Chapter 4

Functional analysis methodology in developmental disabilities

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Since the first publications more than 40 years ago, functional analysis has significantly contributed to improving the lives of individuals with developmental disabilities, including autism. Important gains in both conceptual and applied work have been made in the teaching of adaptive skills and the assessment and remediation of problem behavior (Beavers, Iwata, & Lerman, 2013; Granspeesheh, Tarbox, & Dixon, 2009).

Individuals with developmental disabilities are at increased risk for the development of problem behaviors and associated psychopathology, such as self-injurious, aggressive, stereotypic, and other problem behaviors (Holden & Gitlesen, 2006; Murphy, Healy, & Leader, 2009). Without adequate treatment or support, such behaviors persist (Lloyd & Kennedy, 2014). Risk factors include poor self-help and communication skills, deficits in social and problem-solving skills, lack of self-help skills, punitive parenting practices, restricted access to materials and activities, certain genetic disorders and physical and neurological conditions, and psychiatric disorders (Holden & Gitlesen, 2006; Kearney & Healy, 2011; Murphy et al., 2005). Such factors are more prevalent in people with disabilities than in typically developing people.

Clinicians working in such diverse settings as special schools, residential facilities, clinical treatment or outpatient settings are confronted with a wide range of problem behaviors and psychopathology and the often negative consequences that such behaviors have on the physical and mental health and/or the quality of life of the person and his or her environment. Functional analysis methodology provides an empirically validated framework for the assessment and treatment of challenging behavior. In this chapter, we (a) describe basic assumptions of this approach, (b) review methods for conducting functional analysis in clinical practice, (c) review function-based treatments, and (d) present a brief example of its application.

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Basic assumptions and principles

Functional analysis is a methodology for systematically investigating relationships between problem behavior and environmental events. Its purpose is to identify variables controlling behavior(s) and to generate hypotheses about its function(s). A treatment is then selected that matches this function (Beavers et al., 2013; LaRue et al., 2010; Rispoli, Ninci, Nelly, & Zaini, 2014). The first studies demonstrating behavior-environment relationships in individuals with developmental disabilities were published in the early 1960s (Lovaas, Freitag, Gold, & Kassorla, 1965). These early reports showed that problem behavior is not a characteristic feature of a person, but reflects a response to environmental conditions. Problem behavior in individuals with developmental disabilities is conceptualized as a learned response that is evoked and maintained by environmental conditions and is influenced by establishing operations, antecedents, and consequences (Lloyd & Kennedy, 2014; Matson & Williams, 2014). The four general classes of consequences are (a) positive social reinforcement, (b) negative social reinforcement, (c) positive automatic reinforcement, and (d) negative automatic reinforcement (Iwata, DeLeon, & Roscoe, 2013; Miltenberger, Bloom, Sanchez, & Valbuena, 2016). For example, negative automatic reinforcement occurs when a target behavior produces an alleviation or reduction in an internal aversive stimulus, such as an aversive itch sensation, that is attenuated or terminated contingent upon self-injurious behavior (Kuhn, Hagopian, & Terlonge, 2008).

Individuals differ with respect to which stimuli function as reinforcers (Virués-Ortega et al., 2014). It is the function of the behavior, not its topography that guides treatment selection. Problem behavior is not conceptualized as a symptom of an underlying pathology or personal trait (e.g., personality disorder, genetic disorder, depression, attachment disorder) or developmental stage, but as a response that is lawfully related to environmental conditions. For example, even problem behaviors more or less characteristic for a specific genetic disorder, such as self-injury in Lesch-Nyhan and Cornelia de Lange syndromes, may show considerable variability across environmental conditions and may be treated with interventions based on functions rather than diagnosis or topography (Didden, Korzilius, & Curfs, 2007; Matson & Williams, 2014; Wilke et al., 2012).

Establishing Operations

Establishing Operations (EOs) are factors, such as reinforcer satiation and deprivation, that alter the relationship between antecedent events, the subsequent behavior, and its maintaining consequences (Langthorne, McGill, & Oliver, 2014). For example, social deprivation may be an EO that increases the reinforcing value of attention and that increases the likelihood of behavior that has previously resulted in attention (O'Reilly et al., 2007). The three classes of

EOs are (a) physical, (b) biological, and (c) social (Simó-Pineatella et al., 2013). For example, Carr and De Schryver (2007) found that the frequency and intensity of challenging behavior was greater on days that the participants were sick than on days that they felt well. Other examples of EOs for challenging behavior are pain, environmental complexity, sleep deprivation, and ear infection (Langthorne et al., 2014). McAtee, Carr, and Schulte (2004) developed the *Contextual Assessment Inventory*, which explores and identifies possible EOs. After completing this instrument, clinicians may continue with direct observation to investigate the relationships between EOs and problem behavior further (Herzinger & Campbell, 2007).

Functional analysis methodology

Functional analysis methodology includes methods for the assessment of functional properties of problem behavior. A distinction is made between descriptive and experimental methods. Descriptive or non-experimental methods are also referred to as functional or behavioral assessment. Experimental methods or functional analysis refers to procedures that systematically manipulate environmental conditions to assess effects on the rates of problem behavior (Herzinger & Campbell, 2007; Lloyd & Kennedy, 2014; Matson & Williams, 2014).

Descriptive analysis

Descriptive analysis involves methods of both indirect and direct observation of the target behavior and environmental events (Herzinger & Campbell, 2007). Such methods are typically implemented in naturally occurring applied settings.

Indirect observation

Indirect means that these methods do not require direct observation of the person exhibiting the problem behavior. Indirect methods include interviews, questionnaires and rating scales (Herzinger & Campbell, 2007). These methods rely on reports by informants who are in daily contact with the person, such as parents, caregivers, and teachers, or on reports by individuals themselves. Indirect measures are compared to direct observation measures, time and cost efficient, minimally intrusive and require less expertise and training. Since data gathered through indirect observation are not always reliable, clinicians are advised to use these data as a helpful starting point to functional analysis. However, in cases in which challenging behavior occurs at very low frequencies and with high intensity, gathering information through indirect observation might be the only feasible assessment method (Iwata et al., 2013; Lloyd & Kennedy, 2014; Matson & Williams, 2014). In the

scientific literature, several instruments have been described such as the *Functional Analysis Screening Tool* (Iwata et al., 2013), *Functional Analysis Interview* (FAI), *Motivation Assessment Scale* (MAS) (Durand & Crimmins, 1988), and *Questions About Behavioral Function* (QABF). In this section we will briefly review the QABF.

Questions About Behavioral Function

Rating scales such as the QABF (Matson & Vollmer, 1995) were developed as an alternative to analog baselines (see Multiple Experimental Analyses below). The QBAF is a 25-item rating scale, and each item is rated on a four-point Likert-type scale. The QABF consists of five subscales addressing five maintaining variables: (a) nonsocial (automatic) reinforcement, (b) tangible reinforcement, (c) attention, (d) escape, and (e) physical discomfort. Items are included that describe social avoidance and physical discomfort, making the QABF more comprehensive than other scales. Each subscale contains five items, and subscale and total scale scores are calculated. The subscale with the highest score indicates the most likely function. For example, Didden et al. (2007) assessed the behavioral function of skin-picking in 119 individuals with PWS by administering the *QABF* and found that in most cases skin picking was maintained by contingent arousal reduction.

Koritsas and Iacono (2013) studied the psychometric properties of the QABF and the MAS in 70 adults with ID and challenging behavior. They found good internal consistency of the QABF and based on the intra-class correlation coefficient, inter-rater reliability of the QABF was acceptable for sub-scale scores, but not for individual items. Convergent validity was satisfactory. The authors conclude that the QABF alone may prove unreliable for assessing the function of challenging behavior among adults with ID and that other techniques such as observations should be used to supplement information gathered from the QABF. In contrast, Healy, Brett, and Leader (2013) found exact agreement between the QABF and multiple experimental analysis (see "Multiple Experimental Analyses" below) on the behavioral functions of aggressive/destructive, self-injurious and stereotyped behavior of 24 individuals with autism and partial agreement on six individuals. These latter results suggest that the QABF is an effective tool for identifying behavioral function.

Direct observation

During direct observation, environment-behavior relationships are systematically recorded and analyzed. Methods of direct observation are the foundation of the functional analytic approach and date from the late 1960s (Bijou, Peterson, & Ault, 1968). This section will describe two methods: (a) scatter plot and (b) antecedent behavior consequent (ABC) analysis.

Scatterplot

The scatterplot is a tool for investigating temporal characteristics of problem behavior (Lloyd & Kennedy, 2014). The scatterplot is a recording sheet or grid in which time intervals are blocked within and across successive days. Length of intervals may vary between 5 and 30 min, or more depending on practical constraints and/or behavior frequency. Observers record the extent to which the target behavior and other events occur within these intervals. Scatterplot data may reveal patterns of responding in the behavior, and the target behavior may be related to specific activities, time of day, presence of particular individuals or settings, and combinations of these and other variables.

In a classic study, Touchette, MacDonald, and Langer (1985) presented data on patterns of self-injurious and aggressive behavior in three individuals with developmental disabilities. Scatterplot data collected for 7 days revealed that the rate of target behavior was relatively high when a particular staff member was present and during certain activities. For a third subject, the data could not be interpreted. Substantial reductions in the target behaviors were accomplished by rescheduling the staff member and by revising scheduling of activities.

Maas, Didden, Bouts, Smits, and Curfs (2009) used scatterplot data to assess signs of daytime sleepiness and disruptive behavior in individuals with Prader-Willi syndrome (PWS). More signs of daytime sleepiness were seen when there were no scheduled activities compared to when activities were scheduled, specifically in the afternoon and the evening and during the weekend. Although commonly used in functional analysis, Matson and Minshawi (2007) conclude that the empirical support for the scatterplot is still insufficient.

Antecedent behavior consequent analysis

Two methods of antecedent behavior consequence (ABC) analysis may be distinguished: (a) ABC charts and (b) recording sequences of behavior and environmental events. ABC charts allow the observer to write down narrative descriptions of a target behavior and record events that immediately precede and follow the behavior. The consistency with which specific events appear contiguous to the problem behavior is then analyzed (Lanovaz, Argumedes, Roy, Duquette, & Watkins, 2013).

Bijou et al. (1968) were among the first to describe a method for conducting an ABC analysis. This method may reveal sequences of behavior and associated events through time (Lloyd & Kennedy, 2014). Data may be expressed as percentages (e.g., number of intervals with a consequent event that followed the target behavior divided by the total number of intervals with that behavior). For example, Radstaake et al. (2011) conducted an ABC analysis of skin picking in a 16-year old girl with PWS. Fifty percent of the

antecedents involved waiting for some activity or person. The skin picking also appeared to be more frequent and intense during times that were stressful for the girl, like a staff shift change. This suggests that the skin picking was maintained by automatic reinforcement.

Infrequently, challenging behavior may be analyzed via time-lag sequential analysis (Matson & Williams, 2014). Time-lag sequential analysis involves calculation of conditional probabilities of the onset, occurrence, or termination of one event at specific points in time to the onset, occurrence, or termination of another event. For example, to test whether self-injurious behavior is escape-motivated, the conditional probability of self-injury while demands (i.e., antecedent event) are placed upon the individual is compared with the overall chance or unconditional probability of self-injurious behavior. Then the statistical significance of the difference between the conditional and unconditional probability of an event is tested using the *z*-statistic. (For a step-by-step description of sequential analysis of naturally occurring events see MacLaren Chorney, Marrs Garcia, Berlin, Bakeman, and Kain (2010)). Oliver, Woodcock, and Humphreys (2009) used time-based sequential lag analysis to examine the sequence of behaviors leading up to and comprising a temper outburst in four individuals with PWS. They found that temper outbursts involve a progression of behaviors that proceed and lead up to the challenging behavior shown during the outbursts. In all participants questioning was likely to precede more challenging behaviors such as crying, arguing or ignoring requests. In three individuals, idiosyncratic precursor behaviors such as frowning or stereotypical behavior were more likely to precede more challenging behaviors.

Experimental functional analysis

Experimental functional analyses require the experimental manipulation of antecedents and/or consequences that are hypothesized to influence a target behavior. Potential maintaining and eliciting events are manipulated to assess control of responding (Herzinger & Campbell, 2007). Two types of experimental analyses are distinguished: (a) single experimental analysis and (b) multiple experimental analyses.

Single experimental analysis

During single experimental analysis, only one event is presented and withdrawn to assess its effect on the rate of the target behavior. A functional relationship is demonstrated if the frequency or duration of the target behavior (i.e., dependent variable) changes in relation to a change in the event (i.e., independent variable). For example, Smith, Carr, and Moskowitz (2016) demonstrated a functional relationship between task demands and escape-related problem behavior in three individuals with autism spectrum disorder

and ID in a community setting. Prior to experimental analysis, a staff interview and review of behavioral and medical records indicated that the problem behavior was often preceded by demands (antecedent) and became more frequent when they were fatigued (setting event). During the experimental analysis each individual participated in an ABAB design, where A represented sessions without demands (e.g., watching television, looking at a magazine) and B sessions with demands (e.g., meal preparation, wiping the dining room table, hand-washing). Sessions were repeated during periods of fatigue and no fatigue. Problem behavior was most likely to occur when both task demands (discriminative stimuli) were presented and when the setting event (fatigue) was operative. Furthermore, after a function-based treatment, addressing the two sets of factors (fatigue and demands), all three participants were able to complete a target task with no problem behavior even when fatigued.

Multiple experimental analyses

Multiple experimental analyses may be conceptualized as a series of single experimental analyses. Two types of multiple analyses have been described: (a) analog baselines and (b) structural analysis. Iwata, Dorsey, Slifer, Bauman, and Richman (1982) developed and validated the functional analysis methodology using analog baselines. "Analog" means that test conditions resemble conditions found in natural environments. Typically, the individual is observed during four conditions, each containing an EO, an antecedent event, and a consequent event hypothesized to maintain the problem behavior. These conditions refer to three classes of reinforcement: (a) attention, (b) escape, and (c) sensory. There is also a fourth control condition. A systematic relationship between responding and the four conditions indicates a behavioral function. In eight boys with fragile-X who showed self-injurious behaviors, aggressive behaviors, and/or destructive behaviors, Langthorne et al. (2011) found differentiated patterns of responding across conditions in most cases, indicating sensitivity of problem behavior to different contingencies. No child met criteria for attention-maintained problem behavior, five children met criteria for escape-maintained problem behavior, and four children met criteria for tangible-maintained problem behavior.

This methodology has been extended and replicated in a large number of studies and in a wide range of problem behaviors (see Table 4.1). A variation of analog baselines is a brief functional analysis which uses only one or two repeated experimental and control conditions and can thus identify functions more rapidly in applied settings, such as outpatient clinics (Lyons, Rue, Luiselli, & DiGennaro, 2007). This type of analysis differs from analog baselines in that multiple events are manipulated in the natural context of the individual.

Methods have been developed as an alternative for direct observation in artificially created contexts. For example, Stichter, Randolph, Kay, and Gage (2009) instructed teachers to create situations (e.g., child is ignored, child is

TABLE 4.1 Categorization of function-based treatments.

Behavioral function	Function-based treatment	Behavioral topography	Research article
Attention/ tangibles	NCR	Aggressive behavior	Philips and Mudford (2011), Fritz, Jackson, Stiefler, Wimberly, and Richardson (2017)
	DRO/I/A	Disruptive and off-task behaviors	Shumate and Wills (2010)
	EXT	Vomiting	Alford, Blanchard, and Buckley (1972)
Automatic	NCR	Stereotypic behavior	Rapp (2006)
	EXT	Aggressive behavior	Philips and Mudford (2011)
	DRO/I/A	Nail biting, Self-injurious behavior	Heffernan and Lyons (2016), Toussaint and Tiger (2012)
	FCT	Stereotypic behavior	Boyle, Ortman, Beckman, Aholt, and Keenan (2018)
	Change in EO/antecedent	Stereotypic behavior, Vocal stereotypic behavior	Conroy, Asmus, Sellers, and Ladwig (2005), Haley, Heick, and Luiselli (2010)
	Response interruption	Pica	Hagopian et al. (2011)
Escape/ avoidance	Change in EO/antecedents	Self-Injurious behavior, Aggression and destructive behavior	O'Reilly, Sigafoos, Lancioni, Edrishinha, and Andrews (2005), Lomas, Fisher, and Kelley (2010)
	NCR	Rumination, Aggressive behavior	Wilder et al. (2009), Baker, Hanley, and Mathews (2006)
	Choice-making	Off task behavior, screaming, aggression, delayed echolalia, property destruction, verbal protests.	Rispoli et al. (2013)
	EXT	Food selectivity	Tarbox, Schiff, and Najdowski (2010)

TABLE 4.1 Categorization of function-based treatments.—cont'd

Behavioral function	Function-based treatment	Behavioral topography	Research article
	FCT	Destructive behavior	Harding, Wacker, Berg, Lee, and Dolezal (2009)
	DRO/I/A	Aggressive behavior, disruption and/or inappropriate sexual behavior	Athens and Vollmer (2010)
	TO	Non-compliance	Everett et al. (2007)
Escape/ avoidance (increased arousal)	Change in EO	Stereotypic behavior	Chung and Cannella-Malone (2010)

Note: NCR, noncontingent reinforcement; DRO/I/A, differential reinforcement of other/incompatible/alternative behavior; *FCT,* functional communication training; *EXT,* extinction; *TO,* time out; *EO,* establishing operation.

presented with an instructional demand) to identify the antecedent variables, across environments which promoted prosocial and adaptive behavior in children with autism. The teachers were able to effectively combine optimal antecedents to increase prosocial adaptive behaviors, while concurrently decreasing maladaptive behaviors. Further, the improved rates were maintained during follow-up probes.

Function-based treatments

Within functional analysis methodology, selection of treatment is based on the identified function(s) of problem behavior. Function-based treatment can take the form of (a) modifying EOs, (b) modifying antecedent events, (c) removing or altering the reinforcing or consequent event, and/or (d) teaching the individual functional and adaptive skills that compete with or replace the problem behavior. In this section, we selectively review several important function-based approaches. Table 4.1 provides an overview of function-based treatment related to behavioral function and topography.

Modifying EOs

In their review, Simó-Pinatella et al. (2013) showed that modifying EOs usually has an effect by increasing or reducing the effectiveness of reinforcement. An approach to modifying EOs is noncontingent reinforcement

(NCR), in which the reinforcer is delivered systematically and in a response-independent format (see Richman, Barnard-Brak, Grubb, Bosch, & Abby (2015) for a meta-analysis). For example, NCR in escape-maintained problem behavior may consist of providing escape from a task at regular time intervals and irrespective of whether the individual exhibits problem behavior or not. NCR is started with relatively dense reinforcement schedules (i.e., short time intervals). When low frequencies of the target behaviors are established, the schedule is gradually thinned while maintaining low behavior frequencies. Prior to starting NCR, mean inter-response time of the occurrence of the target behavior is assessed. The reinforcer is then delivered at the end of a time interval, irrespective of whether the target behavior has occurred during or at the end of that interval or not. Occurrence of the target behavior during the interval does not lead to resetting that interval such as in procedures of differential reinforcement of other behavior (DRO). If the function cannot be identified or if a maintaining reinforcer cannot be withheld (e.g., in case of automatic reinforcement), NCR with arbitrary reinforcers may be effective, provided stimuli are identified through preference assessment and they function as a reinforcer (Higbee, Chang, & Endicott, 2005). However, in their meta-analytic study Richman, Barnard-Brak, Grubb, Bosch, and Abby (2015) found a small effect of a matched functional reinforcers over a non-functional reinforcers. Other approaches based on manipulation of EOs include studies that have shown that altering the instructional requests (Butler & Luiselli, 2007), changing the classroom activity schedule (O'Reilly, Sigafoos, Lancioni, Edrisinha, & Andrews, 2005) and providing opportunities for choice making (Rispoli et al., 2013) may be highly effective. Apparently, such interventions lead to a reduction in the aversive properties of instructional demands. A change in EOs may also be effective in case of automatically reinforced problem behavior. For example, Wilder, Register, Register, Bajagic and Neidert (2009) showed in an adult with autism that the use of flavored sprays reduced rumination maintained by automatic reinforcement.

Modifying antecedents

Interventions based on modifying antecedents have included removal, fading, and other manipulation of antecedents. This approach is often indicated in the treatment of problem behavior that is escape maintained. Escape from task demands may be treated by changing task characteristics, such as the level of task difficulty, speed of presentation, novelty, and duration, and interspersing easy with difficult tasks (Geiger, Carr, & Leblanc, 2010; Langthorne et al., 2014). For example, Butler and Luiselli (2007) used a combination of noncontingent escape, instructional fading and increased the frequency of requests in a 13-year-old girl with autism to reduce her escape-maintained problem behavior.

Extinction

Extinction (EXT) occurs when the contingency between a target behavior and its reinforcing consequence is interrupted. EXT involves withholding the consequent event maintaining the problem behavior upon its occurrence or making the consequent noncontingent on the target behavior (Granpeesheh, Tarbox, & Dixon, 2009; Miltenberger et al., 2016). EXT may take several forms depending on the consequence maintaining the behavior. Attention extinction may occur if attention from caregivers or others is withheld contingent on the occurrence of the target behavior. Note that ignoring an individual's problem behavior will be effective in reducing that behavior only when that behavior is maintained by contingent social attention. Extinction of escape/avoidance behavior consists of preventing the individual from escaping from or avoiding the event that elicits negatively reinforced problem behavior. Finally, in case of automatic positive reinforcement, sensory extinction involves removing the sensory consequences resulting from problem behavior.

Extinction is associated with several negative side effects. A clinically important side effect of extinction is the occurrence of the so-called extinction burst, which is an increase, albeit temporary, in the frequency or intensity of the target behavior at the beginning of the treatment (see Weiskop, Richdale, & Matthews (2005) for an extinction burst during treatment of attention-maintained sleep disruptive behavior). Extinction is also accompanied by increased behavioral variability, as seen by the emergence of novel behaviors or the reemergence of old behaviors. This can be the basis of reinforcement of appropriate behavior. Clinicians should be aware that an extinction burst is a signal of treatment effectiveness, not ineffectiveness. EXT in combination with differential reinforcement often results in a faster reduction in the target behavior than EXT used alone (Petscher, Rey, & Bailey, 2009; Seligson Petscher & Bailey, 2008) and is therefore preferable to EXT alone.

Functional Communication Training

Functional Communication Training (FCT) involves teaching an individual a specific communicative response that serves the same function as the problem behavior (Mancil, 2006; Tiger, Hanley, & Bruzek, 2008). FCT is also referred to as differential reinforcement of communicative behavior. In FCT the problem behavior and the new communicative response should be functionally equivalent. Problem behavior and the new communicative response then belong to the same response class because they have identical consequences. Several instructional procedures exist for teaching alternative and communicative responses to individuals with developmental disabilities. In general, FCT interventions progress through three stages. First, environmental events that serve as reinforcers for the challenging behaviors are identified with a functional analysis. Second, a socially acceptable communicative response is

strengthened by reassigning the reinforcer found to maintain challenging behavior to that communicative response. Third, the FCT treatment is extended across settings and caregivers (Mancil, 2006; Tiger et al., 2008).

FCT is most often used for problem behaviors controlled by social contingencies. For example, FCT of attention-maintained problem behavior consists of teaching an individual communicative responses with which she or he is able to request attention. FCT for problem behavior that has the function to escape from demands may take the form of teaching an individual socially appropriate means of asking for a break and escape. For FCT to be effective, it should be combined with extinction of the target behavior, and the new communicative response should require less response effort to perform than the target behavior (Hagopian, Boelter, & Jarmolowicz, 2011).

Comprehensive functional analytic model

Clinicians may use the functional analytical approach in an attempt to explain and treat problem behaviors in individuals with developmental disabilities. Within this approach, variables affecting problem behavior are investigated. In case of individualized treatment plans, a comprehensive, integrative, or multicomponent model should broaden its focus beyond assessing relationships between problem behaviors and environmental conditions. When assessing behavioral function and designing a function-based treatment, presence of and relationship to a variety of factors, such as anxiety and depression, physical discomfort, medication side effects, system factors, coping and problem-solving skills, and caregivers' attributions of the cause of problem behavior, should be considered (De Winter, Jansen, & Evenhuis, 2011; Hartley & MacLean, 2005; Langthorne & McGill, 2008; Myrbakk & van Tetzchner, 2008; Noone, Jones, & Hastings, 2006). If clinicians believe that problem behaviors are influenced by medical or biological variables, a medical consultation should be advised in order to identify or rule out the influence of such variables and arrange medical treatment as necessary (Miltenberger et al., 2016). However, reliable measurement and assessment of such factors may be difficult or even impossible in individuals with mild to profound intellectual disabilities. Recording and analyzing relationships between problem behavior and environmental conditions, however, remain the central feature of the functional analysis methodology, as problem behavior is conceptualized as the final outcome of an individual's learning history during interactions with environmental conditions. In daily clinical practice, clinicians should use the following seven steps: (1) identify problem, then select and reliably define target behavior(s); (2) design and use scatter plot and perform unstructured and/or structured ABC recordings; (3) interview caregivers and client, if possible, using the FAI and complete rating scales/checklists such as the QABF; (4) conduct single experimental analyses; (5)

formulate hypothesis of function; (6) design and implement function-based treatment; and (7) evaluate treatment.

Case study

Tim was a 17-year-old adolescent with a mild intellectual disability. He had relatively good adaptive and communicative skills that were appropriate for his developmental age. Because of his disruptive and aggressive behavior at home, he had been placed in a residential facility about a year ago living with seven other young men of his age. During the day he visited a day care center where he worked in a sheltered workshop-type setting. In the living room and at the workshop, he exhibited highly disruptive behaviors, such as elopement, yelling and shouting, and verbally aggressive behaviors toward peers and caregivers. His verbal aggression mainly consisted of threatening others, causing fear in his caregivers and peers. In an attempt to control verbal aggression, he regularly was sent outside to calm down, sometimes was sent home from work, and was also sent to his room contingent on verbal aggression when he was in the residence's living room. Although this behavior was not frequent, it was nevertheless highly intensive and severe. Given its adverse consequences, verbal aggression was targeted for functional assessment and treatment.

Baseline

Prior to a change in management of Tim's verbal aggression, a baseline was taken for 2 weeks. During baseline, several caregivers in both settings completed the QABF. A structured functional analysis interview was conducted with a caregiver in each setting who worked with him at least 6 months. For 2 weeks, caregivers in both settings recorded antecedent and consequent events when the target behavior occurred and other relevant information, such as sleep and affect. Next, a scatter plot was used in which the occurrence of the target behavior was recorded within 2-h intervals. During a short interview with Tim, he told the interviewer that he often felt tired when he was being verbally abusive. He admitted that his verbal aggression was a problem for others as well as for himself. After 2 weeks, results of functional assessment were discussed with Tim and his caregivers. The highest score on the QABF was found on the escape/avoidance scale followed by attention and physical discomfort. The target behavior exclusively occurred during situations in which others were present and was usually triggered by a demand from a caregiver, being teased by peers, and when being criticized. In the afternoon he often showed signs of sleepiness. He almost always was reprimanded by caregivers when he was verbally abusive and was removed from the situation.

Data from the scatter plot showed that the likelihood of occurrence of the target behavior was greatest on Mondays and lowest on weekends. Furthermore, verbal aggression was observed most often between 7 a.m. and 9 a.m., 1 p.m.

and 3 p.m., and 6 p.m. and 7 p.m. These were periods in which more demands were placed on Tim (e.g., getting up, work) and in which he participated in a crowded group, such as mealtimes. Caregivers thought that his verbal aggression resulted from frustration and anger, that he was spoiled, and that he did not want to comply with instructions. The functional assessment suggested that his verbal abuse was a type of escape-avoidance motivated behavior elicited by demands and crowded social situations in which he sometimes was teased. The behavior was most probably maintained by intermittent escape from demands and social situations. Antecedents included situations in which demands were placed on Tim or when he was criticized. Likely EOs included crowded situations as well as sleepiness. There were no symptoms of a psychiatric disorder or medical problems. He also slept for a normal amount of 9−10 h each night. The mean baseline frequency of verbal abuse was 3 per day (range: 0−5).

Treatment

Treatment was initially implemented for 2 weeks. Modifying EOs consisted of presenting Tim with as many choices between work tasks, eating a meal with the group or in his room, shortening delays before giving him prompts and help during work, and preventing unwanted group interactions as much as possible. Alternate behavior was strengthened by giving Tim opportunities for a break upon a socially appropriate request and increased rates of social attention for socially appropriate behaviors and on-task behavior. In order to modify the contingencies maintaining his tantrums, he was not sent to his room, outside, or to his home after verbal abuse. When Tim was abusive, his caregiver would join Tim in another room, instruct him to relax, and, after he had calmed, discuss with him alternative and appropriate ways to cope with the situation that elicited the behavior. Tim was not verbally punished and his caregiver's tone was emotionally neutral. Negative self-statements (e.g., "I am a bad person") were redirected in positive self-statements (e.g., "I can manage it"). After Tim had calmed, both his caregiver and Tim reentered the room, and Tim was redirected back to his task. Following Tim's redirection, his caregiver paid extra attention to Tim for the remainder of the time period. Initial treatment resulted in a marked decrease of rate of verbal aggression to a mean of 0.8 per day (range: 0−2). This effect was maintained during observations scheduled 3 months following the start of treatment.

Conclusion

In this chapter, we briefly reviewed functional analysis methodology for individuals with developmental disabilities. Developments within the functional analytic approach have undoubtedly led to an increase in our understanding of what may cause problem behavior as well as to the design of effective and

humane treatments. Several meta-analyses in this area have shown that behavioral treatments based on outcomes of a functional analysis have larger effect sizes in terms of a reduction in the target behavior than treatments that are not based on such an analysis (Didden, Korzilius, van Oorsouw, & Sturmey, 2006; Ingram, Lewis-Palmer, & Sugai, 2005). Therefore, function-based treatments are the first choice when behavioral function of problem behavior is reliably identified. Some limitations and strengths of various methods of descriptive and experimental analyses have been noted (Herzinger & Campbell, 2007). First, there are some practical limitations including that functional analyses are time consuming, require expertise and are unsuitable for certain settings and types of behavior. To address these limitations, several alternative types of functional analysis have been developed including brief functional analysis, latency functional analysis, precursor functional analysis, functional analysis with protective equipment, and trial-based functional analysis (see for a review Lydon, Healy, O'Reily, & Lang, 2012). However, although differences between functional analyses are reported between studies, the following four standards should be included: (a) problem behaviors are operationally defined, (b) antecedent behaviors are identified, (c) hypotheses are developed concerning variables maintaining problems behaviors, and (d) direct observation data are collected (Herzinger & Campbell, 2007).

Next, the function is not identified in cases in which the problem behavior shows an undifferentiated pattern across conditions and situations, for example, in individuals with a longer history of CB, as additional maintaining variables may have been established over time (Matson & Williams, 2014). Furthermore, functional analysis may not be possible if the individual is prevented from exhibiting a target behavior (e.g., the individual is restrained to prevent life-threatening self-injury or aggression) or if an individual lives in a highly restricted environment (e.g., separation and isolation to prevent dangerous aggression). Non-function-based treatments, such as adaptive skills teaching and differential reinforcement of appropriate behavior, should then be considered in an attempt to change the individual's situation and enhance the individual's future perspectives. When an individual has a known disorder, studies on challenging behavior should be consulted to determine which variables are most likely to maintain the challenging behavior in individuals with this disorder (Matson & Williams, 2014). For example, Didden et al. (2007) found that in individuals with PWS, skin picking is most often maintained by non-social automatic reinforcement. Therefore, this factor should be taken into account during the treatment of this behavior.

Functional analysis methodology has been validated in children and adults with profound to moderate ID and autism. In the scientific literature less attention has been paid to individuals living relatively independent in the community or at home with their family, those with dual diagnosis, and/or those showing low-frequency and high intensity problem behaviors (e.g., fire setting, sexual offending). Also, only a few studies have been conducted in adults

without ID, for example regarding smoking, nail biting, drug abuse and overeating. An exception is the study of Dufrene, Watson and Kazerski (2008) who conducted a brief functional analysis in a 24-year-old female graduated student and found variability in nail biting across assessment conditions. Following treatment with a simplified habit reversal package, nail biting successfully decreased. At present, the status of functional analysis methodology in these target groups remains unclear, although some studies have been published indicating that this approach is valid in these groups and the use in community settings, such as group and family homes (Moreno & Bullock, 2011).

Future studies should address functional analysis of verbal behaviors, including private verbal behavior such as thoughts and feelings. For example, depressive (verbal) behaviors, psychotic-type behavior, and obsessive-compulsive-type behaviors should be further targeted for functional analysis, as the same learning processes that may cause aggression and self-injury may also underlie these behaviors (e.g., Didden et al., 2007; Sturmey, 2005). As a result, functional analysis methodology may be successfully integrated in cognitive behavioral treatment programs, such as anger management, that are increasingly being used in clinical and outpatient settings. For this purpose, existing functional analysis methodology should be further adapted and refined for use with individuals with verbal abilities and mild cognitive impairments.

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