because this condition eliminates the possibility of social mediation, any behavior that occurs in this condition is considered to be non-social and non-communicative. Such behavior might instead be self-reinforcing or automatically reinforced by the resulting sensory stimulation it produces. Such behavior might also have a primarily biological basis and hence would be expected to be largely insensitive to environmental conditions. Lovaas (1982), however, noted that the alone condition might not necessarily be a pure test for non-social functions. Instead, for some individuals, being alone might increase the motivation/need to recruit attention.

A final condition that is typically included in an experimental-functional analysis is free play, which acts as the control condition. Here, an adult is present and attends to the person. There are no demands made on the person and the person has free access to a range of preferred materials, such as toys and activities. It is expected that socially motivated/communication-related problem behavior would be low in this condition because there is no need to recruit attention, no need to reject a non-preferred task, and no need to request preferred items. If high rates of problem behavior did occur in this condition, it might suggest that the behavior is self-stimulatory or self-reinforcing and that nothing in the present environment was sufficiently powerful to compete with this automatically generated stimulation. Another possibility is that the behavior is largely biological in nature and hence insensitive to environmental stimuli and contingencies.

The function or causes of problem behavior exhibited by persons with ASD has often been attributed to the nature of the impairments associated with ASD. For example, a child engages in self-injury because of a greater need for self-stimulation or due to the neurological disturbances that underlie ASD (see Carr, 1977 and Weiss, 2003 for reviews of such explanations). These explanations are inferences and would be difficult to demonstrate empirically. If data from experimental-functional analyses were to reveal that problem behaviors were instead related to attention, demands, or tangibles, then an environmental/communication explanation would be indicated. So what have been the results from studies that have assessed the problem behavior of persons with ASD via experimental-functional analyses? Do the results of these studies support the hypothesis that some problem behaviors represent prelinguistic forms of intentional communication?

In one study relevant to these questions, O'Reilly et al. (2010) completed an experimental-functional analysis with 10 children with ASD. The sample included 9 boys and 1 girl, ranging from 4 to 8 years of age. The children presented with a range of problem behavior including: (a) aggression (e.g., hitting others), (b) negative vocalizations (e.g., crying, screaming), (c) self-injury (e.g., hitting self, hand mouthing), and (d) stereotypic movements (e.g., spinning objects, hand flapping). For the experimental-functional analysis, each child was exposed to an (a) attention, (b) demand, (c) tangible, (d) alone, and (e) free-play condition as described previously. Children participated in 10 sessions under each condition with each session lasting 5 min. The order in which conditions were presented was alternated to align with a multi-element design (Kennedy, 2005). For example, a child might first receive a tangible session, followed by a demand session and then an attention condition, and so on. After this initial phase, the children received a further phase in which only two conditions (alone and free play) were alternated. This second phase was intended to determine if problem behavior was more likely to occur when the child was alone compared to the play condition when the social motivation for problem behavior was considered minimal. During each session, instances of problem behavior were recorded using a standard observational protocol (i.e., 10-s partial interval recording; Kennedy, 2005) enabling the researchers to calculate the percentage of observation intervals with problem behavior for each 5 min session.

The results revealed two main patterns. The first pattern, evident for 8 of the 10 children, was one of undifferentiated responding. That is, 8 children engaged in comparable amounts of problem behavior across each of the conditions. This pattern could indicate that the children's problem behaviors were largely non-social, perhaps self-stimulatory and/or largely biologically determined. Alternatively, such a pattern could indicate multiple sources of control, as suggested by Lovaas (1982) and Iwata et al. (1982, 1994). Indeed, it is possible that these 8 children had learned to engage in problem behavior under each of the assessment conditions to (a) produce sensory stimulation, (b) recruit attention, (c) request tangibles, and (d) escape from task demands. The second pattern, evident for 2 of the 10 children, was one characterized by a higher percentage of observation intervals with problem behavior under the demand and tangible conditions. This pattern suggests that problem behaviors were related to socially-mediated (a) negative reinforcement in the form of escaping from task demands, and (b) positive reinforcement in the form of gaining access to preferred objects. In these cases, the problem behavior might be interpreted as prelinguistic communicative acts for (a) rejecting tasks, and (b) requesting tangibles.

Based on results of the O'Reilly et al. (2010) study, it might be tempting to downplay the communication hypothesis as applicable to only a small percentage of people with ASD. However, other studies with larger samples have found a higher percentage of cases (64–89 %) with socially-mediated, communication-related problem behavior (Asmus et al., 2004; Derby et al., 1992; Iwata et al., 1982, 1994; Kurtz et al., 2003; Love, Carr, & LeBlanc, 2009; Wacker et al., 1998). For example, Love et al. undertook analyses of the problem behavior exhibited by

32 children with ASD. Types of problem behavior among these 32 children represented all of the main categories (e.g., aggression, tantrums, self-injury, and stereotypy) referenced by Matson and Rivet (2008). The sample included 28 boys and 4 girls, from 3 to 14 years of age (mean age approximately 7 years). Children were assessed using a variety of protocols, including the standard experimental-functional analysis protocol of Iwata et al. (1982, 1994). The results suggested that for approximately 80 % of the children, problem behavior appeared to be maintained by socially-mediated reinforcement. The authors speculated that this high percentage of socially-mediated problem behavior could be related to the children's lack of more socially appropriate forms of communication that would enable them to successfully recruit attention, request preferred items, and/or reject non-preferred objects/activities. Put another way, these children might need to rely on problematic forms of prelinguistic behavior because they lacked more appropriate requesting and rejecting skills.

Lancioni, Singh, O'Reilly, Sigafoos, and Didden (2012) summarized 28 studies that included functional analyses of problem behavior. These 28 studies included a heterogeneous sample of 46 participants ranging from 3 to 90 years of age with varying types and degrees of disability (including ASD) and varying types of problem behavior. Lancioni et al. classified studies as identifying an attention function for 14 participants (30 %), a tangible function for 7 participants (15 %), an escape function for 5 participants (11 %), and an automatic (self-stimulation) function for 18 participants (39 %). The remaining 2 participants (4 %) had idiosyncratic functions, meaning that the maintaining consequence was unique and specific to the individual. For example, a child might learn to engage in problem behavior because, in the past, that behavior has resulted in a very specific type of reinforcing consequence (e.g., the caregiver pushing the child's wheelchair or the child being allowed to go for a walk). The results of this review suggest that socially-mediated functions (i.e., using problem behavior to gain attention, tangibles, and/or to escape) were identified for 55 % of the participants. This is consistent with other studies indicating that a substantial percentage of individuals with ASD and other developmental disabilities are likely to present with problem behavior that could be interpreted as prelinguistic forms of intentional communication.

Overall findings from the extensive literature involving experimental-functional analyses of problem behavior offer partial support for the communication hypothesis in that some individuals' problem behaviors appeared to be maintained by socially-mediated consequences, specifically: (a) attention, (b) access to preferred objects, and/or (c) escape from task demands. Problem behavior maintained by these consequences could be interpreted as prelinguistic and intentional communication acts related to (a) recruiting attention, (b) requesting preferred objects, and/or (c) rejecting non-preferred objects/activities. This tentative support for the communication hypothesis would also seem consistent with studies showing that children with ASD use prelinguistic behavior primarily for instrumental/behavior regulation functions, such as gaining access to preferred objects and rejecting non-preferred objects and activities (Carr & Kemp, 1989; Maljaars, Noens, Jansen,

Scholte, & van Berckelaer-Onnes, 2011; Mundy, Sigman, Ungerer, & Sherman, 1986; Rutter, 1978).

7.3 Implications for Practice

The communication hypothesis, supported as it is by voluminous experimental data, has two major implications for practice. One relates to how practitioners conceptualize problem behavior and the second relates to the design of intervention strategies aimed at reducing problem behavior. With respect to the first implication, findings from experimental-functional analyses support a view that problem behavior can, in some instances, be highly functional and adaptive for the individual. Indeed, when problem behavior is shown to be maintained by (a) attention, (b) access to tangibles, and/or (c) escape from non-preferred objects/activities, the behavior can be conceptualized as functional in the sense that it represents the person's means of communicating important wants and needs. For some individuals, problem behavior may be their only effective way of communicating such wants and needs. Thus, results from experimental-functional analyses suggest that problem behavior is not necessarily maladaptive, but rather that it can serve important and useful (communicative) functions or purposes for the individual. What is maladaptive is the form or topography of the behavior that conveys the message.

This conceptualization implies the value of an intervention approach that begins with an understanding of the function or purpose of the problem behavior. In cases where problem behavior is controlled by socially-mediated consequences, one solution is to teach the person to access these same reinforcers by adopting more socially acceptable (communication) forms. This is an alternative to an intervention approach aimed at suppressing the problematic form by eliminating the controlling variables (i.e., those that trigger or reinforce) or punishing instances of problem behavior. For example, the person might be taught to recruit attention, request tangibles, and/or reject non-preferred activities by using more conventional means of communicating, such as manual signs, picture exchange, or speech-generating devices. This approach is known as functional communication training (FCT; Carr & Durand, 1985).

FCT has been widely used as an intervention to reduce problem behavior in persons with ASD (see Mancil, 2006 and Sigafoos, O'Reilly, & Lancioni, 2009 for reviews). For example, Schmidt, Drasgow, Halle, Martin, and Bliss (2014) provided FCT to three students with ASD. The sample consisted of three boys aged 9, 10, and 15 years, respectively. In addition to ASD, the students were diagnosed with severe to profound intellectual disability. Two children were described as nonverbal, while the other boy had a vocabulary of approximately 100 words, but he mainly used these words in an echolalic fashion. All three students were considered candidates for FCT due to numerous and severe problem behaviors, including aggression, throwing objects, pica, self-injury, fecal smearing, and

inappropriately touching other people. The intervention involved two phases. First, experimental-functional analyses were conducted to identify the variables that controlled each child's problem behavior. The results suggested that one student's (Billy) problem behavior was evoked by situations in which an adult was not attending to him and was reinforced (maintained) by attention from the adult. Thus this student's problem behavior could be interpreted as attention-maintained or as a problematic form of prelinguistic communication for recruiting attention. For the other two students (Ivan and Thomas), problem behavior was most frequent when preferred edibles were out of reach and least frequent when they had access to these same preferred edibles. This pattern suggested that problem behavior functioned as a (prelinguistic) request for preferred edibles.

Based on these assessment results, the second phase of the study aimed at teaching new, functionally equivalent request forms to replace problem behavior. Billy was taught to say "Talk to me" to recruit attention and Ivan and Thomas were taught to sign "eat" to request preferred edibles. Teaching procedures consisted of (a) creating opportunities to communicate with the new forms, such as offering a preferred edible; (b) prompting the new communication form if necessary; (c) fading the prompt by delaying its introduction and giving the students more time to initiate (time delay); and (d) reinforcing the new communication form when it occurred, provided that problem behavior had not occurred. With these procedures, the students learned to use the new communication forms to recruit attention (Billy) and to request preferred edibles (Ivan and Thomas). Most importantly, as the new communication form was acquired, problem behavior showed a collateral decrease to low levels. The decrease in problem behavior as the new communication form was acquired suggests that the new communication form served the same function or purpose as the students' problem behavior. That is, problem behavior and the new communication forms were functionally equivalent (Carr & Durand, 1985; Carr & Kemp, 1989).

The general effect reported by Schmidt et al. (2014) is a consistent finding of many other studies that have evaluated FCT as a treatment for problem behavior among individuals with ASD and other developmental disabilities (Didden et al., 2012; Mancil, 2006; Sigafoos et al., 2009). Indeed, Didden et al. identified over 100 studies on FCT, that all had "... almost entirely positive findings" (p. 134). FCT appears to be among the most effective approaches, in terms of effect size, for addressing problem behavior in individuals with ASD and other developmental disabilities (Didden et al., 2012). Data suggest that there are several features that are critical to the success of FCT.

1. Success depends on ensuring that the new communication forms serve the same communicative function(s) as the existing problem behavior. That is, the new communication form must be functionally equivalent to existing problem behavior. Hence, FCT must be linked to the results of a prior functional assessment that accurately identified the function of problem behavior. The same variables that control problem behavior must come to control the new communication forms that are being taught. For example, if a child's tantrums are triggered when

the parent is distracted/not attending, then the child needs to be taught to recruit the parent's attention on these same occasions, perhaps by selecting a relevant icon from the display of a speech-generating device (e.g., a photograph of the parent), that would produce relevant speech output (e.g., *"Mommy, please come here."*).

2. The new communication form targeted for intervention must be at least as easy to produce as the existing problem behavior. If the new communication form requires more physical effort or greater cognitive demands than the problem behavior, then acquisition of the new form could prove difficult and the child might continue to engage in problem behavior. Tantrums may require more physical effort than selecting a single icon on a speech-generating device. However, if the child also had to discriminate among several different screen icons, then the new communication task becomes more demanding. This could slow acquisition and perhaps cause a resurgence of problem behavior due to the new and more difficult task demand associated with learning to communicate via a speech-generating device.
3. Listeners need to reinforce the new communication forms consistently and refrain from reinforcing the old problematic forms. For example, when problem behavior is maintained by attention, a logical replacement would be to teach the person to recruit attention in a more appropriate way. The person might, for example, be taught to operate a call buzzer when adult attention is desired (Sobsey & Reichle, 1989). Of course, the adult must provide attention in response to the buzzer more quickly and more consistently than for problem behavior.
4. Five factors have been grouped together to determine response efficiency (Halle & Drasgow, 2003; Horner & Billingsley, 1988; Horner & Day, 1991). The label is apt because each of the factors shares a common thread of ensuring that the response produced is the most efficient one in optimizing the desired outcome. Each is described briefly using the common example above of requesting assistance. *Response effort* is the amount of effort (sometimes measured in calories expended or cognitive challenge) required to produce the response. Leading an adult by the hand to obtain assistance is physically more effortful than the other competing responses and, thus, all other factors being equal, would be less probable. The *immediacy of obtaining the desired outcome* is a second efficiency factor. If screaming consistently produces the outcome more quickly than saying, "Help, please", then screaming would be more probable than using words. A third factor, *consistency of obtaining the desired outcome*, refers to the number of responses that occur before the outcome is obtained. That is, if Amelia has to say "Help, please" two or three times before help is provided, yet throwing materials on the floor produces assistance each time it occurs, then this latter response is more efficient. *Quality or magnitude of outcome produced* is a fourth factor determining efficiency. If Amelia wants a drink of water from a fountain in the hall of her school and she requests assistance by saying, "Help, please", her teacher holds the lever down for 20 s, allowing Amelia to drink a large quantity of water. However, when Amelia leads her teacher by the hand to

the fountain, the teacher provides access for only 5 s, and when Amelia screams as she approaches the water fountain, her teacher ensures that Amelia is not allowed to drink. Saying "Help, please" is more efficient than leading, which is more efficient than screaming. A fifth, and final, factor contributing to the efficiency of equivalent responses is their *history of punishment*. Here, punishment is defined as any consequence that reduces the future likelihood of the response. Thus, if screaming or throwing materials on the floor are responses that on occasion are punished by the teacher removing Amelia's favorite squeeze toy from her desk, then these responses are less likely to be used to obtain the teacher's assistance.

At least three caveats warrant mention in this discussion of response efficiency. First, all five determinants of efficiency are highly dependent on the behavior of the social partners with whom a child interacts. It is these partners who decide which request for assistance they will respond to and the immediacy, magnitude, and form of their response. Later, in the intervention section of this article, we revisit this issue by describing in more detail the role that practitioners must assume to ensure the efficiency of desired response forms and the inefficiency of problem forms. Second, none of these five factors functions alone or independently of the other four. That is, the value of all five combined is what determines which member of the class of requesting options will occur in any particular situation. So, all five factors must be considered when selecting responses to teach the child and responses to which the social partners will be responsive. For example, a child would be more likely to attempt to repair a communication breakdown by using a targeted strategy (e.g., selecting a communication symbol) if it required less energy and resulted in a more immediate, consistent, and higher quality outcome compared to other responses in the response class. A final caveat is that our entire discussion of response efficiency has been restricted to requesting assistance. Efficiency factors are equally applicable to communicative functions other than requesting. For example, the form of a comment would depend on the most efficient response for producing joint attention or attention from the listener, or the form of a protest would depend on the most efficient response for removing the unpleasant event or material.

7.4 Implications for Research

Future research examining experimental-functional analyses and FCT is relevant for prelinguistic communication because of the prodigious literature supporting the premise that problem behavior often is socially mediated and, therefore, has communicative intent. That is, problem behavior is a means of influencing the behavior of others, encompassing a fundamental feature of communication. The evidence base linking experimental-functional analysis results with FCT is sufficiently large and robust to support its classification as well established, empirically validated, and highly efficacious for the treatment of problem behavior among

persons with ASD and other developmental disabilities (Didden et al., 2012; Healy, Lydon, & Murray, 2014; Mancil, 2006; Sigafoos et al., 2009; Sigafoos, O'Reilly, Lancioni, Lang, & Didden, 2014). While the efficacy[1] of this approach has been well established, there would seem to be value in undertaking additional research of FCT in at least two general areas.

First, given that FCT has produced consistently positive and large effects (Didden et al., 2012; Healy et al., 2014; Mancil, 2006; Sigafoos et al., 2009, 2014), it is plausible that the early introduction of FCT might prevent the emergence of problem behavior as a communicative option in young children with ASD. An important research question is thus whether or not the early introduction of FCT would prevent the emergence of severe behavior problems in children with ASD. Experimental-functional analytic studies have consistently demonstrated that problem behavior is often maintained by socially-mediated consequences, specifically: (a) attention, (b) access to preferred tangibles, and (c) escape from non-preferred activities (cf. Asmus et al., 2004; Derby et al., 1992; Iwata et al., 1982, 1994; Kurtz et al., 2003; Love et al., 2009; O'Reilly et al., 2010; Wacker et al., 1998). In light of this evidence, a preventative FCT intervention could focus on teaching young children to use easy, yet socially appropriate, forms of augmentative and alternative communication (e.g., gestures, picture exchange, speech-generating devices) to accomplish these same communication outcomes. If some problem behaviors do, in fact, represent prelinguistic forms and emerge because other more socially acceptable communication forms are ineffective or seriously delayed in developing, then the early introduction of FCT might successfully prevent the emergence of problem behavior.

There is some reason to be optimistic about the early introduction of FCT. Reeve and Carr (2000) demonstrated that an FCT intervention was effective in preventing minor problem behaviors (e.g., crying and whining) from escalating to more severe behavior problems in four (33- to 60-month-old) children with developmental delays. Results of an initial experimental-functional analysis suggested that the children's minor behavior problems were maintained by attention. FCT therefore involved teaching the children to request attention by tapping the adult on the arm and saying, "Look what I'm doing." The four children who were taught this replacement, attention-getting response showed less intense and less frequent problem behavior than a matched group of four children who were taught general expressive language responses (e.g., answering questions, labeling objects). Based on the superior outcomes for the FCT group, Reeve and Carr speculated that FCT might also be effective as an "inoculation against behavior problems" (p. 159).

Given these promising results, additional research would seem warranted. Future research could focus on larger samples to increase external validity and on teaching additional communication skills (e.g., teaching children to recruit

[1] Efficacy refers to how well an intervention works under controlled/research conditions, whereas effectiveness refers to how well an intervention works under real-world conditions (Singal, Higgins, & Waljee, 2014).

attention, request preferred objects/activities, and reject non-preferred objects and activities). It might also be useful to include procedures to teach appropriate communicative repair strategies. This may be indicated for many young children with ASD given their propensity to present with a relatively impoverished range of repair skills that are primarily prelinguistic in nature and often problematic in form (Gevarter, Mulloy, Ramdoss, O'Reilly, & Watkins, 2014). It should be noted that successful communication could occur via socially acceptable (non-problematic) forms of prelinguistic behavior. To this end, it may be effective to develop interventions aimed at strengthening appropriate prelinguistic forms, such as the intervention described by Tait, Sigafoos, Woodyatt, O'Reilly, and Lancioni (2004), as part of a preventative FCT program.

Second, a beneficial line of inquiry might focus on the "listener" or those who interact with the individual with ASD, rather than focusing exclusively on teaching new communicative forms to the individual. Remember that essential features of FCT require the social partner to execute prescribed procedures such as employing differential reinforcement of the new response by responding more quickly and more consistently to it and refraining from or delaying a response to problematic forms of behavior. Or partners might anticipate situations known to trigger problem behavior (e.g., a ringing phone signaling the upcoming loss of attention to the child with ASD) by teaching the child to request a preferred solitary activity at the precise time that the phone is ringing.

Third, given that FCT is a well-established, empirically-validated, and highly successful intervention for the treatment of problem behavior among individuals with ASD and other developmental disabilities, there would seem to be considerable value in future research aimed at enabling its uptake in ASD services. The settings for this research could include home-based, school-based, community-based, and clinic-based services. A potentially useful starting point might be research aimed at developing effective methods for training parents, teachers, speech-language pathologists, educational psychologists, and other professional to implement FCT with fidelity.

Again, there is some reason to be optimistic that FCT might be effective under real-world conditions, based on studies showing successful use of FCT by parents (e.g., Suess et al., 2014; Tait et al., 2004; Wacker et al., 2005, 2013). In addition, several studies have shown that non-research personnel (e.g., parents, teachers) can learn to conduct a functional analysis of problem behavior via training programs that employ modeling, video demonstrations, role playing, and/or feedback (Moore et al., 2002; Phillips & Mudford, 2008; Stokes & Luiselli, 2008; Wallace, Doney, Mintz-Resudek, & Tarbox, 2004). Given these promising results, future researchers could seek to determine whether non-research personnel can effectively link the results of a prior functional analysis to the design of a successful FCT program. Successful linking would seem to depend, in part, on not only competence with conducting an experimental-functional analysis, but also with correctly interpreting the resulting data. However, undertaking functional analyses and interpreting their results accurately are not without their challenges.

7.5 Challenges

Before implementing experimental-functional analyses, it is important to highlight a few controversial features. Schlichenmeyer, Roscoe, Rooker, Wheeler, and Dube (2013) conducted a 10-year review of research involving functional analyses that yielded *undifferentiated outcomes*. They hypothesized that these outcomes may have been due to test conditions (e.g., attention, task demand) that failed to identify, and then include, relevant antecedent and consequent events. Relevant here means those events in everyday settings that either trigger or reinforce problem behavior. The resulting outcomes from structured experimental-functional analyses may vary depending on the adult who interacts with the individual with ASD, the preferred items chosen for the tangible condition, the task selected for the demand condition, the type of attention provided for the attention condition, and the setting in which the assessment occurs.

Different teams of investigators (e.g., Vollmer & Iwata, 1991; O'Reilly et al., 2009; Worsdell, Iwata, Conners, Kahng, & Thompson, 2000) have generated a line of research examining the impact of environmental and social variables occurring immediately prior (pre-session) to conducting structured functional analyses and have found that manipulating these variables may produce differing outcomes. Thus, generalizing the results from a structured experimental-functional analysis to the variables operating in the everyday settings in which the individual lives, works, and recreates may be a tenuous process. Often very specific and idiosyncratic variables are precursors, triggers, or consequences for problem behavior and these often are overlooked or imprecisely identified in functional analyses that uncover only more general explanations such as attention, tangibles, or demands.

A number of additional challenges can arise in attempts to employ experimental-functional analyses to identify whether problematic forms of behavior are communicative and, if they are, the function they serve for the individual. Some of these challenges relate to practical and logistical issues. Others are conceptual challenges that impact the interpretation of results from experimental-functional analyses.

One set of practical challenges revolves around ensuring personnel have the competence, time, and resources to complete an experimental-functional analysis. With respect to competence, Rispoli, Ninci, Neely, and Zaini (2014) noted that there is debate as to whether parents and practitioners should be undertaking these types of assessments. The debate has centered, in part, on whether parents and practitioners can be expected to have sufficient skills to execute this sophisticated analysis (cf. Iwata & Dozier, 2008 vs Matson & Minshawi, 2006; see also O'Neill et al., 1997). The issue of time might not necessarily be a major stumbling block. Bloom, Iwata, Fritz, Roscoe, and Carreau (2011) estimated that a standard experimental-functional analysis can typically be completed in 3–4 h. A challenge might arise, however, in attempting to complete 7–10 individual (10-min) sessions across five different conditions (e.g., attention, tangible, demand, alone, free play) within a reasonable span of time (e.g., within 3–4 days). In response to this

logistical challenge, variations on the gold standard experimental-functional analysis protocol have been developed.

Variations have included (a) indirect assessments, (b) brief assessments, and (c) trial-based functional analysis (Matson, 2012). Indirect methods include interviews with caregivers who know the person well and/or the use of standardized questionnaires and rating scales (Crone & Horner, 2003; Durand & Crimmins, 1992; Kozlowski & Matson, 2012). Brief functional analysis involves running one or two sessions under each condition within single 90-min out-patient, clinical appointments (Northup et al., 1991). In the trial-based variation (Schmidt et al., 2014; Sigafoos & Saggers, 1995), the aim is to complete approximately 20 assessment trials under each of the standard conditions (i.e., attention, demand, tangible, alone), but with each trial lasting only about 1–2 min and embedding these trials in typical, everyday routines. While the trial-based approach does not present a time saving overall (Bloom et al., 2011), each trial is relatively brief. This brevity might make it possible to integrate assessment trials into ongoing routines whenever the assessor and assessee have a spare moment. This flexibility could be an advantage in applied settings. While each of these variations can be helpful in identifying the variables that control problem behavior, none offers the same high level of predictive validity as the gold standard experimental-functional analysis methodology developed by Iwata et al. (1982, 1994).

With respect to resources, a well-controlled experimental-functional analysis typically requires highly trained personnel and specialized clinical settings to ensure fidelity of protocol implementation, control over potential confounding variables, and prevention of interruptions (Bloom et al., 2011). Such resources are generally not available in applied settings and, therefore, might not be feasible. In such settings, practitioners might have to rely on assessment approaches with less predictive validity (e.g., interviews, questionnaires). This in turn could lead to an incorrect hypothesis about the function of the problem behavior (e.g., interpreting the child's self-injury as attention motivated vs escape motivated), which could in turn lead to selecting an ineffective, contraindicated prelinguistic replacement.

A major conceptual challenge relates to whether the conditions included within an experimental-functional analysis (e.g., attention, tangible, demand, alone, free play) identify functions that exist in people's everyday routines of life. In examining escape-maintained problem behavior, Carr (1994) argued there could be at least two types of escape behavior. For example, problem behavior might occur to escape from a task (i.e., task avoidance) or to escape from a person (e.g., social avoidance). This latter type of escape might occur because the social partner is non-preferred or perhaps has been associated with non-preferred tasks in the past (e.g., the teacher who presents only difficult math lessons). Knowing about such possible differences in types of escape has important implications for intervention. A common intervention strategy for task avoidance, such as teaching an individual to request a break from work, might not be effective if the true function of the behavior is a type of social avoidance. Furthermore, it could be the case that when a person requests a break, she is not so much escaping a non-preferred task, but rather is accessing a more preferred situation during the break time. It could also be the case that two

motivational states are operating: pushing and pulling the person simultaneously. Golonka et al. (2000), for example, found that escape behavior was maintained by both (a) wanting a break from an activity, and (b) the subsequent access to preferred activities that were available in the break setting. This finding informed the intervention so that when given an opportunity to work for an enriched break (i.e., a break during which the person had access to preferred activities vs a break alone), the authors observed a decrease in escape-maintained problem behavior.

There is also the possibility that certain consequences unrelated to the assessed function of the problem behavior might, nonetheless, be important. For example, Gardner, Wacker, and Boelter (2009) looked at problem behavior maintained by escape under high- versus low-quality attention conditions. Although neither participant had shown sensitivity to the attention condition prior to intervention, when given high-quality attention during the task-demand condition, their seemingly escape-maintained problem behavior decreased. This suggested that high-quality attention might have reduced aversive stimulation related to engaging in the task, thus reducing the motivation to escape.

Similarly, attention-maintained behavior may be impacted by idiosyncratic variables (Carr, Yarbrough, & Langdon, 1997), such as a specific type of attention (e.g., Kodak, Northup, & Kelley, 2007) or attention from a specific person (e.g., Skinner, Veerkamp, Kamps, & Andra, 2009; Tiger, Fisher, Toussaint, & Kodak, 2009). This can complicate the determination of function for attention-motivated, tangibly-motivated, or demand-motivated problem behavior when conducting experimental-functional analyses. For example, if the form of attention provided in the functional analysis is not the same as the type the student is seeking, then the assessment will fail to identify attention as a potential function for the problem behavior.

The challenges described above and many others can be captured by a set of questions. When higher rates of problem behavior occur in the attention condition (the point applies to any of the four conditions), relative to the other conditions, does this mean that the function or purpose of the problem behavior is to gain attention? If so, does that mean that the problem behavior is a form of intentional (prelinguistic) communication that is directed at the goal of obtaining the attention of a listener? If this is true, then a range of additional questions could be asked. For example: Why is the person seeking attention? Are they recruiting attention so that the listener will then mediate some other important outcome for the person? Or is it because other people in the environment too often ignore the person, thus enhancing a state of deprivation and empowering behavior that produces attention? One could also ask whose attention and/or what kind of attention the person is seeking? That is, does the person want a smile, a touch, a jingle sung to them, and/or eye contact? There are a plethora of ways people provide attention, some of which may reinforce the problem behavior, others that might discourage it, and still others that have no effect. Furthermore, are there some social partners whose attention functions as a reinforcer and others whose attention is neutral or aversive? Answers to these questions could have considerable implications for practice in terms of what

would be the best (most functional) communicative replacement to teach the person and who might teach it.

There is evidence to suggest that the types of questions raised above are not purely speculative. Kodak et al. (2007), for example, assessed the influence of different types of attention as consequences for problem behavior. They tested verbal reprimands (e.g., *I don't like what you're doing*.), unrelated comments (e.g., *Today is Wednesday*.), physical attention (holding hands down without verbal interaction), tickles (including *I'm tickling you*.), eye contact (no verbal interaction), and praise (e.g., *I love it when you play with your toys*.). Results indicated that some of these consequences reinforced problem behavior, whereas others did not. This suggests that different forms of attention can have differing effects on attention-maintained problem behavior. In another study that involved analyzing variables related to the attention function, Skinner et al. (2009) found that problem behavior was maintained by both attention from peers and attention from the teacher. This finding suggests that some participants might be seen as generalists in terms of their attention seeking.

In other cases, specific features of the context might come to control problematic forms of prelinguistic behavior. For example, problem behavior might only occur in the presence of a specific person (e.g., McAdam, DiCesare, Murphy, & Marshall, 2004), in a specific setting (e.g., Lang et al., 2009), and/or in the presence of specific environmental variables, such as a noisy background (e.g., McCord, Iwata, Galensky, Ellingson, & Thompson, 2001). Thus, prior to conducting an experimental-functional analysis of problem behavior, it is important to consider the unique circumstances and environmental arrangements that might impact assessment outcomes and adjust assessment conditions accordingly to ensure that the assessment results have ecological validity. Although we believe that identifying the unique circumstances and then embedding them in the functional analysis are essential practices, we have no current means of determining, in advance, what these unique circumstances are for any individual. The more familiar we are with the individual, the more likely we might guess accurately about these unique circumstances or idiosyncratic variables.

There is also the issue of how to interpret the experimental-functional analysis data when they are undifferentiated or ambiguous, as was the case for 8 of the 10 children in the O'Reilly et al. (2010) study. One approach to this predicament is to modify the conditions examined in the functional analysis. This is done in an attempt to isolate variables unique to that person that might be controlling his or her problem behavior. Researchers have shown that an initially ambiguous or undifferentiated result from a functional analysis could be made more definitive by modifying the conditions to assess the effects of hypothesized or potential idiosyncratic variables. Tiger et al. (2009), for example, demonstrated that the variables controlling problem behavior became clear only when conditions were modified to assess idiosyncratic variables that were suspected of being important for the individual. For one participant, conditions were modified to assess whether a specific type of prompt would evoke problem behavior during the demand condition. More than 30 idiosyncratic variables have been identified as influencing the results of experimental-functional analyses (Schlichenmeyer et al., 2013). Given

that problem behavior is likely to be influenced by a range of contextual and idiosyncratic variables, the communicative function, if any, of problem behavior might also become context specific and highly idiosyncratic.

7.6 Conclusion

Results from numerous experimental-functional analysis studies suggest that problem behavior of individuals with ASD often serves a communicative function or purpose. Specifically, the results of these studies suggest that problem behavior often functions as a means of (a) recruiting attention, (b) requesting access to preferred objects/activities, and/or (c) rejecting non-preferred objects/activities. In such cases, the problem behavior might be usefully interpreted as a form of prelingusitic communication, differentiated from other prelinguistic acts only by virtue of its problematic form or topography. There are, however, a number of challenges related to this conceptualization of problem behavior: Is the problem behavior communicative? If so, what function or purpose does it serve? If the problem behavior is attention-, tangible-, or escape-motivated, what are the precise stimuli that reinforce the behavior? Despite these challenges, a conceptualization of problem behavior in terms of (communicative) function has implications for intervention. One primary implication is that intervention should aim at teaching the person socially acceptable forms of prelinguistic communication that produce the same outcome (are functionally equivalent), rather than merely trying to suppress problem behavior. This FCT approach has been evaluated in numerous studies and shown to be highly successful as a treatment for problem behavior among individuals with ASD. FCT introduces its own set of challenges, such as how best to scale-up its associated conceptual framework and procedures to ensure that multitudes of parents and teachers are implementing with fidelity. Investigators continue to push the boundaries of FCT research by exploring the maintenance and generality of its effect and to reduce the likelihood of resurgence of problem behavior. Future research should try to determine if early introduction of FCT might effectively prevent the development of severe behavior problems in persons with ASD by giving them other, socially-appropriate prelinguistic options that serve meaningful, communicative functions.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.

Asmus, J. M., Ringdahl, J. E., Sellers, J. A., Call, N. A., Andelman, M. S., & Wacker, D. P. (2004). Use of a short-term inpatient model to evaluate aberrant behavior: Outcome data summaries from 1996 to 2001. *Journal of Applied Behavior Analysis, 37*, 283–304.

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.

Beitchman, J. H., & Peterson, M. (1986). Disorders of language, communication, and behavior in mentally retarded children: Some ideas on their co-occurrence. *Psychiatric Clinics in North America, 9*, 689–698.

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.

Brady, N., & Halle, J. W. (2002). Breakdowns and repairs in conversations between beginning AAC users and their partners. In J. Reichle, D. Beukelman, & J. Light (Eds.), *Exemplary practices for beginning communicators* (pp. 323–351). Baltimore: Paul H. Brookes Publishing Co.

Carr, E. (1994). Emerging themes in the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 27*, 393–399.

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

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111–126.

Carr, E. G., & Kemp, D. C. (1989). Functional equivalence of autistic leading and communicative pointing: Analysis and treatment. *Journal of Autism and Developmental Disorders, 19*, 561–578.

Carr, E. G., Newsom, C. D., & Binkoff, J. A. (1976). Stimulus control of self-destructive behavior in a psychotic child. *Journal of Abnormal Child Psychology, 4*, 139–153.

Carr, E. G., Schreibman, L., & Lovaas, O. I. (1975). Control of echolalic speech in psychotic children. *Journal of Abnormal Child Psychology, 3*, 331–351.

Carr, E. G., Yarbrough, S. C., & Langdon, N. A. (1997). Effects of idiosyncratic stimulus variables on functional analysis outcomes. *Journal of Applied Behavior Analysis, 30*, 673–686.

Chamberlain, L., Chung, M. C., & Jenner, L. (1993). Preliminary findings on communication and challenging behavior in learning difficulty. *British Journal of Developmental Disabilities, 39*, 118–125.

Crone, D. A., & Horner, R. H. (2003). *Building positive behavior support systems in schools*. New York: The Guilford Press.

Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northup, J., Cigrand, K., et al. (1992). Brief functional assessment techniques to evaluate aberrant behavior in an outpatient setting: A summary of 79 cases. *Journal of Applied Behavior Analysis, 25*, 713–721.

Didden, R., Sturmey, P., Sigafoos, J., Lang, R., O'Reilly, M., & Lancioni, G. E. (2012). Nature, prevalence and characteristics of challenging behavior. In J. Matson (Ed.), *Functional assessment for challenging behaviors* (pp. 25–44). New York: Springer.

Durand, M., & Crimmins, D. B. (1992). *The motivation assessment scale administration guide*. Topeka, KS: Monaco & Associates.

Durand, V. M. (1986). Self-injurious behavior as intentional communication. *Advances in Learning & Behavioral Disabilities, 5*, 141–155.

Durand, V. M. (1990). *Severe behavior problems: A functional communication training approach*. Albany, NY: Guilford Press.

Emerson, E. (2001). *Challenging behavior: Analysis and intervention in people with severe intellectual disabilities* (2nd ed.). Cambridge: Cambridge University Press.

Fitzer, A., & Sturmey, P. (Eds.). (2009). *Language and autism: Applied behavior analysis, evidence, and practice*. Austin, TX: Pro-Ed.

Gardner, A., Wacker, D., & Boelter, E. (2009). An evaluation of the interaction between quality of attention and negative reinforcement with children who display escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 42*, 343–348.

Gevarter, C., Mulloy, A., Ramdoss, S., O'Reilly, M. F., & Watkins, L. (2014). *Communication repair behaviors of children with autism and limited vocal language: A systematic review*. Manuscript submitted for publication.

Golonka, Z., Wacker, D., Berg, W., Derby, K., Harding, J., & Peck, S. (2000). Effects of escape to alone versus escape to enriched environments on adaptive and aberrant behavior. *Journal of Applied Behavior Analysis, 33*, 243–246.

Halle, J. W., & Drasgow, E. (2003). Response classes: Don Baer's contribution to understanding their structure and function. In K. S. Budd & T. Stokes (Eds.), *A small matter of proof: The legacy of Donald M. Baer* (pp. 113–124). Reno, NV: Context Press.

Healy, O., Lydon, S., & Murray, C. (2014). Aggressive behavior. In P. Sturmey & R. Didden (Eds.), *Evidence-based practice and intellectual disabilities* (pp. 103–132). Chichester, UK: Wiley Blackwell.

Herrnstein, R. J. (1961). Stereotypy and intermittent reinforcement. *Science, 133*, 2067–2069.

Holden, B., & Gitlesen, J. P. (2006). A total population study of challenging behavior in the county of Hedmark, Norway: Prevalence and risk markers. *Research in Developmental Disabilities, 27*, 456–465.

Horner, R. H., & Billingsley, F. F. (1988). The effect of competing behavior on the generalization and maintenance of adaptive behavior in applied settings. In R. H. Horner, G. Dunlap, & R. I. Koegel (Eds.), *Generalization and maintenance: Life-style changes in applied settings* (pp. 197–220). Baltimore: Paul H. Brookes Publishing.

Horner, R., & Day, H. M. (1991). The effects of response efficiency on functionality equivalent competing behaviors. *Journal of Applied Behavior Analysis, 24*, 719–732.

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

Iwata, B., Dorsey, M., Slifer, K., Bauman, K., & Richman, G. (1982). Toward a functional analysis of self-injury. *Analysis and Intervention in Developmental Disabilities, 2*, 3–20 (Reprinted in *Journal of Applied Behavior Analysis, 27*, 197–209, 1994).

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

Keen, D. (2005). The use of non-verbal repair strategies by children with autism. *Research in Developmental Disabilities, 26*, 243–254.

Kennedy, C. H. (2005). *Single-case designs for educational research*. Boston: Allyn and Bacon.

Kodak, T., Northup, J., & Kelley, M. (2007). An evaluation of the types of attention that maintain problem behavior. *Journal of Applied Behavior Analysis, 40*, 167–171.

Kozlowski, A. M., & Matson, J. L. (2012). Interview and observation methods in functional assessment. In J. L. Matson (Ed.), *Functional assessment for challenging behaviors* (pp. 105–124). New York: Springer.

Kurtz, P. F., Chin, M. D., Huete, J. M., Tarbox, R. S. F., O'Connor, J. T., Paclawskyj, T. R., et al. (2003). Functional analysis and treatment of self-injurious behavior in young children: A summary of 30 cases. *Journal of Applied Behavior Analysis, 36*, 205–219.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., & Didden, R. (2012). Function of challenging behavior. In J. L. Matson (Ed.), *Functional assessment for challenging behaviors* (pp. 45–64). New York: Springer.

Lang, R., O'Reilly, M., Lancioni, G., Rispoli, M., Machalicek, W., Chan, J., … Franco, J. (2009). Discrepancy in functional analysis results across two settings: Implications for intervention design. *Journal of Applied Behavior Analysis, 42*, 393–397.

Lang, R., Sigafoos, J., van der Meer, L., O'Reilly, M. F., Lancioni, G. E., & Didden, R. (2013). Early signs and early behavioral intervention of challenging behavior. In R. Hastings & J. Rojahn (Eds.), *International review of research in developmental disabilities: Challenging behavior* (Vol. 44, pp. 1–35). London: Elsevier.

Liss, M., Harel, B., Fein, D., Allen, D., Dunn, M., Feinstein, C., . . . Rapin, I. (2001). Predictors and correlates of adaptive functioning in children with developmental disorders. *Journal of Autism and Developmental Disorders, 31*, 219–230.

Lovaas, O. I. (1982). Comments on self-destructive behaviors. *Analysis and Intervention in Developmental Disabilities, 2*, 115–124.

Love, J. R., Carr, J. E., & LeBlanc, L. A. (2009). Functional assessment of problem behavior in children with autism spectrum disorders: A summary of 32 outpatient cases. *Journal of Autism and Developmental Disorders, 39*, 363–372.

Mace, F. C., & West, B. J. (1986). Analysis of demand conditions associated with reluctant speech. *Journal of Behavior Therapy and Experimental Psychiatry, 17*, 285–294.

Maljaars, J., Noens, I., Jansen, R., Scholte, E., & van Berckelaer-Onnes, I. (2011). Intentional communication in nonverbal and verbal low-functioning children with autism. *Journal of Communication Disorders, 44*, 601–614.

Mancil, R. G. (2006). Functional communication training: A review of the literature related to children with autism. *Education and Training in Developmental Disabilities, 41*, 213–224.

Matson, J. L. (Ed.). (2012). *Functional assessment for challenging behaviors*. New York: Springer.

Matson, J. L., & Minshawi, N. F. (2006). Functional assessment of challenging behavior: Toward a strategy for applied settings. *Research in Developmental Disabilities, 28*, 353–361.

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

Matson, J. L., Wilkins, J., & Fodstad, J. C. (2010). Children with autism spectrum disorders: A comparison of those who regress vs. those who do not. *Developmental Neurorehabilitation, 13*, 37–45.

Matson, J. L., Wilkins, J., & Macken, J. (2009). The relationship of challenging behaviors to severity and symptoms of autism spectrum disorders. *Journal of Mental Health Research in Intellectual Disabilities, 2*, 29–44.

McAdam, D., DiCesare, A., Murphy, S., & Marshall, B. (2004). The influence of different therapists on functional analysis outcomes. *Behavioral Interventions, 19*, 39–44.

McCord, B., Iwata, G., Galensky, T., Ellingson, S., & Thompson, R. (2001). Functional analysis and treatment of problem behavior evoked by noise. *Journal of Applied Behavior Analysis, 34*, 447–462.

Mirenda, P., & Iacono, T. (Eds.). (2009). *Autism spectrum disorders and AAC*. Baltimore: Paul H. Brookes Publishing Co.

Moore, J. W., Edwards, R. P., Sterling-Turner, H. E., Riley, J., DuBard, M., & McGeorge, A. (2002). Teacher acquisition of functional analysis methodology. *Journal of Applied Behavior Analysis, 35*, 73–77.

Mundy, P., Sigman, M., Ungerer, J., & Sherman, T. (1986). Defining the social deficits of autism: The contribution of non-verbal communication measures. *Journal of Child Psychology and Psychiatry, 27*, 657–669.

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.

Northup, J., Wacker, D., Sasso, G., Steege, M., Cigrand, K., Cook, J., et al. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis, 24*, 509–522.

O'Neill, R. E., Horner, R. H., Albin, R. W., Sprague, J. R., Storey, K., & Newton, J. S. (1997). *Functional assessment and program development for problem behavior: A practical handbook* (2nd ed.). Belmont, CA: Wadsworth.

O'Reilly, M., Lang, R., Davis, T., Rispoli, M., Machalicek, W., Sigafoos, J., . . . Didden, R. (2009). A systematic examination of different parameters of presession exposure to tangible stimuli that maintain problem behavior. *Journal of Applied Behavior Analysis*, *42*(4), 773–783.

O'Reilly, M., Rispoli, M., Davis, T., Machalicek, W., Lang, R., Sigafoos, J., . . . Didden, R. (2010). Functional analysis of challenging behavior in children with autism spectrum disorders: A summary of 10 cases. *Research in Autism Spectrum Disorders, 4*, 1–10.

Osterling, J., Dawson, G., & McPartland, J. (2001). Autism. In C. E. Walker & M. C. Roberts (Eds.), *Handbook of clinical child psychology* (3rd ed., pp. 432–452). New York: Wiley.

Phillips, K. J., & Mudford, O. C. (2008). Functional analysis skills training of residential caregivers. *Behavioral Interventions, 23*, 1–12.

Reeve, C. E., & Carr, E. G. (2000). Prevention of severe behavior problems in children with developmental disorders. *Journal of Positive Behavior Interventions, 2*, 144–160.

Rispoli, M., Ninci, J., Neely, L., & Zaini, S. (2014). A systematic review of trial-based functional analysis of challenging behavior. *Journal of Developmental and Physical Disabilities, 26*, 271–283.

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.

Rowland, C. M. (2009). Presymbolic communicators with autism spectrum disorders. In P. Mirenda & T. Iacono (Eds.), *Autism spectrum disorders and AAC* (pp. 51–81). Baltimore: Paul H. Brookes Publishing Co.

Rutter, M. (1978). Diagnosis and definition. In M. Rutter & E. Schopler (Eds.), *Autism: A reappraisal of concepts and treatment* (pp. 1–25). New York: Plenum Press.

Schlichenmeyer, K., Roscoe, E., Rooker, G., Wheeler, E., & Dube, W. (2013). Idiosyncratic variables that affect functional analysis outcomes: A review (2001–2010). *Journal of Applied Behavior Analysis, 46*, 339–348.

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.

Sigafoos, J. (2000). Communication development and aberrant behavior in children with developmental disabilities. *Education and Training in Mental Retardation and Developmental Disabilities, 35*, 168–176.

Sigafoos, J., Drasgow, E., Halle, J. W., O'Reilly, M., Seely-York, S., Edrisinha, C., et al. (2004). Teaching VOCA use as a communicative repair strategy. *Journal of Autism & Developmental Disorders, 34*, 411–422.

Sigafoos, J., O'Reilly, M. F., Drasgow, E., & Reichle, J. (2002). Strategies to achieve socially acceptable escape and avoidance. In J. Reichle, D. Beukelman, & J. Light (Eds.), *Exemplary practices for beginning communicators* (pp. 157–186). Baltimore: Paul H. Brookes Publishing Co.

Sigafoos, J., O'Reilly, M. F., & Lancioni, G. E. (2009). Functional communication training and choice-making interventions for the treatment of problem behavior in individuals with autism spectrum disorders. In P. Mirenda & T. Iacono (Eds.), *Autism spectrum disorders and AAC* (pp. 333–353). Baltimore: Paul H. Brookes Publishing Co.

Sigafoos, J., O'Reilly, M. F., Lancioni, G. E., Lang, R., & Didden, R. (2014). Self-injurious behavior. In P. Sturmey & R. Didden (Eds.), *Evidence-based practice and intellectual disabilities* (pp. 133–162). Chichester, UK: Wiley Blackwell.

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

Singal, M. G., Higgins, P. D. R., & Waljee, A. K. (2014). A primer on effectiveness and efficacy trails. *Clinical and Translational Gastroenterology, 5*, e45. doi:10.1038/ctg.2013.13.

Skinner, B. F. (1953). *Science and human behavior*. New York: Macmillan.

Skinner, B. F. (1957). *Verbal behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Skinner, J., Veerkamp, M., Kamps, D., & Andra, P. (2009). Teacher and peer participation in functional analysis and intervention for a first grade student with attention deficit hyperactivity disorder. *Education and Treatment of Children, 32*, 243–266.

Sobsey, D., & Reichle, J. (1989). Components of reinforcement for attention signal switch activation. *The Mental Retardation and Learning Disabilities Bulletin, 17*, 46–60.

Stevens, M. C., Fein, D. A., Dunn, M., Allen, D., Waterhouse, L. H., Feinstein, C., et al. (2000). Subgroups of children with autism by cluster analysis: A longitudinal examination. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 346–352.

Stokes, J. V., & Luiselli, J. K. (2008). In-home parent training of functional analysis skills. *International Journal of Behavioral Consultation and Therapy, 4*, 259–263.

Sturmey, P. (2009). Reducing inappropriate verbal behavior. In A. Fitzer & P. Sturmey (Eds.), *Language and autism: Applied behavior analysis, evidence, and practice* (pp. 279–297). Austin, TX: Pro-Ed.

Suess, A. N., Romani, P. W., Wacker, D. P., Dyson, S. M., Kuhle, J. L., Lee, J. F., … Waldron, D. B. (2014). Evaluating the treatment fidelity of parents who conduct in-home functional communication training with coaching via telehealth. *Journal of Behavioral Education, 23*, 34–59.

Tait, K., Sigafoos, J., Woodyatt, G., O'Reilly, M. F., & Lancioni, G. E. (2004). Evaluating parent use of functional communication training to replace and enhance prelinguistic behaviours in six children with developmental and physical disabilities. *Disability and Rehabilitation, 26*, 1241–1254.

Tiger, J., Fisher, W., Toussaint, K., & Kodak, T. (2009). Progressing from initially ambiguous functional analyses: Three case examples. *Research in Developmental Disabilities, 30*, 910–926.

Vollmer, T. R., & Iwata, B. A. (1991). Establishing operations and reinforcement effects. *Journal of Applied Behavior Analysis, 24*(2), 279–291.

Vollmer, T. R., Roane, H. S., & Rone, A. B. (2012). Experimental functional analysis. In J. L. Matson (Ed.), *Functional assessment for challenging behaviors* (pp. 125–141). New York: Springer.

Wacker, D. P., Berg, W. K., Harding, J. W., Barretto, A., Rankin, B., & Ganzer, J. (2005). Treatment effectiveness, stimulus generalization, and acceptability to parents of functional communication training. *Educational Psychologist, 25*, 233–256.

Wacker, D. P., Berg, W. K., Harding, J. W., Derby, K. M., Asmus, J. M., & Healy, A. (1998). Evaluation and long-term treatment of aberrant behavior displayed by young children with disabilities. *Journal of Developmental and Behavioral Pediatrics, 19*, 260–266.

Wacker, D. P., Lee, J. F., Padilia Dalmau, Y. C., Kopelman, T. G., Lindgren, S. D., Kuhle, J., … Waldron, D. B. (2013). Conducting functional communication training via telehealth to reduce the problem behavior of young children with autism. *Journal of Developmental and Physical Disabilities, 25*, 35–48.

Wallace, M. D., Doney, J. K., Mintz-Resudek, C. M., & Tarbox, R. S. (2004). Training educators to implement functional analyses. *Journal of Applied Behavior Analysis, 37*, 89–92.

Weiss, J. (2003). Self- injurious behaviors in autism: A literature review. *Journal on Developmental Disabilities, 9*, 129–143.

Worsdell, A. S., Iwata, B. A., Conners, J., Kahng, S. W., & Thompson, R. H. (2000). Relative influences of establishing operations and reinforcement contingencies on self-injurious behavior during functional analyses. *Journal of Applied Behavior Analysis, 33*(4), 451–461.