A Functional Analysis of Gestural Behaviors Emitted by Young Children With Severe Developmental Disabilities

Summer J. Ferreri and Joshua B. Plavnick, Michigan State University

Many children with severe developmental disabilities emit idiosyncratic gestures that may function as verbal operants (Sigafoos et al., 2000). This study examined the effectiveness of a functional analysis methodology to identify the variables responsible for gestures emitted by 2 young children with severe developmental disabilities. Potential verbal operants for each participant were functionally analyzed using a multi-element design. Results indicate that gestures were maintained by access to tangible items or the delivery of information about novel stimuli. This study extends the use of functional analysis to identify conditions under which children with developmental disabilities emit gestural verbal behavior.

Key words: functional analysis, autism, Down syndrome, gestural communication, verbal behavior

Young children with developmental disabilities may experience severe delay in the acquisition of verbal repertoires (Sundberg, 2007). Despite this delay, most children develop some response topographies that function as verbal operants (Sigafoos et al., 2000). Responses include problematic behavior such as biting or hitting and non-problematic behavior such as pointing or approaching others. Extensive research has shown that identifying the environmental conditions that produce problematic behavior can improve the effectiveness of interventions designed to reduce such behavior (Carr & Durand, 1985; Hanley, Iwata, & McCord, 2003; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). It may also be possible to identify the conditions that produce non-problematic behavior in order to inform interventions designed to teach conventional verbal responding (e.g., Lerman et al., 2005). However, the application of experimental analysis as an assessment methodology for non-problematic behavior has received limited empirical attention.

This research was supported in part by a grant from the Office of Special Education and Rehabilitative Services of the United States Department of Education (Grant number: H325D030060). We thank Mary Mariage for her collaboration and support.

Correspondence concerning this article should be addressed to Summer Ferreri, Department of Counseling Educational Psychology, and Special Education, College of Education, 340 Erickson, Michigan State University, East Lansing, MI, 48824. (e-mail: sferreri@msu.edu).

A pretreatment functional analysis of problem behavior manipulates potentially relevant consequences and the related motivating operations (MOs; Laraway, Snyckerski, Michael, & Poling, 2003) and discriminative stimuli to identify the precise function of a target behavior (Hanley et al., 2003). The benefit of identifying the function of behavior is that interventions can be developed that disrupt the contingency between the problem behavior and reinforcing consequences, thereby increasing the likelihood of intervention effectiveness (Hanley et al.). Recent research has shown that a similar assessment methodology may be applied to low rate or emerging verbal behavior (Kelley et al., 2007; LaFrance, Wilder, Normand, & Squires, 2009; Lerman et al., 2005; Normand, Severtson, & Beavers, 2008).

Lerman and colleagues (2005) reported a functional analysis methodology to assess the emerging speech of children with developmental disabilities to determine if the observed vocalizations were functioning as mands, tacts, echoics, intraverbals, or some combination of these. The authors posited that this methodology could be helpful for identifying when a child was likely to speak and the conditions under which additional verbal behavior training was needed. Recent extensions have improved the efficiency of a functional analysis of verbal behavior (e.g., Kelley et al., 2007) and demonstrated its applicability to additional response topographies such as sign language (Normand et al., 2008).

Lerman and colleagues (2005) also suggested the functional analysis of gestural

behavior, such as pointing or leading, may inform verbal behavior training procedures for children with developmental disabilities. Extending pretreatment functional analysis to gestural behavior could confirm whether an individual is engaging in verbal behavior and might help interventionists create a contingency between a recognizable verbal response and a reinforcer. The purpose of the present investigation was to extend the use of functional analysis as an assessment methodology to identify conditions under which children with severe developmental disabilities do and do not emit idiosyncratic gestures that might function as verbal behavior.

METHOD

Participants, Setting, and Materials

Felix and Connor, two students enrolled in a public Early Childhood Special Education classroom, participated. Felix was a 3-year-old boy diagnosed with autism who occasionally emitted unintelligible vocal noises. He communicated with others by looking at, standing near, or moving listeners' hands toward things in the environment. Each of these response topographies was confirmed during pre-experimental observation. Connor was a 3-year-old boy with Down syndrome who pointed at objects while standing near adults but did not attempt to obtain those objects or appear distraught if adults did not provide the items.

All experimental sessions were conducted in a small private room (4 m by 3 m) attached to the classroom. Two tables, two chairs, and a bookshelf containing assessment materials were the only items in the room. The experimental materials included (a) a Motiv-Aider[®] vibrating timer, (b) paper and pencil, (c) a Sony[®] ZR 400 video recorder with tripod, (d) stimuli from the classroom such as books, a Mr. Potato Head[®] toy, stacking toys, and sorting activities, and (e) preferred items (i.e., raisins, fruit snacks, and a Koosh-ball[™] for Felix and a toy phone, a musical ball, and a toy truck for Connor) identified during a paired stimulus preference assessment (Fisher et al., 1992) completed prior to the FA.

Response Measurement and Reliability

Researchers conducted an interview with the teacher and a pre-experimental observation for each participant prior to selecting the target behaviors for each child. The criteria for selecting a target behavior were (a) the behavior was reported or observed to occur in the presence (i.e., within 5 ft) of other people, (b) the classroom teacher considered the behavior non-problematic, (c) the behavior was correlated with multiple antecedents or consequences (e.g., an adult might give the child an item and then play with the child and the item), and (d) the topography of the behavior was judged to approximate conventional verbal behavior (e.g., pointing was selected over rocking).

The target behavior for Felix was *alternating gaze*, defined as looking at a predetermined object (i.e., tangible items included in each functional analysis condition) and then to an adult or at an adult and then back to the object (Osterling, Dawson, & Munson, 2002). The target behavior for Connor was *pointing*, defined as an arm extension with the index finger or fingers extended toward an object or person beyond his reach and holding this position for at least one second. Trained doctoral students recorded the frequency of target responding for each participant from video recordings of the experimental sessions.

A second independent observer collected data for 40% of all experimental sessions for each participant. Agreement scores were calculated by dividing the smaller number of recorded occurrences of the target response by the larger number of recorded occurrences for each condition during each session and multiplying by 100 to obtain a percentage. Mean agreement across conditions for Felix and Connor was 94% (range, 0% to 100%) and 94% (range, 50% to 100%), respectively. Agreement scores below 80% occurred during one experimental session for each participant when the primary observer scored a few responses and the second observer scored either a single response or no response.

The experimenters reviewed video recordings of 31% of experimental sessions to assess the accuracy of procedures during FA sessions. A component checklist was used to

Table 1
Functional Analysis Conditions and Corresponding Environmental Variables

Condition	Motivating operation	Prompt or stimulus	Consequence
Tangible	Preferred item withheld	Preferred item visible	Obtain item
Attention Information	Attention withheld	Adult in vicinity	Obtain adult attention
	Novel item visible	Adult plays with novel item	Obtain information about item
Demand	Instructed to complete task	3-step increasing prompt	Escape task demand
Play (control)	None	Regular delivery of attention	Constant access to preferred items

identify the number of procedural components completed correctly. Procedural steps included the experimenter stating the correct instruction to start a session, presenting the instructions or stimulus materials used within each session, providing prompts or other antecedent stimuli if the target behavior did not occur during some conditions, and delivering the programmed consequence contingent on the participant emitting the target response. Procedural integrity was calculated by dividing the total steps completed correctly by the total number of steps on the checklist and multiplying by 100 to obtain a percentage. Mean procedural integrity across conditions was 97% (range, 83% to 100%).

Experimental Design and Procedures

A multi-element design was used to examine gestural behavior under four test conditions and a control condition (see Table 1). Conditions were randomly presented during each session except that the tangible condition always preceded the play condition. The experimental sessions were conducted by a trained member of the research team and occurred over two school weeks. Sessions lasted 17 min and were composed of five experimental conditions with a 30-s break between each condition.

Tangible. The tangible condition assessed for gestural behavior maintained by access to a preferred item. The child's three most preferred items (identified during the preference assessment) were withheld for a period

of 15 min preceding each tangible condition. At the start of the condition, the experimenter instructed the child to sit down at a table upon which no items were present. The experimenter held the most preferred item in the child's line of sight prior to placing it in a small bag or in a location where the child could not reach it. If Connor engaged in the target behavior, the experimenter gave him access to the preferred toy for 20 s. The toy was then taken away from him and placed back in its previous location. If Felix engaged in the target behavior, he was given a small piece of a preferred food item. If after 20 s the child did not engage in the target behavior, the experimenter briefly manipulated the item in the child's line of sight, then placed it back in its original location. This same sequence occurred a second time with the child's second most preferred item. This process continued for the duration of the condition.

Information. This condition assessed for gestures maintained by delivery of specific information about stimuli; similar to a child asking, "What's that?" upon seeing a novel or interesting item. At the start of the condition, the experimenter instructed the child to sit down on the floor where three to five novel items were visible and available to the child. The experimenter sat down with the child and played with one of the items. Contingent on the target behavior, the experimenter labeled the referenced item and made a statement about the function of the item but did not give the item to the child. If the child did not

Figure 1. Responses per minute of Felix's alternating gaze behavior for all experimental sessions.

engage in the target behavior after 20 s, the experimenter selected a new play item. This continued for the duration of the information condition.

Attention. The attention condition assessed for gestural behavior when attention was withheld and then delivered contingent on the target behavior. The child was instructed to play with low preference toys while the experimenter pretended to complete paperwork on the other side of the room. This condition replicated the social disapproval condition utilized by Iwata et al. (1982/1994) except that experimenters delivered vocal attention in the form of a brief comment about the item the child pointed or gazed toward instead of making a statement of concern or disapproval. If the child did not emit the target response, the experimenter did not interact with the child until the end of the condition.

Demand. The demand condition assessed for gestural behavior maintained by task avoidance. This condition was included because school professionals were observed to respond to any attempted interaction even if it did not pertain to the task that was occurring at the time; thus, gestural behavior could be followed by a brief break from task completion. The child was instructed to complete tasks such as sorting blocks or simple puzzles during the demand condition. A least-to-most prompt sequence including the initial instruction, a model, and manual guidance was used to guide compliance to instructions. The child was praised for

completing the task unless manual guidance was required. Contingent on the target behavior, the experimenter picked up the assigned task and moved away from the child for a period of 20 s. Another instructional sequence was delivered after the 20 s elapsed.

Play. This was a control condition to identify gestural behavior occurring when no demands were made and potential maintaining consequences were delivered independent of the child's behavior. During the play condition, the child was given free access to preferred toys or snacks. The experimenter delivered physical and verbal attention (e.g., pats on the back, praise) every 20 s contingent on the absence of the target response or problematic behavior.

RESULTS AND DISCUSSION

Felix (Figure 1) demonstrated the highest rate of responding during the tangible condition ($m = 5.1$; range, 3.0 to 5.5). The information ($m = 1.6$; range, 0.0 to 4.5) and attention ($m = 1.6$; range, 0.0 to 5.5) conditions produced variable responding and the demand and play conditions produced minimal responding. These results suggest Felix's alternating gaze behavior functioned as a mand for access to preferred items. Connor (Figure 2) demonstrated the highest rate of behavior during the information condition ($m = 2.5$; range, 0.0 to 5.6) and some responding during the tangible condition ($m = 1.1$; range, 0.3 to 1.6).

Figure 2. Responses per minute of Connor's pointing behavior for all test and control sessions.

Minimal responding occurred during the demand and play conditions with no responding during the attention condition. These results suggest Connor's pointing behavior functioned as a mand for information about novel stimuli.

The results of the present investigation provide empirical support for the hypothesis that children with developmental disabilities engage in gestural behavior that functions as verbal behavior (Lerman et al., 2005; Sigafoos et al., 2000). Identifying the conditions in the natural environment that evoke gestures might be used to arrange intervention conditions that can reliably evoke and maintain more conventional verbal responding. However, intersubject variability in the form and function of gestures suggest interventions may also need to vary across children. For example, Connor's results suggested a procedure that taught him to mand for information about environmental stimuli would likely lead to the most rapid acquisition of a new verbal response. However, this same intervention would be contraindicated for Felix as he demonstrated a low level of gestural mands during the information condition of the functional analysis. The results of Felix's functional analysis suggest he should be taught to mand for preferred items prior to learning other types of mands.

Some limitations of the present investigation could be addressed by future research. First, treatments based on the results

of the functional analyses were not examined. This limits the extent to which assumptions about the clinical benefits of the functional analysis procedure can be made. In order to better understand the benefit of the methodology used within the present investigation, future research should examine the efficacy of verbal behavior training procedures based on a pretreatment functional analysis of gestural behavior. Second, it is possible that behavior did not occur in some conditions due to a failure to capture or create MOs present within the students' natural environments. Future research should examine the effects of various MOs on responding within certain functional analysis conditions. For example, deprivation from a known versus unknown listener during the attention condition might evoke different levels of responding within the attention condition. A third limitation is that the consequence was delivered for 20 s during the demand condition for both participants and the tangible condition for Connor. This created a potential ceiling on the number of response opportunities the participants could emit during those conditions. However, responding did not reach maximum levels during any session for those conditions.

REFERENCES

- Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through

- functional communication training. *Journal of Applied Behavior Analysis*, 18, 111–126. doi:10.1901/jaba.1985.18-111
- Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis*, 25, 491–498. doi:10.1901/jaba.1992.25-491
- Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis*, 36, 147–185. doi:10.1901/jaba.2003.36-147
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, 27, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities*, 2, 3–20, 1982). doi:10.1901/jaba.1994.27-197
- Kelley, M. E., Shillingsburg, M. A., Castro, M. J., Addison, L. R., LaRue Jr, R. H., & Martins, M. P. (2007). Assessment of the functions of vocal behavior in children with developmental disabilities: A replication. *Journal of Applied Behavior Analysis*, 40, 571–576. doi: 10.1901/jaba.2007.40-571
- Lafrance, D., Wilder, D. A., Normand, M. P., & Squires, J. L. (2009). Extending the assessment of functions of vocalizations in children with limited verbal repertoires. *The Analysis of Verbal Behavior*, 25, 19–32.
- Laraway, S., Snyckerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis*, 36, 407–414. doi:10.1901/jaba.2003.36-407
- Lerman, D. C., Parten, M., Addison, R. L., Vorndran, M. C., Volkert, M. V., & Kodak, T. (2005). A methodology for assessing the functions of emerging speech in children with developmental disabilities. *Journal of Applied Behavior Analysis*, 38, 303–316. doi:10.1901/jaba.2005.106-04
- Normand, M. P., Severtson, E. S., & Beavers, G. A. (2008). A functional analysis of nonvocal verbal behavior of a young child with autism. *The Analysis of Verbal Behavior*, 24, 63–67.
- Osterling, J. A., Dawson, G., & Munson, J. A. (2002). Early recognition of 1-year-old infants with autism spectrum disorder versus mental retardation. *Development and Psychopathology*, 14, 239–251. doi:10.1017/S0954579402002031
- Sigafoos, J., Woodyatt, G., Keen, D., Tait, K., Tucker, M., Roberts-Pennell, D., & Pittendreigh, N. (2000). Identifying potential communicative acts in children with developmental and physical disabilities. *Communication Disorders Quarterly*, 21, 77–86. doi:10.1177/152574010002100202
- Sundberg, M. L. (2007). Verbal Behavior. In J. Cooper, T. Herron, & W. Heward (Eds.). *Applied Behavior Analysis*. (2nd ed., pp. 525–548). Upper Saddle River, NJ: Prentice Hall.