EMPIRICAL MANUSCRIPT

Evaluating the Effects of Function-Based Interventions With Deaf or Hard-of-Hearing Students

Candace J. Gann*,1, Sarah E. Gaines2, Shirin D. Antia2, John Umbreit2, Carl J. Liaupsin2

1University of Texas at San Antonio and 2University of Arizona

*Correspondence should be sent to Candace J. Gann, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249 (e-mail: candace.gann@utsa.edu).

Abstract

This study examined the effectiveness of function-based interventions with students who are deaf or hard of hearing (D/HH). The participants were 3 elementary-aged males attending a center school for the deaf who exhibited chronic off-task behaviors throughout the school day. This study was conducted across 2 phases: (a) a descriptive functional behavior assessment (FBA) was conducted for each participant and (b) individualized function-based interventions were developed based on the results of the FBAs, followed by the implementation of the interventions in each classroom using a single-subject, ABAB reversal design. The function-based interventions significantly improved each participant’s on-task behavior in his classroom environment. Furthermore, social validity ratings by each teacher revealed that the interventions were effective, easy to implement, and appropriate for each participant. Implications for application of the procedures used in this study with the D/HH population, limitations, and directions for future research are discussed.

According to data collected by the Gallaudet Research Institute (2011), approximately 40% of deaf and hard-of-hearing students in a nationwide sample have additional disabilities including developmental delay, attention deficit hyperactivity disorder (ADHD), traumatic brain injury, intellectual disability, emotional disturbance, autism, and other conditions that may result in behavioral difficulties. One primary shortcoming of teacher preparation programs in the field of deafness is a lack of training to develop competencies in working with students who are deaf or hard of hearing (D/HH) and have additional disabilities (Luckner & Carter, 2001). Although teachers of D/HH are highly trained experts on the impact of hearing loss on a child’s development, including language development and acquisition, they are vastly underprepared in their knowledge of the modifications needed to work with students who have additional disabilities, including those which result in behavioral difficulties (Bruce, DiNatale, & Ford, 2008). Thus, many teachers of D/HH do not have appropriate strategies to deal with children who exhibit chronic behavior problems in the classroom.

Functional Behavior Assessment

Children who exhibit chronic aberrant behavior are impacted both socially and academically (Crick, Casas, & Mosher, 1997). This may also negatively impact their peers when teachers must spend instructional time to address these problem behaviors (Montague, Enders, & Castro, 2005). Historically, school personnel have not been supportive of students who exhibit problem behaviors, frequently electing to punish students rather than remediate and teach appropriate behaviors (Moore-Partin, Robertson, Maggin, Oliver, & Wehby, 2010). Further, when non-punitive practices were employed, interventions did not employ function-based techniques. Such non-function-based techniques rarely decreased the occurrence of problem behaviors in the classroom environment (Conroy & Clark, 1999; Hanley, Iwata, & McCord, 2003; Mace, 1994).
Functional behavior assessment (FBA), considered a best practice approach to addressing undesirable behavior, has been significantly researched and shown to be an effective method of assessing behavior (Day, Horner, & O’Neill, 1994; Iwata & Worsdell, 2005; Repp, Felce, & Barton, 1988). This assessment process examines environmental stimuli surrounding problem behaviors in order to determine the function of the behavior, or in other words, what helps maintain the behavior (Horner, 1994; Lane, Gresham, & O’Shaughnessy, 2002). This involves both direct and indirect methods of assessment as well as experimental analysis. Indirect methods include interviews, review of records, checklists, and rating scales. Information about identification of the target behavior, antecedent events, function of behavior, and potential replacement behaviors can be obtained through indirect measures.

Direct measures include direct observation of the behavior in the setting in which it occurs most often. The antecedent-behavior-consequence (ABC) method is a direct method that can lead to identifying a likely function of behavior. In this method, behavior can be observed and recorded to include antecedents preceding the behavior as well as the consequences maintaining the behavior (Iwata & Worsdell, 2005). Experimental analysis occurs when conditions are manipulated surrounding the observed behavior to experimentally identify the specific function of behavior (Gresham, Watson, & Skinner, 2001). Functions identified through FBA include positive and negative reinforcement (Umbreit, Ferro, Liaupsin, & Lane, 2007). Positive reinforcement can include gaining attention, tangible items or activities, or sensory consequences. Negative reinforcement includes escape from peer or adult attention, tangibles and/or activities, or aversive sensory consequences.

Due to ample research that has shown that interventions based on FBAs are successful in decreasing problem behaviors, schools are now legally required to conduct a FBA for individuals with disabilities who are suspended for more than 10 days due to problem behaviors exhibited in the school setting. From the FBA, a behavior plan must be developed and included in the active individual education plan for that student (Stichter, Shellady, Sealander, & Eigenberger, 2000; Weber, Killu, Derby, & Barretto, 2005).

FBA has been continuously used by school districts due to mandates set forth by Individuals with Disabilities Education Act (IDEA) and reforms such as Positive Behavioral Interventions and Supports (PBIS) for students with varying disabilities (Alter, Conroy, Mancil, & Haydon, 2005; Conroy & Clark, 1999). Within the PBIS model, more emphasis is put on reinforcing interactions with students rather than punitive interactions. This approach is consistent with research that has shown that positive reinforcement is more likely than punishment to increase students’ social and academic outcomes (Reinke, Herman, & Stormont, 2014).

Upon appropriate identification of the function of the behavior, interventions that address the function and meet the unique needs of the individual can be implemented to decrease undesirable behaviors and increase the likelihood of positive behaviors (Lane et al., 2002; Scott, Anderson, & Spaulding, 2006). Function-based interventions have been shown to effectively decrease problem behaviors and to maintain over time (Ingram, Lewis-Palmer, & Sugai, 2005; Kamps, Wendland, & Culpepper, 2006; Peck, Sasso, & Stambaugh, 1998; Umbreit, 1995). The Office of Special Education Programs Center on PBIS advocates incorporating three categories of elements into each function-based intervention to ensure maximum potential for change in behavior. These categories are (a) adjusting the environment, (b) teaching replacement behaviors, and (c) adjusting consequences to promote positive behaviors and discourage problem behaviors (Sugai et al., 2000). It is important that function-based interventions are implemented as designed to ensure the effectiveness of the treatment package. Therefore, treatment integrity (i.e., the extent to which an intervention is implemented as originally designed) of these intervention plans should be assessed often. This can be done through direct observation, consultant feedback, permanent products, or the use of intervention scripts (Lane, Bocian, MacMillan, & Gresham, 2004).

Function-Based Intervention Decision Model

One method frequently used to design effective function-based interventions is the function-based intervention decision model (Umbreit et al., 2007). This model begins the intervention development process by posing two questions: (a) “Can the student perform the replacement behavior?” and (b) “Do the antecedent conditions represent effective practice?” The answers to these questions lead to three intervention methods that, individually or combined, are appropriate for a given situation. These methods are as follows: Method 1, Teach the Replacement Behavior; Method 2, Improve the Environment; and Method 3, Adjust the Contingencies. This model has been used in over 30 studies to improve the behavioral outcomes for children in preschool through high school diagnosed with a variety of disabilities (e.g., Gann, Ferro, Umbreit, & Liaupsin, 2014; Nahgahgwon, Umbreit, Liaupsin, & Turton, 2010; Stahr, Cushing, Lane, & Fox, 2006; Turton, Umbreit, Liaupsin, & Bartley, 2007).

Examples of relevant studies using the Decision Model with children with disabilities are described to support the use of this model within various disability categories. Stahr and colleagues (2006) used the decision model to decrease problem behaviors for a student with a disability. In this study, a fourth-grade student with ADHD and a language impairment was displaying disruptive behavior to gain attention from those around him while also escaping difficult tasks. In this case, the student could perform the replacement behavior (i.e., seeking assistance and staying on-task), but the classroom environment did not represent effective practices. When an intervention was developed that adjusted the classroom conditions and reinforced appropriate replacement behaviors while applying extinction procedures to the undesirable target behaviors, disruptive behaviors decreased. Further, both the student and teacher indicated the intervention was both successful and useful.

Turton et al. (2007) applied this method of intervention development with a 16-year-old student with behavioral disorders displaying disruptive behaviors in a self-contained classroom to gain attention from staff and escape assigned tasks. For this student, both Method 1: Teach the Replacement Behavior and Method 2: Improve the Environment were applied to develop a successful intervention to reduce her disruptive behavior and improve her use of appropriate responding in the classroom. The student, one of her peers, and several staff members rated the intervention as being highly acceptable and successful.

Finally, Gann and colleagues (2014) successfully implemented a function-based intervention using the function-based intervention decision model across four classroom settings for an 11-year-old middle school student diagnosed with Asperger syndrome. This student displayed off-task behaviors in all classroom settings throughout his school day. These behaviors frequently resulted in removal from the general education setting to complete assignments in the special education classroom. An FBA conducted across all four classroom settings indicated the student engaged in off-task behaviors to obtain attention,
Behavior Difficulties of Deaf and Hard-of-Hearing Students

FBA emerged from the attempt to understand behavior as communication. As humans, behavior is our earliest form of communication. The responses that infants receive from others will either reinforce a behavior, causing it to be repeated, or result in modifications to the behavior if the child’s needs were not met (Gleason & Ratner, 2013). As children grow, they continue to use behavior as a form of communication. A study by Barker et al. (2009) revealed significant correlations between children’s language skills, attention and action control abilities, and their social-emotional behaviors. Well into school age, children may continue to exhibit a wide range of behaviors, some of which are not considered socially acceptable means of communicating their needs. At a young age, many D/HH children find communication especially difficult, and as a result, may display socially inappropriate behaviors (Zane, Carlson, Estep, & Quinn, 2014). In fact, 72% of D/HH children at age 4 have frequent temper tantrums, twice the percentage seen among hearing 4-year-old children (Arnold, 1999).

Some current studies in D/HH show higher prevalence rates for behavior disorders compared with hearing students (Hintermair, 2013; Vostanis, Hayes, Du Feu, & Warren, 1997). Delays in speech and language development may restrict a child’s ability to communicate. Furthermore, a child may not develop the skills necessary to understand social language. Such children can feel less socially accepted, have more problems in school, experience more depression, and have more social difficulties (Theunissen et al., 2014; Vostanis et al., 1997). D/HH children also report less interest in school compared with their hearing counterparts, and teachers describe these students as more likely to be off-task (Vogel-Walcutt, Schatschneider, & Bowers, 2011). Few researchers, however, have studied behavioral support within the D/HH population.

Rasing and Duker (1992, 1993) instituted social behavior training packages for initiating interaction, interacting appropriately with others, and turn taking with 18 D/HH students receiving services in a residential facility for students who were deaf whose ages from 8 to 13 years. The training included nine 30-min lessons, contingent reinforcement for each appropriate occurrence of the target behavior, and a correction procedure for each occurrence of the inappropriate occurrence of the target behavior. The students who participated in the training program exhibited an increase in positive social behaviors and a decrease in inappropriate social interactions.

Sarti (1993) described a mental health approach used at the Rhode Island School for the Deaf (RISD). Mental health professionals worked with teachers in a group therapy format to remediate behavioral problems within the school. Students included in this program participated in group counseling, during which students received support from staff and peers and had the opportunity to role play daily experiences. After completing the yearlong program, students with significant behavioral difficulties that resulted in removal from the classroom were successfully mainstreamed back into the RISD curriculum.

The PATHS (Promoting Alternative Thinking Strategies) curriculum (Greenberg, Kusché, Cook, & Quamma, 1995) was designed to facilitate the development of self-control, emotional awareness, and interpersonal problem-solving skills in elementary-aged students. This program included classroom lessons that focused on these skills, incorporated pictures and photographs, and illustrated the concepts in each lesson. Additionally, positive reinforcement through social praise and token reinforcement were offered contingent on the demonstration of learned skills. This intervention has been effective in improving the ability of D/HH students to discuss emotional experiences, manage emotions, and develop understanding of some aspects of emotion.

Easterbrooks and Handley (2005/2006) conducted a single-subject study with a 6-year-old student dually diagnosed with deafness and pervasive developmental disorder—not otherwise specified. This student engaged in self-stimulating behaviors that included crossing his arms and squeezing, which caused him to become a target of teasing from his non-disabled peers. To decrease this behavior, the authors employed applied behavior analysis procedures of redirecting the undesired behavior (i.e., crossing his arms and squeezing) and praising the socially appropriate behavior of keeping his arms in a more relaxed position. A decrease in the behavior was recorded and, consequently, the student became more accepted by his peer group.

Through modifications to the classroom environment, Guardino and Antia (2012) were able to decrease disruptive behaviors and increase academic achievement for students in three classrooms at a school for the Deaf. The modifications to the classrooms were discussed with, and agreed upon by, the teachers. Modifications included the seating arrangement, decreased classroom stimuli, the lighting, organization of materials, cleared pathways, specified work areas, and the location of the teacher’s desk. These changes to the environment led to an average 37% increase in academic engagement and a 32% decrease in disruptive behaviors. Additionally, all teachers involved in this study reported they were highly satisfied with the intervention elements.

Although undesirable behaviors in children who are D/HH have been addressed using applied behavior analysis and positive behavior interventions and supports, none to date have used FBAs and function-based interventions (Easterbrooks & Handley, 2005/2006; Sinnott, 2009). Results of studies utilizing FBA and the function-based intervention decision model have shown positive increases in socially acceptable behaviors for children with a variety of disabilities and could potentially show the same findings in D/HH children (Zane et al., 2014).

The purpose of this study was to examine the effectiveness of function-based interventions designed to address the results of FBA interviews and observations for three students diagnosed as D/HH who displayed problem off-task behaviors. All students attended a center school in the southwestern United States. Data were collected across two phases. In Phase 1, a FBA was conducted for each participant through teacher and student interviews, as well as direct observations. Data were analyzed primarily from his peers. It was determined that the student was not able to perform the on-task replacement behaviors of obtaining attention or engaging in assigned tasks. Furthermore, some effective practice elements were present in some classes but not in the others. Therefore, Method 1: Teach the Replacement Behavior and Method 2: Improve the Environment were used to develop an intervention. Teaching the replacement behavior included providing social skills instruction to the student. Improving the environment included modifying the classroom to reduce distractions, designing lessons that utilized multiple methods of delivery and assessment, self-monitoring, frequent praise, and coaching of peers to ignore inappropriate behaviors. As a result, on-task behaviors increased to an average of 92%, a 62% improvement over baseline levels. Each of the student’s teachers reported the intervention was warranted, acceptable, appropriate, and effective compared with previously attempted behavior intervention strategies.
to determine the function of each participant’s target behavior. In Phase 2, the function-based intervention decision model (Umbreit et al., 2007) was used to design and implement individualized function-based interventions for each participant.

Method

Participants and Setting

This study was conducted at a center school that served D/HH students, ages 3–21. All students received educational services in the elementary school setting. The elementary school comprised nine elementary classrooms for grades kindergarten through fifth grade. Each class contained a maximum of eight students. All procedures were conducted within the natural context of the classroom activities.

Three elementary age students and their teachers were recruited for participation in this study (see Table 1). Participants were educated in bilingual classrooms that use American Sign Language (ASL) paired with printed and spoken English when appropriate. Permission to conduct the research with each of the participants was obtained from the institutional review board and the school district. The participants, teachers, administrators, and parents were informed of the research and able to withdraw from the study at any time. The names of all participants were changed to protect confidentiality.

Eligibility requirements for participation in this study were as follows: (a) the participant had been identified by a classroom teacher as displaying chronic off-task behaviors that interfered with instruction and learning (e.g., refusal to work on academic tasks, out-of-seat during instruction, playing with objects), (b) the teacher had requested additional assistance from the principal or school psychologist, and (c) the participant had been rated as having fewer social skills (i.e., a score of 85 or below) or more problem behaviors (i.e., a score of 115 or above) than typical peers based on standardized norms as determined by the Teacher Rating Scale of the Social Skills Improvement System (SSIS; Elliott & Gresham, 2007).

Following initial identification of potential participants based on behaviors observed in the classroom that had interfered with learning or warranted a request for additional assistance from administration or educational psychologists, teachers completed the SSIS rating scale for each identified participant. This assessment measured academic competence, social skills, and competing problem behaviors through the evaluation of 12 domains (Elliott & Gresham, 2007). The academic competence subscales include reading achievement, math achievement, and motivation to learn. The social skills subscales include cooperation, assertion, responsibility, self-control, communication, empathy, and engagement. Finally, the problem behaviors subscales include externalizing, internalizing, bullying, hyperactivity/inattention, and autism spectrum. Statistical analyses of the internal consistency of the SSIS social skills, problem behavior, and academic competence domains have resulted in correlation coefficients of .97, .95, and .97, respectively (Gresham, Elliott, Vance, & Cook, 2011). Participants were selected for this study if standard scores fell at or below 85 on the social skills subscale or at or above 115 on the problem behaviors subscales. Scores at these levels indicated that rated behaviors were undesirable and required intervention (Elliott & Gresham, 2007).

After participants were identified, teachers, with assistance from the second author, an educational psychologist, completed the Functional Rating Scale (Antia, Jones, Luckner, Kreimeyer, & Reed, 2011; Karchmer & Allen, 1999) in the areas of hearing, and expressive and receptive communication. This instrument was developed for the Annual Survey of Deaf and Hard of Hearing Youth (at the Gallaudet Research Institute) and correlates highly with national survey data obtained on hearing loss and communication. The purpose of this scale is to obtain information about the manner in which students function within the classroom setting. It consists of a 3-point rating (i.e., functions normally, mildly limited, severely limited) of hearing, communicative, cognitive, behavioral, and social areas, with descriptive anchors provided for each area (Karchmer & Allen, 1999). For the purposes of this study, only the functional hearing and the expressive and receptive communication ratings were used.

Tomás was a 7-year-old male with a bilateral, moderate to severe sensorineural hearing loss. His functional hearing was severely limited; he was unable to function adequately without visual communication. He had been fit for behind-the-ear hearing aids but no longer used them after losing two pairs. His speech detection thresholds were 40 dB HL bilaterally. He functioned normally both expressively and receptively using ASL. However, he was severely limited in both expressing and understanding spoken language. His teacher used ASL as the primary language in the classroom. On the SSIS, Tomás scored within the average range for academic competence, indicating his reading and math achievement and his motivation to learn was average when compared with his peers. However, standard scores in the social skills (65) and problem behaviors (126) domains were at least 1 standard deviation (SD) from the mean.

Honiahaka was an 8-year-old male with a profound, rising to moderate, hearing loss bilaterally. His functional hearing was severely limited, making him unable to function adequately without visual communication. He had been fit for behind-the-ear style hearing aids but rarely wore them. His speech awareness thresholds were 60 dB HL for the right ear and 55 dB HL for the left ear. Although he functioned within the normal range for receptive ASL, he was mildly limited in the use of expressive sign language, and severely limited in expressing and understanding spoken language. His teacher used ASL as the primary language in the classroom. On the SSIS, Honiahaka scored within the average range for academic competence and problem behaviors. However, his standard score in the social skills domain (85) was 1 SD below the mean.

Table 1. Participants’ descriptive data

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Grade</th>
<th>Ethnicity</th>
<th>Name</th>
<th>Gender</th>
<th>Years of teaching</th>
<th>Total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tomás</td>
<td>Male</td>
<td>7</td>
<td>2</td>
<td>Hispanic</td>
<td>Ms. Vallard</td>
<td>Female</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Honiahaka</td>
<td>Male</td>
<td>10</td>
<td>3</td>
<td>Native American</td>
<td>Ms. Decker</td>
<td>Female</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Carlos</td>
<td>Male</td>
<td>6</td>
<td>2</td>
<td>Hispanic</td>
<td>Mr. Pickerman</td>
<td>Male</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

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Carlos was a 7-year-old male with a bilateral, moderate to moderately severe sensorineural hearing loss. His functional hearing was mildly limited and he needed only occasional visual communication support. He consistently used two behind-the-ear hearing aids. His speech reception thresholds were 60 dB HL for the right ear and 80 dB HL for the left ear. His expressive ASL skills were severely limited, but receptive ASL was mildly limited. He was mildly limited in expressive and receptive spoken language. His teacher used spoken communication with sign language support in the classroom. On the SSIS, Carlos scored within the average range for academic competence. However, scores in the social skills (SS = 70) and problem behaviors (SS = 132) domains were 2 SDs from the mean.

Behavioral Definitions

The target behavior was defined as off-task behavior. Off-task behaviors included talking out (verbal or ASL), leaving the assigned area, turning away from the speaker/signer, and playing with objects unrelated to task. The replacement behavior was on-task behavior, defined as engagement in assigned tasks, remaining seated, looking at the speaker/signer, and any socially acceptable alternatives to the target behavior that was selected based on the function of the problem behavior.

Phase 1: FBA

Phase 1 consisted of a descriptive FBA. The purpose of this assessment was to identify the antecedent conditions that set the occasion for the participants’ target behaviors and consequences that maintained these target behaviors. Data were collected through teacher interviews, student interviews when appropriate, and direct observations in the classroom. Data were then analyzed to identify the function of each participant’s target behaviors.

Structured Staff Interviews

Interviews were completed with the teachers using the Preliminary Functional Assessment Survey (Dunlap et al., 1993). The author who was experienced in conducting FBAs and using this interview tool as well as the second author, an educational psychologist who was fluent in ASL, conducted interviews. The tool is a 22-item survey developed to identify information about the antecedents that occasion, and the consequences that maintain, challenging student behavior. Specific items provide information about the antecedent conditions under which the behavior is and is not likely to occur, the frequency with which the behavior occurs, the possible influence of skill deficits or medical conditions, and the consequences that may affect the occurrence of the behavior.

### Structured Student Interviews

The first 2 authors used the Student-assisted Functional Assessment Interview (Kern, Dunlap, Clarke, & Childs, 1994) to interview the participants. The student interview includes three sections. First, the student is asked open-ended questions about the conditions under which he engages in the problem behavior, what he likes about each of the content area courses, and what could be done to improve his behavior. Second, the student rates each content area course or school activity using a 5-point scale. Finally, the student uses a 3-point scale to respond to questions that focus on the influence of variables such as task difficulty and the availability of reinforcers.

### Structured Observations

ABC data were collected individually for each participant (Bijou, Peterson, & Ault, 1968). Each observation was conducted within each participant’s elementary classroom setting during naturally occurring activities for a minimum of 30 min. During ABC data collection, the first author recorded the specific antecedent and consequent conditions that preceded and followed the occurrences of the identified target behavior. ABC data were collected until there was a clear pattern of antecedents and consequences related to the behavior.

### Identification of the Function

For each participant, the function(s) of the target behavior were identified through the analysis of the data collected via interviews and direct observations using the function matrix (Umbreit et al., 2007; see Figure 1). The function matrix is a six-celled visual tool that organizes information into two columns identifying positive or negative reinforcement, and three rows identifying specific types of consequences. The tool prompts users first to decide if the participant is gaining access to something (positive reinforcement) or escaping/avoiding something (negative reinforcement). The user then identifies whether the participant is gaining or escaping attention, tangibles/activities, or sensory consequences.

### Results

**Tomás**

Tomás’s teacher, Ms. Vallard, reported that problem behaviors occurred daily and throughout the day. She described him as impulsive, hyperactive, and easily frustrated. He enjoyed socializing with the teacher, the classroom aid, and his peers. According to Ms. Vallard, she had tried moving him off to the side, asking him to explain his behavior and what he needed to do to improve it. He did better with short, structured activities that required movement or hands-on activities.
During the student interview, Tomás struggled with understanding and answering the open-ended questions. As a result, little information was gathered from this process. Tomás expressed that he was able to control himself best during physical education and recess. He enjoyed math because they did many hands-on activities and he was allowed to get out of his seat to check the number grid on the wall.

Three direct observations for ABC data collection were conducted for three 30-min periods at the beginning of the school year. Tomás engaged in a total of 56 off-task behaviors during this time. All but one of these behaviors resulted in obtaining attention from either his teacher, the classroom aid, or his peers. Information collected via ABC recording and the teacher interview was entered into the function matrix to determine function of behavior. Once sorted into the function matrix, interview and observation data indicated that the primary function of Tomás’s off-task behavior was to obtain attention.

**Honiahaka**

Honiahaka’s teacher, Ms. Decker, reported that problem behaviors occurred daily, especially in the afternoon or if he was unmotivated by the activity. She described him as fun, hands-on, and very social. He enjoyed socializing with the teacher, the classroom aid, and his peers. According to Ms. Decker, she had tried redirecting and prompting him to return to the task as well as punitive strategies such as providing a countdown to losing recess.

Though Honiahaka’s language skills were limited, he was able to provide some insight into his behavior during the student interview. He felt he learned best when someone taught him how to complete a task in a one-to-one setting. He felt he also performed better when allowed to work with a peer. Honiahaka expressed that he enjoyed receiving praise from his teacher and wished he could be praised more often.

Honiahaka engaged in a total of 65 off-task behaviors across three 30-min ABC observation periods. Seventy-one percent of these behaviors resulted in obtaining attention from others in his classroom. The remaining 29% of behaviors resulted in escape from the task. Interview and observation data indicated that the primary function of Honiahaka’s off-task behavior was to obtain attention, with a secondary function of avoiding tasks.

**Carlos**

Carlos’s teacher, Mr. Pickerman, reported that problem behaviors occurred daily, especially during group activities. He felt Carlos liked attention and wanted to impress people with his intelligence. He had tried ignoring the behavior, redirecting, prompting the correct behavior, and removing him from the group activity.

Because Carlos’s spoken and sign language skills were limited, the interview process caused frustration and was discontinued. Across three ABC data collection sessions, Carlos engaged in a total of 64 off-task behaviors. Ninety-two percent of these behaviors resulted in obtaining attention from his teacher, the classroom aid, or his peers and it was determined that the function of his off-task behavior was to obtain attention.

**Phase 2: Function-Based Intervention Development and Implementation**

In Phase 2, individualized function-based interventions for each participant were designed using the function-based intervention decision model (Umbreit et al., 2007). These interventions were then implemented with each participant within naturally occurring classroom activities.

**Procedure**

The function-based intervention decision model (Umbreit et al., 2007; see Figure 2) was used to identify the intervention most appropriate for each participant. Using this model, the intervention development process began by posing two questions: (a) “Can the student perform the replacement behavior?” and (b) “Do the antecedent conditions represent effective practice?”

The answers to these questions led to four possible outcomes. Each outcome identified which of three intervention methods, individually or combined, was appropriate for a given situation. If the participant could not perform the replacement behavior, but the antecedent conditions represented effective practice, then Method 1: Teach the Replacement Behavior was used. If the participant could perform the replacement behavior, but the antecedent conditions did not represent effective practice, then Method 2: Improve the Environment was used. If the answer to both questions was “no,” then both methods were applied. Finally, if the answer to both questions was “yes,” then Method 3: Adjust the Contingencies was used.

Each intervention method had three common components: antecedents were adjusted to increase the likelihood the replacement behavior would occur, reinforcement was provided when the replacement behavior occurred, and reinforcement was withheld when the target behavior (in this case, off-task) occurred (extinction). The intervention methods differed in the ways specific antecedent and consequent variables were manipulated to address the problems (Umbreit et al., 2007; see Table 2). If the participant could not perform the replacement behavior and the antecedent conditions did represent effective practice, then Method 1: Teach the Replacement Behavior was implemented. Method 1 used direct instruction strategies to teach the replacement behavior. Skills such as social, academic, communication, or self-management skills were taught. The learned skills were then reinforced and reinforcement for the inappropriate target behaviors was withheld.
If the participant could perform the replacement behavior, but the antecedent conditions did not represent effective practice, then Method 2: Improve the Environment was implemented. Method 2 involved implementing strategies to improve the environment including classroom instruction, structure, and operating procedures and routines. If the participant could not perform the replacement behavior and the antecedent conditions did not represent effective practice, then both Method 1 and Method 2 were implemented.

If the participant could perform the replacement behavior and the antecedent conditions did represent best practice, then Method 3: Adjust the Contingencies was utilized to design the intervention. Method 3 involved using strategies to adjust the contingencies of reinforcement for the target behavior. The reinforcement that was previously provided for the occurrence of the target behavior was withheld. Antecedent conditions were also adjusted to increase the likelihood the replacement behavior would occur.

### Intervention Design and Implementation

#### Tomás

Based on the information collected during interviews and classroom observations, it was determined Tomás was not able to perform the on-task replacement behavior, specifically requesting attention in an appropriate manner and attending to the different tasks required throughout a lesson. Further, an assessment of the classroom environment determined that antecedent conditions did not represent best practice. Routines were not established, rules were not set, behavior-specific praise was absent, and instruction was not delivered in the absence of distractors. Because both questions of the decision model were answered “no”, the intervention was designed using Method 1: Teach the Replacement Behavior and Method 2: Improvement the Environment. A token economy utilizing visual supports located on Tomás’s desk was designed to teach and reinforce specific on-task behaviors and the teacher was trained in elements of effective instruction and classroom management. These elements included classroom arrangement and organization, teaching of rules and routines, transition between activities, delivery of directions, and lesson delivery to include frequent praise and opportunities to respond (Conroy & Stichter, 2003; Kern, Choutka, & Sokol, 2002; Zlomke & Zlomke, 2003).

#### Honiahaka

Based on the information collected during interviews and classroom observations, it was determined Honiahaka was not able to perform the on-task replacement behavior, specifically requesting attention in an appropriate manner and attending to the different tasks required throughout a lesson. However, antecedent conditions in the classroom setting did represent effective practice. Therefore, Method 1: Teach the Replacement Behavior was used to design his intervention. Prior to the beginning of this study, Ms. Decker used a behavior management program that allowed students to earn items from the class store. At the end of each period, the teacher moved a clothespin with student names up or down on a color chart based on each student’s behavior during that period. At the end of the day, students earned a specified amount of class money according to the color to which their clothespin was clipped. Because Honiahaka was not able to perform the tasks that would earn rewards, this system was modified to fit his needs. On his desk was a chart utilizing pictorial supports that listed five desired on-task behaviors. At the end of each period, the teacher provided one penny for each behavior he displayed during that time. He could then place the money into his cup to be used to purchase class items. This system allowed him to earn the same amount of money as his peers each day but in a structured manner, which taught and reinforced specific behaviors (Musser, Bray, & Kehle, 2001; Novak & Hammond, 1983).

#### Carlos

Based on the information collected during interviews and classroom observations, it was determined Carlos was not able to perform the on-task replacement behavior, specifically...
requesting attention in an appropriate manner, social turn-taking, and attending to the different tasks required throughout a lesson. Further, an assessment of the classroom environment determined that antecedent conditions did not represent best practice. Routines were not established, rules were not visible, specific behavioral praise was absent, and instruction was not delivered in the absence of distractors. Because both questions of the decision model were answered “no,” the intervention was designed using Method 1 and Method 2. A token economy designed to teach and reinforce specific on-task behaviors utilizing visual cues located within Carlos’s line of sight was implemented and the teacher was trained in elements of effective instruction and classroom management. These elements included establishing behavior-specific classroom rules and routines such as raising a hand and waiting for turns, transition between activities, delivery of task-specific directions, and awarding task-specific praise (Conroy & Stichter, 2003; Kern et al., 2002; Zlomke & Zlomke, 2003).

Design and Measurement
A single-subject ABAB reversal design across participants was used to determine whether there was a functional relationship between the intervention and each participant’s behavioral improvement due to the low incidence and heterogeneity of the population included in this study (Cooper, Heron, & Heward, 2007; Kazdin, 2010). Single-subject methodology is relevant for establishing experimental control and defining basic principles of behavioral and educational practices (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). Baseline and intervention data were collected 5 days per week, whereas follow-up data were collected once per week for 5 weeks upon return from a 3-week holiday break. A minimum of five data points was collected during baseline for each participant. During baseline (A), typical classroom activities and behavior management practices were in place. During intervention (B), the individualized interventions were implemented for each participant for five consecutive data points. Interventions were then withdrawn for 3 days (A) and then implemented again (B) to show a functional relationship between the increase in on-task behavior and implementation of intervention elements.

On-task behavior was measured using 15-s whole-interval recording for 20-min per data collection session. At the end of each interval, a “plus” was scored if on-task behavior occurred throughout the entire interval. A “minus” was scored if the participant was off-task at any time during the interval.

Treatment Intensity
Intervention treatment integrity data were collected concurrently during every baseline and intervention session using a rating scale. Elements of the intervention were listed next to a scale of zero, one, or two. An intervention element was given a score of two if it was in place throughout the observation period. A score of one was given if the element was sometimes in place. A zero was scored if the intervention element was not observed. A sample treatment integrity form for Tomàs can be seen in Figure 3.

Interobserver Agreement
A second observer independently collected on-task behavior and treatment integrity data to assess interobserver agreement (IOA). The second observer was trained during two data collection sessions to ensure IOA percentages met or exceeded 85% agreement. The percentage of IOA was determined by dividing the number of agreements (i.e., intervals scored identically) by the total number of intervals, then multiplying the result by 100% (Kazdin, 1982). IOA data were collected for a minimum of 33% of sessions per phase for each participant and averaged 98%.
(range = 96–100%) agreement for Tomás and Honiahaka and 99%
(range = 96–100%) for Carlos across all phases.

The same two observers collected treatment integrity data
using a rating scale to assess each of the intervention compo-
nents for at least 33% of observation sessions per phase. Number
of agreements (i.e., elements scored the same) were divided
by the total number of intervention elements and then multiplied
by 100%. Treatment integrity IOA averaged 100% for all partic-
ipants across all phases.

Social Validity

Each teacher who participated in delivering the intervention
for each participant completed the Treatment Acceptability
Rating Form-Revised (TARF-R; Reimers & Wacker, 1988). The
TARF-R is a social validity instrument that includes a total of
17 items, with multiple items addressing each of the following
areas: reasonableness, effectiveness, side effects, disruptiv-
eness/time required, cost, and willingness. Each item is rated
on a 7-point Likert-type scale. Scores can range from 17 to 119,
with higher scores representing greater acceptability (Reimers
& Wacker, 1988). Statistical analyses of the internal consisten-
ty of the TARF-R items have consistently resulted in correlation
coefficients above .90 (Reimers, Wacker, Cooper, & DeRaad,
1992). In addition, positive ratings have been connected with
higher probability of implementing and sustaining an inter-
vention (Petersen & Ellison, 2005). In addition to the TARF-R,
the teachers completed the SSIS (Elliott & Gresham, 2007)
prior and post-intervention to compare the participants’ scores in
the social skills, problem behaviors, and academic competence
domains.

Results

The data presented represent participant behavioral changes
as a result of interventions designed using the function-based
intervention decision model (Umbreit et al., 2007). Results
include information from baseline, intervention, return to base-
line, return to intervention, and follow-up conditions. Treatment
integrity data were graphed along with on-task levels to dem-
onstrate the effect of treatment implementation on levels of
on-task behavior for each participant. Social validity results
are also presented to indicate the intervention acceptability and
any changes in social skills, problem behaviors, and academic
competence as determined by each teacher.

Tomás

As shown in Figure 4, Tomás’s on-task behavior averaged 22%
(range = 11–28%) of intervals during baseline, and increased
immediately to an average of 75% (range = 66–88%) of inter-
vals when intervention was implemented in his classroom
setting. Upon return to baseline, on-task levels dropped to 17%
(range = 14–21%) of intervals, and once again increased to an
average of 83% (range = 79–88%) of intervals when intervention
was re-established. During the follow-up phase, on-task behav-
iors varied with an average of 71% (range = 50–90%) of intervals
on-task. There were no overlapping data points between condi-
tions. Treatment integrity levels corresponded to intervention
data trends with levels averaging 4% (range = 0–10%) during the
baseline conditions and 86% (range = 45–100%) during interven-
tion and follow-up phases.

Honiahaka

Honiahaka’s on-task behavior averaged 25% (range = 19–34%)
during the initial baseline and increased to an average of 87%
(range = 79–94%) of intervals during the first intervention
phase (see Figure 5). Upon return to baseline, on-task levels
decreased to an average of 31% (range = 28–34%) of intervals.
When intervention was reinstated, on-task levels returned to
87% (range = 80–91%) of intervals. Data collected during the
follow-up phase showed the intervention continued to be suc-
sessful with on-task behavior levels remaining steady at 88%

Figure 4. Tomás: Effect of function-based intervention.
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There were no overlapping data points between conditions. Treatment integrity averaged 4% (range = 0–13%) during baseline and 98% (range = 88–100%) during intervention and follow-up.

Carlos

As shown in Figure 6, Carlos’s on-task behavior averaged 24% (range = 18–34%) of intervals during the first baseline condition and increased to an average of 86% (range = 80–93%) of intervals upon implementation of intervention procedures. Upon return to baseline, on-task levels dropped to 26% (range = 21–33%) of intervals, and once again increased to an average of 88% (range = 78–95%) of intervals when intervention was reinstated. During the follow-up condition, on-task behaviors remained steady with an average of 85% (range = 81–95%) of intervals on-task. There were no overlapping data points between conditions. Treatment integrity levels corresponded to intervention data trends with levels averaging 4% (range = 0–13%) during baseline and 96% (range = 75–100%) during intervention and follow-up.

Social Validity

The teachers’ social validity ratings on the TARF-R averaged 100.3 (range = 92–107). Ratings were 92 for Tomás’s teacher, 107 for Honiahaka’s teacher, and 102 for Carlos’s teacher. These scores indicated that all teachers found the interventions were effective overall, easy to implement, and appropriate for each participant. However, Ms. Vallard felt too much time was needed each day to carry out the intervention and intervention elements would be disruptive to her class operations. Ms. Decker was unsure whether the intervention would create a permanent improvement in Honiahaka’s behavior and felt a little extra time was needed each day to carry out the intervention with high integrity. Mr. Pickerman was also unsure whether the intervention would create a permanent improvement in Carlos’s behavior. Based on Carlos’s history, he was also only fairly confident the treatment would remain effective across time.

Based on the SSIS scores, all participants made improvements in the areas of social skills, problem behaviors, and/or academic competence. Tomás made improvements in the social skills domain, but problem behavior scores increased and academic competence scores decreased. According to the subscale areas, he made gains specifically in the areas of communication and internalizing behaviors. However, his teacher felt he had begun engaging in more bullying behaviors and exhibited a decrease in empathy. Honiahaka improved in each of the three areas, making marked improvements in the subscale areas of co-operation, assertion, and responsibility. Improvements in the subscale of areas of co-operation, responsibility, empathy, and internalizing behaviors resulted in increased scores on the social skills and problem behavior domains for Carlos. All three participants improved in the areas of engagement and hyperactivity/inattention. Domain scores for each participant can be found in Table 3.

Discussion

The results of this study support the use of FBAs and function-based interventions with D/HH students. Information gathered through interviews and direct observations was used to identify attention and escape functions for three male elementary D/HH students. Individualized function-based interventions were developed for each participant that incorporated social skills instruction, effective classroom practice, positive reinforcement, and extinction procedures. As a result, on-task behaviors increased for each participant. According to the TARF-R (Reimers, & Wacker, 1988), all interventions were deemed effective, appropriate, and easy to implement.

Treatment integrity levels proved to be important in the effectiveness of function-based intervention in this study. Behavioral interventions are a set of components implemented as a package (Greenwood, 2009). When interventions are not executed as designed, researchers and school staff are unable to draw conclusions about their effectiveness (Lane et al., 2004). The treatment integrity data for each of the three participants depicted a relationship between the extent to which interventions were implemented and on-task behavior. Some of the lowest levels of on-task behavior were recorded on the days treatment integrity levels were low. Tomás’s teacher struggled with implementing intervention components on a consistent basis. In fact, the
return to intervention phase was discontinued after only three data points due to low treatment integrity levels. During the follow-up condition, implementation was inconsistent, resulting in low levels of on-task behavior.

Over the course of the study, a relationship between treatment integrity and participant behavior was observed. This was especially true in the case of Tomás’s behavior and intervention implementation by Ms. Vallard. On Day 18, an administrator had just observed Ms. Vallard to assess her classroom management skills. On this day, treatment integrity levels rose from 55% to 70%. This facilitated a 35% increase in Tomás’s on-task behavior. The following week, in the absence of administrative visits, treatment integrity levels decreased to 45%, resulting in a decrease in on-task behavior (i.e., 50% of intervals). Prior to data collection on Day 20, Ms. Vallard was involved in a meeting regarding Tomás’s function-based intervention. His behavior plan was formally included in his Individualized Education Program (IEP) and Mrs. Vallard was required to implement it in her classroom. As a result, the following data collection periods demonstrated an increase in both treatment integrity and on-task levels for Tomás.

Lane and colleagues (2004) suggested several factors that can affect treatment integrity: (a) intervention complexity, (b) implementation time required, (c) materials required, (d) number of personnel involved, (e) perceived and actual effectiveness, and (f) motivation of the teacher. Ms. Vallard reported that the intervention was time consuming and interrupted her daily classroom routines. Providing praise statements at frequent intervals was not a part of her daily routine and she particularly found this cumbersome when paired with delivering token reinforcement. Further, she struggled with providing function-based reinforcers to Tomás because she felt this practice was unfair to her other students. These factors may have had a negative impact in the treatment integrity levels for Tomás.

The results of this study are consistent with previous research using function-based intervention methods (Ingram et al., 2005; Scott et al., 2008; Scott, Liaupsin, Nelson, & McIntyre, 2005) and with previous studies that have examined the efficacy of the function-based intervention decision model (e.g., Nahgahgwon et al., 2010; Turton et al., 2007; Wood, Ferro, Umbreit, & Liaupsin, 2011). For each participant, a functional relationship was established and positive behavior change could be directly attributed to the function-based interventions that were implemented. This study’s findings support the use of these methods with the D/HH population.

One aspect requiring consideration when conducting FBA is the utilization of the assessment interview tools used in this study (Dunlap et al., 1993; Kern et al., 1994). When assessing individuals from culturally diverse backgrounds, complications may arise because of the cultural meanings and associations of a particular term in the host language (Temple & Young, 2004). Mason (2005) pointed out, “Specific nuances of a word in one language may not be easily conveyed into another language. Cultural experiences shape mental images and affect how the meanings of ideas, concepts, and world views are determined” (p. 68). In this study, an individual proficient in ASL assisted in the interviews with both teachers and students for the purpose of interpretation and translation. However, like translations of test items, translation of interview items still proved to be difficult. Items were not easily converted into another language due to different meanings within languages (Mason, 2005). This is

### Table 3. SSIS teacher form standard scores

<table>
<thead>
<tr>
<th>Participant</th>
<th>Tomás</th>
<th>Honiahaka</th>
<th>Carlos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>Pretest</td>
<td>Post-test</td>
<td>Pretest</td>
</tr>
<tr>
<td>Social skills</td>
<td>65</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>Problem behaviors</td>
<td>126</td>
<td>141</td>
<td>109</td>
</tr>
<tr>
<td>Academic competence</td>
<td>107</td>
<td>89</td>
<td>93</td>
</tr>
</tbody>
</table>
important to note, not only within the field of Deaf education but also in the field of bilingual education. Steps should be taken to decrease the “loss in translation” effect in interviews between two people who are not proficient in the language of the other. Mason (2005) makes the suggestion of back- translating the presented items to ensure that the original and translated versions of the instrument are equivalent. During this process, bilingual individuals translate the items into the target language. Other bilingual individuals then retranslate the items to the original language with comparisons made until both versions of the tool are equivalent. This allows for conceptual equivalence, which implies that an item is translated into different words, but the original meaning or conceptual framework remains intact. If these steps had been taken with the interview tools prior to this study, the teachers could possibly have answered the questions in an easier, more comfortable manner, while students may have been included in the interview process using the interview tool developed by Kern and colleagues (1994).

Incidental learning opportunities for deaf and hard-of-hearing children are limited due to the absence of auditory cues in the environment (Antia & Kreimeyer, 1997). Due to the nature of ASL as a visually based language, if a student is off-task and not able to see the teacher, he is missing 100% of what the teacher is communicating at that moment. A hearing child, however, would still receive auditory input if facing away from the teacher and could potentially benefit from the delivered instruction. Further, for redirection purposes, the teacher must move into a D/HH student’s line of sight, obtain his attention, and then deliver the instruction or redirection. This requires more effort than would be required of a teacher of hearing students and takes time away from class instruction. Therefore, interventions had to be developed with these considerations in mind. Inclusion of visual supports related to desired behaviors would be beneficial to both students and teachers. This is the reason that each intervention included some sort of visual representation of desired on-task behaviors on the participant’s desk or in his line of sight. This practice allowed the teacher to walk up to each participant, get his attention by tapping on his desk, and then point to the desired behavior as a means of redirection (Kelly, Forney, Parker-Fisher, & Jones, 1993). This method required less effort than methods of redirection previously used by each of the participating teachers.

Limitations and Future Research

Certain factors limit the interpretation and generalization of the results. First, this study included only three elementary-aged participants; however, each participant engaged in behaviors similar to those in other studies utilizing FBA procedures to develop effective behavior interventions. Additional studies with multiple D/HH students of varying ages would further verify the results. During the course of this study, skills to promote on-task behavior were taught and observed during only one academic subject. To address generalization of skills, the function-based intervention would need to be taught and reinforced in each additional academic area throughout the school day (Gann et al., 2014; Whitford, Liauspin, Umbreit, & Ferro, 2013).

Although the TARF-R (Reimers & Wacker, 1988) was given to the teachers post-intervention, they did not complete this evaluation of intervention acceptance and effectiveness prior to the implementation of intervention to assess previously used methods of behavior management. If given pre- and post-intervention, the TARF-R could have been used to assess social validity differences between the non-function-based interventions previously used by the teachers and the function-based interventions implemented during the course of this study.

Future research should examine the use of function-based intervention with the D/HH population. This work should investigate the effects of this approach with multiple participants of varying ages who exhibit differing problem behaviors. Furthermore, research in the use of function-based interventions with this population should extend to additional settings including residential, public school, and home settings. Research in how to best conduct FBA in tandem with not only teachers of the deaf, but also teachers from other language backgrounds, is necessary to ensure the correct functions are identified prior to implementation of function-based interventions. This will involve back- translating interview tools in tandem with bilingual individuals and researchers. Without additional research in function-based intervention methods with the D/HH population, future teachers of the deaf could continue to struggle with management of chronic behaviors exhibited by their students. As a result, these students will continue to be underserved in their need for effective behavior management strategies.

Conflicts of Interest

No conflicts of interest were reported.

References


