Spring 2017

The Case of the Boy with Anomia: Contributions of Visual and Language Processing in Naming

Sharon Serper

THE CASE OF THE BOY WITH ANOMIA: CONTRIBUTIONS OF VISUAL AND LANGUAGE PROCESSING IN NAMING

by

Sharon Serper

A thesis submitted in partial fulfillment of the requirements
for graduation with Honors in the Speech Pathology and Audiology

_____

Alison Lemke
Thesis Mentor

Spring 2017

All requirements for graduation with Honors in the
Speech Pathology and Audiology have been completed.

_____

Amanda Van Horne
Speech Pathology and Audiology Honors Advisor

The Case of the Boy with Anomia:

Contributions of Visual and Language

Processing in Naming

Sharon Serper

University of Iowa

Conceptual Knowledge Areas

Overview

Language is an extraordinarily complex phenomenon that encompasses the use of many systems in the human body. Each of them must function properly and interact with one another appropriately in order for language to be produced or understood. Damage to a portion of one of these systems or malfunctioning interactions between them can be catastrophic. The American Speech-Language-Hearing Association (ASHA) defines a language disorder as "impaired comprehension and/or use of spoken, written, and/or other symbol system." An alternative definition is provided by the American Psychiatric Association, which states that there must be a discrepancy between one's language abilities and nonverbal intelligence for the diagnosis of "language disorder" to be made (Hegde & Maul, n.d.). Another model used to classify language disorders is known as the behavioral definition of language. This view proposes that an individual has a language disorder if he/ she cannot effectively or appropriately communicate with others, and therefore is unable to influence the behavior of those around them (Hegde & Maul, n.d.).

Undoubtedly, children who exhibit the characteristics of any of these definitions are a notably heterogeneous group. While some struggle more with expressive language, others have problems with both their expressive and receptive language skills. These children also fall into one of two categories, those with specific language impairment (SLI) and those with a language disorder that is also associated with some type of clinical condition. Despite the variability amongst children with these difficulties, they commonly share the following: a limited vocabulary in their repertoire, trouble with using proper

grammar, the inappropriate social use of language, problems using nonverbal communication, and difficulties with literacy (Hegde & Maul, n.d.).

Neuroanatomy

Formulating or comprehending language begins in the brain; therefore, neuroanatomy is at the basis of understanding language. There are various ways in which the brain is organized. For example, the brain is organized into lobes, each of which has a particular function. A primary function of the frontal lobe is voluntary control of movement. The temporal lobes serve the function of hearing and analyzing auditory signals. The parietal lobes aid in perception and elaboration of bodily sensations, and finally, the occipital lobes serve the function of analyzing vision. Another way that the brain and its structures are organized is through systems. For example, the limbic system includes a variety of different components and is a motor center for emotive behavior. The limbic system is important in producing speech and language.

Neuropathology

Lesions in different parts of the brain can cause various types of language deficits. Perhaps one of the most commonly known forms of language disorder caused by a esion is called Broca's aphasia, in which the lesion is in the left lateral frontal, pre-Rolandic, suprasylvian region (Broca's area). The lesion may also extend into adjacent subcortical periventricular white matter. Another form of aphasia is called Wernicke's aphasia, which involves damage to the posterior third of the superior temporal gyrus. Conduction aphasia affects the supramarginal gyrus and underlying white matter pathways that connect Broca's area and Wernicke's area. Another type of aphasia is known as anomic aphasia, which the text describes as "the least useful localizing sign in aphasia." This is

because any lesion in or near the "zone of language" can produce anomia. Anomia is the difficulty of retrieving words. Generally, all aphasia syndromes include a component of anomia, however, lesions of the angular gyrus, and second temporal gyrus are most closely associated with anomic aphasia. Transcortical motor aphasia occurs due to a lesion that interrupts the pathway between the supplementary motor cortex and Broca's area, yet spares Broca's area. Such a lesion may be present in more than one location. Transcortical sensory aphasia occurs due to lesions on the boundary between the middle and posterior cerebral artieries in parieto-temporal regions, sparing Wernicke's area. Another form of aphasia is known as global aphasia, which is caused by an infarction of both divisions of the middle cerebral artery. Damage generally affects brain tissue throughout the "zone of language."

The most common difficulty associated with aphasia is anomia. Because anomia is present in almost all subtypes of aphasia, it has been hypothesized that the naming system is facilitated by a neural network within the left hemisphere (Hart & Kraut, 2007). Specifically, research has revealed that the left inferior temporal cortex has an especially significant role in this aspect of language. It is important to understand which parts of the brain are affected in these various forms of aphasia because of the clinical implications this information has. Additionally, learning where the lesions occur has been an ongoing focus of research.

Aphasia can be influenced or caused by several neurological and medical conditions. Approximately half of aphasia cases are caused by cerebrovascular disease (strokes). Strokes occur due to a blockage or rupture of blood vessels in the brain. Blockages cause a sudden interruption of blood flow to areas of the brain supplied by the

blooded vessel. Ruptures cause bleeding into or around the brain. About one third of aphasia cases are caused by traumatic brain injuries. Damage to the brain upon harsh impact often causes bruising on one or more areas of the cortex. Underneath this cortical contusion there may also be intracerebral hemorrhage. Depending on the location of the damage, aphasic symptoms may arise. Another potential cause of aphasia is seizures, which are brief interruptions in typical neurologic function. Helm-Estabrooks and Martin state that they occur because of the "abnormal, excessive, paroxysmal discharge of neurons" (p. 34). Seizures may cause a number of different abnormalities in the brain that lead to aphasia. Similarly, tumors arise in a multitude of degrees and may have varying affects on the brain. Different aphasic symptoms may emerge depending on the type of tumor, its location in the brain, and its growth rate. Lastly, the text describes different forms of neurodegenerative disorders and their influence on language. Dementia is a neurodegenerative disorder that develops due to gradual deterioration of the brain.

Semantics

It is important to study word meanings and word combinations because they reveal a great deal about language development. There are patterns that children generally follow when learning language and having an understanding of these patterns can be advantageous in the clinical setting. A common phenomenon that occurs when children are learning language is overextension, which is when a child's category boundaries are too wide. Conversely, underextension is when children use words to refer only to a subset of possible referents. Children may also use a word or phrase differently than an adult would. This is important to note when analyzing a language sample.

Syntax

Sentence structure and complexity may make it language more difficult to understand. Gayle DeDe and Erin O'Bryan Richtsmeier explain that there are certain features of a sentence that could make it more difficult for people with aphasia to comprehend. For instance, aspects of semantics such as vocabulary difficulty can influence sentence complexity. Word order also affects how difficult a sentence is to understand. In English, the most typical word order is subject-verb-object. The number of prepositions also affects how difficult a sentence is to understand.

Assessment and Diagnosis

There are a number of tests that clinicians use to diagnose aphasia. Common tests used to determine if an individuals has anomia are naming tests. These assessments require individuals to name pictures of objects or actions. A commonly used assessment of naming is called the *Boston Naming Test* (Kaplan, Goodglass, & Weintraub, 2000). Other tests are used to examine lexical retrieval abilities. An example of a test of lexical retrieval is the *Aphasia Diagnostic Profiles* (Helm-Estabrooks, 1992). Word fluency is also assessed through tests of generative naming. Aphasia tests are used to classify aphasia. The most commonly used system for classifying aphasia is called the "Boston" classification system, which categorizes aphasia subtypes based on symptoms. The Boston Diagnostic Aphasia Examination manual and accompanying text also provides a step-by-step outline how to determine which subtype of aphasia an individual has. The average number of words per longest three utterances is calculated through a language sample or assessment. This will determine if an individual has a nonfluent, borderline fluent, or fluent form of aphasia. Next, the standardized test of auditory comprehension should be administered. Results will reveal auditory comprehension skills and will help

to further distinguish which type of aphasia an individual has. Lastly, the standardized test of repetition is conducted. These three pieces of information form the basis of classifying the aphasia syndrome.

Assessment of language disorders should provide clinicians with several essential pieces of information preceding treatment. First, existing and non-existing communicative behaviors should be identified. The demands of the individual's environment must be determined, as well as other associated factors which could potentially affect their language abilities. When working with a child, the clinician should also consider the communication patterns of the child's family, and lastly, the specific strengths and limitations of the child and their family. Assessments may also be administered during treatment for the purpose of monitoring progress. Tests measure a child's abilities in several ways. There are norm-referenced standardized tests, criterion-referenced assessment tools, and child-specific measurement procedures. Standardized, norm-referenced tests compare the client to a set of normative data about children of the same age in order to make a decision about their individual skill level. Criterion-referenced assessments determine the client's success based on a performance standard, rather than a set of norms. Child-specific measurements are designed in order to meet the specific needs of the child. An example of procedures that are personalized based on the child's needs are interviewing the child's family, preparing stimulus materials that the child is familiar with, and obtaining language samples from home. Each of these three methods has specific strengths and weaknesses. It is essential to diagnose a child based on multiple assessment methods rather than just one.

In addition to these three broad models of assessment, there are specific tools used to grasp an understanding of a child's language abilities. Two specific methods are the mean length of utterance (MLU) and type-token ratio (TTR). MLU is calculated by taking a language sample, and counting the number of total morphemes. This number is then divided by the total number of utterances to find the MLU. TTR is a measure of lexical diversity. To calculate TTR, the clinician must also take a language sample and count each different word used in the sample. The number of different words used is then divided by the total number of words in the sample. These procedures are commonly used when assessing a child's language skills.

Treatment

Naming impairments are common amongst individuals with aphasia, thus, it is paramount that clinicians have an understanding about what they are and how to treat them. Semantic and phonologic treatments have been studied and identified as advantageous forms of treatment. An example of semantic training is semantic feature analysis (SFA). In SFA, clients sometimes use visual cues to retrieve semantic information. In the article "*A Comparison of Semantic Feature Analysis and Phonological Components Analysis for the Treatment of Naming Impairments in Aphasia,"* authors Van Hees, Angwin, McMahon, and Copland studied this particular form of treatment. They conducted a study in which eight participants with aphasia underwent three therapy sessions for four weeks. The researchers hypothesized that participants with primarily deficits in semantics would show a greater advantage from semantically based treatment, while those with greater issues in phonological processing would show a greater benefit from phonologically based treatment. Treatment times

depended on the subjects' degree of language impairment. Half the sessions involved semantic feature analysis and the other half involved phonological component analysis. During treatment, pictures were presented on a computer screen and participants were asked to name the item pictured. For those receiving semantic feature analysis in their treatment, associated words were related to were group/ category, use, action, properties, and association. For the sessions involving phonological component analysis, words were associated by first sound, syllable, last sound, and rhyme. The results of this study indicated that seven of the eight individuals participating in the study made significant strides in their language abilities immediately after being treated with phonologically based therapy. Only half of the participants, however, benefitted greatly after being treated with semantically based therapy. The results of this study do not support the researchers' original hypothesis, but seem to indicate that SFA did show some positive results, but PCA had greater effects.

Another form of treatment called Verb Network Strengthening Treatment (VNeST) can be used to improve the retrieval of content words. This method of therapy requires individuals to complete tasks that include generating, writing, and repeating the agent and patient for given verbs and answering interrogatives about these verbs. The article "*Effect of Verb Network Strengthening Treatment (VNeST) on Lexical Retrieval of Context Words in Sentences in Persons with Aphasia"* explains the impact of such treatment. Researchers Lisa Edmonds, Stephen Nadeau, and Swathi Kiran had the following four objectives in this study: To determine if training with a set of verbs using VNeST help individuals with (1) the production of an agent, trained verb, and patient in response to an unfamiliar picture and (2) the production of an agent, untrained

semantically related verb and patient in response to an unfamiliar picture. (3) To determine if participants had the ability to continuously determine the agent and patient from a given, unfamiliar picture. (4) To determine if this type of treatment might also help with the identification of nouns and other verbs (ones that are not directly related to those presented in this study). In order to answer these questions, four participants with aphasia underwent VNeST. A total of 24 pictures were used in order to stimulate language. Subjects were required to generate agents and patients for the verbs seen in these pictures. The four participants attended 2 hour therapy sessions twice per week in which they were asked to orally produce 3-4 semantic role pairs for the verbs in the pictures they were seeing. Next, they would answer wh-questions about the verbs and role pairs. The results of this study indicated that VNeST did, in fact, help with generalization. Three of the four participants were able to generalize what they learned in treatment to connected speech. These results are significant because they reveal that verb network strengthening treatment is useful for people with aphasia.

Right Hemisphere

The right hemisphere's role in language has been meticulously studied. The article "*Prevalence and Patterns of Right Hemisphere Cognitive/ Communicative Deficits: Retrospective Data From an Inpatient Rehabilitation Unit"* aims to explain how damage to the right hemisphere may impact language. Authors Blake, Duffy, Meyers, and Tompkins focused on two main objectives when conducting their research: examining the frequency of cognitive and communicative difficulties in adults with right hemisphere damage, and investigating the patterns of co-occurrence that occur within these deficits. Several primary factors (medical records not released, incomplete records,

etc.) excluded many individuals with right hemisphere stroke who were contacted to be a part of this study. After the initial sorting process, 123 subjects were included in this study's analysis. After a comprehensive review of each participant's medical history, 14 deficit categories were established. Researchers then performed a cluster analysis to study the patterns of these deficits. The most common deficits were attention, neglect, visual perception, and learning/ memory. These deficits were consistent with commonly reported deficits of individuals with right hemisphere lesions. A number of pragmatic difficulties such as verbosity and unelaborated speech were also noted.

A second study, conducted by David L. Rivers and Russell J. Love aimed to examine whether minor hemisphere lesions in the right and left hemisphere have varying effects on speech and language abilities. In their article, "*Language Performance on Visual Processing Tasks in Right Hemisphere Lesion Cases*," the authors compared three groups of individuals: adults with a right hemisphere lesion, adults with a left hemisphere lesion, and a control group with no history of neurological involvement. Each of the thirty participants (ten per group) was right handed and had normal hearing acuity. In order to investigate this, seven language tests that focus on visuo-spatial processing were administered. The purpose of using tests that focus on visual cues was to create the opportunity for researchers to examine how visual cues can influence language. Thus, the results would not occur because of an impairment of the language system itself. The results of this study indicated that minor right hemisphere lesions were associated with frank language disturbances. The left hemisphere lesion group produced significantly fewer correct responses than the other two groups on the following tests: Picture Naming, Fragmented Picture Naming, and Printed Sequence Construction. This group also

produced fewer complete sentences than the right hemisphere lesion group, and significantly more incomplete utterances than the control group. Both the left and right hemisphere lesion groups told significantly fewer complete stories than the control group, but between the two lesions groups, there was no significant difference in the results of this particular task. Overall, the right hemisphere lesion group was judged to have significantly reduced communication abilities. Rivers and Love indicated that this group certainly had difficulties with tests that required visuo-spatial processing. They recommended that research should be done on complex tasks such as story telling in a non-picture related task.

Description of the Case

Background Information

The patient presented here, CT, exhibits expressive and receptive language deficits. No notable concerns were observed during gestation or at his time of birth. At age 6 months, his parents started noticing some changes in his development. At age 8 months, CT was diagnosed with a right parietal malignant primitive neuroectodermal brain tumor and he began chemotherapy and radiation. Treatment concluded at age 15 months, with no reoccurrence. Developmental assessments that were administered at age 2 years, 7 months and 2 years 9 months revealed delayed developmental milestones, particularly in the domains of speech and language. Word retrieval difficulties were identified as a significant component of his language disorder. Speech and language therapy services were then provided at various levels of intensity. Additionally, physical therapy, occupational therapy, music therapy, and behavioral interventions were provided

during CT's early childhood years. Significant progress was made in the areas of speech articulation and left upper extremity movement, however language difficulties persisted.

At age 8, during the summer of 2015, CT underwent intensive language therapy and the Wendell Johnson Speech and Hearing Clinic at the University of Iowa. He made substantial improvement on goals during therapy but did not make notable gains on standardized picture naming assessments.

Treatment Plan

Treatment was administered over the course of 4 weeks, 4 days a week for 4 hours each day. Mornings were focused on Semantic Feature Analysis (SFA) and Verb Network Strengthening Treatment (VNeST) in order to stimulate semantic networks and enhance word retrieval abilities, as well as more traditional goal-oriented language activities. These goals focused on the improvement of receptive and expressive spatial concepts, "wh-" questions, the use of pronouns, and the use of present progressive morphemes. Afternoons emphasized the integration of goals through music therapy (twice a week), story time (twice a week), activities incorporating gross motor movement, and snack time.

Results of Treatment

Goals	Baseline Performance	End of Treatment Performance
Spatial Concepts Receptive	57%	93%
Spatial Concepts Expressive	63%	80%
"Wh" Questions Receptive	70%	88%
Pronouns Expressive	65%	82%
Present Progressive Expressive	50%	89%
Semantic Feature Analysis	100% (max verbal cues)	100% (reduced verbal cues)
VNeST	83%	100%

Assessment	Baseline (6/29/15)	End of Treatment (7/29/15)

Mean Length of Utterance	2.17	3.50
Type Token Ratio	.39	.40
% Verbs in Sample	6%	10%

Error Types	Test of Word Finding (4/2/15)	Test of Word Finding-2 (7/29/15)
	Percentile: <1	Percentile: 1
	Number/ Total Errors	Number/ Total Errors
Visual	5/9 (56%)	5/14 (36%)
Semantic	1/9 (11%)	0/14 (0%)
Phonologic	0/9 (0%)	1/14 (7%)
Nonword/ Phonologically Related	0/9 (0%)	5/14(36%)
Unfamiliar/ Didn't know (Didn't pass comprehension)	3/9 (33%)	3/14 (21%)

Analysis of Client's Response to Intervention

CT made significant progress on his goals, improving in each targeted domain. Because he did not improve noticeably on standardized noun picture naming assessments, a modified version of the Philadelphia Naming Test scoring guide was used to identify the types of errors CT made on the Test of Word Finding (administered on April 2, 2015) and the Test of Word Finding-2 (administered on July 29, 2015).

Upon examining the types of word retrieval errors CT made when naming pictures in the Test of Word Finding and the Test of Word Finding-2, apparent visual errors were noted. 56% of errors made in the Test of Word Finding were visually related. This number remained significant but decreased to 36% for the Test of Word Finding-2 in July. Other notable errors included non-word phonologically related errors, which made up 0% of the errors in the Test of Word Finding results, and 36% of the errors in the Testing of Word Finding-2 results. It is unclear exactly why these types of errors occurred. It is hypothesized that CT's visual processing difficulties are influencing his responses to these picture stimuli as well. For example, when looking at a picture of a

cow and a calf, he said “cowf.” This nonword/ phonologically related error may have occurred because he began focusing on the cow itself, despite the fact that he understood in the directions that he was supposed to name the colored calf instead.

These findings are significant for several reasons. First, they support that the initial hypothesis stating that CT either has right hemisphere or mixed dominance for language is correct. Additionally, the results support that semantically based treatments administered to CT was able to assist in the improvement of non-visually based tasks. Had his goals been measured by visually based criteria or included visually based stimuli, CT would not have made significant progress on them due to his difficulties with visual processing.

Further Recommendations

CT continues to demonstrate a developmental receptive and expressive language disorder with notable difficulties with word retrieval. Due to his significant progress during intensive treatment, it was thought that he has a good prognosis for ongoing improvement. It was recommended that future services target “wh-“ questions, pronouns, sentence structures, reading and listening comprehension, and basic language concepts (comparisons, prepositions, descriptive adjectives, quantities, time/ sequence concepts). Treatment of these aspects of language should include non-picture stimuli in order to bypass the difficulties CT is experiencing with visual processing.

Works Cited

Blake, M. L., Duffy, J. R., Myers, P. S., Tompkins, C. A., (2002). Prevalence and Patterns of Right Hemisphere Cognitive/ Communicative Deficits: Retrospective Data From an Inpatient Rehabilitation Unit. *Aphasiology,* 16, 537- 547.

Boyle, M., & Coelho, C. A. (1995). Application of Semantic Feature Analysis as a Treatment for Aphasic Dysnomia. *American Journal of Speech-Language Pathology, 4*(4), 94. doi:10.1044/1058-0360.0404.94.

Edmonds, L. A., Nadeau, S. E., & Kiran, S. (2009). Effect of Verb Network Strengthening Treatment (VNeST) on Lexical Retrieval of Content Words in Sentences in Persons with Aphasia. *Aphasiology, 23*(3), 402-424. doi:10.1080/02687030802291339.

German, D. (1986). National College of Education Test of Word Finding (TWF). DLM Teaching Resources, Allen, TX.

German, D. (2000). Test of word finding. 2nd ed. Austin: Pro-ed. Roach, A., Schwartz, M. F., Martin, N., Grewal, R. S., & Brecher, A.

Hegde, M. N., & Maul, C. A. (2006). *Language Disorders in Children: An Evidence-Based Approach to Assessment and Treatment*. Boston: Pearson/Allyn & Bacon.

Helm-Estabrooks, N., Albert, M. L., & Nicholas, M. (2014). *Manual of Aphasia and Aphasia Therapy*. Austin, TX: PRO-ED.

LaPointe, L. L. (2004). *Aphasia and Related Neurogenic Language Disorders*. New York: Thieme.

Lund, N. J., & Duchan, J. F. (1993). *Assessing Children's Language in Naturalistic Contexts*. Englewood Cliffs, NJ: Prentice Hall.

The Philadelphia Naming Test: Scoring and rationale. *Clinical Aphasiology*, 24, 121–133.