Speech and language assessment: A verbal behavior analysis

Barbara E. Esch, Kate B. LaLonde, and John W. Esch

Abstract

Speech-language assessments typically describe deficits according to form (topography), without identifying the environmental variables responsible for the occurrence (function) of a particular utterance. We analyze a database of 28 standardized speech-language assessments according to six response classes including five of Skinner's (1957) verbal operants. We discuss the importance of including a functional analysis of speech-language skills to better inform treatment planning and target selection. Recommendations for future research are included.
Keywords*:* speech-language, assessment, verbal behavior, functional analysis, verbal operant

Introduction

As practitioners concerned with treating speech-language disorders, one of our primary goals is to accurately and efficiently determine which communication skills should be targeted for intervention. How do we know when something needs to be taught? What defines a *skill deficit* or a *communication breakdown*? In everyday terms, a speech-language problem is signaled when a breakdown occurs in the interaction between a speaker and a listener. That is, we say that communication is successful when the outcome of an interaction is effective (i.e., functional), but when the interaction is weak and ineffective, we suspect a deficit in the repertoire of one of the communication partners. Thus, the critical aspect that defines communicative competence lies in the success of the dyad, a dynamic process comprised of functional units of discourse between a speaker and a listener, even when these roles are assumed within a single individual (e.g., Lodhi & Greer, 1989; Palmer, 1998; Skinner, 1957).

Despite the fundamentally social nature of communication, assessment tools for speech-language deficits rarely take into account this requisite speaker-listener unit, nor is it routine to test for, describe, or analyze specific breakdowns in this unit. Most speech-language assessments in widespread use today evaluate response topographies (forms of responses) alone, without regard for a functional analysis of the causal variables that lead to the specific topographic features of responses. Indeed, much assessment time and energy is expended in classifying speech-language performance, not by its role within a unit of functional communication between a speaker and a listener (i.e., cause and effect), but instead only by its arbitrarily-labeled categories describing non-function based properties such as word structure (e.g., nouns, verbs, plurals), modality (expressive, receptive), relationship (e.g., antonyms/synonyms, agreement), or other inferred characteristics (e.g., ellipsis, nomination, phonological process). This focus is illustrated by ASHA's (1993) definition of language disorder as an impairment in "comprehension and/or use of spoken, written, and/or other symbol systems. The disorder may involve (1) the form of language (phonology, morphology, and syntax), (2) the content of language (semantics), and/or (3) the function of language in communication (pragmatics) in any combination." Although function is an element of this definition, this usage of the term refers to a linguistic feature of language (pragmatics) in contrast to Skinner's analysis of function in which environmental variables describe (and thus, define) the contingent relation that accounts for each particular instance of an utterance (i.e., *language*). As such, linguistic descriptions are less adequate for applied work (i.e., treatments) than is Skinner's model, which specifies the variables that evoke and strengthen verbal behavior.

To be sure, a thorough topographic description of an individual's speech-language repertoire may be a necessary component to plan an appropriate therapy program, but it is insufficient to accomplish the

task because a key element of the evaluation is missing. Our job during assessment is to document not merely *occurrences* of wrong responses to assessment items, but also the speaker-listener environment (antecedent and consequent variables) in which the topography occurs. If a functional analysis of the speaker-listener exchange is omitted from the assessment, a critical part of language learning is at risk of being excluded from an effective intervention plan (Damico, 1993; Frost & Bondy, 2006; LaRue, Weiss, & Cable, 2008; Rowland & Schweigert, 1993; Spradlin & Siegel, 1982; Sundberg, 2008).

Meaning defined by environmental context. The meaning of verbal behaviors is a function of their controlling variables (Hegde, 2008; Skinner, 1957). Speakers and listeners do not "make mistakes," "use the wrong word," or "fail to generalize" in the ordinary sense. A response does not occur in a vacuum, without its controlling variables or variable (Austin, 1975; Bates, 1976; Catania, 2006; Schlinger, 1995; Searle, 1969) and attempting to catalog responses without this information prevents our understanding of what a particular response "means." It is the analysis of a response form within a context defined by antecedent and consequent variables that allows us to determine whether the response is correct or not. For example, the cause-effect context in which a thirsty person asks for *water please* is different than that in which he or she is not thirsty but nevertheless emits *water* in responding to a teacher's instructions to *repeat after me: "water."* The point is the same regardless of topographies; saying *water* in New York or *agua* in Costa Rica or *Wasser* in Germany does not "mean" the same thing when one wants water as it does when one is responding to *say "water"* or *repita "agua"* or *bitte wiederhole "Wasser."*

Topography is interesting only in terms of the functional context in which it occurs. The point applies whether considering a single topography (e.g., *water*, *agua*, *Wasser*) or equivalent forms (synonyms). Whether assessing or treating speech-language skills, a knowledgeable clinician will recognize that the conditions that evoke *pickle* and *cucumber* are not at all the same as those stimuli that evoke *pickle* and *predicament*. It is not the words that *mean* the same thing; antecedent and consequent relations (e.g., request vs. repeat contingencies) are what explain the occurrence of these forms. That is, forms may be interchangeable only to the extent that they share the same controlling variables. Thus, "meaning" is topography within a contingent relation of controlling variables and it is this contingent arrangement that establishes function (i.e., *mean ing*).

Without assessing the controlling variables (motivation, discriminative stimuli, consequent stimuli) that evoke and strengthen or weaken speech-language responses, we may fail to identify appropriate functional (cause-effect) relations by which defective forms (e.g., grammatical errors) of a disorder should be remediated. Evaluations that result in effective intervention plans include an examination of the reasons (controlling variables) that an individual's verbal environment would occasion or maintain particular speech-language topographies (right or wrong) in the first place. We must account for these occurrences by determining the conditions that evoke and maintain them, to adequately prescribe a treatment program that will eliminate, modify, or otherwise resolve these errors.

In sum, a complete speech-language account (Skinner, 1957) would describe not only the form of a speaker's response but it would also explain the function of interactions between a speaker and a listener, resulting in a detailed description of response errors in terms of their topographies (specific words) and the environmental contexts (antecedent/consequent stimuli) in which those topographical errors occur. This would provide both the *description* (topography) and the *explanation* (function) for any given response. Such an account is essential for planning and carrying out effective interventions, whether they involve simple or complex treatments. Without such information, we risk embarking on an incomplete or poorly articulated treatment program that produces or maintains errors (i.e., poor stimulus control over correct responses), resulting in gaps (e.g., splinter skills) in the overall verbal repertoire (see Baker, LeBlanc, & Raetz, 2008; Greer & Ross, 2008).

Treatment Efficacy

A perplexing discrepancy currently exists with respect to assessment and treatment of speech-language disorders. On the one hand, standardized assessment tools that dominate in the field of speech-

language pathology are based on, and result in, a *linguistic* description of speech-language, yet, at best, these assessments can only weakly inform treatment because a linguistic approach to treatment does not exist (Hegde & Maul, 2006). It is true that not all speech pathologists rely solely on standardized tools to inform their treatments. However, whether they use standardized tests alone or they supplement them with other information (e.g., language samples), the analysis of skills for the purpose of diagnosis and treatment planning is linguistically based. This is handicapping because, despite linguistic information from the assessment, the therapist lacks the functional analysis of verbal behavior needed to effect behavior change, which is the sole aim of therapy. Moreover, he or she must look elsewhere (i.e., applied behavior analysis) for effective teaching tools (e.g., Cooper, Heron, & Heward, 2007; Hegde, 1998; Miltenberger, 2001) and formats (e.g., Lovaas & Smith, 2003) that can support clinical intervention. By contrast, a *functional* (behavioral) approach to speech-language has already been described for both assessment (e.g., Carr & Durand, 1985; Duker, 1999; Frost & Bondy, 2002; Greer & Ross, 2008; Hart & Rogers-Warren, 1978; Lerman et al., 2005; Spradlin, 1963; Sundberg, 2008; Sundberg & Partington, 1998) and for treatment (see Hegde, 1998, Ogletree & Oren, 2001, and Sautter & LeBlanc, 2006 for reviews). Despite this, it is only speech-language *treatment* that seems to have been influenced by behavior analysis and its technology (e.g., Bourgeois, 1992; Kouri, 2005; Rvachew, 1994) whereas assessment of these disorders remains firmly linguistically based on tools (see *Directory*, American Speech-Language-Hearing Association, ASHA, 2009) that do not include or provide for an analysis of environmental variables that control the speech-language performances assessed.

It is perhaps this problem referred to by proponents of informal (i.e., criterion-referenced) assessments (Notari & Bricker, 1990; Romanczyk, Lockshin, & Matey, 2001) for children with a diagnosis of Autism Spectrum Disorder (ASD). These advocates argue that, for this population at least, standardized assessments typically do not identify appropriate curricular targets. Although focused on the needs of individuals with ASD, these and other discussions (National Autism Center, 2009) emphasize the issue of treatment efficacy for all individuals receiving speech-language intervention and the need to administer assessments that are comprehensive enough to inform treatment.

The Purpose of Assessment

Speech-language assessment is conducted for many reasons. It can provide diagnostic labels (e.g., specific language impairment, apraxia of speech, aphasia) and help determine therapy progress. It can also support documentation required by agencies, such as performance comparisons (i.e., norm-referenced data) for Individualized Educational Plans in schools, and status updates for reimbursement purposes in medical and clinical settings. But by far, one of the most important purposes of an assessment tool is to provide adequate information to plan an effective intervention that fits into a sequenced curriculum of skills. As mentioned earlier, most standardized assessment tools used by SLPs are based theoretically on a linguistic analysis of language for which no corresponding treatment methods are available. This "conceptual inconsistency" (Hegde & Maul, 2006) results from several historical influences on the development of the profession's theoretical base and may explain the prominence (Novak & Pelaez, 2004) of diagnostic labels (e.g., apraxia, auditory processing disorder) in terms of hypothetical constructs in lieu of function-based explanations of behavior. Duchan (2008) traces the current conceptual perspective in speech pathology from an emphasis on *psychological processing* (1945 to 1965) to *linguistics* (1965 to 1975) and, finally, to *pragmatics* (1975 to 2000) at which time "we reconsidered and reframed language in light of its communicative, linguistic, cultural, and everyday-life contexts" (p. 2). It is unclear what is meant by "everyday-life contexts," but a functional (cause-effect) analysis of language may be the goal. Much of what is described in this historical review hints at the need to address behavioral function (see also Prizant & Duchan, 1981) and there is a tangential nod to behavior analysis evident in Duchan's program descriptions that include *sabotage techniques* (i.e., *motivating operations*; Laraway, Snycerski, Michael, & Poling, 2003) and response *intents* (i.e., *mand, tact, intraverbal*; Skinner 1957). Despite this, the descriptive focus, including that widely available (e.g., Pinker, 1994) to general consumers interested in language development, remains clearly non-behavioral

(e.g., psycholinguistic skills, linguistic relationships). What has evolved, and permeates the field of speech pathology, appears to be largely a non-behavioral view of language learning in which a *functional analysis* for many professionals may not mean a causal, explanatory analysis of verbal behavior in terms of the environmental stimuli that evoke and maintain it but, rather, may resonate more as a description of the "use of language." This can impede prescription and remediation efforts by failing to provide a full account of speech-language performance: speaker-listener interactions comprised of not only topographic/structural descriptions but also of functional (i.e., causal) explanations for the occurrence of those topographies.

Challenges to Resolve

A number of issues present both assessment and clinical application challenges for speech pathologists and others responsible for teaching speech-language skills. We propose that solutions are available to help resolve these issues by applying a behavioral analysis to the assessment process initially and, later, throughout treatment. Our discussion of these concerns follows.

1. *Receptive-Expressive Dichotomy*

   Speech-language and its assessment is typically described as consisting of two categories, receptive and expressive. Accordingly, treatment plans are likely to channel the therapeutic focus into this same dichotomy. As a result, speaker and listener repertoires may be regarded as simply two halves of a common cognitive process in which words are "understood" in one modality and "used" in another. Instead of considering language as performance (i.e., behavior), this traditional view of language implies that a language entity exists structurally as a type of cognitive holding tank from which appropriate responses (i.e., "meaning") are chosen to fit a particular communicative situation. The notion is that speakers toggle between selecting a word and using it. It is significant, however, that we do not appeal to a similar cognitive account to explain *nonverbal* behaviors, such as scratching an itch or scrubbing a pot. No one would assert that, when the mosquito bites, we select a scratch from a mental reservoir of available muscle actions. We would be satisfied to contend that the itchiness occurred, we scratched it, and the itch went away.

   In contrast to linguistic explanations of language, a behavioral view posits that we would not "use" a word, *water* for example, any more than we would "use a reach" (Skinner, 1957, p. 7) to obtain the water itself. Instead, antecedent and consequent conditions related to water are sufficient to evoke either response, whether a nonverbal reach for water or a verbal *water* (Hegde & Maul, 2006). Nothing is gained by inserting a hypothetical construct (receptive or expressive "use") into an explanation of why the response occurred. We still have to account for each instance of the proposed use (Sundberg & Michael, 2001). This requires identifying the response of interest as part of a unit of motivational variables, prompts, instructions, and consequences. Instead of residing at-the-ready in a sort of cognitive container, speech-language skills are more usefully characterized as different repertoires based on separate functional relations between antecedent and consequent conditions (Hegde & Maul, 2006; Schlinger, 1995; Sundberg & Michael, 2001).

   Appealing to hypothetical constructs to explain instances of verbal behavior can obscure a clinician's efforts to pinpoint errors during assessment and to target a coordinated sequence of skills for remediation. Consider a situation in which a child does well on a receptive test of verb tense but fails verb items on an expressive test (e.g., CELF-4; Semel, Wiig, & Secord, 2003). Is the problem with the speaker repertoire (expressive) in general or with verb tense specifically? Should treatment consist of repeating verb tense forms while looking at pictures (e.g., *the boy is running*) or should it provide practice in completing sentences (e.g., *Bob is walking but Reggie is . . .*), with pictures or without? What if the learner can label pictures with progressive verb forms (e.g., TWF-2; German, 2000), but cannot complete sentences with correct verb forms, or changes

verb tense when asked to repeat sentences (e.g., CELF-4; also CELF-P, Wiig, Secord, & Semel, 2004; TOLD-P:3, Newcomer & Hammill, 1988), a task that essentially tests echoic skills? Is this a problem of verb tense, sentence completion, or poor repetition (i.e., echoic)? What about the learner who can say rhyming words but cannot point to them (e.g., PLS-4; Zimmerman, Steiner, & Pond, 2002)? Is the problem receptive or does it indicate a poor (possibly covert) echoic repertoire (i.e., "expressive")? How are we to interpret results of a test that shows a child can point to a puppy in response to *which one is little* but cannot tell you the opposite of *big*? Should you work on adjectives, opposites, or general expressive skills? These situations exemplify the difficulty in determining intervention targets from assessments where skills are not explained functionally (i.e., by their controlling variables) but, instead, they are defined linguistically and categorized topographically as either receptive or expressive.

2. *Mismatch Between Assessment Focus and Real-World Contingencies*

Most speech-language tests in wide use today are standardized instruments (ASHA, 2009) that provide information about skills solely according to linguistic parameters, described earlier as *topographic* responses. However, the speech-language behavior emitted by an individual does not exist in a topography-only sense, absent its effect on a listener (Skinner, 1957) and, in the real world, topographic errors (*thoup* for *soup*) are disregarded (Hart & Rogers-Warren, 1978) unless their form is too deviant (e.g., my doggy *runded* away). Topographies become functional entities (i.e., meaningful) only when they occur in a dynamic environment consisting of at least one speaker and one listener. We cannot know what a speaker means if we hear him or her say *shoe* merely on the basis of the topography (word) itself. We need access to the speaker's reasons, a description of the conditions that evoked such a response (Hegde, 2008). Functional speech-language behavior is evoked and strengthened in a unit in which antecedent and consequent stimuli occur in temporal proximity to an instance of a speaker's topographic behavior and combine to become functional communication (see Sautter & LeBlanc, 2006). Therefore, its description, to be useful for treatment planning, must involve more than just a description of topography. Instead, we need to describe speech-language behavior more functionally (e.g., Baker et al., 2008; Greer & Ross, 2008; Koegel & Koegel, 1995) with resulting evaluation tools (e.g., Sundberg, 2008; Partington & Sundberg, 1998) that take this functional unit into account.

3. *Treatment Interference Due to Problem Behavior*

We have often heard the sentiment expressed by clinicians and others that "I can't work with this person until his (or her) behavior is fixed." It is true that interfering behavior is a problem, yet it need not preclude our assessment and teaching efforts. A good first step is to ask "if he were speaking English (or any language) right now, instead of crying, hitting, running away, what would he be saying?"

Through functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1994), it is possible to identify and address weak speech-language repertoires that are functioning as problem behavior. Functions have been identified that indicate problem behavior, although not recognizable as true language in *form*, is indeed *functioning* as language to gain access to (i.e., request) attention, tangibles, or escape from task demands (e.g., Dwyer-Moore & Dixon, 2007; Kodak, Northup, & Kelley, 2007).

For learners with weak communication skills disguised as problem behavior, listener skills are often the initial focus of therapy (i.e., compliance training) because these skills were the weakest (and thus most salient) during assessment. Although listener skills are critically important in the overall speech-language repertoire, focusing initial treatment on those skills may be unproductive for learners with interfering behavior problems. From a functional standpoint, this is because the consequences for listener responses do not directly benefit the speaker

(Skinner, 1957). Learners who already find little to compel them to engage in treatment are unlikely to be motivated by generalized social reinforcers (i.e., praise) when they can emit easier responses (e.g., hitting) that readily produce consequences of greater value to them. For the learner with a history of failure for speech-language attempts, *mand* (i.e., request) assessment and training is a good first choice (Esch, 2009; Koegel & Koegel, 1995) because the consequences that maintain mand behavior are specific and are of direct benefit (i.e., you get what you ask for). The key issue is to train responses that are equivalent in function (e.g., access to attention) but yet are more socially acceptable in form (e.g., asking instead of hitting).

Typically developing children develop a strong repertoire of mands before other verbal operants (Bijou & Baer, 1965; Novak, 1996) and, like any other learner, when this skill set is defective, it is not unusual to see problem behaviors arise that fill the functional vacuum. Therefore, the task of assessment is to identify not only inappropriate response *form,* but its *function*. Without determining function, eliminating an offensive form alone is unlikely to succeed. Through assessment of verbal functions, the therapist can identify appropriate mands to teach in order to provide the learner, child or adult, with speech-language responses that are adaptive in the natural environment, regardless of diagnosis (e.g., ASD, traumatic brain injury), disability label (e.g., developmental language impairment, aphasia, apraxia of speech), or educational setting (e.g., home, school, hospital, clinic).

4. *Identifying and Sequencing Intervention Targets*

Assessment should lead to a plan for intervention, a prescriptive list of targets to be acquired (LeBlanc, Dillon, & Sautter, 2009). When assessments identify deficits in non-functional, topographic terms alone (e.g., derivational adjectives, inflection verbs), it can be difficult to pinpoint specific speech-language responses that would be manageable therapy targets or to determine how they fit together as part of a competent verbal repertoire. What should we teach first – nouns, opposites, plurals, or colors? Should we work to resolve word-finding problems before number repetition or relational vocabulary? Because none of us has access to a learner's *perceptions* or *cognitions* (Schlinger, 1995; see also, Schlinger, this issue), targets identified in linguistic terms are not easily modifiable until they are re-interpreted as a measurable, observable set of responses, defined as part of a functional verbal unit comprised of antecedent and consequent stimuli. Given these more concrete criteria, it is easy to see how topographic descriptions alone do not resolve our diagnostic task.

Functions of verbal behavior. No doubt most readers of this journal are familiar with Skinner's (1957) analysis of verbal behavior, which provides a useful theoretical framework for assessing, and thus treating, speech-language behavior in terms of the environmental variables that control verbal responses (see also Greer & Ross, 2008; Hegde, this issue; Sundberg, 2008; Sundberg & Partington, 1998). Table 1 presents five of these verbal operants that are most relevant to our discussion. In brief, consider the conditions under which we might emit the response *cookie*. When hungry, we might ask for *cookie*. We could say *cookie!* in response to seeing, smelling, or tasting one even if we are not hungry. Given the instruction *say 'cookie',* we may emit the required repetition. Also, we could likely respond *cookie* to one of many verbal stimuli related to the topic of cookies (e.g., *what did your mom bake, what does c-o-o-k-i-e spell).* Finally, we might read *cookie* if we saw it written on the Keebler® box. The foregoing examples are identified as *mand, tact, echoic, intraverbal, and textual* operants, respectively, and, in each instance, the form of the response is the same, yet the environmental conditions (antecedent/consequent stimuli) in which each response would likely be emitted are not at all equivalent. When assessments provide this level of speech-language information, a more effective intervention plan can be designed, one that addresses not only response topographies but

response function as well, thus ensuring a more integrated language learning experience for those we teach.

Table 1. Descriptions of five elementary verbal operants (Skinner, 1957)

Verbal Operant	Antecedent events that evoke the operant	Response	Consequent events that strengthen the operant
Mand	Motivating conditions (e.g., wants toy airplane)	Asking (e.g., *Airplane*)	Specified by the mand (e.g., Gets toy airplane)
Echoic	Verbal stimulus (vocal) (e.g., "Say 'airplane'")	Repeating (e.g., *Airplane*)	Generalized social reinforcers (e.g., "Right!")
Tact	Nonverbal stimulus (e.g., Airplane flies overhead)	Labeling (e.g., *Look Mommy, Airplane!*)	Generalized social reinforcers (e.g., Mom: "Wow! That's really big!")
Intraverbal	Verbal stimulus (any) (e.g., "Did you arrive by train?")	Conversation (e.g., *No, airplane*)	Generalized social reinforcers (e.g., "Oh, how was the flight?")
Textual	Verbal stimulus (textual) (e.g., Word: AIRPLANE)	Reading (e.g., *Airplane*)	Generalized social reinforcers (e.g., "Good reading!")

NOTE: Functions that may involve complex language behavior (e.g., problem solving, remembering, joint control, emergent relations) are outside the scope of this paper. Readers interested in these topics are referred to Donahoe and Palmer (1994), Lowenkron (2006), or Rehfeldt and Barnes-Holmes (2009).

Sequential targets. Assessments need to do more than just identify what needs to be taught. Intervention targets also need to be sequenced in such a way that the learner's new communication skills achieve success in his or her verbal community as quickly as possible (Greer & Ross, 2008). Teaching targets sequenced according to a functional analysis of verbal behavior may be more efficient than following traditionally defined sequences (i.e., receptive before expressive) (Miguel & Petursdottir, 2009). For example, Williams and Greer (1993) demonstrated that, when targets were defined in terms of their verbal function, children learned functional and spontaneous speech, whereas, when linguistic targets were taught, the children learned fewer forms and functions. This study shows that when the variables that control a speech-language target response are identified, they can be used, modified, or otherwise brought to bear on the response of interest to help a therapist effect change in the learner's verbal behavior to ultimately become a more competent speaker. As we shall see in the next section (see *Error Analysis* below), this is a powerful tool for therapists.

Sometimes the controlling variables for certain intervention targets are inside the learner's body and thus they are inaccessible to the clinician. Response targets like these, often called *feelings* (e.g., *tired, happy, sad, angry, sick*), are difficult to teach because, as clinicians, we cannot verify the presence/absence of the stimuli that evoke them. Yet these and other *private events* (Schlinger & Poling, 1998; Skinner, 1957) are commonly tested in speech-language assessments (e.g., PLS-4; ROWPVT, Brownell, 2000; TOLD-P:3) and are often selected as targets to teach labeling non-verbal stimuli (i.e., tact) to children whose tact repertoires are weak even for stimuli that are outside the skin and thus are verifiable by teacher and learner alike (e.g., *book, wagon, pizza*). Because of this, assessments that identify controlling variables for potential

intervention targets (e.g., Sundberg, 2008) have the advantage of pointing clinicians toward appropriate targets and, at the same time, focusing their efforts away from targets that may seem important but that are premature in the developmental-functional curriculum.

5. *Error analysis*

The purpose of speech-language assessment is to identify response errors in the learner's verbal repertoire so treatment can be provided that will eliminate these errors in the day-to-day communication environment and replace them with more adequate responses. As discussed, a careful analysis of the controlling relations for speech-language responses can provide valuable information for treatment planning.

The value of an error. Error responses are instructive for clinicians because they tell us precisely what variables control the extant incorrect response. An analysis of these errors allows us to thereby establish correct responses and to eliminate stimuli as prompts (i.e., multiple control) that are extraneous, but currently required, to evoke these responses (Sundberg & Michael, 2001).

For example, a learner may indeed be able to correctly answer *How many feet does a duck have* when visiting the duck pond at the park but may not be able to emit the same correct response on the ride home when the visual stimulus (i.e., the duck) is absent. By cataloging the conditions in which a desired response does and does not occur, we have the information we need to write intervention plans to transfer control from the current evocative variables to those that should evoke and maintain correct responding.

Functional independence of operants and stimulus control transfer. Whereas a verbally competent speaker may readily tact after learning to mand, or to respond intraverbally after learning to point to an item, this seemingly automatic transfer of function does not occur easily for individuals with speech-language impairment. For example, in a study of tact, mand, and intraverbal responding (Sundberg, San Juan, Dawdy, & Argüelles, 1990), individuals with traumatic brain injury demonstrated *hierarchies* of acquisition, showing that verbal functions (e.g., tact, mand) could be acquired from echoic or textual (i.e., letters) control but that stimulus control transfer (Catania, 1998) from one function to another did not occur without direct training.

A growing body of literature in error analysis has shown the functional independence of many language-related responses (e.g., Braam & Poling, 1983; Hall & Sundberg, 1987; Lamarre & Holland, 1985; Luciano, 1986; Miguel, Petursdottir, Carr, & Michael, 2008; Partington & Bailey, 1993; Petursdottir, Carr, Lechago, & Almason, 2008; Sidman, 1971; Sigafoos, Doss, & Reichle, 1989; Twyman, 1995; Watkins, Pack-Teixeira, & Howard, 1989) and stimulus control transfer has been reported for several verbal functions.

Sweeney-Kerwin, Carbone, O'Brien, Zecchin, and Janecky (2007) transferred control of mand responses by children diagnosed with ASD from nonverbal stimuli (i.e., tact) to appropriate motivating conditions. In another study of children with ASD, Goldsmith, LeBlanc, and Sautter (2006) reported successful transfer of stimulus control to bring tact responses under intraverbal control. A study by Lerman et al. (2005) illustrates particularly well the value of analyzing language responses by their controlling variables. In this study, a child could tact *baby* but could not mand *baby* nor emit any baby-related intraverbal responses. The specificity of this type of information, by verbal function, clearly pinpoints treatment goals (e.g., teach mand and intraverbal responses for the same topography as that acquired under tact control).

Clinical competence with stimulus control transfer is particularly useful in identifying appropriate intraverbal targets and in providing treatment that avoids inducing errors with this complex repertoire. Whereas the conditions that might evoke a single mand, tact, or echoic response are fairly straightforward, the variables controlling any particular intraverbal response

can be numerous. For instance, a mand requires only sufficient motivating conditions; the tact is evoked by a particular nonverbal stimulus; and an echoic, in general terms, is simply a repetition of an auditory model. On the other hand, a competent speaker has an intraverbal repertoire in which a single response is under the control of tens, perhaps hundreds, of antecedent stimuli that evoke it. For example, under appropriate conditions, we could easily emit the intraverbal response *salsa* to stimuli such as *what's tortilla dip called*, *let's chop tomatoes to make some. . .*, *what dance class are you taking*, and any number of other salsa-related questions. But learners with weak speech-language repertoires will be challenged by any one of these stimuli and, as we have suggested, simply teaching a selection, tact, echoic, or mand response is unlikely to result in an extensive *salsa* repertoire.

A behavioral interpretation of the findings discussed above dissuades us from cognitive explanations of deficits identified through our assessments. Because a learner can point to a dog when asked, but cannot name a dog when he sees one is not well explained by saying that he does not yet have the concept of dog. Instead, we can more profitably turn our attention to the variables that evoke various *dog* responses to plan and carry out an effective treatment program. We cannot blame learners or their disability for error responses when we have yet to arrange appropriate stimulus conditions that will evoke and strengthen more accurate responses. Indeed, clinicians who understand how to assess error responses in terms of their controlling variables have a distinct advantage in helping learners increase their speech-language skills (Sundberg & Michael, 2001) by strengthening appropriate stimulus conditions under which particular target responses occur.

Functional Assessment in Speech-Language Pathology

A few models (partial or comprehensive) are available for functional assessment of speech-language disorders (e.g., Baker et al., 2008; Carr & Durand, 1985; Grow, Kelley, Roane, & Shillingsburg, 2008; Lerman et al., 2005; Partington & Sundberg, 1998; Sundberg, 2008; note: SLPs interested in functional assessment related to feeding disorders are referred to Piazza & Roane, 2009) and researchers have called for increased attention to environmental variables for analysis of communication disorders (e.g., Hyter, 2007; Roth & Spekman, 1984). However, in general, SLPs largely rely on standardized, linguistic-based assessment tools to provide diagnostic information, which are unlikely to inform or adequately support efforts to design appropriate and effective intervention programs. It is perhaps not surprising, then, that speech-language pathologists often turn to criterion-referenced tests to develop appropriate intervention targets, although, absent analyses of causal variables, such informal measures arguably offer no advantage over their standardized counterparts in terms of providing a behavioral analysis of language performances, which we maintain is essential for effective treatment planning.

Database of Speech-Language Tests

As a first step in bridging this gap, it would be helpful to have a "translation" of existing assessment instruments, reinterpreted according to the verbal functions that are represented by their test items. To that end, we examined a group of speech-language tests (Tables 2 through 7) designed to diagnose aphasia, apraxia of speech, articulation and phonological disorders, and language disorders (expressive, receptive, or both). Assessments for other speech-language disorders such as fluency (i.e., stuttering), voice quality, and dysphagia (swallowing disorders) were excluded from the database.

The assessment database consists of 28 standardized speech-language tests that were selected from among those commonly used at a university-based speech and language clinic. The clinic is associated with a graduate program for SLP, which is accredited by ASHA's Council on Academic Accreditation in Audiology and Speech-Language Pathology. Tests are administered to individuals referred for diagnostic purposes or, in the case of established clients, the tests are given to document progress toward therapeutic goals.

The database lists the probable controlling variables for responses required in each test or subtest. For some test items, it is likely that multiple stimuli must be self-generated to emit a "correct" response (e.g., self-echoics). Thus, a more complex analysis may be needed in which additional variables are considered (e.g., joint control, Lowenkron, 2006; emergent relations, Sidman, 1994; see also Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000; autoclitics, Skinner, 1957). Nevertheless, a beginning analysis is offered, listing the test item's probable controlling variables for 5 of Skinner's verbal operants *mand, echoic, tact, intraverbal,* and *textual*, and for the nonverbal operant involving listener relations commonly referred to as *receptive language*.

Procedures

Each test (or subtest) was coded according to the verbal operant represented by the inherent or implied antecedent conditions prescribed by the test and by any other information available with respect to the functional unit represented by each test item. Antecedent conditions included examiner's instructions (e.g., *point to, say what I say, tell me about*), materials, allowed prompts, and actual or implied motivating operations (Laraway et al., 2003; Michael, 1982, 2004) to evoke appropriate responses. In some assessments, allowed prompts changed the operant being tested by providing additional stimuli that could exert control over the response. Tables 2 through 7 specify these situations (when they could be identified by the test protocol) with the letter *P* (prompt) under the appropriate operant column, indicating a potential change in, or addition to, the basic operant being tested.

Other factors that informed the coding procedure included controlling variables that were only implied, but not directly tested, due to the nature of the test (i.e., informant assessments, see Table 5). Such indirect assessments are so designated in the *Comments* column.

Each test or component subtest was coded twice, once by the first author, a board certified behavior analyst and speech-language pathologist, and again by the second author, a graduate-level speech-language pathology student with an undergraduate degree in behavior analysis. In the case of disagreement, an independent behavior analyst reviewed items until agreement was reached.

Code Definitions

Test items were coded according to Skinner's (1957) five basic verbal operants (*mand, tact, intraverbal, echoic, textual*) or, in the case of nonverbal operants, as *receptive* items. To be precise, the test items themselves were not operants, but they were coded as such because of the type of functional unit that would exist if a correct response to the test item occurred and was reinforced. It should be noted, however, that in many general testing situations, reinforcement is specifically proscribed (presumably to maintain test integrity). For this reason, no such functions are assumed to be established through the testing procedure with the assessments in our database. For the examiner-practitioner, advantages of withholding reinforcement during assessment should be carefully evaluated as some studies have shown improved test performance under reinforcement, compared to non-reinforcement conditions (e.g., Edlund, 1972; Koegel et al., 1997).

Mand. A test item was coded mand (M) if there was evidence that the item evaluated responses under the control of a motivating operation or if a consequence, provided or implied, was response-specific (e.g., child says *cookie* and gets cookie).

Echoic. Items coded echoic (E) presented verbal stimuli for which a correct response would be verbal with point-to-point correspondence. For example, a correct echoic response to the instruction "*Say 'what's your name'"* would be *what's your name.*

Tact. A tact (T) code designated items in which a non-verbal stimulus (e.g., picture, object) was presented to evoke a verbal response. For example, an item would be coded T if it instructed the examiner to show a picture of a house, with *house* being the correct response. Note, however, that in both assessment and instructional situations, it is a frequent practice to add the question *what's this* when

presenting pictures or objects to test "labels." In such cases, a response is more accurately described as being under both tact (house picture) and intraverbal (*what's this*) stimulus control. Items were also coded T if a nonverbal stimulus was given to evoke verbal responses regarding attributes such as stimulus feature, function, or class (e.g., a correct answer would be *bounce* or *beach* instead of *ball*).

Intraverbal. A test item was coded intraverbal (IV) if it contained a verbal stimulus to evoke a verbal response that did not match (repeat) the examiner's model. For example, if the verbal stimulus was *what's your name,* a correct response under the control of intraverbal contingencies might be *Riley.* Items were also coded IV if a verbal stimulus was presented to evoke verbal responses regarding stimulus attributes such as feature, function, or class (e.g., *wheel, ride in,* or *vehicle* instead of *car*).

Textual. A test item was coded textual (Tx) if the assessment instructed the examiner to present a written stimulus and a correct response required reacting to the written material verbally (i.e., reading). Items were further designated intraverbal (IV) if reading comprehension was required.

Receptive. Items asking the examiner to present an instruction, in which a correct response would be nonverbal, were coded as receptive (R). Examples of R-coded items are *point to cup, give me the pencil,* and *show me jumping.* Items were also coded R if a conditional discrimination was required regarding stimulus attributes (e.g., *point to the one that has a tail* instead of *point to dog*). Note that other operants are implicated in conditional discriminations and these are designated in the Tables (e.g., echoic, tact).

Finally, items that may have required multiple controlling variables are so designated with the probable operants marked within parentheses.

Following the database (Tables 2-7 below), we present a summary in which we discuss patterns found in our analysis along with implications for future work on this topic.

Table 2, Next Page!

Table 2. Aphasia Tests

Test and author(s)	Sub-test name or description	Implied function of test items[a]						Comments
			Verbal				Nonverbal	
		Mand	Echoic	Tact	Intraverbal	Textual	Listener	
Boston Assessment of Severe Aphasia (BASA) Helm-Estabrooks et al. (1989)	Items 1 – 8				x	P[b]		
	Items 9-11			(x)	(x)	(x)	x	
	Items 12-17				x		x	Imitative prompts
	Items 18-23		x					
	Items 24-27			(x)			x	Imitative prompts
	Item 28			x	(x)			
	Items 29-30			x	(x)		P	
	Items 31-32			(x)			x	
	Items 33-35			x	x		(x)	
	Items 36-37			(x)			x	
	Items 38-40			(x)	(x)	(x)	x	
	Items 41-43			(x)			x	
	Items 44-46			(x)	(x)	(x)	x	
	Items 47-49		(x)	x	x			
	Items 50-54			x		x		
	Item 55			(x)	(x)	(x)	x	
	Items 56-59						x	Includes match-to-sample
	Items 60-61		(x)		x			
Reading Comprehension Battery for Aphasia (RCBA-2) LaPointe & Horner (1998)	Subtest 1: Word-Visual		(x)	x	(x)	x	x	
	Subtest 2: Word-Auditory		(x)	x	(x)	x	x	
	Subtest 3: Word-Semantic		(x)	x	(x)	x	x	
	Subtest 4: Functional Reading		(x)	x	(x)	x	x	
	Subtest 5: Synonyms		(x)	x	(x)	x	x	
	Subtest 6: Sentence-Picture		(x)	x	(x)	x	x	
	Subtest 7: Paragraph-Picture		(x)	x	(x)	x	x	
	Subtest 8: Paragraph-Factual		(x)		x	x	x	
	Subtest 9: Paragraph-Inferential		(x)		x	x	x	
	Subtest 10: Morpho-Syntax		(x)		(x)	x	x	
	Subtest 11: Letter Discrimination		(x)		x	(x)		
	Subtest 12: Letter Naming					x	(x)	
	Subtest 13: Letter Recognition		(x)			x	x	
	Subtest 14: Lexical Decision		(x)		(x)	x	x	
	Subtest 15: Semantic Categorization				x	x		
	Subtest 16: Oral Reading: Words					x		
	Subtest 17: Oral Reading: Sentences					x		
Western Aphasia Battery Revised Kertesz (2007)	Spontaneous Speech							
	A: Conversational Questions				x			
	B: Picture Description			x	x			
	Auditory Verbal Comprehension							
	A: Yes/No Questions			(x)	x			
	B: Auditory Word Recognition					x	x	
	C: Sequential Commands						x	
	Repetition		x					
	Naming & Word Finding							
	A: Object Naming		P	x	(x)			
	B: Word Fluency				x			Categories
	C: Sentence Completion				x			Fill-in-blank
	D: Responsive Speech				x			WH-questions

[a] Items marked (x) indicate additional operant repertoires required or assessed by this item
[b] Correction prompts may additionally assess this operant

Table 3. Apraxia Tests

		Implied function of test items[a]						
		Verbal					Nonverbal	
Test and author(s)	Sub-test name or description	Mand	Echoic	Tact	Intraverbal	Textual	Listener	Comments
Apraxia Battery for Adults (ABA-2) Dabul (2000)	Diadochokinetic Rate		x				x	Requires comprehension of "as many as" and "as fast as"
	Increasing Word Length (A & B)		x					
	Limb Apraxia & Oral Apraxia						x	Imitative prompts
	Latency Time and Utterance Time for Polysyllabic Words			x	(x)			
	Repeated Trials		x		(x)			Also requires self-echoic
	Inventory of Articulation Characteristics of Apraxia			x	x	x		
Kaufman Speech Praxis Test for Children (KSPT) Kaufman (1995)			x				x	
Test of Oral and Limb Apraxia (TOLA) Helm-Estabrooks (1992)	Limb Apraxia: Proximal Gestures						x	Imitative prompts
	Limb Apraxia: Distal Gestures						x	Imitative prompts
	Oral Apraxia						x	Imitative prompts
	Gestured Pictures						x	
The Apraxia Profile: Preschool (P) School-age (S) Hickman (1997)	Volitional Oral Movement - Verbal		x				x	
	Diadochokinesis		x				x	
	Words (repetition) (P)		x				x	
	(S) Difficult word repetition		x				x	
	Phrases and Sentences (P, S)		x				x	Requires prosody echoic
	(S) Rhymes		x				x	
	(S) Counting		P[b]		x			
	(S) Prosody		x				x	
	Connected Speech Sample			(x)	x			Morpheme/intelligibility analysis

[a] Items marked (x) indicate additional operant repertoires required or assessed by this item
[b] Correction prompts may additionally assess this operant

Table 4. Articulation/Phonology Tests

		Implied function of test items[a]					
		Verbal					Nonverbal
Test and author(s)	Sub-test name or description	Mand	Echoic	Tact	Intraverbal	Textual	Listener
Bankson-Bernthal Test of Phonology (BBTOP) Bankson & Bernthal (1990)			P[b]	x			
Clinical Assessment of Articulation and Phonology (CAAP) Secord & Donohue (2002)	Articulation Inventory: consonants		P	x	P		
	Articulation Inventory: sentences		x				
	Phonological Process Probes		P	x			
Comprehensive Test of Phonological Processing for ages 5 and 6 (CTOPP) Wagner et al. (1999)	Elision		x		x		(x)
	Rapid Color Naming			x	x		(x)
	Blending Words		x		x		
	Sound Matching		x	x	x		
	Rapid Object Naming			x	x		
	Memory for Digits		x				
	Nonword repetition		x				
	Blending Nonwords		x				
Goldman-Fristoe Test of Articulation (GFTA-2) Goldman & Fristoe (2000)			P	x	(x)		
Hodson Assessment of Phonological Patterns (HAPP-3) Hodson (2004)			P	x	(x)		
Khan-Lewis Phonological Analysis (KLPA-2) Khan & Lewis (2002)			P	x	(x)		
Photo Articulation Test (PAT-3) Lippke et al. (1997)			P	x	(x)		

[a] Items marked (x) indicate additional operant repertoires required or assessed by this item
[b] Correction prompts may additionally assess this operant

Table 5. Receptive-Expressive Language Tests

Test and author(s)	Sub-test name or description	Implied function of test items[a] Verbal: Mand	Echoic	Tact	Intraverbal	Textual	Nonverbal: Listener	Comments
Clinical Evaluation of Language Fundamentals Ages 5-8 (CELF-4) Semel et al. (2003)	Concepts & Following Directions						x	
	Word Structure			x	x			
	Recalling Sentences		x					
	Formulated Sentences		(x)	x	x		(x)	
	Word Classes 1 (ages 5-7)		(x)	(x)	x		x	
	Word Classes 2 (ages 8-21)		(x)	(x)	x		x	
	Sentence Structure		(x)	(x)	(x)		x	
	Expressive Vocabulary			x	x			
	Understanding Spoken Paragraphs				x			
	Phonological Awareness		x		(x)			
	Word Associations		P[b]		x			
	Number Repetition		x		(x)			
	Familiar Sequences		x		(x)			
	Rapid Automatic Naming			x				
	Pragmatics Profile							Informant
Clinical Evaluation of Language Fundamentals Preschool (CELF-P2) Wiig et al. (2004)	Sentence Structure		(x)	(x)	(x)		x	
	Word Structure			x	x			
	Expressive Vocabulary			x	x			
	Concepts & Following Directions		(x)	(x)			x	
	Recalling Sentences		x					
	Basic Concepts		(x)	(x)	(x)		x	
	Word Classes (Ages 4-6)		(x)	(x)	x		x	
	Recalling Sentences in Context		x					
	Phonological Awareness		x		(x)			
Comprehensive Receptive and Expressive Vocabulary Test (CREVT) Wallace & Hammill (1994)	Receptive Vocabulary		(x)	(x)			x	
	Expressive Vocabulary				x			
MacArthur-Bates Communicative Development Inventories Fenson et al. (2007)	Checklist of words, phrases, sentences Instructions to mark words child uses							Informant
Preschool Language Scale (PLS-4) Zimmerman et al. (2002)	Auditory Comprehension		(x)	(x)	(x)		x	Allows informant
	Expressive Communication	x	x	x	x			Allows informant
Receptive-Expressive Emergent Language Test (REEL-3) Bzoch et al. (2003)	Receptive		x	x	x		x	Informant
	Expressive	x	x	x	x			Informant
Test of Language Development - Primary (TOLD-P:3) Newcomer & Hamill (1988)	Picture Vocabulary		(x)	(x)			x	
	Relational Vocabulary				x			
	Oral Vocabulary				x			
	Grammatic Understanding		(x)	(x)			x	
	Sentence Imitation		x					
	Grammatic Completion				x			
	Word Discrimination		(x)		x			
	Phonemic Analysis		x		x			
	Word Articulation		P	x	x			

[a] Items marked (x) indicate additional operant repertoires required or assessed by this item
[b] Correction prompts may additionally assess this operant

Table 6. Expressive Language Tests

		Implied function of test items[a]						
		Verbal					Nonverbal	
Test and author(s)	Sub-test name or description	Mand	Echoic	Tact	Intraverbal	Textual	Listener	Comments
Expressive One-Word Picture Vocabulary Test (EOWPVT) Gardner (1990)				x	(x)			
Expressive Vocabulary Test (EVT) Williams (1997)				x	x			
Structured Photographic Expressive Language Test (SPELT-3) Dawson et al. (2003)				x	x			
Test of Word Finding (TWF-2) German (2000)	Picture Naming Nouns		P[b]	x			(x)	Accuracy plus response time
	Sentence Completion Naming		P		x		(x)	
	Picture Naming Verbs		P	x			(x)	
	Picture Naming Categories		P	x			(x)	Accuracy plus response time

[a] Items marked (x) indicate additional operant repertoires required or assessed by this item
[b] Correction prompts may additionally assess this operant

Table 7. Receptive Language Tests

		Implied function of test items[a]					
		Verbal					Nonverbal
Test and author(s)	Sub-test name or description	Mand	Echoic	Tact	Intraverbal	Textual	Listener
Peabody Picture Vocabulary Test (PPVT-3) Dunn et al. (1997)			(x)	(x)			x
Receptive One-Word Picture Vocabulary Test (ROWPVT) Brownell (2000)			(x)	(x)			x
Test for Auditory Comprehension of Language (TACL-3) Carrow-Woolfolk (1999)	Vocabulary		(x)	(x)			x
	Grammatical Morphemes		(x)	(x)			x
	Elaborated Phrases and Sentences		(x)	(x)			x

[a] Items marked (x) indicate additional operant repertoires required or assessed by this item

Results, Discussion, and Considerations for the Future

Information from the speech-language assessment database points to several issues of interest for future investigations.

First, analysis of the database revealed a striking omission in traditional speech-language tests. The mand function, widely regarded as the earliest verbal operant established (Bijou & Baer, 1965; Schlinger, 1995; Sundberg, 2008) and of greatest benefit to speakers (Skinner, 1957), was assessed in only two of the 28 database tests (PLS-4; REEL-3, Bzoch, League, & Brown, 2003). Despite their inclusion, the mand function in these tests was only indirectly evaluated (i.e., informant report, such as parent or caregiver responses, was either required or allowed). This means that relevant motivating conditions for the occurrence of mands were not directly arranged or evaluated for their evocative effects.

Moreover, it is of particular concern that mand contingencies were absent from the three assessments for aphasia, an acquired neurological disorder that often is profoundly damaging to speech-language repertoires. It would seem that, of all the verbal functions potentially impaired in aphasia, the mand would be of foremost importance to evaluate and, if weak, to re-establish quickly. Collectively, aphasia tests in the database represent a total of 475 response opportunities for persons with aphasia, yet the tests contained no mand contingencies to evaluate this critically important repertoire for these individuals. Behavioral researchers have begun to offer alternative (i.e., non-traditional) models for the description of aphasia deficits (Baker et al., 2008), but functional evaluation of this critical skill in the repertoires of actual individuals appears unaddressed in this population.

Next, analysis of the assessment database brought the importance of stimulus control into clearer focus on at least two issues related to its identification. Unlike assessments in which controlling stimuli are specified by the test items (e.g., tact, mand), traditional speech-language tests may unintentionally require *multiple stimulus control* for correct responding. At other times, they may inadvertently provide multiple stimuli (i.e., prompts) when it is undesirable to do so. As a result, test items may be harder or easier than they are meant to be, obscuring the repertoire purportedly being tested. That is, learners would

be disadvantaged if they do not have the requisite learning history to respond correctly when doing so requires control by more than one independent variable or when, conversely, multiple stimuli must be in place for the learner to respond correctly to items intended to test a single function.

Several assessments in the database illustrated this issue in which it seemed that several stimuli must, or could, converge to evoke a correct response, thereby risking confounded test results. For example, some assessments (e.g., TOLD-P:3) require the learner to listen to a word and then repeat only part of it (e.g., *say 'baseball' without saying 'base'*). Although this clearly evaluates echoic control, other repertoires may be required (e.g., intraverbal, autoclitic; Schlinger, 2008; Skinner, 1957), particularly since the correct response must necessarily omit part of the echoic model, as a self-editing response.

Multiple control was also implicated in situations where instructions to the learner seemed ambiguous (e.g., prompting a pointing response with *tell me*; PLS-4). In this case, although a pointing response is presumably sufficient to be scored as correct, a learner who not only points but also responds verbally (i.e., *it's that one!*) may have a more sophisticated repertoire than a learner who only points to the answer. If so, this information would be important for treatment planning. Multiple control required for correct responding was also evident in assessment items where the actual function being evaluated changed as a result of prompts allowed during correction procedures. For example, the Goldman-Fristoe Test of Articulation (GFTA-2; Goldman & Fristoe, 2000) consists of asking *what's this* while showing pictures one at a time. Each response is then evaluated for point-to-point correspondence with the phonemic elements of the (unspoken) model. As such, this test evaluates a tact repertoire (more precisely, a tact-intraverbal repertoire). However, if no response occurs, an echoic prompt is allowed (e.g., *say* '*house'*). Thus, the task changes from one requiring tact/intraverbal control to one that requires echoic-only control. However, because the pictures are presumably still present, the clinician cannot be certain whether there is partial tact control over an echoic response, should one occur.

These examples illustrate the difficulty in trying to assess speech-language skills with assessments that specify only topography, and not contingencies, required for a correct response. That is, individuals without the requisite learning history or those with obvious impairment (e.g., aphasia) may have only part of the skills necessary to perform well on these assessments and, without a clear identification of the variables required for correct responding, the learner's repertoire may appear more or less deficient. Therefore, assessments to identify therapy intervention targets need to clearly identify (1) the stimulus control for various operants that define a competent speech-language repertoire and (2) the foundational, cumulative repertoires that may need to be in place (e.g., tact, listener) to support more complex responding (e.g., intraverbal). This explication should take into consideration recent research and supporting literature regarding complex speech-language skills such as naming and categorization (e.g., Miguel et al., 2008; Petursdottir et al., 2008), equivalence (Sidman, 1994), and other derived relations (e.g., Rosales & Rehfeldt, 2007).

Speech-language assessments yielding a functional hierarchy of skill deficits have the advantage of being more prescriptive for subsequent intervention than are those that yield structural-only descriptions of errors (Baker et al., 2008; Lerman et al., 2005; Sundberg et al., 1990). This is because the independent variables governing, and thus crucial to, behavior change are not typically assessed, described, or otherwise addressed in traditional speech-language assessments (although there is evidence of emerging interest in the contextual communication environment; e.g., Hyter, 2007). One recently published assessment of verbal functions and related language skills is the *Verbal Behavior Milestones Assessment and Placement Program* (VB-MAPP, Sundberg, 2008), which provides clinicians with a hierarchy of 170 skills developmentally referenced from ages 0 – 48 months. Skills are balanced across the verbal functions (e.g., mand, tact, intraverbal, echoic) and related areas (e.g., social skills, linguistic skills, reading) in order to avoid the rote responding that can occur when out-of-sequence skills are taught (e.g., intraverbal) without having first established the requisite supporting functions, such as tact and listener repertoires (also see Greer & Ross, 2008). To address behaviors that may interfere with skill acquisition, an additional component test, the *VB-MAPP Barriers Assessment*, identifies 24 potential

learning barriers to which environmental (i.e., behavioral) solutions can be applied in order to maximize instructional efficiency.

Future research needs to establish the clinical efficacy of the *VB-MAPP* and other function-based speech-language assessments (e.g., Partington & Sundberg, 1998) as they become available. In the meantime, assessments of this sort offer immediate clinical benefit over non-functional speech-language tests because they allow clinicians to identify speaker-listener deficits according to developmental norms in a curricular sequence and, at the same time, they pinpoint the environmental variables that currently control these responses errors. By identifying the variables of which errors are a function, assessments like the *VB-MAPP* also highlight the stimuli that do not yet control desired speech-language responses; thus, interventions can be designed that incorporate stimulus control transfer procedures for more effective and efficient learning. Practitioners who have yet to access function-based speech-language assessments can nevertheless begin to analyze their existing evaluation tools (some of which may appear in the database) for the likely functions represented by these instruments. This first-step would be invaluable for informing treatments by assisting therapists in the selection and sequencing of appropriate targets for their interventions.

Additional research is needed to further elucidate speaker-listener functions. For example, Poon and Butler (1972) suggest there may be developmental influences on intraverbal relations (e.g., different acquisition stages for *how, when, where).* As noted earlier, Baker et al. (2008) offer an initial function-based taxonomy for evaluating speaker-listener repertoires following neurological impairment (i.e., aphasia). Lerman and colleagues (2005) discuss positive treatment implications by including existing responses in functional assessments of the verbal repertoire. Yes-no responding has been assessed and trained across the verbal functions (Shillingsburg, Kelley, Roane, Kisamore, & Brown; 2009) following demonstrations that these responses did not generalize from one operant (e.g., mand) to another (e.g., tact) without specific training. Finally, Carr and Firth (2005) call for researchers and practitioners alike to publish results of individual treatments based on Skinner's (1957) analysis of verbal behavior. Key to this body of evidence would be the contributions of speech pathologists in which speech-language assessments and clinical progress reports include analyses of independent variables (i.e., functions) that are responsible for topographies of interest.

There is much to be explained in verbal behavior (Sundberg, 1991) and much is still speculative (Palmer, 1998). Nevertheless, the utility of our assessments will be strengthened by a more thorough accounting of the observable variables that control speech-language behavior. If it is true that "learning occurs best when embedded within functional activities" (Rowland & Schweigert, 1993, p. 173), then assessment that includes a functional account is essential.

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(Asterisk indicates references in assessment database)

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Author Contact Information

Correspondence concerning this article should be addressed to the first author.

Barbara E. Esch
Esch Behavior Consultants, Inc.
P. O. Box 20002

Kalamazoo, MI 49019
Phone: 561-676-7212
E-mail: besch1@mac.com

Kate B. LaLonde
Esch Behavior Consultants, Inc.
P.O.Box 20002
Kalamazoo, MI 49019

John W. Esch
Esch Behavior Consultants, Inc.
P. O. Box 20002
Kalamazoo, MI 49019
