The Analysis of Verbal Behavior 2008, **24,** 147–158

A Behavioral Conceptualization of Aphasia

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Aphasia is an acquired language impairment that affects over 1 million individuals, the majority of whom are over age 65 (Groher, 1989). This disorder has typically been conceptualized within a cognitive neuroscience framework, but a behavioral interpretation of aphasia is also possible. Skinner's (1957) analysis of verbal behavior proposes a framework of verbal operants that can be integrated with the work of Sidman (1971) and Haughton (1980) to describe the language difficulties individuals with aphasia experience. Using this synthesis of models, we propose a new taxonomy of aphasia based on the observed deficit relations. Assessment and treatment implications are also discussed.

Key words: aphasia, language, verbal behavior, equivalence, learning channels

Aphasia is an acquired language impairment characterized by an inability to understand or produce language not related to sensory or motor deficit (Spreen & Risser, 2003), though noncausal motor deficits may also exist (Lieberman, 2002). That is, hearing and physical capabilities to produce phonemes still exist, but language understanding, production, or use is impacted due to observable or inferred damage to the central nervous system (CNS; LaPointe, 2005). A diagnosis of aphasia requires the demonstration of neurological damage, which can be the result of several different etiologies such as stroke and traumatic brain injury. These etiologies result in damage that can only be directly observed through neuroimaging tests. Originally researchers thought damage was restricted to the cortical level; however, recent neuro-imaging research has shown that damage also occurs at the sub-cortical level (e.g., Lieberman; Thompson, 2005).

Aphasia can severely limit an individual's functioning across many areas with communication deficits leading to social isolation, loss of preferred activities and depression, overdependence, and a reduced quality of life (Beeson & Bayles, 1997; Groher, 1989). An estimated 80,000 Americans acquire aphasia each year with total estimates of 1–2 million suffering from aphasia. Aphasia affects individuals across both genders and all age groups but most commonly occurs in the middle to late years, with a dramatic increase in incidence of aphasia in adults aged 85 and older (Beeson & Bayles; Groher).

The purposes of this paper are threefold. First, the paper will provide a brief overview of aphasia describing the dominant paradigms and classification system typically used in current aphasia research. Second, the paper identifies some of the drawbacks to the mainstream classifications of aphasia. Third, the paper presents an alternative behavior analytic conceptualization of aphasia and ideas for future research investigations that might confirm or refine this conceptualization.

Aphasia Characteristics and Subtypes

The dominant paradigms in aphasia research have been information processing and neuroscience (LaPointe, 2005) with resulting classifications based on neurological damage sites and associated deficits conceptualized from a cognitive paradigm. The classification initially described by Goodglass and Kaplan (1972) is considered the most current classification taxonomy for aphasia (Gordon, 1998; LaPointe, 2005; Spreen & Risser, 2003). Two of the seven types of aphasias are named for the discoverer of the location of specific damage correlated with deficits (i.e., Broca's, Wernicke's), while the other five are general descriptions of deficits because: (a) there are several possible damage sites (e.g., the transcortical aphasias) or (b) because no specific damage site has been pri-

We thank Ed Morris, the Esch Behavior Consultants, Inc. lab, and the Developmental Disabilities and Aging lab for their invaluable comments and suggestions on earlier versions of this manuscript.

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Table 1
Types of Aphasia and Corresponding Deficits

Aphasia Type	Observed Deficit: Word retrieval (naming)	Impaired reading or writing	Paraphasia	Repetition	Comprehension	Fluency	Agrammaticism	Stereotypic Utterances
Anomia								
Main	X	-	-	-	-	-	-	-
Possible	-	X	-	-	-	-	-	-
Broca's								
Main	-	-	-	X	-	X	X	-
Possible	X	X	-	-	-	-	-	-
Wernicke's								
Main	-	X	-	-	X	-	-	-
Possible	-	-	X	X	-	-	-	X
Conduction								
Main	-	-	X	X	-	-	-	-
Possible	X	X	-	-	X	-	-	-
Transcortical sensory								
Main	-	-	X	-	X	-	-	-
Possible	X	X-	-	-	-	-	-	X
Transcortical motor								
Main	-	-	-	-	-	X	X	-
Possible	-	X	-	X	-	-	-	-
Global								
Main	X	X	X	X	X	X	X	X
Possible*	-	-	-	-	-	-	-	-

Note. One or more main deficits are required for diagnosis, though all may be evident. Possible deficits are not required for diagnosis but one or all may be evident.
*Global aphasia is characterized by damage across all modalities, making all deficits main deficits.

marily on a dichotomous description of the production of speech with subtypes based on the presence and absence of specific features (see Table 1 for a summary). Fluent aphasias result in normal intonation and little hesitancy in speech with inappropriate substitution of words, nonwords, and phonemes (Kearns, 2005). In contrast, nonfluent aphasias result in abnormal intonation and difficulty with expression with halting speech and long pauses (Groher, 1989). The four fluent aphasias are Wernicke's aphasia, conduction aphasia, anomia, and transcortical sensory aphasia, while the three nonfluent aphasias are Broca's aphasia, transcortical motor aphasia, and global aphasia.

Broca's aphasia is characterized by difficulty in verbal production, labored articulation, and telegraphic language construction (e.g., saying "I go car" instead of "I am going to the car") occurring with a lesion in the anterior portion of the left hemisphere (Kearns, 2005). Wernicke's aphasia occurs when damage to the posterior portion of the left hemisphere produces impaired reading and writing, difficulty comprehending words/sentences, and semantic errors (e.g., substituting "chair" for "table"; Caspari, 2005). Kearns illustrates the difference in responding with Broca's, a nonfluent aphasia and Wernicke's aphasia, a fluent aphasia:

> In response to the request, "Tell me what you do with a cigarette," a person with chronic Broca's aphasia replied, "Uh…uh…cigarette [pause] smoke it." This response was halting and agrammatic, but it clearly conveyed an accurate response to the request. In response to the same request, a patient with chronic Wernicke's replied, "This is a segment of a pigment. Soap a cigarette." …the fluent speech sample was melodic and uninterrupted, but it was essentially devoid of any meaning. (p. 125)

The transcortical aphasias are named for one of the possible damage sites related to the observed deficits. In the transcortical aphasias, repetition (i.e., imitation) is spared with damage occurring in the cortical speech center or in the left hemisphere. Transcortical sensory aphasia involves difficulty naming items, stereotypic utterances, and verbal and syntactic paraphrases, though the flow of speech is undisturbed (i.e., fluent). Transcortical motor aphasia involves decreased speech with little variety or elaboration, as well as a lack of motor precision in speaking, and is characterized by verbal and/or written output that is choppy and halting but retains meaning (i.e., nonfluent).

The final three aphasias are named for resulting impairments rather than damage sites. Anomia, a fluent aphasia, typically has no specific site of damage but can be associated with lesions on the left side of the angular gyrus. Anomia refers to difficulty recalling specific words when no other language deficit is present (Groher, 1989) and involves substitution of semantically related responses (saying "plate" for *fork*), semantically empty naming errors ("the thing on the thing over there"), and perseveration (i.e., using the same unrelated word over and over; Raymer, 2005). Conduction aphasia (also a fluent aphasia) has the characteristics of significant deficits in repetition with paraphrasing and word retrieval problems resulting from lesions that separate the two major speech areas (Simmons-Mackie, 2005). Global aphasia, a nonfluent aphasia, refers to severe deficits in both receptive and expressive language with no preserved communication modality or aspect of language and encompasses a combination of all the deficits discussed in the preceding paragraphs. There is no general pattern associated with global aphasia, aside from the observed ubiquitous deficits (Collins, 2005). A person with a diagnosis of global aphasia may still be able to communicate or understand some language, but the important aspect is that every modality is affected in some way.

Drawbacks of the Current Classification System

Recently, researchers have begun to note that the current taxonomies based on cognitive paradigms are "less than adequate in terms of models of language processing" (Kearns, 2005, p. 120). Despite acknowledging the inadequacies of the current theories and classifications of aphasia, there appears to be little attempt to develop a "single explanation …[that]…can yield the observed intricate patterns" (Kearns, p. 124). Several drawbacks to the current classification system for aphasias include inefficiency, overlap across categories, and lack of treatment utility. For example, although many deficit symptoms are listed within a diagnostic category in the current classification, only a few main deficits are necessary for a diagnosis (see Table 1). This "menu" approach to diagnosis results in the possibility for many language deficits to fit into multiple categories and for two people with the same diagnosis to have entirely different symptoms. As a result, developing a treatment for someone with a diagnosis of a specific aphasia is difficult based solely on the diagnosis alone, since several deficits with different treatment implications can fit within one diagnosis (e.g., auditory deficits in Wernicke's aphasia are treated differently than press of speech; Caspari, 2005).

Another flaw in the current classification is the receptive/expressive dichotomy often used when describing deficits. Receptive and expressive deficits are common, but rarely is the entire receptive or expressive repertoire affected, casting doubt on the utility of such a dichotomy. For example, although a person may not be able to read the word *apple* (referred to as a receptive deficit), that same person may be able to copy the letters "A-P-P-L-E." Not only is this person able to "receive" information, he or she can "receive" the very stimulus that is supposed to be impacted receptively. The stimulus in the two responses is the same (i.e., the written word "apple") while the response requirement is the one that differs. If the deficit were truly a receptive deficit, all responses related to similar visual or auditory stimuli should be affected. As a final concern, all of the deficits are based on a linguistic framework though deficits occur that do not make sense linguistically and cannot be accounted for in the current taxonomy. For example, a person may not be able to name an item when he or she sees it, but can say the name of the item given its spoken definition.

Conceptual Models in Behavior Analysis Relevant to Aphasia

An alternative behavior analytic conceptualization may avoid some of the above stated concerns with the current taxonomy. The works of three behavior analysts are pertinent to a behavioral conceptualization of aphasia. First, Skinner's *Verbal Behavior* (1957) provides a functional framework for examining aphasia as well as specific comments using aphasia as an example and illustration of the functional independence of verbal operants. Second, Sidman's analysis of stimulus-response relations and his empirical work on aphasia in the 1970s (e.g., Sidman, Stoddard, Mohr, & Leicester, 1971) provide excellent groundwork for developing an assessment method for deficits based on stimulus-response relations. Finally, Haughton's (1980) classification of stimulus-response relations (i.e., "learning channels") in his work on fluency seems pertinent to the patterns of deficits often observed in aphasia and is compatible with Skinner's analysis of verbal behavior (Lin & Kubina, 2004). This section will provide a brief overview of each conceptual model and its specific pertinence to aphasia followed by a proposed synthesis of the three to provide a viable behavior analytic account of aphasia.

Analysis of the Function of Verbal Behavior

Skinner stated in his 1957 analysis that verbal behavior could be classified according to function and proposed seven operants as a nonexhaustive taxonomy of the functions of verbal behavior. The operants are considered functionally independent and are organized according to the functional aspects of language, with each operant defined by the unique antecedents and consequences that occasion and maintain it. This functional approach to language stands in stark contrast to the more traditional psycholinguistic model that is based on the form and grammatical structure of language (LaPointe, 2005).

Skinner (1957) used several examples of aphasia to illustrate aspects of his conceptual model. For example, Skinner used aphasia to illustrate one of the major tenets of the model, functional independence, noting that "a response of a given form may no longer be under the control of one functional relation, although it is still under the control of another" (p. 190). Skinner argued that such deficits in a person were a result of a loss of "functional relationships which control his [sic] verbal behavior" (p. 194). For example, a person with aphasia may no longer be able to name an item when he or she sees it (i.e., tact), but can say the name of the item when given its spoken definition (i.e., intraverbal). Thus, functional independence during language acquisition and loss is readily explained by Skinner's model of verbal behavior but is difficult to reconcile with traditional psycholinguistic theory, which relies on the topography of behavior rather than the function of a specific operant.

Table 2
Descriptions and Examples of Sidman's Identity/NonIdentity Matching Tasks

Type	Required Skills	Sample Tasks
Identity	No specific learning history Ability to discriminate physical aspects of stimulus or generalized imitation repertoire	Matching visual letters to visual letters **A →A** Vocally repeating an auditory stimulus **Auditory "ora" → say "ora"** Writing printed words **Read Hat → write *Hat***
Non-identity	Conditional discrimination history	Matching auditory digits to text digits **Auditory "Four" → 4** Writing an auditory stimulus **Auditory "ora"** ***ora*** Spelling an auditory stimulus **Auditory "dog" → D-O-G**

Skinner (1957) also elaborated on the behavioral phenomena that might result in different forms of aphasia, suggesting that "aphasia is a condition of lowered probability of response" (p. 194) and that the "[damage] in aphasia is clearly the functional control of the behavior, and the damage respects the lines of control" (p. 218). He argued that the order of decline might be correlated with the deducible level of difficulty of the minimal repertoire required for the response. Skinner described a minimal unit for each of his operants that indicate the requisite repertoires for development of the operant. For example, the echoic's minimal unit is a speech sound while the intraverbal has a much more complex minimal unit that "greatly exceeds the number of different forms of response in that repertoire" (p. 76) including subtle features such as inflection. Echoics, transcriptives, and textuals primarily require a simple minimal repertoire (e.g., speech sounds, fine motor responses) and survive longer given adequate sensory functioning. Mands, intraverbals, tacts, and autoclitics require more complex minimal repertoires and appear to be more vulnerable, becoming "excessive and usually confused (paragrammatism) or lacking (agrammatism)" (Skinner, p. 219). Skinner also hypothesized that operants maintained by more generalized reinforcers would be more affected than operants maintained by specific reinforcers.

Analyses of the Stimulus-Response Relations of Language

Sidman and colleagues conducted work on aphasias in the early 1970s to further investigate the disorders, as well as to develop more effective and accurate assessments for deficits in aphasia based on stimulus-response relations (Leicester, Sidman, Stoddard, & Mohr, 1971; Sidman, 1971; Sidman, et al., 1971). Sidman (1971) noted that most definitions of aphasia fall short of an accurate description due to their inability to define language, as well as their reliance on collective terms like receptive and expressive deficits. Instead, he argued that most language could be defined as a collection of stimulus-response relations. Although one stimulus-response relation does not constitute what is commonly referred to as language[1], when a single stimulus results in multiple responses and multiple stimuli result in the same response, one approaches language. Sidman believed that descriptions of aphasia should denote the deficits in these relations. Based on this approach, Sidman posited that aphasia was a deficit of stimulus-response relations, rather than strictly receptive or expressive deficits as argued by psycholinguists. That is, aphasia is often a lack of or impairment in stimulus control with unique stimulus features failing to effec-

[1] Sidman (1971) did not elaborate on the definition of language to which he was referring.

tively occasion responding. For example, Sidman et al. reported a participant with difficulty naming printed words (i.e., traditionally diagnosed with receptive or input deficits), but found he was able to write and match those same letters, indicating that it was not an input deficit, but a relational deficit between written words and spoken words.

Based on the notion that language is made up of stimulus-response relations and aphasia represents a deficit in those relations, Sidman and colleagues developed an assessment method to identify the culprit relational deficits. This assessment included visual, auditory, and tactile stimuli and the potential responses included vocal responses, writing, and selection from an array. Within this new assessment method, Sidman (1971) described two main types of differentially effected stimulus-response relations: identity and nonidentity matching (see Table 2). An identity task includes a sample stimulus in the same form as the comparison stimulus (e.g., written letter to written letter, auditory word to spoken word, picture to picture) that does not require a prior learning history with a specific stimulus feature to engage in a correct response as long as the ability to respond appropriately to physical stimulus aspects or a generalized imitative repertoire exists. A nonidentity task has sample and comparison stimuli that differ in form (e.g., spoken letter to written letter, written color name to visual color, any delayed matching to sample) and requires a learning history with the specific stimulus to engage in a correct response. Sidman hypothesized that nonidentity tasks would be more vulnerable than identity tasks to disruption in the course of aphasia.

Sidman's (1971) identity/nonidentity dichotomy is compatible with Skinner's (1957) deducible level of difficulty of the minimal repertoire. Responses with a less extensive learning history requirement (i.e., identity) also have a simpler minimal repertoire, whereas responses that require a more extensive learning history (i.e., nonidentity) have more complex minimal repertoires. Sidman et al. (1971) found that participants with substantial language deficits tended to have more nonidentity deficits than identity deficits. After assessing participants, Sidman et al. attempted to change performance using generalized reinforcers (i.e., money) and found that participants' performances improved in both identity and nonidentity tasks with various stimuli (e.g., letters, words, pictures) when correct responses were followed by a chime and a nickel, though identity tasks showed greater increases.

Haughton (1980) also noted the importance of stimulus-response relations in language and pushed for the adoption of learning-channel matrices that specify the stimulus sensory modalities (i.e., stimulus input) and response behavior forms (i.e., response output) for a given behavioral performance (Lin & Kubina, 2004). He viewed the use of descriptive terms in education settings (e.g., a child will be able to "write" the answer to over 100 addition problems) as an improvement over commonly used vague terms that failed to specify performance indicators (e.g., the student will "know" how to do math). Though his chosen terms "input" and "output" are commonly associated with mentalistic computer analogies of human information processing, the notion of specifying stimulus and response parameters for a given learning event is appealing and potentially useful in describing problems in aphasia.

Learning channels are displayed in learning channel matrices, which provide a categorical classification of stimulus-response relations (see Table 3 for a sample learning matrix). Common stimulus inputs include see (visual modality), hear (auditory modality), touch (tactile modality), and smell (olfactory modality). Common response outputs include say (i.e., vocal response), write (i.e., transcriptive response), point (i.e., selection response), and do (Lin & Kubina, 2004). For example, instead of the psycholinguistic term "naming," responding to an item's presence (visual stimulus) by producing the name would be referred to as a "see-say" response in which the first and second terms denote the stimulus input and behavior output, respectively. Haughton suggested that "see-say" provides a more precise topographical description of the stimulus and behavior than "naming." A person might respond to one or more stimulus inputs (e.g., "see-hear" in which a teacher writes on the board and reads her writing aloud) and emit one or more response outputs (e.g., "write-say" in which the student writes and speaks aloud) (Lin & Kubina). Lin and Kubina and Haughton also mentioned a "free" or "think" input category and a "think" output category that encompassed covert or unspecified stimuli and responses. Lin and Kubina describe the "free"

Table 3
Pertinent Components of Haughton's (1980) Learning Channel Matrix

	Response Output		
Stimulus Input	Say	Write	Point
See	See-say	See-write	See-point
Hear	Hear-say	Hear-write	Hear-point
Touch	Touch-say	Touch-write	Touch-point

input category as "'free from' external sensory modalities" (p. 3). They argued that the "free" category should be used if the stimulus that evokes the response is unobservable (e.g., writing in a diary about what happened that day). Although such stimuli and responses are clearly important, these categories have been left out of our analysis because of the broad unspecified nature of the stimuli and responses and the difficulty in isolating such stimuli or response in the context of assessment of aphasia.

Integrating the Frameworks

These three behavioral conceptual frameworks can readily be integrated. The stimulus-response relations used by Sidman and colleagues are compatible with Haughton's learning-channel matrices. Furthermore, Lin and Kubina (2004) suggest that Skinner's (1957) work and Haughton's work can be combined for a more precise and technical account of language based on the notion that verbal behavior is made up of stimulus-response relations that share functional control, but differ topographically. To call a response a "see-say" response is technical, but does not provide information about the functional control of the response. For example, seeing another person with water while in a state of water deprivation and subsequently manding for water is a "see-say" response, specifically a "see-say" mand. However, tacting "water" is another common "see-say" relation that occurs under differing functional control. Using the term "tact" provides information about the functional control of the response, but lacks precision for assessment or treatment of aphasia, since some tact forms may be affected and others are not (e.g., a "see-say" tact versus a "hear-say" tact). According to Lin and Kubina, the fully descriptive term "see-say" tact provides both the precise technical description of the stimulus response relation as well as information about the functional control of the response.

Further precision is afforded by including Sidman's identity/nonidentity dichotomy when examining aphasia because evidence suggests that nonidentity relations appear vulnerable to deficit and less amenable to treatment than identity relations (Leicester et al., 1971). Although the vast majority of stimulus-response relations are nonidentity, the significance of the few identity relations should not be underestimated. The robustness of identity relations can be fully appreciated in developing treatments for aphasia deficits when using transfer of stimulus control procedures, which are predicated on using an existing repertoire to re-establish a deficit repertoire. The three responses mentioned above (i.e., the "see-say" mand and tact, "hear-say" tact) would be classified as nonidentity tasks where the stimulus modality differs from the response form and a specific learning history is required to engage in the response. However, a "see-write" transcriptive is an identity task if the response is copying a written letter but becomes a nonidentity task, and a presumably more vulnerable skill, if the written letter is presented and then removed before the copying occurs. This distinction may be critical to determining how specific aphasia assessment tasks are designed and to developing an aphasia taxonomy that uses precise technical descriptions of stimulus-response relations and functional control of the response with potentially predictive information about the likelihood of the repertoire being affected (i.e., identity vs. nonidentity).

A New Taxonomy of Aphasia

A complete behavior analytic account of aphasia can be developed based on the deficit stimulus-response relation, its classification (i.e., identity/nonidentity) and function, rather than simply topographical deficits (e.g., paraphasia, press of speech, optic anomia). The work of Sidman and colleagues (Leicester et al., 1971; Sidman, 1971; Sidman et al., 1971) and Haughton (1980), when combined with Skinner's (1957) analysis of verbal behavior, provides a new taxonomy based on specific stimulus-response relations and operant function. In addition, this taxonomy allows the adoption of Sidman's assessment model for identifying deficit stimulus-response relations, the only behavior analytic framework with empirical support.

Table 4 shows the new taxonomy based on a combination of stimulus-response relations, verbal operants, and the affected repertoire. With this new taxonomy, the stimulus-response relation or learning channel is the main category, with the potential operant deficits listed as subtypes (further classified as identity/nonidentity). Symbols indicate whether a stimulus-response relation is identity or nonidentity. Some entire stimulus-response relations are classified as identity or nonidentity across all operants; however, when some operants within a stimulus-response relation are identity and others are nonidentity, the classification symbol is located next to the specific operant.

This presentation illustrates each of the potential deficits that need to be empirically evaluated and a means to begin to talk about those deficit patterns. Note that functional characteristics and stimulus-response characteristics operate independently and may be impacted independently. For example, if the entire first column of Table 4 (i.e., the "say" response output category) were impaired, the nonidentity "see-say" tact would be affected but other tacts may not be (e.g., the "see-write" and "hear-point"). However, tacts in a specific stimulus response relation may be impaired while mands are not (e.g., "see-say" tacts versus "see-say" mands). Additionally, not all nonidentity tasks are necessarily eliminated, as nonidentity tasks in other stimulus-response relations (e.g., the "touch-write" and "hear-point") may not be affected.

The most commonly noted deficits in aphasia (LaPointe, 2005) appear to affect entire stimulus inputs or response outputs rather than affecting entire operants across channels, though this pattern will need to be confirmed or refuted through experimental evaluation of the new taxonomy. Until data are gathered to determine the common deficit patterns, we advocate avoiding simple terms to classify deficits in favor of specifying the deficit stimulus-response relations and relevant operants. If research supports that entire stimulus modalities or response forms are typically affected, the result might be that a person with pervasive "say" deficits across stimulus types, classifications (i.e., identity, nonidentity), and operants could be described as experiencing a *say aphasia* with "see," "hear," and "touch" deficits. However, deficits in aphasia may not break cleanly across classification, functional or topographical lines and specification of all aspects of the deficit would result in optimal effectiveness from a therapeutic point of view, regardless of the lack of sharply delineated diagnostic classes.

Assessment with The New Taxonomy

Sidman (1971) developed an effective technique for identifying deficit stimulus-response relations within a match-to-sample and delayed match-to-sample preparation using written letters, spoken words, or tactile (pictures or objects) stimuli to evoke responses such as selections, writing, or vocal responses. Sidman's assessment preparation fits well with our proposed taxonomy of aphasia and could be expanded to include specific operant functions. Such an assessment would involve presenting specific questions or tasks for each stimulus-response combination (identity or nonidentity) of every relevant operant, based on types of questions commonly used to assess deficits in aphasia in mainstream neuropsychology and speech therapy (Spreen & Risser, 2003).

An example assessment form based on this new taxonomy is presented in Table 5 with hypothetical results for a specific stimulus-response relation (i.e., "hear-say") across the relevant potential operant deficits. Although each task would involve a "hear" stimulus and "say" response, the functions would differ. Operants in the "hear-say" channel include echoics, tacts, intraverbals, and autoclitics but not listener behavior because a "say" listener response would also require speaker behavior and would fall into one of the designated operants. The clinician might loudly ask a person, "Am I speaking loudly or quietly?" to assess an identity match "hear-say" tact (i.e., tacting the volume of the speaker) or "Describe my voice volume" to assess a nonidentity "hear-say" tact. "Hear-say" intraverbals could be assessed by

Table 4
A Behavioral Taxonomy of Aphasia Combining Learning Channels, Verbal Operants, and Identity/Nonidentity Tasks

	Response Output		
Stimulus input	Say	Write	Point
See	See-say* Mand Tact Intraverbal Autoclitic Textual	See-write Listener* Mand* Tact* Intraverbal* Autoclitic* Transcriptive*⊗	See-point*⊗ Listener Mand
Hear	Hear-say Echoic*⊗ Tact* Intraverbal* Autoclitic*	Hear-write* Listener Transcriptive Intraverbal Autoclitic	Hear-point* Listener Mand Tact
Touch	Touch-say* Mand Tact Intraverbal	Touch-write* Listener Transcriptive	Touch-point*⊗ Listener Mand

⊗ Identity tasks * Non-identity tasks

presenting an auditory stimulus such as a sentence with part of the text missing, requiring a fill-in response (e.g., "I need to sharpen my _______."). To assess "hear-say" autoclitics, the person could be presented with a short story of a person writing and asked to orally complete the sentence "the woman was writing ______ a pencil." Additionally, echoics may differ as to identity/nonidentity classification. For example, to assess an identity "hear-say" echoic, one trial might involve the clinician instructing the person to immediately, "Repeat after me. Pencil." By arranging a delay between the presentation of the stimulus ("marker") and the opportunity to respond on the next trial, the task becomes a nonidentity task. The hypothetical data in Table 5 indicate that the person has deficits in tacts, intraverbals and autoclitics. The person also has deficits in nonidentity echoics but does not appear to have any identity echoic deficits.

This assessment form, based on the new taxonomy of aphasia, has several benefits over the traditional account. It eliminates the problems associated with overlap between one type of aphasia and another. Unlike the traditional account, where having additional deficits resulted in possible misclassification (e.g., a person with Broca's aphasia presenting symptoms of anomia), having "say" deficits neither precludes nor results in "write" deficits. Also, the traditional account forces clinicians to view the deficits as separate disorders and results in confusion when two individuals with different disorders present similar symptoms. Under the new taxonomy, "hear-say" deficits exist and are described independently but can be designated as co-occurring with other types of deficits without reference to the hypothesized or known locus of damage or the name of a founder of the disorder. In the new taxonomy, the diagnostic information provides information about the deficits and about the strengths that might be prescriptively incorporated into treatment.

Treatment with the New Taxonomy

Once the deficit stimulus-response relations and the specific operant deficits have been identified, treatments could be developed that in-

Table 5
A Sample Assessment Form for "See-Say" Deficits

Channel	Operant	Class	Trial	Response (Check one)	Points	Total
See-Say	Tact	Non-ID	1	C __ I √ NR __	0	
		Non-ID	2	C __ I √ NR __	0	
		Non-ID	3	C __ I √ NR __	0	
		Non-ID	4	C __ I __ NR √	0	
		Non-ID	5	C __ I __ NR √	0	0
See-Say	Echoic	Non-ID	1	C __ I √ NR __	0	
		ID	2	C √ I __ NR __	1	
		Non-ID	3	C __ I √ NR __	0	
		ID	4	C √ I __ NR __	1	
		Non-ID	5	C __ I __ NR √	0	2
See-Say	Intraverbal	Non-ID	1	C __ I √ NR __	0	
		Non-ID	2	C __ I √ NR __	0	
		Non-ID	3	C __ I √ NR __	0	
		Non-ID	4	C __ I √ NR __	0	
		Non-ID	5	C __ I __ NR √	0	0
See-Say	Autoclitic	Non-ID	1	C __ I √ NR __	0	
		Non-ID	2	C __ I __ NR √	0	
		Non-ID	3	C __ I __ NR √	0	
		Non-ID	4	C __ I __ NR √	0	
		Non-ID	5	C __ I __ NR √	0	0

corporate transfer of stimulus control technology. Many studies looking at children with autism illustrate the utility of using operants within the child's repertoire to re-establish the affected operants that have been lost or have not yet been developed (Sautter & LeBlanc, 2006). For example, Sundberg, Endicott, and Eigenheer (2000) reported experimental data on the successful use of an intraverbal prompt to teach tacts via transfer of stimulus control. Although there is not yet direct evidence that such an intervention might work, Sidman and colleagues demonstrated the effectiveness of behavioral treatment of aphasia deficits. For example, Leicester et al., (1971) demonstrated that aphasia deficits were amenable to treatment with differential reinforcement (i.e., a chime and a nickel contingent upon correct responding) in individuals with long-standing deficits. Recent advances in preference assessment and stimulus control technology could enhance this type of differential reinforcement program by assuring use of powerful reinforcers and by incorporating the natural contingencies that must eventually maintain responding in a complex verbal community. For individuals with tact deficits, empirically validated methods for training tacts often include transfer of stimulus control and differential reinforcement (e.g., Peine, Gregersen, & Sloane, 1970; Sundberg, San Juan, Dawdy, & Arguelles, 1990). For individuals with mand deficits, prompts or picture exchange systems (Frost & Bondy, 1994) along with differential reinforcement may prove beneficial.

Future Research

Few behavior analysts have turned their attention to research on aphasia though many interesting questions remain unanswered. This paper proposes a taxonomy that is primarily organized by stimulus and response learning channels (and their classification) and secondarily by verbal operant based on our hypothesis that aphasia appears to be more a deficit of antecedent stimulus control and response production rather than ineffective consequences. Since all verbal operants can be further classified into learning channels (i.e., allowing for a description of the form of antecedent stimulus), this taxonomy places appropriate emphasis on the discriminative stimulus with a technical and precise way to assess the deficits beyond use of the term "expressive." However, no empirical evidence supports the utility of this organizational pattern over potential alternatives, though Sidman's work provides evidence for the usefulness of behavioral treatment. Future research should examine whether behavior classified by function, and further classified by topography, is more precise or lends any added benefit to assessment/treatment over other systems.

Additionally, Skinner's notion of a hierarchy of probability of impairment based on the minimum required repertoires, as well as the specificity of the reinforcer, is appealing but speculative and needs experimental examination. The work of Sidman (1971) and Leicester, et al., (1971) appears to support Skinner's notion, as the nonidentity tasks (i.e., most like Skinner's more complex deducible level of difficulty) were more affected and more resistant to treatment. However, additional research should examine to what extent mands are affected in aphasia, as the mand is the only operant maintained by highly specific reinforcers that are often nonsocial in nature. Based on Skinner's analysis, the mand should remain intact due to the specificity of the reinforcing benefits; however, mands require complex and difficult minimal repertoires (i.e.,nonidentity), making them more susceptible to deterioration.

Researchers will also need to further develop and investigate assessment tools that incorporate this new taxonomy. A comprehensive assessment of each stimulus and response channel with a sub-analysis of each pertinent verbal operant, as illustrated in Tables 4 and 5, would require approximately 40 different trial types. Initially, researchers might examine existing aphasia assessments to identify tasks with reasonable psychometric properties that might fit into the new taxonomy. When no current measure adequately samples the relevant variables, as appears to be true with mands, researchers must develop the tasks based on certain stimulus inputs, evoking the appropriate response outputs, and possibly incorporating the relevant reinforcers and putative EO when appropriate.

Finally, adults with aphasia represent an untapped resource for verbal behavior research focused on operants other than the mand and tact, which have been the most frequently studied (Sautter & LeBlanc, 2006). Comparatively little research has examined complex verbal operants such as autoclitics and intraverbals more advanced than basic question answering, fill-in-the-blank responding, and categorization (Sautter & LeBlanc). The paucity of research on autoclitics and the limited breadth of research on intraverbals may be an artifact of the populations studied (i.e., individuals with autism and developmental disabilities, typically developing children). Complex human language such as intraverbals and autoclitics are predicated on the development of other repertoires, which are not yet developed in the majority of participants that have been targeted in previous applied studies. Adults with aphasia have a history of well-developed complex verbal behavior repertoires and the explicit goal of rehabilitation. Many elementary operants may still be functional allowing focused research on development and maintenance of complex verbal behavior that is predicated on other operant repertoires.

CONCLUSION

We have presented a behavior analytic conceptualization and taxonomy for aphasia, incorporating several behavioral models. This exercise in behavioral interpretation is preliminary and remains open for investigation. Although Sidman and his colleagues provided initial findings over three decades ago, the majority of this paper is not based on empirical research because that research simply does not exist. Our goal has been to synthesize existing conceptual models to foster research in the area of aphasia. Whether this new taxonomy based on a synthesis of the work of Sidman, Haughton, and Skinner will prove to be the most useful will depend on the research it stimulates. Regardless, the taxonomy is more behavioral and conceptual than the current classification, allowing researchers and clinicians to develop assessments and treatments for the deficits based on the function of the deficit relations. As the taxonomy of aphasia is refined, treatments for aphasia can be developed. Although treatments do exist for aphasia, an operant model of treatment may be more effective and quicker than traditional treatments. Research demonstrating the effectiveness of behavioral interventions and the potential benefits of behavioral interventions to current treatments will lend strength to the adoption of a new taxonomy of aphasia, allowing behavior analysts to make their mark on yet another socially important problem with socially relevant outcomes.

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