Populations and problems evaluated with functional assessment

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Populations and Problems Evaluated with Functional Assessment

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Abstract

Functional assessment is a technique consisting of a set of procedures that define the relationship between events in the environment and specific target behaviors. The purpose of functional assessment is to identify maintaining contingencies for challenging behavior in an individual's environment. This chapter provides an overview of populations evaluated with functional assessment which includes the following: Autism Spectrum Disorder, Intellectual Disability, Emotional Behavioral Disorder, Attention-Deficit/Hyperactivity Disorder, Fragile X Syndrome, Angelman Syndrome, Prader-Willi Syndrome, Smith-Magenis Syndrome, Lesch-Nylan Syndrome, Acquired Brain Injury, Typically Developing Children, Children at Risk of Developmental Disabilities, Children with Prenatal Drug Exposure, and Children who use Wheelchairs. The subsequent part of this chapter will focus on the behaviors and problems evaluated with functional assessment, which include the following: aggression, self-injurious behavior, stereotypy, bizarre speech, skin picking, hand mouthing, feeding problems, elopement, non-compliance and disruptive behavior, multiple typographies of problem behavior, sleep problems, as well as happiness behaviors. An extensive review of the research will provide the reader with the range of possible uses of functional assessment.

Keywords: functional assessment, functional analysis, challenging behavior, behavior problems, aberrant behavior

1. Introduction

Functional assessment is defined as "a process of identifying functional relationships between environmental events and the occurrence or non-occurrence of a target behavior" (Dunlap et al., 1993, p. 275). The purpose of functional assessment is to identify environmental events that reliably predict and maintain challenging behaviour (CB) (McIntosh, Brown, & Borgmeier, 2008; Steege, Pratt, Wickerd, Guare, & Watson, 2019). Functional assessment has most commonly been conducted in clinical settings with individuals who have developmental disabilities exhibiting severe forms of CB including self-injurious behavior (SIB), aggression, and disruptive behaviors (Hanley, Iwata, & McCord, 2003). The focus of this chapter is to review the literature on the range of CB and populations for whom functional assessment has been used.

The first part of this chapter will review the different populations commonly evaluated with functional assessment. These populations include the following: autism spectrum disorder (ASD), intellectual disability (ID), Emotional Behavioral Disorder, Attention-deficit/hyperactivity disorder (AD/HD), Fragile X Syndrome, Angelman Syndrome, Prader-Willi Syndrome, Smith-Magenis Syndrome, Lesch-Nylan Syndrome, Acquired Brain Injury, Typically Developing Children, Children at Risk of Developmental Disabilities, Children with Prenatal Drug Exposure, and Children who use Wheelchairs. The second part of this chapter will focus on the specific behaviors exhibited by these populations, including the following: aggression, SIB, stereotypy, bizarre speech, skin picking, hand mouthing, feeding problems, elopement, non-compliance and disruptive behavior, multiple topographies of behavior, sleep problems and happiness behaviors.

2. Populations Evaluated with Functional Assessment

2.1 Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction in combination with restricted, repetitive patterns of behavior, interests or activities (American Psychiatric Association, 2013). Individuals with ASD often engage in CB that interfere with their quality of life. The most common challenging behaviors (CBs) assessed in individuals with ASD are aggression, property destruction, SIB, stereotypy and tantrums (Devlin, Healy, Leader, & Reed, P., 2008; O'Reilly et al., 2010; Leader & Mannion, 2016; Liddon, Zarcone, Pisman, & Rooker, 2016; Machalicek et al. 2010; Kern, 1997). Other behaviors include elopement, flopping, inappropriate vocalizations, verbal protesting, pica and spitting (Olive, Lang & Davis, 2008; O'Reilly, Edrisinha, Sigafoos, Lancioni, & Andrews, 2006).

CBs are often assessed through functional assessments. A wide number of studies showed the effectiveness of functional analysis (FA) in identifying the maintaining functions of CB displayed by individuals with ASD in both applied and school settings (Falcomata, Muething, Gainey, Hoffman, & Fragale, 2013; Falcomata & Gainey, 2014; Fragale, Rojeski, O'Reilly, & Gevarter, 2016; Sasso et al., 1992; Scalzo & Davis, 2017; Smith, Carr, & Moskowitz, 2016; Olive, Lang, & Davis, 2008; Rose & Beaulieu, 2019). Additional studies suggested the importance of individualizing functional analyses (FAs) in order to both identify multiple functions of CB (LaBelle & Charlop-Christy, 2002) and to incorporate specific establishing operations in the FA test conditions (Strohmeier, Murphy, & O'Connor, 2017). Machalicek et al. (2009; 2010) also showed the effectiveness of FAs with video conferencing equipment to identify the functions of aggression, SIB, property disruption, flopping, and stereotypy in children with ASD in a classroom setting. However, Hausman, Kahng, Farrell, and

Mongeon (2009) showed that when CB are idiosyncratic in nature, FAs may be inconclusive and further analysis to evaluate more idiosyncratic functions might be necessary. Although effective, FAs have a number of limitations including the length of time, the high level of expertise required, and the reinforcement of CB. For this reason, alternatives and variations of FAs have been investigated to identify CB displayed by children with ASD.

The length of FAs has been addressed with the implementation of shorter test conditions in Brief Functional Analyses (BFA). Several studies showed the effectiveness of BFA in identifying the maintaining functions of CB displayed by children with ASD (Kelly, Axe, Allen, & Maguire, 2015; Roberts-Gwinn, Luiten, Derby, Johnson, & Weber, 2001). The limitation of reinforcing CB during the implementation of FAs can be addressed with the implementation of manding analysis (MA). LaRue et al. (2011) showed the effectiveness of MA in identifying the maintaining functions of CB. The analysis involved reinforcement contingent on mands rather than CB in four individuals with ASD. Studies also suggested the benefits of using a trial-based functional analysis (TBFA) to investigate the maintaining functions of CB of individuals with ASD compared to traditional FAs. TBFA does not require the repeated reinforcement of CB and it is conducted in shorter time than FAs (LaRue, Lenard, Weiss, Bamond, Palmieri, & Kelley, 2010; Larkin, Hawkins, & Collins, 2016).

Studies also found a high correspondence between Questions About Behavioral Function (QABF; Matson &Vollmer (1995) and FAs in the analysis of function of CB displayed by individuals with ASD (Healy, Brett, & Leader, 2013; Watkins & Rapp, 2013). Devlin, Healy, Leader, and Hughes (2011) also found the QABF and Functional Analysis Screening Tool-Revised (FAST-R) effective in identifying the maintaining functions of CB displayed by children with ASD. Herman, Healy, and Lydon (2018) showed the effectiveness of an Interview-

Informed Synthesized Contingency Analysis to identify the function of flopping in one child with ASD in a school setting. Studies showed the effectiveness of descriptive observational assessment in identifying the maintaining functions of CB displayed by individuals with ASD (Carr & Carlson, 1993; Toogood, Boyd, Bell, & Salisbury, 2011). Tarbox et al. (2009) showed that descriptive assessments did not identify clear maintaining functions of CB when compared to indirect assessments and experimental FAs which led to conclusive functions. Martens, Gertz, de Lacy Werder, and Rymanowski (2010) showed the correspondence of Contingency Space Analysis of behavior-consequence recordings with the results of FAs under naturalistic test conditions for three children with ASD. Discrete-trial functional analysis was also found to be an effective experimental methodology to identify the maintaining functions of CB in natural routines (Schmidt, Drasgow, Halle, Martin, & Bliss, 2014).

Although there is a wide variety of FA methodologies, the most common identified functions of CB displayed by individuals with ASD are attention and escape from demand, followed by self- stimulation and access to preferred food or toys (Matson, Kozlowski, Worley, Shoemaker, Sipes, & Horovitz, 2011). CB displayed by individuals with ASD are often maintained by multiple functions and studies showed that function-based interventions are more effective when the maintaining variables are identified through FAs (Heyvaert, Saenen, Campbell, Maes, & Onghena, 2014).

2.2 Intellectual Disability

Intellectual disability (ID) is seen as a disorder with onset during the developmental period that includes both intellectual and adaptive functioning deficits in conceptual, social, and practical domains (American Psychiatric Association, 2013). Between 10-15% of individuals with ID present with CB (Emerson et al. 2001; Lowe et al. 2007). In the adult ID population

prevalence estimates for SIB is 15% (Kahng, Iwata, & Lewin, 2002), and 10-24% for aggressive behavior (Crocker et al. 2006). Regarding the prevalence of behavior functions for people with ID, previous research has identified that SIB and stereotypy are more likely to be maintained by automatic reinforcement (Chieh-Chung & Cannella-Malone, 2010; Delgado-Casas, Navarro, Garcia-Gonzalez-Gordon, & Marchena, 2014) and aggressive behavior is more likely maintained by social positive or negative reinforcement (Britton et al., 2002; Delgado-Casas et al., 2014; Emerson, Reeves, Thompson, Henderson, Robertson, & Howard, 1996; Hanley, Piazza, Fisher, & Maglieri, 2005; Ellingson, Miltenberger, Stricker Galensky, & Garlinghouse, 2000; Rispoli et al., 2011; Smith & Churchill, 2002; Vollmer et al., 1998). Data from other studies, however have identified higher percentages of cases of SIB as maintained by social positive and/or negative reinforcement (Hanley, Iwata & McCord 2003; Hetzroni & Roth, 2003; O'Reilly et al., 2008; Smith & Churchill, 2002; Wacker, Berg, Harding, Derby, Asmus, & Healy, 1998; Wacker et al., 1990).

Previous literature has also identified that CB may be maintained by a combination of social positive, social negative and automatic reinforcement (Lloyd & Kennedy, 2014; Matson & Boisjoli, 2007; Scheithauer, Cariveau, Call, Ormand, & Clark, 2016). In some cases, the function of CB has been found to vary by topography. For example, Derby et al. (1994) identified stereotypy to be maintained by automatic reinforcement and SIB to be maintained by social positive or social negative reinforcement for two individuals with ID. Similarly, Delgado-Casas et al. (2014) identified SIB to be maintained by both automatic reinforcement and social positive reinforcement across three participants with ID. For one participant in particular, aggression was maintained by negative reinforcement, social attention, and tangible positive

reinforcement. Their SIB was maintained by automatic reinforcement and stereotypy was maintained by social attention and tangible positive reinforcement.

Hall (2005) examined the outcomes of descriptive, experimental and informant-based methods of FA for four individuals with ID presenting with CB. Results indicated that the descriptive and experimental assessments were concordant in only one of the four cases whilst informant-based and experimental assessments were concordant in three of the four cases. For example, the experimental and informant-based assessment identified an escape function for SIB whilst the descriptive assessment identified attention. Results suggested that information from descriptive assessments may not be useful adjunct to experimental assessment. In order to accurately identify CB in ID, recent research has shown promise in training non-professionals in learning to carry out a FA and implementing the information gained from the FA into effective behavioral interventions (Tassé, 2006).

2.3 Emotional Behavioral Disorder

Emotional Behavioral Disorder (EBD) is a broad term used to describe a range of CB observed in individuals that would often be characteristic of the presence of a disability (Kavale et al., 2005). Although attempts to define EBD in research have been difficult, certain characteristics are assessed as part of a diagnosis (Kavale et al., 2005): 1) Incompetence when forming and sustaining relationships; 2) Learning difficulties due to factors outside of intellectual or health problems; 3) Consistent and abnormal behaviors and feelings in normal situations; 4) Consistent development of fears and physical symptoms related to personal and professional problems, and 5) General low mood and feelings of depression or sadness. Individuals diagnosed with EBD usually display behavior pertaining to at least one of the characteristics

above which result in problems with development and interpersonal relationships (Poulou, 2013). Often EBD is associated with other sub-disorders, for example, AD/HD.

CB associated with EBD are often studied and treated in the context of a FA. Flanagan and DeBar (2018) conducted a TBFA to identify the idiosyncratic functions of CB in a ten-year-old boy with an EBD. The CB under analysis were vocal disruptions, physical aggression and falling on the floor/crawling. Indirect and experimental assessments of CB were conducted to identify the conditions favorable to the FA. The TBFA involved trials of ten varying conditions. FA results showed that the CB was maintained by attention and escape from demands. This study provides evidence to support the use of trial-based FAs in the analysis of CB in EBD.

2.4 Attention-Deficit/Hyperactivity Disorder

Attention-deficit/hyperactivity disorder (AD/HD) is the most common neurodevelopmental disorder diagnosed in childhood (Perou et al., 2013), and is characterized by chronic symptoms of inattention, impulsivity, and/or hyperactivity that lead to functional impairment experienced in multiple settings (American Psychiatric Association, 2013). Kodak et al. (2004) conducted a FA with a 5-year-old girl with AD/HD in a summer school setting to identify the maintaining function of elopement during a kickball game. Elopement was operationally defined as running more than one meter away from the kicking area or designated base when it was not functional to the game. The FA included attention, escape, and control conditions. Results of the FA showed that the duration of elopement was consistently high in the attention condition and was always low in the escape and control conditions. A subsequent treatment consisting of non-contingent attention and time-out was used to eliminate elopement during the kickball game.

2.5 Fragile X Syndrome

Fragile X Syndrome (FRAX) is caused by a change in the DNA sequence of the Fragile X Mental Retardation 1 (FMR1) gene which results in a wide range of intellectual disabilities and is often associated with different disorders such as ASD (Hagerman, 2008; Newman, Leader, Chen & Mannion, 2015). Kurtz, Chin, Robinson, O'Connor, and Hagopian (2015) investigated the use of FA in understanding the function of CB in children with FRAX. FA conditions of attention, demand, tangible, alone and play were implemented. Results found CB to be primarily maintained by escape from demands and access to tangibles.

Monlux, Pollard, Rodriquez, and Hall (2019) used FA in a population diagnosed with FRAX when investigating the efficiency of telehealth to uncover functions of and treat CB. Results indicated escape from academic demands, escape from transition demands, access to tangibles and attention as the primary functions behind CB. These results were then used to implement treatments via telehealth. Machalicek et al. (2014) examined the function of CB in 12 participants with FRAX under attention, social avoidance, demand, tangible, and play conditions. They found escape from demands and/or escape from social interactions as maintaining functions in eight participants and access to preferred items in nine participants. Three participants showed attention as a maintaining factor.

2.6 Angelman Syndrome

Angelman Syndrome (AS) is a clinical, neurogenetic disorder, affecting approximately 1 in 12,000 to 20,000 people (Buckley, Dinno, & Weber, 1998; Galván-Manso et al., 2002). Symptoms of the disorder include craniofacial abnormalities, an ataxic gait, limbic weakness, seizures, decreased cognitive functioning, lack of communication, hyperactivity, inappropriate laughter and a perceived happy demeanour (Adams, Horsler, Mount, & Oliver, 2015; Holland, Whittington, & Butler, 2002; Williams et al., 1995).

Studies have used FA to assess the functions of CB in participants with AS. Conditions similar to Iwata et al. (1994) were implemented for both of the following studies (Radstaake et al., 2013; Radstaake, Didden, Oliver, Allen, & Curfs, 2012). Radstaake et al. (2012) found attention, access to tangibles and demand as maintaining factors of CB and results showed the presence of precursors before nearly all incidences of CB. Similarly, Radstaake et al. (2013) found attention and access to tangibles to be primary maintaining factors for CB in participants and identified precursor behavior in one of three participants.

Strachan et al. (2009) conducted experimental FAs of CB in 12 children with AS. The target behavior being observed was aggression, with 10 of 12 participants displaying aggressive behaviors. Results indicated that one participant showed attention as a maintaining factor of CB, three showed social interaction and two showed escape as a maintaining factor. Based on these results, authors suggested that in their sample, aggression may serve as a means to maintain and initiate social contact.

2.7 Prader-Willi Syndrome

Prader-Willi syndrome (PWS) is a rare genetic disorder consisting of several implications to metabolic, endocrine, neurologic systems, with behavior and intellectual difficulties (Gutierrez & Mendez, 2020). PWS is characterized by hypotonia, feeding difficulties, hyperphagia and can lead to morbid obesity (Gutierrez & Mendez, 2020). Functional assessment has been used to identify the maintaining functions of CB associated with food displayed by individuals with PWS. Lambert et al. (2019) used latency-based FA in a clinical setting to investigate the functions of food stealing behaviors of a 7 year-old girl with PWS. Results of the FA revealed that food stealing was maintained by contingent access to food. As part of a function-based intervention, differential reinforcement (DR) procedures combined with a token board and

schedule thinning were implemented. The intervention was successful in teaching the participant to wait for small portions of food across longer timeframes, eliminating food stealing behaviors and creating family inclusion during mealtime.

Didden, Korzilius, and Curfs (2007) used FA to investigate the association of skin-picking with compulsive behavior and SIB in 119 children with PWS. Two rating scales were distributed to the participants' parents to investigate behavioral and operant functions of skin-picking while collecting data on SIB and compulsive behaviors. QABF was used to assess functions of skin-picking. FA results showed that skin-picking was primarily reinforced by non-social and intrinsic consequences in 70% of the sample. Authors hypothesized that skin-picking is negatively reinforced by tension and arousal reduction. Therefore, skin-picking may be treated using relaxation training, anxiety and anger management, teaching coping strategies in dealing with psychological stressors.

2.8 Smith-Magenis Syndrome

Smith-Magenis Syndrome (SMS) is a rare neurobehavioral disorder characterized by a recognizable pattern of physical, behavioral, and developmental features. It is caused by particular genetic changes on chromosomal region 17p11.2, which contains the gene RAI1 (Juyal et al., 1996). A diagnosis of SMS is associated with high levels of CB, specifically SIB and aggression towards others (Arron, Oliver, Berg, Moss, & Burbidge, 2011; Sloneem, Oliver, Udwin, & Woodock, 2011). Hodnett, Scheithauer, Call, Mevers, and Miller (2018) assessed and treated severe CB exhibited by two children with SMS. The primary target behaviors of the first participant, a thirteen year old male, were SIB, disruptive behavior, and disrobing. The primary target behaviors of the second participant, a four-year-old female, were SIB, aggression and disruptive behavior. For both participants, the function of CB was identified through a FA. All

sessions started with a multi-element design. If rates of CB were variable across conditions, a pairwise design was employed. If no CB was observed, the caregivers of the participants were incorporated into the FA. Control, escape, attention, tangible and alone (the first participant only) conditions were conducted.

The first participant, the thirteen year old male, engaged in consistently higher rates of CB in the escape condition when compared to the control. Inconsistent rates of CB were observed in the tangible and attention conditions. In a pairwise design, elevated rates of CB were observed in the tangible condition. Initially in the attention pairwise analysis, high rates were observed that decreased to stable rates, suggesting that the CB of the participants was not maintained by access to attention. It was concluded that the participant's CB was maintained by escape from demands and access to tangible items. The second participant, engaged in no CB during the initial FA with the therapist. However, elevated rates of CB were observed in the tangible and attention conditions when her mother conducted the FA. It was determined that the participant's CB was maintained by access to attention and tangible items.

Torres-Viso, Strohmeier, and Zarcone (2018) conducted a FA of the relation between mands and CB. The participant was a 12-year-old female diagnosed with ASD and SMS. The mands involved requests from others to change their body positioning or proximity, or rearrange items back to their original position. For example, her mother's legs could only sometimes be crossed or her father could not stand at certain windows. When her parents did not comply with these demands, she would exhibit CB. A multi-element FA was conducted in which the role of social positive reinforcement in the form of access to an individual's attention, divided attention, and toys contingent on CB was evaluated. Social negative reinforcement in the form of escape from demands and automatic reinforcement was also evaluated in which her behavior was

ignored. The results of FA confirmed the relation between CB and mand compliance indicating that CB was maintained by other's compliance with mands for rearrangement.

2.9 Lesch-Nyhan Syndrome

Obi (1997), designed a function-based intervention to decrease the occurrences of SIB and the use of wrist restraints in a 24 year-old adult with Lesch-Nyhan Syndrome. The target behavior under analysis was SIB which was operationally defined as banging his head and hands on different objects such as wall, bed rails, or Plexiglass screen, finger biting, and flipping out of his wheelchair. A semi-structured behavioral interview was conducted with the participant and a simple questionnaire and direct observation was completed by the staff as part the functional assessment process. Results were then analyzed in a concurrent analysis which identified negative reinforcement in the form of avoidance of anxiety contingent on the absence of restraints as the maintaining function. From the functional assessment results, a 4-phase intervention was successfully designed and delivered to decrease the restraint time and the occurrences of SIB.

2.10 Acquired Brain Injury

Rahman, Oliver, and Alderman (2010) conducted a descriptive FA investigating the CB exhibited by nine adults with acquired brain injury (ABI). The target behaviors were operationally defined under aggression as "physical aggression", "property destruction", "SIB" and " verbal aggression". The descriptive FA involved observation of the participants in their natural environment and data was collected using a coding system on a personal computer. A concurrent analysis was conducted to assess the likelihood that environmental events occurred prior the target behaviors. A sequential analysis was conducted to investigate the sequences in which CB were related to appropriate environmental events. The two analyses were compared

and 88% of concordance was found. The overall findings showed that the CB displayed by the adults with ABI occurred in a functional, orderly and predictable way. Escape from demand and escape from social attention were identified as maintaining functions for 13 behaviors, respectively. Multiple functions were identified for five participants and 88% of CB were found to be significantly likely to co-occur with environmental events.

Rahman, Alderman, and Oliver (2013) investigated the effects of structured descriptive assessments in identifying the maintaining functions of CB displayed by four adult survivors of traumatic brain injury. Three participants sustained a brain injury following a road traffic accident and one participant following a suicide attempt. For three participants, the CB under analysis was aggression in the form of property destruction, physical and/or verbal aggression. The CB exhibited by the fourth participant was verbal perseveration defined as repetitive recitation of a phrase, word or indecipherable verbalization. A hybrid approach to functional assessment and experimental FA was used to identify the functions of the target behaviors. The structured descriptive analysis involved the systematic manipulation of antecedent events typically involved in a FA but without manipulating the consequences in a structured descriptive way. The target behaviors were observed in the natural environment, in contrast with the FA methodology but characteristic of a typical functional assessment. Results from the analysis showed that escape from demand was the maintaining function for two participants, and social attention was the function for the other two participants. Results showed that structured descriptive assessment is an efficient methodology to effectively identify behavior functions in individuals with ABI.

2.11 Typically Developing Children

Arndorfer and Miltenberger (1993) reviewed literature on FA and treatment of CB in children with developmental disabilities. Informant assessment, direct observation assessment, and experimental analysis were reviewed in-depth. The implications for early childhood were discussed and the authors revealed that because FA involves the manipulation of antecedent or consequent variables, a school psychologist or other professional would need to organize the process and instruct parents/teachers how to carry out the FA conditions. The authors revealed that practitioners in the field of early childhood special education, or other areas of developmental disabilities should approach CB from a functional perspective in order to develop effective treatments.

CB presented in young children have increased over the years, which places them at risk for developing an emotional/behavioral disorder (Conroy, Davis, Fox, & Brown, 2002). Conroy et al. (2002) examined FA of behavior and effective supports for young children with CB. A multi-level system model that outlines prevention on various levels, as well as remediation strategies that can be used to ameliorate CB exhibited by young children was assessed. This hierarchical model consists of applying a multilevel FA and interventions when working with young children who present with CB. Conroy et al. (2002) suggested that early intervention can make a significant difference in behavioral and developmental outcomes and this model provides a framework for addressing these behaviors across three levels of prevention and intervention. The importance of addressing CB of children in early childhood settings and the incorporation of this model may prevent further development of EBD in children. This model provides a least restrictive, intrusive framework for identifying and intervening with high risk environments and children in early childhood programs. This model may be time efficient for teachers and typically developing children.

Rispoli et al. (2015) investigated TBFA on Head Start teachers during classroom routines. The purpose of this study was to train teachers to conduct TBFA in the classroom, assess the accuracy of TBFA results by comparing function-based with non-function-based CB interventions as well as to assess teacher observations of the social validity of a TBFA in Head Start classroom setting. Three Head Start teachers and one child from each teacher's classroom was selected to participate. Data was collected on the children's CB and appropriate communication and an A-B-A-C-D design was employed for the purpose of the study. Function-based intervention produced greater decreases in CB than the non-function-based intervention for in all three children. TBFA represents an important innovation for developing function-based interventions for children with challenging behavior.

2.12 Children at Risk of Developmental Disabilities

A variety of research has been conducted into children that may be at risk of developmental disabilities and the factors that may contribute to this (Macks & Reeve, 2007). Schroeder, Richman, Abby, Courtemanche, and Oyama-Ganiko (2014) investigated the prevalence of CB in young children at risk of developmental disabilities in 17 at-risk children. SIB, stereotypy, property destruction, aggression and tantrums as target CB were assessed using an analogue FA under play, attention, escape and alone conditions and the Behavior Problem Inventory was also conducted. Researchers found that most of the CB displayed was maintained by automatic reinforcement with a minority being attributed to social reinforcement.

2.13 Children with Prenatal Drug Exposure

Very few studies focus on the analysis of CB in a population consisting of children with a history of prenatal drug exposure. Kurtz, Chin, Rush, and Dixon (2008) used FA to identify the functions of CB displayed by children who had experienced prenatal drug exposure. The

participants were two toddlers under the age of two years that had been prenatally exposed to drugs (cocaine, heroin, alcohol) and were reported to often display various forms of CB. The CB under analysis were aggression, SIB and destructive behaviors. An experimental FA consisting of attention, play, tangible and demand conditions was carried out in order to establish the variables maintaining the CB. The results showed that the CB of both children were maintained by positive reinforcement in the form of attention from adults and access to tangible items. For one child, escape from demands was also a maintaining function of CB. Function based interventions were then delivered based on the results of FA that were shown to be effective in reducing CB. The results showed the effectiveness of using a FA to analyze behavioral functions in children with prenatal drug exposure and to provide evidence that often CB derive from environmental factors.

2.14 Children who use Wheelchairs

DeLeon, Kahng S, Rodriguez-Catter, Sveinsdóttir, and Sadler (2003) conducted an experimental FA in order to identify the maintaining functions of CB in a child with a developmental disability using a wheelchair. The participant was a 14-year-old boy with severe mental problems, cerebral palsy and visual impairments. The target behavior under analysis was aggression in the form of hitting, grabbing, and pushing. Experimental FA involved seven different conditions; toy play, social attention, alone, demand, activities of daily living, social escape and contingent wheelchair movement. The results showed movement as a positively reinforcing CB in the participant, with aggression levels rising contingent on being pushed in the wheelchair.

3. Behaviors and Problems Evaluated with Functional Assessment

3.1 Aggression

Aggression is defined as a behavior that is intended to harm another person who is motivated to avoid that harm (DeWall, Anderson, & Bushman, 2012). Cariveau, Miller, Call, and Alvarez (2019) used a FA to determine whether aggression exhibited by an eight-year old male with a diagnosis of ASD and AD/HD was maintained by termination of interruptions to repetitive behavior. A multi-element FA was conducted which included attention, toy play, tangible, escape and interruption conditions. The results of the FA demonstrated that aggression was maintained by escape from demands and termination of interruptions to repetitive behavior.

Newcomb, Wright, and Camblin (2019) examined aggressive behavior maintained by access to physical attention using two preparations of a FA. The participant was a 13-year-old male with a diagnosis of ASD who attended a private, specialized education facility due to underdeveloped communication skills and CB. The target behavior under analysis was aggression. A FA was carried out similar to procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1994). Test conditions included in the FA were escape from demands, ignore, physical attention, nonphysical attention and a control condition. Following the FA, a competing stimulus assessment was carried out to identify one or more stimuli that would compete with aggression. Results showed that physical attention was the maintaining function of aggression and that certain stimuli competed with it. The intervention consisted of non-contingent reinforcement (NCR) using competing stimuli and it was successful in decreasing the occurrences of aggression.

Romani et al. (2019) focused on aggressive behavior exhibited by two children during public outings. The first participant was a 5-year-old boy with ASD and unspecified disruptive, impulse-control, and conduct disorder. The second participant was a 12-year-old boy diagnosed with ASD, mild ID, and unspecified disruptive, impulse-control, and conduct disorder. The

target behavior was aggression and it was operationally defined as when the participant's hand or foot contacted the body of another adult resulting in the movement of an adult's body. The FA based on procedures described by Iwata et al. (1994), was conducted in a clinic setting within a multi-element design. A tangible condition was added based on parent report of CB occurring when preferred activities were denied. Results of the clinic-based FAs, showed that the CB displayed by the first participant was maintained by tangibles. However, the second participant did not engage in aggressive behavior neither in the clinic setting nor in the public setting but aggressive behavior was observed when the modified tangible condition was conducted in the hospital cafeteria. Results showed that the CB of both participants were maintained by tangibles. The intervention for both participants involved differential reinforcement of alternative (DRA) behavior which was effective in decreasing aggressive behavior and increasing compliance to instructions.

White et al. (2011) examined aggressive and stereotyped behavior in two children diagnosed with ASD using analogue FA protocols. This study demonstrated the link between aggressive and stereotyped behavior using an extended FA protocol. The participants included two 7-year-old males diagnosed with severe ASD. The CB exhibited by the first participant consisted of aggressive behavior, which was defined as grabbing and shaking the arm of the therapist and/or biting. Stereotypical play was defined as repeatedly spinning or rocking the stacking rings. Appropriate play was defined as use of the toy as intended (i.e., sorting and stacking the rings). The second participant also exhibited aggressive behavior. For this participant, aggression was defined as grabbing the therapist or an item and pulling forcefully. When he grabbed, he also engaged in screaming (loud vocalizations above the typical conversational level). Stereotypical play was defined as nonfunctional repetitive play with the

toy glove (e.g., tossing the glove from one hand to the other). A multi-element FA, similar to Iwata et al. (1982, 1994)'s was conducted. Test conditions included in the FA were attention, demand, tangible and free play. For both participants, high rates of aggressive behavior occurred during the tangible condition suggesting that access to the glove or ring stackers was a maintaining consequence for aggression. Data on the rates of stereotypy and appropriate play were collected during an extended FA tangible condition, where ten additional sessions were conducted. The purpose of the extended assessment was to assess the potential influence of stereotypy on the occurrence of CB in a FA tangible condition. Results revealed that once the participant was given access to the items shown to be maintaining CB, these items were then used to engage in stereotypy. These results suggested a relationship between stereotypy and socially mediated CB.

Previous research has identified that false-negative errors can occur during FAs, whereby some individuals do not engage in CB during analogue conditions (Wacker, Berg, Harding, & Cooper-Brown, 2004). One reason for this is that antecedent variables manipulated in test conditions do not function as motivating operations (Laraway, Snycerski, Michael, & Poling, 2003), and therefore do not occasion CB. O'Reilly, Lacey, and Lancioni (2000) demonstrated that combinations of antecedent variables might motivate CB in a FA. Call et al. (2005) examined whether manipulating multiple antecedent variables within FA test conditions would be one means of clarifying false-negative outcomes. The participants were a 17-year-old male diagnosed with a genetic disorder resulting in ID and a seizure disorder and a 2-year 8-month-old male diagnosed with a disruptive behavior disorder. The first participant engaged in aggressive and destructive behavior in the form of throwing objects. The second participant also engaged in aggressive behavior. Aggression was defined as audible contact between an extremity and

another person or displacement of an object that resulted in audible contact between that object and another person. This study used a single-antecedent FA test condition and combined antecedent test conditions within a multi-element design. FA procedures included free play, attention, escape, and tangible conditions (Iwata et al., 1982, 1994). The combined-antecedent conditions for the first participant included demand and diverted attention/contingent attention. Demand and restricted tangible item/contingent escape conditions were implemented for the second participant.

For both participants, elevated rates of aggressive behavior were observed within the combined-antecedent test conditions, whereas little or no aggressive behavior was observed in the control or single-antecedent test conditions. Failure to include the combined-antecedent variables would likely have resulted in false-negative findings for these participants. Results suggested that FAs that combine selected pairs of antecedent variables may clarify outcomes when standard test conditions do not result in CB.

The majority of FAs are implemented in highly controlled, long-term inpatient settings. Northup et al. (1991) recognized that in order to provide further evidence of the utility of FA as an assessment procedure for severe CB, it is necessary to demonstrate the generalizability of the assessment procedures and to determine if a more brief version of assessment is feasible. Northup et al. (1991) conducted a brief FA on three individuals exhibiting aggressive behavior in an outpatient setting during a 90-minute period. The first participant was a 24-year-old male diagnosed with severe to profound range of ID and was non-verbal. His aggressive behavior included scratching, pinching, grabbing, hitting, and pulling hair. Participant two, 21-year-old female, was also diagnosed with severe to profound ID and was non-verbal. Her aggressive behavior consisted of pinching, hitting and biting. The third participant was a 13-year-old

female diagnosed with cerebral palsy and had moderate to severe ID. Her aggressive behavior included pinching, biting and hitting which have occurred daily for the past five to ten years.

This study used a multi-element design, consisting of two rapidly changing reversal designs conducted in two phases: an initial analogue assessment and a contingency reversal. For the second and third participants, the analogue assessment consisted of alone, tangible, demand, and/or social attention conditions, based on the analogue conditions used by Iwata et al. (1982; 1994). For the first participant, the analogue assessment consisted of alone, escape, alone, and escape conditions. The social attention and tangible conditions were not conducted for this participant, as he was observed to be unresponsive to social interaction and tangible reinforcement (he initially lay on the classroom floor and physically resisted any attempts to engage him in activities or physical contact). Following the initial analogue assessment, all participants were observed during three additional conditions, referred to as a contingency reversal. In the first contingency reversal condition, the contingency producing the highest percentage of aggressive behavior during the analogue assessment was again presented, but the consequence was provided contingently upon the occurrence of appropriate manding rather than for aggressive behavior. Aggressive behavior was ignored for Participant 2 and 3, or graduated guidance was used to redirect the participant to task for Participant 1. This condition was followed by a control condition, which was either a complete reversal in which the condition producing the highest percentage of aggressive behavior during the initial analogue assessment was repeated (Participant 2 and 3) or the alone condition was repeated (Participant 1). The control condition was then followed by a second contingency reversal condition to form a reversal design.

During the initial analogue assessments, each of the participants displayed a greater percentage of aggressive behavior during one maintaining condition than during any other. For Participant 1, elevated rates of aggressive behavior occurred during the escape conditions. Participant 2 displayed aggressive behavior during the tangible and escape conditions. Participant 3 displayed aggressive behavior during the escape and attention conditions. During this contingency reversal phase, each participant displayed a substantial reduction in aggressive behavior and a substantial increase in alternative behavior, therefore providing a direct analysis of the equivalency of the contingency for maintaining either behavior. This demonstrated that the contingencies identified as maintaining aggressive behavior also served to reinforce an alternative, replacement behavior.

3.2 Self-Injurious Behavior

Dunkel-Jackson, Kenney, Borch, and Neveu (2018) investigated TBFA on a 9 year-old male with ASD in a school setting and evaluated the effects of a function-based intervention informed by TBFA results. CB was assessed as two TBFAs were conducted for swearing and head banging. The intervention team replicated and extended previous treatment evaluation research by using the results of the TBFAs to identify yet another function-based intervention: demand fading. Results determined that head banging and swearing were most sensitive to contingencies involving escape from challenging tasks as well as access to tangibles. These results support the effectiveness and practicality of TBFAs to assess behavioral function and the resulting behavioral approaches to reduce challenging and disruptive behavior in publicly funded school settings.

Davis et al. (2013) examined the effects of a weighted vest on aggression and SIB in young boy with ASD. The effects of the weighted vest were examined during a FA utilizing an

ABAB design with an embedded multi-element design. This consisted of two phases each of no vest (A) and weighted vest (B). Within each phase, alternating conditions of a FA were conducted. The FA was conducted in a manner similar to that described by Iwata et al. (1982; 1994), consisting of five conditions. The occurrences of CB (i.e. biting) were compared across phases in which a weighted vest was worn or not worn. Findings revealed that the weighted vest had no effect on levels of aggression and SIB. Undifferentiated responding occurred across conditions of the FA, which suggested that SIB was maintained by automatic reinforcement.

Healey, Ahearn, Graff, and Libby (2001) investigated chronic SIB utilizing an experimental FA conducted with a 21-year-old male with ASD and ID. A multi-element FA was conducted in which several conditions alternated rapidly (attention, edible, demand, alone, play, sensory). Based on the results of the multi-element phase and the blocked assessment phases, a sensory condition was introduced to further assess whether SIB was maintained by automatic reinforcement. These results suggested that SIB was unrelated to programmed positive or negative reinforcement contingencies. The behavior appeared to be automatically reinforced; it decreased when access to alternative sensory stimuli was provided. Findings of this study related to those of Thompson and Iwata (2007) as they found that three participants' SIB was maintained by automatic reinforcement. Similar findings were found by Scheithauer, Mevers, Call, and Shrewsbury (2017) as results of the FA suggested that SIB was maintained by automatic reinforcement alone for one participant and both automatic reinforcement and physical attention for the other participant. These results were used to create function-based treatments for SIB that were successfully generalized across settings and caregivers.

O'Reilly, Sigafoos, Lancioni, Edishinha, and Andrews (2005) examined levels of engagement and SIB with a child with severe ASD using a FA methodology within a classroom

setting. A series of four FAs were conducted to identify contexts in which SIB occurred in the 12 year-old boy's classroom (i.e. attention, no interaction, demand, and play). SIB was associated with academic demands and SIB rarely occurred during play and no interaction conditions of the FA. The results of an analogue FA were used to determine an individualized schedule for a child with severe ASD who exhibited severe SIB. The FA revealed that SIB did not occur under a specific schedule of activities, therefore the schedule of activities in the child's classroom curriculum was modified based on these results. This modified curriculum resulted in considerable reductions in SIB and increases in classroom engagement.

Vollmer, Iwata, Zarcone, Smith, and Mazaleski (1993) investigated differential reinforcement of other behavior (DRO) and non-contingent reinforcement (NCR) in three females with developmental disabilities with severe SIB. A series of conditions were presented in multi-element format to each participant (i.e. alone, attention, demand and play). Results from the FA showed that, for each of the three participants, SIB was differentially sensitive to attention as a positive reinforcer. Findings revealed that both DRO and NCR can be effective treatment procedures for SIB that is maintained by socially mediated positive reinforcement. In contrast, Vollmer, Marcus and LeBlanc (1994) examined interventions for three children with severe disabilities and their findings revealed that FA results were inconclusive.

Iwata et al. (1994) focused on the identification of variables associated with the occurrence of SIB. SIB was relatively high during the alone condition in four of the participants, suggesting a form of self-stimulation as a motivational variable. Lower levels of SIB was associated with the control condition. The authors suggested that their results provide empirical evidence that SIB may be a function of different sources of reinforcement. Iwata et al. (1994) summarized 152 single-subject analyses of the reinforcing functions of SIB. Their findings

revealed that social negative reinforcement accounted for the largest proportion of the sample at 38.1%. Social positive reinforcement accounted for 26.3% of cases, followed closely by automatic reinforcement at 25.7%. Overall, these studies suggest that SIB could be maintained by multiple functions.

3.3 Stereotypy

Stereotypy is defined as repetitive, invariant, and contextually inappropriate behavior that persists in the absence of socially mediated reinforcement (Rapp & Vollmer, 2005). Common examples of stereotypy are hand flapping, body rocking, toe walking, spinning objects, sniffing, immediate and delayed echolalia and running objects across one's peripheral vision (Schreibman, Heyser, & Stahmer, 1999).

FA methodologies are often used to identify the maintaining functions of vocal stereotypy. Rapp, Patel, Ghezzi, O'Flaherty, and Titterington (2009) used FA to identify the maintaining functions of vocal stereotypy exhibited by three children with ASD. Vocal stereotypy was operationally defined as a vocal response that was either not appropriate to the context, indistinguishable or repetitive. The FA included no-interaction, attention and demand as experimental conditions and free play as control condition. Results suggested that vocal stereotypy exhibited by all participants was maintained by non-social reinforcement and a punishment procedure was used to establish stimulus control to decrease the occurrences of vocal stereotypy. Asmus, Franzese, Conroy, and Dozier (2003) conducted two FAs to identify the maintaining functions of vocal stereotypy in a 7-year-old boy with ASD. In both FAs the participant was exposed to the same 5-min conditions: attention, tangible and escape as experimental conditions and free play and alone as control conditions. However, in the first FA, reinforcement was delivered contingent on the occurrence of the target behaviors while in the

second analysis no consequence was delivered. Results from both FAs suggested that automatic reinforcement was the maintaining function of vocal stereotypy.

Belfiore et al. (2016) examined the role of a staff-delivered rule on the occurrence of stereotypic behavior of a 37-year-old female diagnosed with a severe ID. The participant engaged in repetitive, stereotypic touching of objects and people. A multi-element design was used to assess stereotypy variability across four experimental conditions: attention, rule & attention, rule only, and a control condition. Data of stereotypy behavior during all analogue FA sessions were collected using a 10 second partial interval recording procedure for continuous 15 minute sessions. The data from the FA yielded a percentage of intervals of stereotypy occurring within two consecutive 10 second intervals of a controlled environmental event. Results from this analysis showed that the percentage of intervals in which stereotypy behavior occurred was greater within the experimental condition where a rule statement was embedded with contingent attention.

Previous research has identified that stereotypy is most commonly served by automatic reinforcement functions. Automatic reinforcement is reinforcement that is not mediated by the deliberate action of another person (Vaughan & Michael, 1982). Wilke et al. (2012) used indirect FAs across 53 children and adolescents with ASD and found that 90% of the stereotypic behavior appeared to be maintained by automatic reinforcement. Watkins and Rapp (2013) also employed indirect functional assessment and found similar results whereby six participants diagnosed with ASD presented with stereotypy behavior that was maintained by automatic reinforcement. Similar results using experimental FAs procedures have also been found in the literature (Athens, Vollmer, Sloman, & Pipkin, 2008; Britton, Carr, Landaburu, & Romick, 2002;

Brusa & Richman, 2008, Doughty et al., 2007; Neely, Rispoli, Gerow, & Ninci, 2015; Rapp, Patel, Ghezzi, O'Flaherty, & Titterington, 2009; Wilder, Kellum, & Carr, 2000).

3.4 Bizarre Speech

Bizarre or maladaptive speech is common across both individuals with developmental disabilities and psychiatric populations (Mace & Lalli, 1991). There have only been two experimental studies that were performed that analyze the connection between maladaptive speech and reinforcement contingencies with individuals with schizophrenia and ASD (Mace & Lalli, 1991; Durand & Crimins, 1988). Mace and Lalli (1991) identified contingencies made from bizarre statements. The participant was a 46 year-old adult male, Mitch, with moderate ID and a history of epilepsy. Due to his maladaptive speech behavior, he had trouble initiating conversations, he would often self-talk, and say unrelated statements in conversation (Mace & Lalli, 1991). During a food preparation task, Mitch made attention-oriented comments. The researchers investigated how Mitch acted within a group setting, being interrupted and uninterrupted by the experimenter. Mitch's interactions were recorded and placed into a number of categories such as interaction, no interaction, task, and alone, and their subsequent events; social disapproval, no staff/client response, positive interaction, tangible reinforcement, and task disengagement (Mace & Lalli, 1991).

The data from the first experiment backed the two hypotheses presented, that was supported by the findings from Mitch's maladaptive speech; bizarre speech was positively reinforced by attention, but it was negatively reinforced by escape-task related demands (Mace & Lalli, 1991). The data from the second experiment showed that manipulation of the consequences of Mitch's bizarre speech culminated a large level of maladaptive vocalizations during the social disapproval subsequent event (Mace & Lalli, 1991). It was determined from

this data that Mitch's behavior and speech was provoked by others at his group home (Mace & Lalli, 1991).

3.5 Skin Picking

Skin picking is a common SIB, among those with developmental disabilities. Skin picking can be categorized as different repetitive manners. Although it seems relatively mundane, skin picking can pose a lot of health problems. Of a survey conducted by Wilhelm et al. (2003) about skin picking; over 90% of participants recorded that they experienced tissue damage, 61% recorded infections, and 45% of participants recorded deep craters in the skin as a result of their skin picking. As it is normally designated as a relatively rare behavior, with the pervasiveness of skin picking only being seen in about 2-4 percent of those with ASD, there are little to no effective treatment approaches (Griesemer, 1978; Gupta, Gupta, and Haberman, 1987).

A competing stimulus assessment and FA was used in both phases of the study to identify effective types of treatments to be delivered in various formats to those with ASD. It investigated which format of item delivery was to reduce skin picking the most using noncontingent access to items in session durations, such as different types of toys (Clay et al., 2018). Molly was a 12-year-old girl diagnosed with ASD who also exhibited covert SIB, skin picking specifically that would occur daily (Clay et al., 2018). The FA was modeled on the FA performed by Iwata et al. (1982; 1994). The first phase focused specifically on the FAs used in the study. A multi-element design was implemented in the form of a five-minute session where Molly was introduced to five different conditions: ignore, play, attention, escape, or play with no items (Clay et al., 2018). These sessions relied on Molly's engagement with the stimulus provided, or not provided by a therapist. This would either result in a SIB or would prevent the

behavior from occurring. The phases that followed were competing stimulus assessment and treatment evaluation, respectively. It was determined that Molly's SIB was maintained by automatic reinforcement and not socially mediated reinforcement (Clay et al., 2018). Non-contingent access to a singular item provided to be the most effective way of decreasing skin picking. Play items that were removed during the five-minute sessions showed an 11% increase in SIB (Clay et al., 2018). When the reversal design was introduced and play items were reintroduced into the room, skin picking decreased to a 2.5% mean interval, from a previous 14% (Clay et al., 2018). A positive automatic function for SIB for Molly (Clay et al, 2018). Most importantly, out of the toys provided, a BopIt© had the highest mean percent interval of engagement, and the lowest mean percent interval for SIB (Clay et al., 2018). The introduction of competing stimuli allowed for Molly's SIB, or her skin picking, to decrease.

3.6 Hand Mouthing

Hand mouthing is a type of stereotypical behavior and is categorized by inserting the hand, or a finger, past the plane of the lips. The behavior continues by proceeding to bite or suck on the body part or allowing it to remain with the mouth agape for long durations of time (Cannella et al., 2006). This behavior can bring harm to the individual, creating such problems as scarring, skin breakage, and even a hematoma; and it also allows for maladaptive social behavior.

Cannella-Malone and O'Reilly (2014) focused on five individuals with ID and hand mouthing. All participants were 21 or younger and presented with different disorders such as epilepsy, speech disorders, and ASD. The study had two purposes, both derived from a previous paper by Goh et al. (1995). Cannella-Malone and O'Reilly (2014) investigated reinforcement properties to determine if sensory stimulation would automatically maintain hand mouthing, and

to examine if other function-matched substitutes would produce reinforcement, such as a switch or button (Cannella-Malone & O'Reilly, 2014; Goh et al., 1995). An analogue FA was performed within the study to confirm that hand mouthing was maintained by automatic reinforcement (Cannella-Malone & O'Reilly, 2014). Toys, vibrating items, and switches/buttons were provided for the five participants to play with during the 15-minute observation sessions without consequence. When a preferred item was obtained that could be manipulated by the hands, hand mouthing decreased extensively. It was determined that this was a pre-dominant reinforcer. However, for those who were provided with substitute reinforcements, the stimulus was not preferred. Automatically maintained behaviors can be influenced by items that match sensory contingencies, but by using pre-intervention, researchers would be able to decrease the automatic maladaptive behavior by outlining an intervention tailored to the participant.

The relationship between Gastro-Esophageal Reflux Disorder (GERD) and hand mouthing was the primary focus of the following research. In Study 1 of Swender, Matson, Mayville, Gonzalez, and McDowell (2006), there were 60 participants in total; 30 who engaged in frequent hand mouthing and 30 who did not. Participants were matched with each other within one year of age, level of disability, and gender to keep a control. The only aspect that differed was the diagnosis; a positive diagnosis referred to a participant who had been diagnosed with GERD by a physician. After analyzation of the data, it was determined that GERD occurred in those who hand mouthed more frequently than those who did not (Swender et al., 2006). In Study 2 of Swender et al. (2006), the same 30 participants who frequently hand mouthed participated again. The QABF was used, where responses are divided into tangible, attention, escape, physical, and non-social (Paclawskj et al., 2000). It was found by researchers that those who hand mouthed scored highest in the non-social subscale of the QABF than the

other subscales with no other significant results (Swender et al., 2006). Those who participated in the autonomous maladaptive behavior of hand mouthing had an increased chance, by 36.7%, of receiving a GERD diagnosis and being categorized as non-social than other possible subscales.

3.7 Feeding Problems

Feeding problems are defined as the inability or refusal to orally consume adequate nutritional, hydration or caloric intake in the amounts required to thrive, results in negative nutritional, developmental, social and psychological consequences (Babbitt et al., 1994). Feeding problems have been identified as a common issue among individuals with ASD and other populations (Leader, Tuohy, Chen, Mannion, & Gilroy, 2020).

Sprague et al. (1998) conducted a FA of feeding problems in a 13-year-old female with severe ID and cerebral palsy. The participant engaged in high levels of spitting and whining following bites of food. A preliminary functional assessment was conducted by interviewing the family and classroom staff regarding the participant's eating problems at home and at school. Based on these observations, two separate FAs were conducted in a lunchtime setting to detect the influence of trainer attention and pace of eating. In the first analysis, the participant was assessed under two eating conditions to detect the differential effect of trainer attention for CB versus a no attention condition. Results from this analysis identified attention was not a maintaining factor. A second analysis examined the reinforcing effects of food on trainer paced eating, and student paced eating (SR spoon grasping) and tangible (food) reinforcement for CB. Results from this analysis identified that CB was highest when access to food was contingent on CB and lowest when contingent on the participant grasping the spoon. The intervention of

reinforcement for spoon grasping and a 10 second removal of food following CB resulted in reduction of spitting and whining during meals.

Girolami and Scotti (2001) compared the results of the analogue FA to those with less direct methods of assessments including interviews, questionnaires and descriptive observations with three children with a history of mealtime behavior problems. Participants were a 32-month-old female with congenital bilateral perisylvian syndrome, a 32-month-old female with Down Syndrome and a 28-month-old male. The CB exhibited included pushing or slapping away the hand of the feeder, throwing food, crying and screaming excessively during mealtimes and refusing to eat food. A standard analogue FA was conducted to determine each child's preferred and non-preferred foods. The FA conditions included attention, demand, tangible-toy, tangible-food, alone and control. Prior to this, the clinician interviewed the parents of the children with the FA interview Form (FAIF; O'Neill, Horner, Albin, Storey, & Sprague, 1990), and had parents complete the Motivation Assessment Scale (MAS; Durand & Crimmins, 1988). Direct observation by the clinician (i.e., A-B-C observations at a mealtime setting) and a food preference assessment were then conducted. Results from the analogue FA indicated that the primary function of food refusal for the first two participants was escape from food presentation and mealtime demands. For the third participant, contingent access to toys and attention were the maintaining variables. These analogue results were highly consistent with other forms of functional assessment data, including interviews, questionnaires, and direct observations, demonstrating the feasibility, and concurrent validity, of conducting an analogue FA of mealtime behaviors.

Wacker et al. (1996) investigated the effects meal schedule and quantity had on displays of CB in two children with developmental disabilities. The first participant was a 2 years, 2

months old male, diagnosed with severe to profound developmental delays. He had a visual impairment, was not ambulatory, and displayed severe SIB in the form of hand biting, eye gouging, and head banging. The primary behavior of concern was eye gouging, which had caused retinal damage and severe bruising around both eyes. The second participant, a 7 years 6 months old female, was diagnosed with Rett-like syndrome and severe ID. She was non-ambulatory and had severe SIB and feeding problems. She also displayed SIB in the form of hand biting and continuous stereotypy in the form of placing her hands on her face.

For the first participant, a brief FA that alternated contingent attention and free play conditions was conducted within a multi-element design. In order to assess the effects of meal schedule on his behavior, high and low levels of non-contingent parent attention were alternated within a multi-element design, whereby the analysis was conducted under two conditions, before his meal and after his meal. For the second participant, contingent attention, free play and alone conditions were counterbalanced three times each within a multi-element design. In order to assess the quantity of food eaten on her behavior, two phases were conducted using a reversal design. Phase 1 comprised of eating three meals each day compared to eating six meals each day to evaluate the effects of food quantity on SIB and crying during free-play conditions. Phase 2 consisted of comparing the effects of eating six meals to no meals on SIB and crying behavior. Free-play was replaced with a DRO treatment package in which attention and toys were provided if the participant did not engage in SIB for 5 seconds. Phase 3 included four follow-up probes, two at 4 months and another two at 6 months.

For the first participant, results suggested that SIB, which was identified by the FA as being maintained by attention, was also correlated with the schedule of meals. Differences in SIB occurred across the two social conditions, but only after a meal. Crying, however, was

correlated almost exclusively with meal schedule and was not associated with the social conditions. Crying occurred frequently before a meal but rarely after a meal, irrespective of high or low levels of attention.

Based on the FA for the second participant, results suggested that SIB was not maintained by social reinforcement. Results for Phase 1 of the assessment indicated that SIB and crying occurred more often during the three-meal sequence (Conditions 1 and 3) than during the six-meal sequence (Conditions 2 and 4) in free-play sessions. Crying and SIB appeared to be correlated. Results from Phase 2 suggested that crying and SIB were related to gastric discomfort, rather than to food satiation only. When this was evaluated further, both SIB and crying occurred more frequently during the no-meal condition than during the six-meal condition. Results from the follow-up probes indicated that SIB occurred at low frequencies and showed a decreasing trend over time and crying also occurred infrequently.

3.8 Elopement

Elopement is when an individual runs away from or leaves a supervised area (Boyle & Adamson, 2017), which can be a dangerous and challenging problem. Elopement compromises the safety of people with disabilities at disproportionately high rates (Phillips, Briggs, Fisher, & Greer, 2018). Neidert, Iwata, Dempsey, and Thomason-Sassi (2013) conducted TBFAs in which latency was the index of elopement for two students. Participants were two males aged 21 and 22-years-old who had a profound ID diagnosis. The FA consisted of three test conditions – ignore, attention, demand, as well as a control condition. A reversal design was used for Participant 1's assessment where he was exposed to each condition until stable levels of responding were observed. A pairwise test-control design was used for Participant 2's assessment, where test conditions were presented sequentially, as in a reversal design, but were

altered with the control condition within each phase in a multi-element design. Elopement was maintained by social positive reinforcement as it continued to occur in the attention condition, in which the therapist provided contingent attention but did not allow the behavior to occur.

Boyle, Keenan, Forck, and Curtis (2019) conducted a FA on the elopement of a child and evaluated a treatment that did not include blocking. The participant was a 6 year-old girl with ASD. A multi-element FA was conducted using the following conditions; demand, attention, play, and ignore. This study entailed a FA of elopement and successfully decreased elopement through the use of a rule and without the need for blocking. Elopement during the FA occurred in all test conditions which suggests that it was maintained by multiple contingencies (escape and attention), perhaps including automatic reinforcement. These findings are comparable to those of Piazza et al. (1997), as they conducted a multi-element FAs on three children who displayed elopement and found that behavior was maintained by a variety of functions.

Lang et al. (2010) assessed the elopement of a 4-year-old child with Asperger syndrome using a FA. This study evaluated the influence of assessment setting on the analysis and treatment of elopement. Separate FAs and corresponding interventions were compared in two school settings; classroom and resource room. Elopement was assessed during 5-min individual sessions across play, attention, escape and tangible conditions. FAs indicated that elopement was maintained by access to attention in the resource room and obtaining a preferred activity in the classroom. Attention and tangible-based interventions were compared in an alternating treatments design in both settings. These results replicated previous research that suggests that setting can influence FA results and that such an influence is relevant to intervention design.

3.9 Non-Compliance and Disruptive Behavior

Populations and Problems Evaluated with Functional Assessment

Non-compliance (NC) is defined as a passive maladaptive behavior when it involves refusing to follow an instruction or direction within a specific time frame, and as an active maladaptive behavior when it involves behaviors such as crying, aggression or self-injurious (Ekas, McDonald, Pruitt, & Messinger, 2017). Factors that can interfere with the function of NC are communication difficulties, lack of comprehension, lack of motivation or high response effort (Kleinsinger, 2003). Disruptive behavior (DB) is defined as a maladaptive behavior that includes angry outbursts, irritability, and oppositional, noncompliant, and aggressive behaviors (Petrovic, & Scholl, 2018). Examples of disruptive behaviors include throwing materials, leaving the activity area, screaming, kicking, flopping, crying and property destruction (Waters, Lerman, & Hovanetz, 2009).

Several studies showed the effectiveness of FAs and its variations in identifying the maintaining functions of NC and DB in the form of aggression and property destruction. Reed, Ringdahl, Wacker, Barretto, and Andelman (2005) used FA with attention, tangibles escape and play conditions with two children aged 8 and 10 years who were referred for their CB. FA results showed that CB was maintained by escape from demand. The function-based intervention consisted of differential negative reinforcement of alternative behavior (DNRA) which was delivered alone and in combination with lean and dense fixed-time schedules of reinforcement on CB and appropriate behavior.

Waters, Lerman, and Hovanetz (2009) used brief FA with two six-year-old boys with ASD who were reported to engage in transition DB in multiple settings. The brief FAs consisted of three different transitions including pre-transition, the transition itself and post transition activity. Results of the FA showed that the DB was maintained by avoidance of non-preferred activities and access to preferred activities. As part of the function-based intervention, results

showed that DRO was effective in reducing the occurrences of CB with or without the presence of visual schedules.

Schmidt, Shanholtzer, Mezhoudi, Scherbak, and Kahng (2014b) investigated the utility of BFA with a 14-year-old boy with PDD-NOS and mild ID. Target behaviors were operationally defined as physical aggression, verbal aggression and disruption. The study consisted of three phases: FA, brief experimental analysis of different intervention procedures and an extended treatment evaluation. Results suggested that the highest occurrences of CB occurred during subtraction. In the second phase, a brief experimental analysis was conducted to investigate the effectiveness of five procedures on reducing the occurrences of CB and increase compliance during subtraction problems. Each condition lasted 5 minutes and involved: cover-copy-compare, DRA for compliance, DRA for appropriate communication, the use of choices and a number line. Results showed when the participant used a number line no CB was emitted while he exhibited high rates of problems behavior across all the other conditions. In the third phase, stimulus fading and differential reinforcement procedures were implemented to promote independence from the number line while attempting to maintain low rates of CB.

Studies also investigated whether the setting in which a FA is conducted influences the results and incongruent results have been found. Lang et al. (2008) conducted two FAs with a 12-year-old girl and a 7-year-old girl with ASD who were referred for the frequency and intensity of the CB exhibited in school. For both participants, the target behaviors under analysis were operationally defined as dropping to the floor, aggression, elopement, and head hitting. Two FAs were conducted for each participant to investigate the maintaining functions of the CB in an assessment room and in the classroom. Both FAs included the same 5-min conditions: attention and escape with play as control condition. For one participant the two FAs identified

the same functions of attention and escape from demand in both settings. For the second participant, the FA conducted in the classroom did not provide clear results while the FA conducted in the assessment room identified attention and escape as maintaining functions. The results showed a discrepancy between settings suggesting that if idiosyncratic controlling stimuli are absent in the setting the analysis may fail to yield conclusive results.

Other studies suggested a good applicability of FA with ID across different settings while showing high variability in the functions identified. Cooper et al. (1992) conducted a two-study analysis to evaluate two slightly different variations of experimental FA in the assessment of CB in an outpatient clinic and classroom. The purpose was to identify variables to facilitate appropriate behavior. In the first study, participants were 10 children between the ages of 6 and 14 years in an outpatient clinic while in the second study participants were two 8 and 9-year-old boys with mild range of ID and histories of non-compliant behaviors in class. The target behaviors were problems with conduct such as noncompliance, aggression and opposition at home or school. Slightly different brief FAs were conducted in the two studies but with both the same conditions: task preference, task demand and adult attention as experimental conditions in an outpatient clinic and school setting, respectively. Results of the first study showed that one child engaged in appropriate behavior during task preference, three children showed improved behavior when changes were made to the task demand condition and four showed improved behavior after changes were made in the adult attention conditions.

Studies also showed the effectiveness of functional behavioral assessment (FBA) in identifying the maintaining functions of NC and DB. Luiselli and Sobezenski (2017) used FBA to identify the maintaining functions of frequency of bathroom requests and the duration of bathroom visits of a 22-year-old woman with ASD and ID. The FBA included: direct

observation, review of the baseline data and FA interviews with the participant's care providers. The results of FBA suggested that the CB was maintained by negative reinforcement in the form of escape from demand. The intervention included activity scheduling and cuing, demand-fading and cuing and duration-fading. The function-based intervention was effective in decreasing both frequency and duration of the bathroom visits.

Reese, Richman, Belmont, and Morse (2005) conducted functional behavioral assessment interviews to investigate the maintaining functions of DB. Parents of 23 children with ASD and 23 typically developing children completed the assessment process. The Functional Assessment Interview (O'Neill et al., 1997) was conducted with caregivers in which they were asked to define the disruptive behaviors and describe the situations in which they occurred. Results suggested that escape from demand, positive reinforcement in the form of social attention and tangibles were the maintaining functions of disruptive behaviors for typically developing children and girls with ASD. However, disruptive behaviors displayed by boys with ASD were found to be maintained by escape from demands that interfere with repetitive behavior, access to tangibles used in repetitive routines or to avoid idiosyncratically aversive stimuli. The findings suggested that disruptive behaviors occur with high variability between functions and populations, and suggested the importance of considering the role of gender in disorders when conducting an FBA.

3.10 Multiple Typographies of Problem Behavior

Matson et al. (2011) reviewed 173 studies that used FA as a method in addressing problem behaviors. They found that SIB and aggression tended to be the most studied forms of CB, and where multiple typographies of behavior were assessed with two or three being the most common. Rojahn, Zaja, Turygin, Moore, and Van Ingen (2012) conducted a FA which

investigated whether behavior categories or behavior topographies determine behavioral function. Participants consisted of 115 adults with ID and a history of CB. SIB, stereotyped and aggressive behaviors were the focus in this study. The QABF was used to establish the functions of each CB. The results of this study showed that aggression, SIB and stereotypy tended to be maintained by negative social reinforcement. SIB and stereotypy were shown to be maintained by automatic positive reinforcement. Behavior categories were found to be far more determining of behavioral function than behavior topographies.

Bell and Fahmie (2018) emphasized using FA to analyze multiple topographies of CB by examining the function of primary behavioral topographies alongside topographies that would be viewed as secondary or less influential. Participants consisted of three young children under the age of six with ASD. A primary topography was identified for each child (aggression, chin-hitting and biting) alongside less extreme secondary topographies (vocal disruptions and stereotypy). A visual analysis was carried out to predict the function of secondary topographies of CB and was followed by a FA consisting of ignore, attention, play, escape and tangible conditions to test the accuracy of predictions. Results showed a high consistency between the predictions of the functions of CB and the results of the FA. There was an indication that aggression tended to be maintained by social functions with vocal disruptions being sensitive to escape. Stereotypy tended to be maintained by automatic reinforcement in one participant and social reinforcement in another. Biting was maintained by escape and access to tangibles. This study provided support for the use of a FA to analyze both primary and secondary topographies of CB and may be useful for clinicians who are under time restraints.

Call et al. (2017) presented the issue that often carrying out FAs of various topographies of CB can be controversial as it could potentially cause interaction effects resulting in an

increase of CB as opposed to being beneficial. Call et al. (2017) investigated whether conducting a FA of CB may lead to an increase in the behavior outside of a FA setting. Participants consisted of six children chosen from a day-treatment clinic where they had been admitted due to their history of CB. Target CB consisted of aggression, disruptive behaviors and SIB. CB were assessed both within and outside of the FA setting under escape, attention and tangible conditions. The functions of each behavior varied per person between escape, access to tangibles and attention. The results were found to be idiosyncratic with CB being both increased, decreased and unaffected outside of the FA setting depending on the individual.

Following on from the hypothesis that conducting a FA of CB may cause carry-over effects, Davis, Durand, Fuentes, Dacus, and Blenden (2014) investigated the effect that a school-based FA may have on subsequent classroom behavior. They investigated five children all diagnosed with a disability, who had been identified through teacher reports as frequently displaying multiple topographies of CB. Each child displayed at least one CB in the forms of aggression, screaming, verbal protest, throwing and pinching. The procedure involved a FA of CB in an academic setting followed by observations of subsequent behavior. The FA involved four conditions which lasted ten minutes each; attention, tangible, demand and play. Results found that CB in participants both immediately after the analysis and in the following days showed no significant increase. This provides evidence that FA procedures do not negatively influence subsequent CB in children and supports the use of FAs in school-settings to assess and treat behavior.

Derby et al. (2000) investigated the idea that individuals often display multiple topographies of CB that may each hold varying functions. They present an alternative approach to understanding the multiple topographies of an individual's behavior that does not involve

carrying out individual FAs for each. Their method involved conducting a single FA of numerous CB and analyzing the results as part of an aggregated graph, also consisting of separate topographies. Participants were 48 individuals with severe ID that had a history of multiple topographies of severe CB. Target behaviors consisted of SIB, aggression, destruction and disruptive behaviors. FA sessions consisted of multiple conditions in which behavior was assessed; escape, attention, alone, tangible and a control condition. The results of the FA suggested that often individuals display numerous topographies of CB and these may be maintained by multiple contingencies. The authors acknowledged that this method of analyzing behavioral functions may not be as definitive as conducting several individual analyses however the purpose was to reduce time taken for clinicians using FAs to analyze multiple topographies of CB.

Derby et al. (1994) investigated the idea that separate typographies of behavior are maintained by the same reinforcing factors. Their methods involved two brief and two extended FAs to understand the functions of distinct topographies of CB. Participants for the extended analyses consisted of a 23-year-old man and a six-year-old girl with IDs and histories of CB. Participants for the brief analyses were a 28-year-old woman and a 12-year-old boy with IDs. Target behaviors were aggression, SIB and stereotypy. Conditions for the FAs were divided attention, non-contingent, alone, high sensory, tangible, escape and social attention. Behaviors were analyzed both together and separately. An important finding was found during the brief FA where functions of a behavior were not identified when analyzed as part of an aggregate, whereas when each target behavior was plotted separately more functions were identified. This study provided an important contribution to the area of FA in that it emphasized the importance

of being wary of results when viewing an aggregate analysis and shows the efficiency of viewing target behaviors separately in order to get more accurate perspectives on the function of CB.

Matson and Boisjoli (2007) discussed the difficulties presented to researchers when attempting to identify a single maintaining factor of CB in individuals with ID. They emphasized that often functions of an individual's CB can be manifold and referred to the lack of studies investigating the possibility of multiple factors being present. The QABF was implemented by researchers in order to identify the maintaining factors of CB in 88 participants with an ID. Each participant had a history of SIBs and/or aggression. The authors found that in the vast majority of cases the CB of individuals with an ID was maintained by multiple functions as opposed to a single definite function. They emphasized the importance of clinicians taking the possibility of multiple maintaining factors into account when using FA to understand CB.

Hagopian, Contrucci, Long, and Rush (2005) discussed the challenges that often occur when implementing functional communication training (FCT) in individuals with ID, following the use of FA in the identification of maintaining variables of CB. Researchers conducted a successful FA that effectively identified the functions of CB in three individuals diagnosed with ID and ASD. Participants were assessed under four experimental conditions; social attention, tangible, toy play and demand. Within the target CB of SIB, aggression and disruption, it was shown that attention and access to tangibles were the primary factors maintaining CB in participants. Results also showed that the presence of reinforcing stimuli allowed for an enhancement in FCT success and caused a significant reduction in CB. Hagopian, Fisher, Thibault-Sullivan, Acquisto, and LeBlanc (1998) incorporated the use of FCT as a treatment procedure following FA, basing their treatments on the functions of problem behavior identified from FAs of each of their participants.

Hagopian, Bruzek, Bowman, and Jennett (2007) carried out FAs on multiple topographies of CB of two participants diagnosed with ASD. CB of interest consisted of aggression, SIB and disruption. Analyses were carried out within multiple conditions; attention, tangible, demand, ignore and control. However, researchers found these to be inconclusive with a lack of CB being shown in 16 of 18 sessions. In order to overcome the inconclusive nature of these results a subsequent interruption analysis was conducted which involved conditions in which participants were interrupted from what they were doing and given 'do' or 'don't' demands to follow. Results showed that CB occurred at high rates during the interruption analysis indicating that an interruption and demand to engage in a different activity caused CB to occur more frequently. A second FA was administered to assess the CB of a 12-year-old girl with ASD and cerebral palsy who frequented aggressive behaviors. Little to no instances of CB were reported during the analysis. An interruption analysis taking the same form as previously described was then conducted with instances of aggressive behavior occurring frequently providing further evidence for interruption with a demand as a reinforcer for CB.

Wacker et al. (2013) investigated the efficiency of using telehealth when conducting FAs of CB in individuals with ASD. Participants consisted of 20 children diagnosed with ASD with a history of displaying multiple topographies of CB in the forms of aggression, SIB, disruption and/or destruction. FA procedures were implemented by the parents of participants, they had been trained by a qualified behavioral consultant via telehealth. The parents were brought into a room in a clinic and given information from a consultant via telehealth about the various conditions and situations that would be implemented during the FAs. Parents implemented the FAs within the conditions of attention, escape, tangibles and free-play based on the direction given by professionals via telehealth. The results showed that identification of the function of

CB was successful through telehealth communication with multiple functions being identified in each child. The results of this study are vital for the field of behavioral analysis as they support the practice of implementing FAs via telehealth meaning that distance, travel costs and other obstructing factors may be eliminated in the analysis and treatment of individuals with ID.

Patel, Carr, Kim, Robles, and Eastridge (2000) conducted FAs and other subsequent antecedent assessments in order to investigate the sensory qualities that maintain CB. Participants consisted of a ten-year-old male with ASD displaying rapid tongue movements and a 30-year-old male with ID, fetal alcohol syndrome and a history of SIB. An experimental FA consisting of various conditions (attention, escape/avoidance, no interaction and control) was conducted to identify the maintaining factors of the individuals' CB. Results showed that both behaviors were maintained independent of the social environment, showing that CB derived from automatic reinforcement. An antecedent assessment allowed interpretation of the nature of sensory stimuli maintaining CB in both participants. Results of this assessment indicated that rapid tongue movements were significantly reduced when auditory stimulation was present, suggesting audition as a maintaining factor. SIB was reduced in the presence of another form of tactile stimulation (forehead stimulation reduced head-banging). These results provided evidence supporting a strategy within FA that allowed for the assessment and treatment of various topographies of CB maintained by sensory stimulation.

Often when individuals with IDs display severe symptoms of CB it may be necessary for them to be kept under restraint to prevent them from injuring themselves or others. The use of restraint to reduce CB can be controversial and may cause stress or impose danger to those involved. Petursson and Eldivek (2018) discussed how it may often be difficult for carers to reduce time spent in restraint for individuals with disabilities due to the severity or continued

prevalence of CB. They suggested the use of FA and FCT as a method of reducing CB and the amount of time individuals need to be kept in restraint. A FA with multiple conditions (alone, demand, attention and control) was carried out to identify the functions behind precursors and CB in a 30-year-old man with ASD. The individual's aggressive behavior and SIB were the focus of assessment. Results showed that CB and precursors were highly prevalent in three of the demand conditions with CB appearing to be maintained by escape from demands. Following the FA, FCT was then implemented in order to teach the individual to use an alternative response and reduce CB.

Asmus et al. (1999) carried out a study with the purpose of recognizing an efficient method of identifying maintaining factors of CB in individuals with ID. Emphasis was placed on the investigation of the presence of task instructions as a maintaining factor of CB. Participants were three children diagnosed with an ID and had a history of multiple CB. The focus was different for each participant with a range of CB being assessed including aggression, SIB, disruption and destruction. The investigation was comprised of multiple phases all serving different functions. Phase 1 involved an analysis of antecedents in order to identify if task instructions precede instances of CB. Results from this phase showed that participants tended to display more CB following being presented with a task instruction and less instances when task instruction was not applied. Phase 2 involved investigating if the participants' behavior varied with changes in therapist, setting and task instruction. Results showed that regardless of who presented task instructions or what the context was participants consistently displayed CB, therefore, eliminating confounding variables and providing evidence for task instruction as a maintaining factor of CB. Phase 3 consisted of a FA of CB to determine if negative reinforcement was a maintaining factor. Results confirmed this hypothesis showing that for two

of the participants CB was maintained by negative reinforcement. This study provided significant results that add to the ever-growing research into the use of FA to analyze CB and the various functions that maintain this.

Karsh, Repp, Dahlquist, and Munk (1995) carried out FAs and multi-element interventions of CB in three individuals with ID. CB in participants included pinching, shouting, hitting, kicking, pulling other people's hair, falling on the floor and yelling. The FAs were carried out in a natural setting without any prescribed conditions in order to identify the function of each CB. Results showed that two of the three participants engaged in CB when given instructions to carry out a task, especially when this task required active as opposed to passive responses. The third participant showed CB during toileting, these proved to be almost non-existent in the absence of demands. Following these FAs, interventions for each participant were developed that were based off the premise that participant's CB are a means of escape from various environmental antecedents. These were proven to be successful with instances of CB reducing significantly in each child following intervention.

Marcus and Vollmer (1996) investigated the efficiency of non-contingent reinforcement based on FA in the reduction of CB. Participants consisted of three individuals with histories of CB seeking assessment and treatment. An initial brief FA was carried out to determine the function of CB in the form of aggression, SIB and disruption. The results of this showed that each participant's CB were maintained by positive reinforcement in the form of access to tangible items. Based on these FA results further experiments were carried out using non-contingent reinforcement and differential reinforcement of alternative behavior. Vollmer, Roane, Ringdahl, and Marcus (1999) used FA in conjunction with differential reinforcement of alternative behavior.

Marcus, Swanson, and Vollmer (2001) carried out a study that investigated the efficiency of parent training in reducing CB following FA. Participants consisted of four children with ID and histories of CB in the form of tantrums and/or aggression. A FA was implemented in order to identify the function of CB in participants to later allow for the development of treatment practices. Results of this analysis showed that for two of the participants CB occurred in the demand condition and was maintained by escape. Another participant showed that their CB was reinforced by contingent access to materials. The last participant displayed CB under multiple reinforcers, the dominant of these being during self-care activities and in instances when their mother's attention was elsewhere. The results of these FAs were then used to develop parental training procedures to allow parents to implement interventions and reduce CB.

O'Reilly, Lacioni, King, Lally, and Nic Dhomhnaill (2000) investigated the use of brief experimental functional assessments in identifying idiosyncratic variables associated with multiple CB. Participants consisted of two individuals with ID with target CB involving hitting, pinching, SIB and property destruction. Parents were trained to carry out the brief functional assessments which consisted of attention, demand, non-contingent attention and diverted attention conditions. Researchers found that CB for both participants were apparent in the diverted attention condition which consisted of participants' parents placing their attention onto a third person in the room. This provides evidence that CB can be maintained by low levels of or diverted parental attention.

O'Reilly et al. (2012) demonstrated how often FA is used as a first step in gathering information that is later used in the development and implementation of intervention practices. Their focus was on the efficiency of implementing an antecedent communication intervention to reduce CB. An initial FA was carried out in order to establish the function of CB in three

students with varying developmental disorders. Multiple topographies of behavior were examined including elopement, yelling, flopping, head slapping and biting. FA conditions consisted of demand, attention, tangible and play. Results of the FA indicated that for all three participants CB was maintained by access to tangible items. This was then used to develop antecedent communication interventions.

Peck et al. (1996) investigated choice-making behavior in children with developmental disabilities who had frequent CB. Their study consisted of multiple analyses serving various functions, one of which was a FA. Participants consisted of five children with developmental disabilities and different CB such as pulling medical tubes and leads connected to them, food refusal, SIB, tantrums, noncompliance and aggression. Each participant's FA consisted of different conditions to fit the needs and behaviors of each. Results showed that for three participants low-attention was a maintaining factor for CB, one participant showed high-demand as a maintaining factor and escape was identified as a maintaining factor in the final participant.

Piazza, Adelinis, Hanley, Goh, and Delia (2000) carried out a study with a purpose to extend on previous literature surrounding matched stimuli to three dissimilar CB. They wished to identify the effect of matched stimuli on automatically reinforced CB. A FA was conducted in order to identify if certain behaviors were maintained by automatic reinforcement. Participants were three individuals with a previous diagnosis of intellectual and behavioral disorders. The target behaviors of interest were dangerous behavior, saliva play and hand-mouthing. The FA consisted of multiple conditions; social attention, alone, toy play, demand and tangible. Results found that for the first participant, dangerous behavior was most frequent in the alone condition, the second participant showed increases of saliva play across all experimental conditions and the final participant also displayed increased levels of hand-mouthing across all conditions. The

results from all three participants suggest automatic reinforcement as a maintaining factor for CB.

Petursdottir, Esch, Sautter, and Stewart (2010) conducted an archival study which examined the different types of CB that occur and later conducted a FA of participants to determine functions of these behaviors. They wished to identify the primary topographies of CB and their functions. The initial assessment involved 174 participants with ID that were found to display a total of 536 CBs. The assessment showed that the most frequented behaviors were physical aggression, verbal aggression, noncompliance, property destruction, inappropriate verbal and social behavior, and SIB, in this order. A FA showed that for 53.2% of behaviors only a single maintaining function was identified and 41% seemed to show multiple functions. The most common function of CB identified was attention with aggression and SIB being the most common behaviors usually assessed.

Research studies have conducted FAs of multiple topographies of CB followed by extinction procedures (Richman, Wacker, Asmus, & Casey, 1998; Richman, Wacker, Asmus, Casey, & Andelman, 1999). Tucker, Sigafoos, and Bushell (1998) carried out a study involving FA of CB and suggested that analyzing the conditions associated with low rates of CB as well as those in which the behavior is maintained may be beneficial to treatment and intervention. Call, Pabico, and Lomas (2009) used FA to establish escape and attention as maintaining factors of CB in children with ID. Research has investigated different ways of establishing functions maintaining multiple topographies of CB and contrasted varying methods (Camp, Iwata, Hammond, & Bloom, 2009; Potoczak, Carr, & Michael, 2007).

3.11 Sleep Problems

McLay, France, Blampied, and Hunter (2019) conducted a study to investigate the effectiveness of functional behavioral assessment in identifying the maintaining functions of sleep problems in two children with ASD. The participants were a 4 and 10-year old nonverbal children who were referred for sleep problems by their parents and they both engaged in vocal stereotypy. The target behaviors under assessment for the first participant were frequent curtain calls and frequent and prolonged night-wakings. The CB exhibited by the second child were bedtime resistance, delayed sleep onset latency, frequent curtain calls, frequent and prolonged night-wakings and unwanted co-sleeping. The FBA consisted of a clinical interview with the parents, the Sleep Assessment Treatment Tool (SATT), sleep diaries and videosomnography (VSG). Results of the FBA showed that all target behaviors were maintained by at least two functions and it suggested that vocal stereotypy was an active component of the CB. In the intervention phase, function-based procedures were conducted in the attempt to decrease sleep problems. Results showed a decrease in the frequency and duration of the night-wakings for each participant and reduction of curtain calls for one of the children.

3.12 Happiness Behaviors

Although FA have been primarily been used to identify controlling environmental variables of CB, there is emerging literature suggesting the effectiveness of FA methodologies in identifying the maintaining functions of positive and prosocial behaviors. Thomas, Charlop, Lim, and Gumaer (2019) used TBFA to conduct a concurrent analysis of Happiness Behaviors (HB) and CB displayed by four children with ASD. HB included smiling, grinning and laughing while CB included yelling and screaming. The TBFA consisted of four conditions with a control and test trial per each condition: attention, escape, tangible, and ignore. The TBFA included contingent reinforcement for CB but no consequence was delivered contingent on HB. Overall

the results of the FA showed that CB occurred most often in the tangible test conditions while the respective tangible control conditions showed high percentages of HB, suggesting the pattern of an inverse relationship between CB and HB. However, results also showed that HB occurred at high percentages during the control attention conditions. The concurrent information gathered during the TBFA were used for subsequent treatment analyses that resulted effective in both decreasing CB and increasing HB. This study showed that using FA to identify controlling variables of HB in addition to CB can provide valuable information that could be masked or hidden with the use of a traditional FA. This study showed that measures of HB identified within FA can be used to support the implementation of effective behavioral interventions to decrease CB and increase appropriate and positive ones.

4. Conclusion

FA has widely been used to identify the environmental variables that predict and maintain severe CB displayed by individuals with developmental disorders. This chapter provided a descriptive analysis of how FA methodologies have been used to identify the maintaining functions of CB across different populations and topographies of behavior. The chapter focused on how the different types of FA methodologies are used across different developmental disorders and other populations, while taking into consideration the disorder, the topography of the CB, details on the FA methodology conducted, the maintaining functions of CB identified with it and the function-based interventions designed based on the FA results. In describing the use of FA, how different types of FA are used with specific topographies of behavior were discussed, outlining the different operational definitions of CB, characteristics of the populations displaying the CB, possible variables that should be taken into consideration

when assessing specific topographies of behavior, the FA methodologies used, and the functions identified with the FA.

Conducting a FA is the first crucial step to design an intervention that can successfully decrease CB in both clinical and outpatient settings. In addition, because every CB has a maintaining function, it is important that the functions identified through FA are used to design a function-based intervention that can functionally replace the CB with an appropriate one whenever the function allows the behavior to be replaced. Analyzing the use of FA across different populations and topographies allows clinicians to consider additional controlling variables that can add value and reliability to the use of FA while better guiding its implementation. Interventions designed and delivered following the implementation of FAs increase the likelihood that the intervention will be successful in decreasing CB while improving the quality of life of individuals.

Table 1.

Summary of Populations and Behaviors Evaluated with Functional Assessment

Authors	**Population**	***N***	**Age**	**Behavior**	**Type of Functional Assessment Used**	**Function Identified**
Asmus et al. (1999)	ID	3	P1: 3-year-old P2: 4-year-old P3: 5-year-old	P1: SIB, aggression, destruction and disruption. P2: Aggression, destruction and disruption. P3: SIB, aggression, destruction and disruption	Multi-element FA	Two participants showed negative reinforcement as a maintaining factor. In all participants, the presence of a task instruction increased problem behavior.
Asmus et al. (2003)	ASD & language impairment	1	7-year-old	CB1: Stereotypical vocalizations CB2: Disruptive behavior	Multi-element FA	CB1: Automatic reinforcement, CB2: Tangibles & Escape from demands
Athens et al. (2008)	ASD & Down Syndrome	1	11-year-old	Stereotypy including loud, repetitive, non-contextual verbalizations & repetitive, loud, unintelligible vocalizations	Multi-element FA	Automatic reinforcement

Belfiore et al. (2016)	Severe ID	1	37-year-old	Stereotypic touching of objects & people	Multi-element FA	Rule + attention
Bell & Fahmie (2018)	ASD	3	P1: 4-year-old P2: 4-year-old P3: 5-year-old	P1: Physical aggression (primary typography), vocal disruption and property destruction P2: Chin-hitting (primary typography) and motor stereotypy P3: Biting (primary typography)	Multi-element FA	P1: Escape & access to tangibles P2: Automatic reinforcement P3: Access to tangibles and social reinforcement
Boyle and Adamson (2017)	ASD	1	6-year-old	Elopement	An indirect assessment using the Functional Analysis Screening Tool (FAST) & Multi-element FA	Multiple contingencies, possibly including automatic reinforcement
Britton et al. (2002)	ID & ASD	3	P1: 28-year-old P2: 26-year-old P3: 8-year-old	P1: Head rocking P2: Face rubbing P3: Repetitive hand movements	Multi-element FA	Automatic reinforcement
Brusa & Richman (2008)	ASD	1	8-year-old	Stereotypy behavior including	Multi-element FA	Automatic reinforcement

				shaking objects, & string play		
Call et al. (2005)	P1: Genetic disorder resulting in ID & seizure disorder P2: Disruptive behavior disorder	2	P1: 17-year-old P2: 2-year 8-month-old	P1: Aggressive and destructive behavior in the form of throwing objects. P2: Aggressive behavior	Multi-element FA	P1: Demands & diverted attention/contingent attention P2: Demands & restricted tangibles item/contingent escape conditions
Call et al. (2017)	Aggression, disruptive behavior, SIB, dropping, hair pulling, pica, & spitting	6	Ranged between 5-13-years-old	Aggression, disruptive behavior, SIB, dropping, hair pulling, pica, & spitting.	Descriptive FA	Escape, access to tangibles, & attention.
Call et al. (2009)	P1: ASD P2: Cerebral palsy & ID	2	P1: 6-year-old P2: 14-year-old	P1: Aggression, SIB, & disruptive behavior P2: Aggression, SIB, disruptive behavior, & swearing	Multi-Element FA	P1: Attention & escape P2: Escape
Camp et al. (2009)	Developmental Disabilities	7	16-54-years-old	SIB & property destruction	Multi-Element FA	Automatic reinforcement, escape, & attention
Canella et al. (2006)	ID	33	1-4-years-old	Hand mouthing	Intervention & FA	Automatic reinforcement
Canella-Malone & O'Reilly (2014)	ID, Rett Syndrome, ASD, Cerebral Palsy	5	P1: 6-year-old P2:12-year-old	Hand Mouthing	Multi-Element FA	Automatic Reinforcement

			P3:11-year-old P4: 19-year-old P5: 21-year-old			
Cariveau et al. (2019)	ASD & AD/HD	1	8-year-old	Aggressive behavior	Multi-element FA	Escape from demands & termination of interruptions to repetitive behavior
Carr & Carlson (1993)	ASD	3	P1: 18-year-old P2: 17-year-old P3: 16-year-old	Aggression, property destruction, SIB, & tantrum behavior	FBA	Escape from demands & tangibles
Chung & Cannella-Malone (2010)	P1: Multiple disabilities P2: Multiple disabilities P3: ASD & ID P4: Multiple disabilities	4	P1: 11-year-old P2: 14-year-old P3: 11-year-old P4: 16-year-old	P1: Stereotypy behavior including chair scratching P2: Stereotypy behavior including shirt biting P3: Stereotypy behavior including putting one or both of her hands into her pants, between her pants and her diaper	Multi-element FA & a pre-session access analysis, & a treatment analysis	Automatic Reinforcement

				P4: Stereotypy behavior including teeth tapping & knuckle clapping		
Clay et al. (2018)	ASD	1	12-year-old	Skin Picking	CSA, reverse FA, & multi-element FA	Automatic reinforcement
Cooper et al. (1992)	AD/HD, Anxiety disorder, conduct disorder, Developmental motor dyscoordination, Developmental reading and language disorders, learning disorders, Mild ID, Mixed developmental disorder, & Oppositional Defiant Disorder (ODD)	10	Ranged between 6-14-years-old	Noncompliance, aggression, & opposition	BFA	Escape from demands, Tangibles & Adult attention
Davis et al. (2013)	ASD	1	9-year-old	Aggression & SIB	Multi-element design embedded within an ABAB design	Automatic reinforcement
Davis et al. (2014)	ID	5	Ranged between 6-10-years-old	SIB, aggression, destruction	Multi-element FA	Attention, escape from demands & access to tangibles

DeLeon et al. (2003)	Mental problems, cerebral palsy, & visual impairments	1	14-year-old	SIB, aggression, & disruptive behavior	Multi-element FA	Wheelchair movement
Delgado-Casas et al. (2014)	P1: ASD & profound ID P2: ASD & profound ID P3: ASD & severe ID P4: Down Syndrome, profound ID, & Obsessive Compulsive Disorder (OCD) traits	4	P1: 42-year-old P2: 33-year-old P3: 43 -year-old P4: 40 -year-old	P1: SIB, aggression, & disruptive behavior P2: SIB, aggression, & stereotypy behavior P3: SIB & disruptive behavior P4: SIB & aggression	Multi-element FA	P1: Social attention, self-stimulation, & escape from task demands P2: Social attention, self-stimulation, & tangibles P3: Social attention, self-stimulation, & escape P4: Negative reinforcement
Derby et al. (1994)	ID	4	P1: 23-year old P2: 6-year-old P3: 28-year-old P4: 12-year-old	Aggression, SIB & stereotypy	Multi-element FA	P1: Automatic & sensory reinforcers P2: Automatic & sensory reinforcers P3: Automatic function & negative reinforcement P4: Attention

Derby et al. (2000)	ID	48	Ranged between 3-32-years-old	SIB, aggression, destruction & dangerous acts	Multi-element FA	Different reinforcement contingencies e.g. attention, escape, tangibles
Devlin et al. (2011)	ASD	4	P1: 6-year-old P2: 11-year-old P3: 10-year-old P4: 9-year-old	Aggression, stamping feet, crying, & SIB	P1: QABF P2: Multi-element FA P3: Multi-element FA P4: FAST-R.	P1: Escape from demands & Tangibles P2: Escape from demands P3: Escape from demand & Tangibles P4: Escape from demand & Tangibles
Didden et al. (2007)	Prader Willi Syndrome (PWS)	119	4-49-years-old	Skin-picking	QABF	Non-social & intrinsic consequences
Doughty et al. (2007)	P1: Severe ID, profound deafness, & legal blindness P2: Profound ID & Down syndrome P3: Severe ID & bipolar disorder	3	P1: 45-year-old P2: 40-year-old P3: 54-year-old	P1: Stereotypy including hand, & arm flapping P2: Stereotypy including finger manipulation P3: Stereotypy including repetitive line drawing	Multi-element FA	Automatic reinforcement

Populations and Problems Evaluated with Functional Assessment

Dunkel-Jackson et al. (2018)	ASD	1	9-year-old	Swearing & head banging	QABF, ABC checklist, & TBFA	Escape from challenging tasks & access to tangibles
Durand & Crimmins (1988)	ASD	1	9-year-old	Psychotic Speech	Multi-Element FA	Reduction of behavior
Ellingson et al. (2000)	P1: ID & Cerebral Palsy P2: ID & Angelman's Syndrome P3: ID	3	P1: 19-year-old P2: 18-year-old P3: 12-year-old	P1: Disruptive behaviors including hand pounding on flat surfaces P2: Aggression including head butting, hitting, & kicking P3: Disruptive behavior including hand pounding, kicking, rocking, leaving the immediate work area and wandering about the immediate area, and pushing and throwing materials	Descriptive assessment using a questionnaire and interview format, & direct observation using an ABC checklist	Attention
Emerson et al. (1996)	Severe learning disabilities	3	P1: 8-year-old P2: 13-year-old P3: 11-year-old	SIB & aggression	Time-based lag sequential analysis	Socially mediated negative reinforcement involving escape from demands and social contact, &

						automatic reinforcement
Falcomata et al. (2013)	ASD	2	P1: 7-year-old P2: 12-year-old	P1: Aggression & disruptive behavior P2: Aggression & SIB	Multi-element FA	P1: Attention, escape & tangibles P2: Escape & tangibles
Falcomata & Gainey (2014)	ASD	1	4-year-old	SIB	Multi-element FA	Escape, tangibles, & attention
Flanagan & DeBarr (2018)	Emotional Behavioral Disorder (EBD)	1	10-year-old	Vocal Disruptions, Physical Aggression and falling on the floor/crawling	Trial-Based FA	Attention & escape from demands
Fragale et al. (2016)	ASD	4	P1: 9-year-old P2: 5-year-old P3: 4-year-old P4: 4-year-old	P1: SIB including head slapping & biting P2: Elopement, flopping, & whining P3: Vocal protesting, physical protesting, aggression, & elopement P4: Elopement	Multi-element FA	Tangibles
Girolami & Scotti (2001)	P1: Congenital bilateral perisylvian syndrome	3	P1: 32-months-old	P1: Pushing/slapping away the hand of the parent feeding	Multi-element FA	P1: Escape from food presentation & mealtime demands

	P2: Down Syndrome P3: Language & feeding difficulties		P2: 32-months-old P3: 28-months-old	her, throwing food and crying and screaming P2: Vomiting, gagging, refusal of solid food, screaming crying, throwing food, and turning her head away from food during mealtimes P3: Throwing food, crying during mealtimes, & food refusal		P2: Escape from food presentation & mealtime demands P3: Access to toys & attention
Hagopian et al. (2007)	ASD	3	P1: 12-year-old P2: 6-year-old P3: 12-year-old	P1: SIB & disruption P2: SIB, aggression, & throwing objects P3: Aggression	Multi-Element FA	Inconclusive results of the FA
Hagopian et al. (2005)	ID & ASD	3	P1: 13-year-old P2: 12-year-old P3: 7-year-old	P1: SIB, aggression, & disruption P2: SIB, aggression, disruption	Multi-element FA	P1: Social attention P2: Access to preferred items P3: Access to verbal and physical

				P3: Aggression		attention, & access to tangibles items
Hagopian et al. (1998)	ID & Behavior Disorders	21	Ranged between 2-16-years-old	SIB, aggression, & property destruction	Multi-element FA	Escape, attention, demands, & tangibles
Hall (2005)	ID	4	P1: 29-year-old P2: 51-year-old P3: 31-year-old P4: 31-year-old	P1: Pica which included the ingestion of toilet tissue, pages of magazines, plaster, threads, pegs and stones P2: SIB including head-banging, throat-pulling, arm-pulling, face-scratching, & hair-pulling P3: Aggression including hitting and grabbing support-staff and pulling at their hair P4: Aggression including hitting or kicking support-staff or pulling at their hair	Direct observations, Multi-element FA, & QABF	P1: Non-social reinforcement & attention P2: Escape & attention P3: Attention P4: Attention & tangibles

Hanley et al. (2005)	P1: Moderate ID, ASD, & a seizure disorder P2: Mild to moderate ID, AD/HD, & ODD	2	P1: 5-year-old P2: 8-year-old	P1: SIB, aggression, & disruptive behavior P2: SIB, aggression, & pica	Multi-element FA	P1: Attention P2: Attention & Escape
Hausman et al. (2009)	ASD, Cerebral Palsy, & moderate ID	1	9-year-old	SIB, aggression, property destruction, & ritualistic behaviors	Multi-element FA	Automatic Reinforcement (Access to ritualistic behaviors)
Healy et al. (2013)	ASD	32	Ranged between 6-19-years-old	CB1: Aggressive/destructive behavior CB2: SIB CB3: stereotypy	QABF & Multi-element FA	CB1: Escape from demands, & Tangibles CB2: Automatic reinforcement & Escape from demands CB3: automatic reinforcement
Herman et al. (2018)	ASD & ODD	1	4.6-year-old	Flopping	An open-ended interview and brief direct observation informed an Interview-Informed Synthesized Contingency Analysis (IISCA)	Escape from demands & Tangibles
Hetzroni & Roth (2003)	P1: Moderate ID P2: Moderate ID	5	P1: 14-year-old P2: 12-year-old	P1: Tugging a staff member, pulling his pants down,	Descriptive assessment & direct observation	P1: Attention & request for assistance

	P3: Severe ID & Cri-du-chat syndrome P4: Moderate ID & Down Syndrome P5: Severe ID		P3: 16-year-old P4: 19-year-old P5: 19-year-old	pulling and biting classroom peers, and screaming P2: Pushing, pinching, spitting, and pulling the hair of peers and staff P3: Aggressive behaviors including pushing and throwing items, running away from the classroom, and SIB that included lying on the floor while head banging P4: Crying, laughing, passivity, ignoring, putting head on table, & siting under the table P5: Sitting on the floor while banging his head, screaming, jumping on chairs, and manipulating pieces of' paper		P2: Attention & request for assistance P3: Escape from activity P4: Escape from task demands & general refusal to communicate with staff P5: Attention & request for assistance

Hodnett et al. (2018)	Smith-Magenis Syndrome	2	P1: 13-year-old P2: 4-year-old	P 1: SIB, disruptive behavior & disrobing P 2: SIB, aggression, & disruptive behavior	Multi-element FA	P1: Escape from demands & access to tangibles items P2: Access to attention & tangible items
Iwata et al. (1994)	ID	9	Ranged between 1.5-17.5-years-old	SIB	Multi-element FA	SIB may come from different sources of reinforcement
Karsh et al. (1995)	P1: ASD P2: Developmental delay, cerebral palsy, dysarthria P3: Developmentally disabled and seizure disorder	3	P1: 11-year-old. P2: 11-year-old. P3: 7-year-old.	P1: Yelling, crying, pinching, & hitting P2: Crying, kicking, hitting, & pulling hair P3: Crying, whining, kicking, struggling, falling on the floor, & grabbing	Multi-element FA	P1: Problem behaviors reinforced by instructions to carry out an active task P2: Problem behaviors reinforced by instructions to carry out an active task P3: Problem behaviors reinforced by toileting demands
Kelly et al. (2015)	ASD	3	P1: 9-year-old P2: 11-year-old P3: 11-year-old	P1: SIB & crying P2: Task refusal, non-responsiveness, & negative statements	Descriptive assessments & multi-element FA	P1: Escape from demands P2: Attention & escape from demands

				P3: Task refusal, non-responsiveness, negative statements about task, & property destruction		P3: Attention & escape from demands
Kern (1997)	ASD	1	15-year-old	CB1: SIB CB2: aggression	Multi-element FA	CB1:Tangibles CB2: Escape from demands
Kern & Vorndran (2000)	ID	1	11-year-old	Flopping	ABC Data	Tangibles (Preferred activities) & Adult attention
Kodak et al. (2004)	AD/HD	1	5-year-old	Elopement	Multi-element FA	Verbal & physical attention
Kurtz, Chin, Robinson, O'Connor and Hagopian (2015)	Fragile X Syndrome	9	Ranging from 6-15-years old	SIB, destructive behaviors & aggression.	Multi-element FA.	Escape from demands & access to tangibles.
Kurtz et al. (2008)	Children with Prenatal Drug Exposure	2	P1: 10-month-old P2: 22-month-old	P1: SIB, aggressive behavior, & severe tantrums P2: SIB, aggressive, & disruptive behavior	Multi-element FA	Attention, tangibles, & escape

LaBelle & Charlop-Christy (2002)	ASD	3	P1: 9-year and 6-month-old P2: 8-year and 6-month-old P3: 8-year and 8-month-old	P1: Disruptive behavior, aggression, & throwing objects P2: Inappropriate vocalizations P3: Disruptive behaviors	Individualized Multi-element FA	Attention, escape, tangibles, & automatic reinforcement
Lambert et al. (2019)	PWS	1	7-year-old	Food stealing	Latency-based FA	Differential reinforcement
Lang et al. (2008)	ASD	2	P1: 7-year-old P2: 12-year-old	Dropping to the floor, aggression, elopement, & head hitting	Multi-element FA	Attention & Escape from demands
Lang et al. (2010)	Asperger Syndrome	1	4-year-old	Elopement	Multi-element FA	Attention & tangibles
Larkin et al. (2016)	ASD	3	P1: 7-year-old P2: 4-year-old P3: 5-year-old	P1: Loud vocalizations & elopement P2: Elopement & flopping P3: Inappropriate vocalizations & aggression	TBFA	P1: Escape from demands & Adult attention P2: Tangibles P3: Tangibles
LaRue et al. (2010)	ASD	5	P1: 9-year-old P2: 8-year-old	Aggression, SIB, disruption, spitting,	Multi-element FA & TBFA	P1: Tangibles P2: Tangibles

			P3: 20-year-old P4: 29-year-old P5: 4-year-old	stereotypy, vocalizations		P3: Tangibles P4: Escape from demands (Multi-element FA) Tangibles (TBFA) P5: Automatic
LaRue et al. (2011)	ASD & ID	4	P1: 7-year-old P2: 24-yearold P3: 15-year-old P4: 10-year-old	P1: Inappropriate vocalization P2: SIB P3: SIB P4: Aggression & SIB	Multi-element FA & Manding Analysis (MA)	P1: Escape from demands & Tangibles P2: Social attention P3: Social attention P4: Social attention & Tangibles (secondary)
Liddon et al. (2016)	ASD & ID	110	Ranged between 1 and above 21-years-old	SIB, aggression, & property destruction	Multi-element FA & anecdotal information	ASD Only Group: Automatic reinforcement (58.9%) & access to activities/items (29.4%) ASD + ID Group: Access to activities/items (61.4%) & automatic

						reinforcement (42.2%)
Luiselli & Sobezenski (2017)	ASD and ID	1	22-year-old	Bathroom Visits	Functional Analysis Interview (FAI)	Escape from demands
Mace & Lalli (1991)	ID & Epilepsy	1	46-year-old	Bizarre Speech	Multi-element FA	Positive & Negative reinforcement
Machalicek et al. (2009)	ASD & ID	2	P1: 7-year-old P2: 11-year-old	Aggression, property destruction, SIB, & flopping	FA using video conferencing equipment	Escape from demand & attention
Machalicek et al. (2010)	ASD	6	Ranging from 5-9-years-old	Aggression, SIB, & stereotypy	Multi-element FA using video tele-conferencing	Unknown
Machalicek et al. (2014)	Fragile X Syndrome	12	Ranging from 27-51-years old	Aggression, SIB & disruptive behavior.	Multi-element FA.	Escape from demands, escape from social interactions and attention.
Marcus & Vollmer (1996)	P1: Down syndrome, language delay, & speech articulation difficulties P2: ID P3: ASD	3	P1: 5-year old P2: 4-year-old P3: 5-year-old	P1: SIB, aggression, & disruptive behavior P2: Aggression P3: SIB, aggression, & disruptive behavior	Multi-element FA	Tangibles
Marcus et al. (2001)	ID & Speech delays	4	Unknown	Tantrums & aggressive behavior	Multi-element FA	Escape, tangibles, & attention

Martens et al. (2010)	ASD	3	P1: 4.5-year-old P2: 5.5-year-old P3: 4-year-old	P1: Aggression & inappropriate vocalizations P2: Noncompliant behavior & inappropriate vocalizations P3: Inappropriate vocalizations	Multi-element FA & Contingency Space Analysis (CSA)	P1: Attention P2: Escape P3: Automatic reinforcement
Matson & Boisjoli (2007)	ID	88	Mean = 49.13	SIB & aggression	QABF	Both behaviors were all found to have multiple maintaining functions
McLay et al. (2019)	ASD	2	P1: 4-year and 2-month-old P2: 10-year and 10-month-old	P1: Frequent curtain calls & frequent and prolonged night-wakings P2: Bedtime resistance, delayed sleep onset latency and frequent curtain calls, frequent and prolonged night-wakings, & unwanted co-sleeping	Sleep Assessment Treatment Tool (SATT), parent-reported sleep diaries, & videosomnography (VSG)	Multiple functions: Parental Attention, Automatic Reinforcement & Tangibles

Monlux, Pollard, Rodriquez and Hall (2019)	Fragile X Syndrome	10	Ranging from 3-10-years old	SIB, aggression & destructive behaviors.	Multi-element FA via telehealth.	Escape from academic demands, escape from transition demands, access to tangibles and attention.
Neely et al. (2015)	ASD & severe ID	2	P1: 8-year-old P2: 7-year-old	P1: Repetitive rocking & bouncing P2: Repetitive arm swinging & head touching	Multi-element FA	Automatic reinforcement
Neidert et al. (2013)	Profound ID	2	P1: 21-year-old P2: 22-year-old	Elopement	Multi-element FA	Social-positive reinforcement
Newcomb et al. (2019)	ASD	1	13-year-old	Aggressive behaviour, property destruction, & loud vocalizations	Multi-element FA & CSA	Access to physical attention
Northup et al. (1991)	P1: ID P2: ID P3: ID & Cerebral Palsy	3	P1: 24-year-old P2: 21-year-old P3: 13-year-old	P1: Aggressive behavior including scratching, pinching, grabbing, hitting, and pulling hair P2: Aggressive behavior including pinching, hitting and biting & SIB consisting of face-	Multi-element FA consisting of two rapidly changing reversal designs conducted in two phases: an initial analogue assessment & a contingency reversal	P1: Escape P2: Escape & tangibles P3: Escape & attention

				slapping and self-pinching P3: Aggressive behavior including pinching, biting and hitting		
Obi (1997)	Lesch-Nylan Syndrome	1	24-year-old	SIB	FBA including a semi-structure interview with participant, questionnaire with staff & ABC Data	Avoidance of anxiety contingent on the absence of restraints
O'Reilly et al. (2005)	ASD	1	12-year-old	SIB	Multi-series FA	Antecedent intervention in positive behavioral support plans through scheduled activities
O'Reilly et al. (2006)	ASD	1	20-year-old	Bizarre speech & elopement	Multi-element FA	Attention
O'Reilly et al. (2008)	ASD	3	P1: 16-years-old P2: 22-years-old P3: 25-years-old	Challenging behavior	Multi-element FA	Attention or tangibles items
O'Reilly et al. 2010)	ASD	10	Ranged between 4-8-years-old	SIB, aggression, inappropriate vocalizations, stereotypy	Multi-element FA	Automatic reinforcement (8 Participants)

						Reinforcement (multiple sources) (2 Participants)
O'Reilly et al. (2012)	Developmental Disorders	3	P1: 5-year-old P2: 9-year-old P3: 5-year-old	P1: Elopement, yelling, & flopping P2: Head slaps & biting P3: Elopement, yelling, & flopping	Multi-element FA	Tangibles
O'Reilly Lacey, & Lancioni (2000)	Williams Syndrome	1	5-years and 2-months	Aggressive behavior	Multi-Element FA	Aversiveness of task demand
O'Reilly, Lacioni, et al. (2000)	ID	2	P1: 22-year-old P2: 9-year-old	P1: Pushing & pinching P2: Property destruction & SIB	Multi-element FA	Attention, especially when parents were interacting with another person
Olive et al. (2008)	ASD	1	4-year-old	Screaming, running from the table, placing materials in mouth, lying on the floor, or shouting ''no!''	Multi-element FA & FBA	Attention
Patel et al. (2000)	P1: ASD P2: ID & Fetal Alcohol Syndrome	2	P1: 10-year-old P2: 30-year-old	P1: Rapid tongue movements P2: SIB	Multi-element FA	P1: Auditory stimulation P2: Tactile stimulation

Peck et al. (1996)	Developmental disabilities	5	P1: 22-months-old P2: 16-months-old P3: 3-year-old P4: 4-year-old P5: 2-year-old	Pulling and chewing medical tubes and wires, food refusal, SIB, noncompliance, & aggressive behavior	Multi-element FA, FCT, & choice making analysis	Low attention, high demands, & escape
Petursdottir et al. (2010)	ID	174	Under 18: 46 Adults: 128	Physical aggression, verbal aggression, noncompliance, property destruction, inappropriate verbal and social behavior, and SIB	Multi-element FA	Attention accounted for 62.9% of behaviors, escape, access to tangibles
Petursson & Eldivek (2018)	ASD	1	30-year-old	Aggression & SIB	Multi-element FA	Escape from demands
Piazza et al. (1997)	P1: Moderate ID, ASD, AD/HD, & a seizure disorder P2: Severe ID, ASD, bipolar disorder, & AD/HD	3	P1: 10-year-old P2: 11-year-old P3: 4-year-old	Elopement	Multi-element FA	P1: Access to tangibles P2: Attention & ignore conditions P3: Attention

	P3: Cerebral palsy, a seizure disorder, & learning and speech delays					
Piazza et al. (2000)	P1: AD/HD P2: AD/HD P3: ID	3	P1: 6-year-old P2: 8-year-old P3: 17-year-old	P1: Dangerous behavior, aggression, disruption & SIB P2: saliva play, aggression, disruption & SIB P3: SIB	Multi-element FA	Automatic Reinforcement
Potoczak et al. (2007)	P1: Down Syndrome P2: ASD P3: No diagnosis P4: AD/HD	4	P1: 9-year-old P2: 7-year-old P3: 8-year-old P4: 17-year-old	P1: Refusal to reply and/or participate P2: Grabbing/tearing materials, refusal to participate P3: Grabbing/tearing materials and out-of-seat behavior P4: Refusal to reply & out-of-seat behavior	Multi-Element FA	Escape from demands

Radstaake et al. (2013)	Angelman Syndrome	3	P1: 7-year-old P2: 15-year-old P3: 6-year-old	SIB, hurting/pinching others, biting, throwing and hair-pulling.	Multi-Element FA	Attention, escape & access to tangibles.
Radstaake, Didden, Oliver, Allen and Curfs (2012)	Angelman Syndrome	4	Ranged from 5-18-years-old.	Hitting other people, hair-pulling, saliva-play, disruption and throwing items.	Multi-Element FA	Attention, access to tangibles and demand.
Rahman et al. (2010)	Acquired Brain Injury (ABI)	9	Ranged between 30-59-years-old	Physical aggression, property destruction, self-injury and verbal aggression	Descriptive FA	Escape from demands, Escape from social attention & Multiple functions
Rahman et al. (2013)	ABI	4	P1: 60-year-old P2: 49-year-old P3: 45-year-old P4: 50-year-old	P1: Aggression P2: Aggression P3: Aggression P4: Verbal perseveration	Structured descriptive assessment	P1: Escape from demand P2: Escape from demands P3: Social Attention P4: Social Attention
Rapp et al. (2009)	ASD	3	P1: 8-year-old P2: 8-year-old	Vocal stereotypy	Multi-element FA	Automatic reinforcement

			P3: 5-year-old			
Richman et al. (1998)	ID & ASD	1	27-year-old	Disruptive behavior & SIB (finger picking)	Multi-element FA	Escape & automatic reinforcement
Reed et al. (2005)	P1: ASD, moderate ID, & seizure disorder P2: ODD, AD/HD, & mild ID	2	P1: 8-year-old P2: 10-year-old	P1: Property destruction, non-compliance, aggression, & disruptive behaviors P2: Aggression & non-compliance	Multi-element FA	Escape from demands
Reese et al. (2005)	Typically developing & ASD	23 ASD 23 Typically developing	Unknown	Disruptive behavior	Multi-element FA	Girls with ASD and typically developing: escape from demands, attention, & tangibles Boys with ASD: Access to tangibles & escape from demands
Richman et al. (1999)	P1: ID & AD/HD P2: Developmental delays & ASD	3	P1: 8-year-old P2: 4-year-old P3: 6-year-old	P1: Stereotypic movements, facial tics, disruptive, & aggressive behaviors P2: Aggression	Multi-element FA	P1: Access to tangibles items & attention P2: Escape, attention, & tangibles

	P3: ID & AD/HD			P3: Disruptive behavior		P3: Escape
Rispoli et al. (2011)	Severe ID & Cerebral Palsy	1	5-year-old	Hitting others & throwing objects	Multi-element FA	Attention & demands
Rispoli et al. (2015)	Not specified	3	P1: 4-year-old P2: 4-year-old P3: 3-year-old	Challenging Behavior	TBFA	Access to tangibles
Roberts-Gwinn et al. (2001)	ASD	1	11-year-old	Aggression, disrobing, & elopement	BFA	Automatic reinforcement
Rojahn et al. (2012)	ID & Developmental Disabilities	115	Ranged between 20-73-years-old	SIB, stereotyped & aggressive behaviors	QABF	Aggression: attention and escape SIB & stereotypy: self-stimulation & escape
Romani et al. (2019)	P1: ASD, unspecified disruptive, impulse-control, & conduct disorder P2: ASD, mild ID, unspecified disruptive, impulse-control,	2	P1: 5-year-old P2: 12-year-old	Aggression	Multi-element FA	Tangibles reinforcement

	& conduct disorder					
Rose & Beaulieu (2019)	ASD	2	P1: 3-year-10-month old P2: 5-year-11-month old	P1: Vocal protests P2: Vocal protesting, aggression, and environmental destruction	FBA & Multi-element FA	Tangibles & attention
Sasso et al. (1992)	ASD	2	P1: 7.5-year-old P2: 13-year-old	P1: Aggression, loud vocalizations, and noncompliance P2: Aggression in the form of hitting, pinching, scratching, and kicking & stereotypy in the form of hand waving and rocking	Multi-element FA	Escape from demands
Scalzo & Davis (2017)	ASD	4	P1: 4-year-old P2: 5-year-old P3: 4-year-old P4: 12-year-old	P1: Crying P2: Screaming P3: Aggression P4: Aggression	Functional assessment interview & Multi-element FA	Tangibles
Scheithauer et al. (2016)	ASD, AD/HD, Conduct disorder, Disruptive	24	Ranged between 3-18-years-old	Aggression, disruptive behavior, elopement,	Multi-element FA	Escape, tangibles, attention, & automatic reinforcement

	behavior disorder, & Development delay			inappropriate vocalizations, SIB, & spitting		
Scheithauer et al. (2017)	ASD	2	P1: 12-year-old P2: 9-year-old	P1: SIB including hand-to-head, hand-to-body, head-to-surface, & shoulder-to-head hits P2: SIB including head-to-surface, hand-to-head, body-to-surface (specifically wrists), and hand-to-body hits	Multi-element FA	P1: Automatic & social reinforcement P2: Automatic reinforcement
Schmidt, Drasgow, et al. (2014)	P1: ASD & Profound ID P2: ASD & Profound ID P3: ASD, severe ID, depressive disorder–not otherwise specified, & psychotic disorder–not otherwise specified	3	P1: 9-year-old P2: 10-year-old P3: 15-year old	P1: food stealing & aggression P2: food stealing & aggression P3: aggression, inappropriate touching & cursing/sexual statements	Discrete-trial Functional Analysis (DTFA)	P1: Tangible-edible & escape P2: Tangible-edible P3: Attention

Schmidt, Shanholtzer, et al. (2014)	Mild ID	1	14-year-old	Physical aggression, verbal aggression, & disruptive behaviors	Multi-element FA	Escape from demands
Schroeder et al. (2014)	Children at risk of developmental disabilities	17	Ranged between 17-41-month-old	SIB, stereotypy, property destruction, aggression and tantrums	Multi-element FA & the Behavior Problem Inventory	70% maintained by automatic reinforcement, 22% maintained by escape from demands
Smith et al. (2016)	ASD	3	P1: 28-year-old P2: 9-year-old P3: 14-year-old	P1: SIB P2: Aggression & tantrums P3: Tantrums	FBA & Multi-element FA	Escape from demands & Fatigue
Smith & Churchill (2002)	Profound ID	4	P1: 41-year-old P2: 53-year-old P3: 35-year-old P4: 52-year-old	P1: SIB P2: SIB P3: Aggression P4: SIB	Multi-element FA	P1: Demands P2: Demands P3: Attention P4: Demands
Sprague et al. (1998)	Severe ID & cerebral palsy	1	13-year-old	Feeding problems including spitting & whining following bites of food	Preliminary FA, attention analysis & differential reinforcement analysis	Access to food
Strachan, Shaw. Burrow, Horsler, Allen	Angelman Syndrome	12	Ranged between 4-16-year-old.	Aggression.	Multi-Element FA	Attention, social interaction & escape.

and Oliver (2009)						
Strohmeier et al. (2017)	ASD	1	12-year-old	Self-injury, aggression, & disruption	Parent conducted combined establishing operations (EO) FA	Tangibles & escape from demands
Swender et al. (2006)	ID	60	Range between 21-79-years-old	Hand Mouthing	Behavioral multi-element FA & QABF	GERD was more likely under non-social conditions
Tarbox et al. (2009)	ASD	7	Range between 3-9-years-old	P1: Aggression P2: Tantrums P3: Property destruction P4: Whining P5: Stereotypy P6: Verbal protesting P7: Stereotypy	Indirect assessment, descriptive assessment & Multi-element FA	P1: Escape from demands P2: Tangibles P3: Attention & escape from demands P4: Escape from demands P5: Escape from demands P6: Tangibles P7: Automatic reinforcement
Thompson & Iwata (2007)	ASD	12	Range between 30 - 52-year-old	SIB & aggression	Multi-element FA	Access to tangible (3 Participants)

						Attention (3 Participants) Escape from demands (3 Participants) Automatic reinforcement (3 Participants)
Torres-Viso et al. (2018)	SMS & ASD	1	12-year-old	Mands	Multi-element FA	Others' compliance with mands for rearrangement
Toogood et al. (2011)	ASD & Severe ID	1	32-year-old	CB1: Aggression, SIB & Property disruption CB2: Stereotypy CB3: Skin-picking CB4: Vocalization	FBA	CB1: Attention, & Escape from demands CB2: Automatic reinforcement CB3: Automatic reinforcement CB4: Attention
Tucker et al. (1998)	ID	2	P1: 18-year-old P2: 13-year-old	P1: Screaming & property disruption P2: Aggression & grabbing	Multi-element FA	P1: Access to tangibles P2: Social attention
Vollmer et al. (1999)	ID	3	P1: 17-year-old P2: 16-year-old P3: 4-year-old	P1: SIB & aggression P2: SIB	Multi-element FA	P1: Escape P2: Materials P3: Escape

				P3: Aggression		
Vollmer et al. (1993)	P1: Profound ID P2: Severe ID P3: Profound ID	3	P1: 32-year-old P2: 40-year-old P3: 42-year-old	P1: SIB including head hitting, body hitting, & head banging P2: Hand mouthing P3: SIB including head banging & head hitting	Multi-element FA	Attention
Vollmer et al. (1994)	Severe disabilities	3	P1: 3-year-old P2: 3-year-old P3: 4-year-old	SIB & hand mouthing	Multi-element FA	P1: Access to tangibles P2: Access to tangibles P3: Unknown
Vollmer et al. (1998)	P1: Severe ID P2: Moderate ID & severe hearing loss P3: Moderate ID	3	P1: 22-year-old P2: 6-year-old P3: 16-year-old	P1: Aggression n in the form of hitting other people & pinching P2: Disruptive, SIB & tantrum behavior P3: Aggression including hitting others	Multi-element FA	P1: Escape from social proximity P2: Positive reinforcement in the form of attention P3: Escape from instructional proximity
Wacker et al. (1990)	P1: ASD, severe to profound ID,	3	P1: 7-year-old P2: 30-year-old	P1: SIB including hand-biting	Multi-element FA	P1: Positive reinforcement

	& a seizure disorder P2: Phenylketonuria & Profound ID P3: Severe to profound ID		P3: 9-year-old	P2: Stereotypy including body-rocking P3: Aggression including slapping & biting others		P2: Automatic reinforcement P3: Attention
Wacker et al. (1998)	P1: Severe to profound developmental delays P2: Rett-like syndrome & severe ID	2	P1: 2 year 2 months old P2: 7-year-6 months old	P1: SIB in the form of hand-biting, eye-gouging & head banging P2: SIB & feeding problems	Multi-element FA	P1: Parent attention P2: Automatic reinforcement
Wacker et al. (2013)	ASD	20	Ranged between 18-83-months-old	Aggression, SIB, destruction, disruption.	Multi-element FA	90% of participants showed a social function, 13 participants showed an escape function and 2 showed a tangibles function
Waters et al. (2009)	ASD	2	P1: 6-year-old P2: 6-year-old	P1: Aggression P2: Aggression & Disruption	BFA	Escape from demands (non-preferred activities and transition) & Tangibles (preferred activities)
Watkins & Rapp (2013)	ASD	6	Ranged between 9-19-years-old	Repetitive, SIB & stereotypy behavior	QABF	Automatic reinforcement

White et al. (2011)	ASD	2	P1: 7-year-old P2: 7-year-old	Aggressive & stereotypy behavior	Multi-element FA	P1: Access to tangibles P2: Access to tangibles
Wilder et al. (2000)	ID	1	30-year-old	Stereotypy behavior	Multi-element FA	Automatic reinforcement
Wilke et al. (2012)	ASD	53	Ranged between 30–204 months	Stereotypy behavior	QABF	Automatic reinforcement

Multi element FA= Experimental Functional Analysis
FBA=Functional Behavioral Assessment
QABF = Questions About Behavioral Function
BFA= Brief Functional Analysis
TBFA= Trial-Based Functional Analysis

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