A Theory Describing the Multiple Aspects of Language and Its Assessment

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According to the Integrative Language Theory (ILT), language is an internal/external multiprocess activity that uses a multifaceted phonemic/grammatic/semantic coded structure for multipurpose intentions in communication. The above is a complex definition of the complex use of a complex code for communication purposes. An understanding of the code itself as well as the way the code is used is essential to the understanding of language, its disorders, and its assessment.

The assessment of language employs both formal and informal procedures for obtaining information about the language knowledge and use by an individual. The formal means are referred to as tests or measurement instruments. For a complete and formal assessment, a test of language must be able to provide information on two major areas of language performance and a method for obtaining it.

1. The language structure forms that make up the language code.
2. The pathways that carry the language structure that has been converted into neural sequences and taken to parts of the brain where the messages are understood and expressed.
3. The arrangement, construction, and administration of test items that provide the stimulus and the expected response needed for measurement.

The first two of the three components will be described in greater detail in the present paper. The third component will be described in a subsequent white paper.

Multifaceted Structure of Language

Each language has a unique code made up of vocal sounds referred to as speech sounds, or phonemes. The rules of each specific language dictate the acceptable combination of phonemes that will carry meaning in that language. The meaningful units are called morphemes. All words are morphemes, but not all phonemes or phoneme combinations are morphemes; phoneme combinations are called morphemes when they provide additional meaning to free morphemes to which they are attached. Words are free morphemes, while additions to the words that give them expanded meaning are called bound morphemes. For example, the word “book” is a free morpheme, but the sound /s/ is a bound morpheme when added on to “book,” causing “book” to mean plural and to become two morphemes instead of one.

It is at this point that we separate morphemes into categories. The difference among morpheme types and categories of structure is primarily caused by the function that each morpheme class serves in language. Following is a brief discussion of each of three language structure groups of morphemes: (1) Lexical/Semantic, (2) Syntactic, and (3) Supralinguistic. A fourth category, Pragmatics, will be discussed later.

Lexical/Semantic Category

The first category of language structure includes free morphemes; they stand alone and have a direct relationship between the morpheme and its meaning. Free morphemes are words that carry the content of a communicative exchange, words that refer to an object, or its quality, action, and/or the nouns, verbs, adjectives, and adverbs of the language. The Lexical/Semantic group of

words is an open one; new members are constantly being admitted to the group, in contrast to morphemes that belong to a closed class to which no new morpheme members can be added. Words in the first category are referred to as Lexical/Semantic, or content words, that provide meaning even when used alone. The term *semantics*, in its narrow sense, is often used to describe this category of words, although the term is more accurately used to refer to language meaning in general. In a way, this first category is the most essential to language.

Syntactic Category

A second category of morphemes includes single and combined phonemes that communicate grammatical meaning. The term *grammatical*, in this context, refers to the description of language units that apply grammatical rules for structural usage. It includes rules governing the use of (a) function words, (b) inflections, and (c) word order or syntax. Function words are free morphemes that are not used alone but act in conjunction with content words to add and clarify meaning to the content words. These function words are, as are all structural units in this category, limited in number but occur more frequently than the content words in the first category. Inflections are bound morphemes because they give additional and specific meaning to the words to which they are attached or bound. Even when they are comprised of single phonemes, they function as morphemes (the meaning of /s/ attached to a noun or verb "means" plural; adding /-ed/ to a verb indicates past tense). The inflections in a language belong to the grammatical morphemes group. The third structural unit included under the Syntactic category of a language is that of word order. The permissible word orders in a language are dictated by rules and generally include a subject, object, and verb. The order of these clauses is different across different languages. In English, word order typically follows subject + predicate, with the predicate being either a verb or verb with an object. A change in the order of words within a sentence may effect a change in meaning. "Can I go?" has a distinctly different meaning from "I can go." While the words in both sentences are identical, the word order changes the message that is being conveyed.

Supralinguistic Category

A third category, the Supralinguistic, was introduced by Woolfolk (1995, 1996) to accommodate language structures that cannot be interpreted by decoding the literal meaning of the words and grammar in spoken and written language. Interpreting a nonliteral utterance literally may result in a failure to understand the intended meaning of the speaker or writer. To comprehend such a nonliteral utterance, information may be needed from sources outside of the linguistic structure itself. Neither the Lexical/Semantic nor the Syntactic categories need additional information, beyond that conveyed in the literal message itself, to be understood. Conversely, the utterances that fall in the Supralinguistic category do not follow the same pattern. Evidence of the difference between literal and nonliteral language comprehension has been found in linguistic structure comparisons of the two types of construction as well as in actual studies of neural processing, suggesting different neural pathways for processing literal vs. nonliteral language.

Additionally, comprehending nonliteral utterances is a different process than comprehending either Lexical/Semantic or Syntactic category sentences. With a Supralinguistic structure, a listener needs to use his or her background information ("world knowledge"), the environmental context in which the speaker/listener verbal interaction takes place, or the general linguistic context of the exchange to receive clues as to how the message is intended to be received. The Supralinguistic category includes utterances that contain figurative language, words with double meaning, sarcasm, indirect requests, or those that require inference for understanding. Examples of the above will be described in the following section.

There is a fourth category of language structure that includes pragmatic language. The Pragmatic category is a broad one that has its basis on the use of language appropriate for a situation, for a person, or for verbal interaction. Because of the wide variation in these factors, this category will be analyzed in depth in a subsequent paper.

Validation of Structural Category Differences

The design of the Comprehensive Assessment of Spoken Language (CASL/CASL-2; Carrow-Woolfolk, 1999; 2017) provides separate tests for measuring (1) Lexical/Semantics—the content words of the English language; (2) Grammar/Syntax; (3) Supralinguistics; and (4) Pragmatics. As described above, the first three categories differ from each other in structural components as well as in the neurological systems that govern their use. Fortunately, in revising the CASL, a statistical method was used to further investigate the validity of these category differences. This was done to further support the theory that all three areas represent distinct processes in language and should be tested, particularly when identifying disordered language. Using a confirmatory factor analysis to compare the categories, three theoretical analysis models were considered: (1) a one-factor model, whereby all tests within CASL-2 measured an overall linguistic factor with no discernible categories among them; (2) a two-factor model separating all of the CASL-2 tests into either expressive or receptive measures; and (3) a two- or three-factor model grouping the tests by language knowledge categories (Lexical/Semantic and Syntactic tests for 3- to 6-year-olds; Lexical/Semantic, Syntactic, and Supralinguistic tests for 7- to 21-year-olds). The linguistic structure of Supralinguistics was not included for the youngest age group because there is only one test (Inference) available in that age group. Pragmatics was also not included because there is only one test in that category for all age groups. Comparing model goodness-of-fit statistics by age groupings suggests that the multifactor models based on the ILT are superior to a single, undifferentiated factor. This result was upheld in samples of typically developing individuals as well as those with clinical diagnoses of language disorders. These findings support the structural validity of the theoretical distinction of each linguistic category, with Supralinguistic, Lexical/Semantic, and Syntactic skills all being independent from each other (Carrow-Woolfolk, 2017).

The information about the statistical difference among the three categories described above gave rise to the establishment of *index scores*, a procedure for combining several tests within a category to yield a standard score and comparing the three category standard scores to determine their significance. Given the theoretical and statistical evidence supporting the difference among the three categories of language structure, it appears that tests of all three categories of structure are needed to identify and describe language disorders. A single assessment should not be used to describe the complex nature of the external and internal *structure and use* of language.

The Forgotten Category of Language Structure

Throughout this paper, I have referred to phonemes, morphemes (lexical and grammatical), and word order as the major building blocks of the structure of language. And they are. There is, however, another structural component of language that describes the way phonemes and morphemes relate to one another in spoken language to make it more comprehensible. The segmental aspects of language have been described earlier as the phonemes and morphemes. However, they are assisted by what are called suprasegmental phonemes: less tangible speech features such as stress and pitch designed to clarify syntax expression of meaning. The temporal aspects of utterances, the spoken syllables and words, require transition or emphasis from one sound or syllable to another. The suprasegmental phonemes are superimposed on an utterance to provide this additional clarification.

Unfortunately, suprasegmentals, although an integral part of oral communication, are not as easy to perceive nor to measure as are the segmental phonemes. In general, the former is often used without awareness on the part of the speaker. For example, the **stress** on a syllable or word conveys meaning. A declarative sentence such as "Mary baked the cake," changes when the word "Mary" receives the stress and pitch. Stressing the word "Mary" changes the sentence to mean that it was *Mary* who made the cake and not anyone else. If, on the other hand, the word "cake" is stressed, the meaning is that the *cake* was made by Mary. The emphasis on "Mary" in the first sentence answers the question "Who made the cake?" whereas the stress on "cake" in the second sentence answers the question "What did Mary make?" Changing the **pitch** at the end of the sentence can also change

meaning. If the pitch is raised on the sentence, a declarative sentence can be changed into an interrogative one: "Mary baked the cake" changes to "Mary *baked the cake*?" The stress and pitch changes are examples of the use of suprasegmental phonemes for changing meanings.

Although there are other suprasegmental phonemes, one that occurs frequently in spoken language is that of **juncture**. The suprasegmental phoneme that is characterized by pauses or modification of the temporal space in the transition of one word to another or in one syllable to another in continuous speech is called *juncture*. Learning to use juncture in appropriate linguistic situations is part of the language-development process. Although difficult to discern when listening to spoken language, it is possible to illustrate by using the written form of what is said. The following words or phrases use the same phonetic sequence, but, depending on the juncture, they can differentiate between meanings; *Ice cream* and *I scream* can be distinguished by a listener by the different location of the pause in phonetic transition: /aɪs krim/ and /aɪ skrim/.

Most children learn the suprasegmental phonemes as part of their oral language development. Their actual presence or absence in speech is not easily identifiable by a listener without training. Because of the difficulty in identifying them, these structures generally are not included in the assessment protocol for individuals with language disorders.

The Assessment of Language Structure

In the early years of identifying children with language disorders, it was considered adequate to measure the process of comprehending the linguistic structure of vocabulary as a means of determining the presence of a language disability. Because of the seminal works of Noam Chomsky and Roger Brown in the area of linguistics, a subsequent test, the Test for Auditory Comprehension of Language (TACL), was developed to include the linguistic structures of free and bound grammatical morphemes as well as the word order of phrases and sentences as part of the assessment of language comprehension. Numerous tests, such as those of Hammil and of Wiig, Semel, and Secord, added the assessment of the process of expression to that of comprehension. Subsequently, Woolfolk included the language structure of Supralinguistics to the categories of Lexical/Semantic and Syntactic to test language. A fourth category, Pragmatics, was included in the CASL but not in a comprehensive form, owing to the difficulty in capturing language *use* in a test format.

As described above, the multistructural aspects of language—its Lexical/Semantic, Syntactic, and Supralinguistic features—differ from each other in the requirements for their use in the comprehension and expression of oral and written language. The CASL-2 index scores, representing each of these differences, have been found to be significantly different from each other by the statistical method of factor analysis. The significant difference supports the need to assess each of the structural features of language independently, to determine what factors may be interfering with their correct use.

Discussion of the details of the design and construction of the CASL-2 in each of the three structural categories of language—Lexical/Semantic, Syntactic, and Supralinguistic—as well as in the processes of comprehension and expression, will be provided in subsequent white papers. Analysis of the types of test items contained within each category and between categories will assist in discovering the nature of the language disability.

Multiprocesses of the Neural Bases of Language

Not only do the differences among the external components of language *structure* require them to have independent assessments, but the internal neural *processes* required to *perform* language (expression and comprehension) must also be assessed

independently from one another to identify their differences. The language process has four major processing avenues, one each for oral language reception and expression and one each for written language reception and expression. These processing avenues differ from one another with respect to the demands they make on the central nervous system—the sequence of neural processes in comprehending oral language differs from the sequence for the expression of it, as is true of the sequences in reading and writing. Each of the four pathways requires a set of neural events to carry a message from the external source to decoding the message in the brain or to encode a message in return. In the auditory comprehension journey, the neural pathway that passes from the entrance of the spoken sound waves at the outer ear into the central nervous system is a complex one. Although words appear to be heard and understood at the moment that they are spoken, they, in fact, engage in numerous neural events in the brain along the way.

The human nervous system is alike in general but also individually different: some of us can carry a tune and some cannot; some of us can play the piano, others cannot; some can bat a baseball, others cannot, and so forth. Our inability to execute everything well is not thought of as a disability but as a difference. The differences are present in most aspects of our lives—looks, abilities, and so forth. Unfortunately, when it comes to speaking and understanding, individual skill differences weigh more heavily because of the dependency in our life on being able to speak and understand oral language. Exhibiting language difficulties does make a difference, and the dependency of language skills upon the sequence of events that make up the neural system causes some of these differences. There is a relationship between our language and our brain.

There are two major ways we have learned of the neural correlates of language. One is from research of studies of the developmental milestones of sound discrimination and language growth that follow the emergence of the neural substrates of language (Bates et al., 2002). A second source of information on the relationship between the brain and language comes from probing the literature that relates to brain injury or dysfunction with the type of disability that occurs in language. To be more specific, let us consider the neural pathway used in auditory comprehension of language. An oral sequence of sounds is uttered by a speaker. The utterance is encoded in a series of speech sounds that belong to the phonetic system used by both the speaker and listener. It is then carried as sound waves to a listener in a temporal sound sequence matching the speaker's production. The sound waves include the original characteristics that have been placed on the phoneme sequence—stress, space, inflection, and so forth. When the sound waves reach the outer ear canal, the small bones in the canal vibrate in synchrony with the sound waves. It is at this point that the physical waves are converted to neural ones and the utterance makes its way to the central cortex. There the sound sequence is transfigured into the code of language as underlying *phonemes/morphemes* and understood. However, as suggested above, continuing the journey from the eardrum to the place in the brain where a message is understood is not as direct as most might think. For example, in the language reception sequence, the failure of the messages to be understood can be caused by a problem at:

1. the acuity level, where the sound enters the auditory nerve and is heard;
2. the discrimination level of normal auditory perception, where the sound is differentiated from other sounds such as:
    a. in isolation or in combination with other sounds
    b. in the context of background noise
    c. in the quality, rate, or accent changes;
3. the perception level of memory, the level where learned phonemes can be recognized, remembered, and imitated;
4. the cognitive level, where language is understood through the association of words and word sequences with meanings that are held in memory.

In other words, for auditory comprehension to occur, a language utterance is coded into a series of phonemes, uttered by the vocal mechanism, received by the ear where it is converted to neural form, and processed through the perceptual level and the storage or memory level of the brain. From there, the utterance reaches the level of transfer at the cognitive level, where not only is the selection of isolated words matched with meaning, but also words in sentences. In expression, the recall from storage of isolated words and word sequences is passed to word and sentence generation and then translated to the motor utterance of the expression for the desired communication.

Speech production (expression) is similar to comprehension in that it follows a similar pathway between the central cortex and the peripheral system, but in the opposite direction. Language production at the central level is comprised of several processes that transform an idea into motor speech expression. The expression of language includes the following sequences: (1) an intended meaning or idea is selected, (2) a message is encoded into linguistic form using information from the language storage systems, (3) the linguistic form is then encoded into speech structure, and (4) it is expressed through the speech motor system. Speech then goes from the speaker's mouth to the listener's perception and into the central cortex of the listener, mirroring the original sequence.

As stated above, the neural language sequences pass through the perceptual and memory stages, but these stages are not possible to observe because they occur so rapidly as not to recognize their sequential form. However, when the reception or expression is delayed or disordered in some way, we recognize that one or more of the levels may not be functioning properly. A problem at any point in the sequence can cause failure in reaching the ultimate goals of language reception and expression.

The pathway to word knowledge and use needs to be free of processing problems. Although it is difficult to assess their adequacy, an effort to do so is essential to a description and interpretation of processing language. At a later period in this series of white papers, I will discuss, in greater detail, the measurement of language *structure* and its *processes* in the development of language tests.

As described in the paragraphs above, perceptual discrimination and memory combinations may impede an external utterance in its passage to auditory comprehension testing, as well as those of language structure itself. This is why I included some of these tasks in the tests I developed, so that any difficulties in these areas of language processing are identified instead of being overlooked in tests that focus solely on Lexical/Semantic and Syntactic knowledge.

Comparing Structural and Neural Category Differences

The categories of Lexical/Semantic, Syntactic, and Supralinguistic, as described previously, are different from each other in several ways.

First, the linguistic units in the categories differ from each other in their function in the sentence. The Lexical/Semantic units carry the substance of a message, using morphemes that have reference to things, actions, and ideas and their qualities. The Syntactic category of morphemes adds information about tense, number, gender, and so forth to the Lexical/Semantic morphemes. The Supralinguistic category applies the units of these first two categories within another layer of language knowledge to fully understand nonliteral utterances.

Second, the categories differ in size. The Lexical/Semantic and Supralinguistic categories have an infinite number of members—they are each an open category. Comparatively, the Syntactic category includes a small closed set of members that often occur together, in sequence and with frequency, in language use.

Next, the memory demands of each category differ. Lexical/Semantic includes the symbol (word) and its referent (that to which the word refers) that must be associated in the cognitive system for the word to be understood. Many words have more than one meaning and many meanings are associated with more than one word. The storage system is large and constantly increasing with new words and adapting the meaning of old words. The memory for the language units in the Syntactic category is small, compared to Lexical/Semantic. There are a fixed number of linguistic units, words, and phrases in the Syntactic category, and these are repeated so often that they become automatic, reducing the demands on storage and recall. Further, the memory stores for Lexical/Semantic vs. Syntactic are located in different regions of the brain and employ different neural processes (Ullman, 2008). This is true also for expressive language, which is used differently in response to an immediate oral stimulus from its use to initiate language expression from memory stores.

Additionally, the perceptual demands of categories also differ. The content words (Lexical/Semantic) stand out in sentences because they carry the meaning of the sentence, and, as a result, they are associated with an increase in emphasis and volume used to communicate meaning. Often, we do not attend to or discriminate the function words and inflections that form the grammar of the sentence, because the grammatical morphemes are not as acoustically predominant nor as important to meaning as the semantic ones. As such, they are less easily perceived. The grammatical morphemes occur so often together in phrases and sentences that one can predict and assume their presence. The frequency and temporal contiguity of the words in grammatical phrases increases the probability that certain words will follow other words. A process analogous to the anticipation of one word after another in grammatical phrases is found in the predictive text function of cell phones (whereby a banner appears under a message while texting; the banner completes the spelling of a word and/or suggests a word to follow the previous one before the writer types it). Word patterns such as these have been found to have a high probability of co-occurrence. Therefore, the grammatical words are remembered and used more automatically than content words, because these grammatical morphemes are set, limited, and unchanging in size.

Finally, there is evidence for differences in how the brain stores and accesses these distinct categories of language. Procedural memory is the unconscious memory for skills and how to accomplish them. Core deficits of procedural memory are said to explain disorders of grammar. The grammar skills are acquired through repetition and, once learned, permit us to use the activity automatically and implicitly, without conscious effort. Stored in a different region of the brain is declarative memory, which is memory for specific events or facts that are explicitly stored and retrieved. Declarative memory underlies the encoding, storage, and retrieval of knowledge, both world knowledge and the semantic/lexical knowledge of word forms (content words) and meanings (Ullman et al., 1997; Lum et al., 2012).

During the past twenty years, the studies of the relation between language and the brain have increased in number and narrowed in scope, by selecting to compare smaller units of language structure and neural representation (Bates et al., 2002; Cohen et al., 2016; Friederici, 2002, 2006; Lum et al., 2012; Van Lancker Sidtis, 2012; Ullman et al., 1997). Results have shown that relation among these language categories exists, both within and across categories, and is complex, at times showing correspondence and at times differences. Small units of language structures may travel different routes to the central area of language meaning. It seems logical to imply that language difficulties may arise from different neural structural units as well as from different neural connections.

The above considerations serve to recommend that the language structure aspects of language differ from one another in a number of factors. The difference is probably related to their differences in location and type of brain involvement in their production. It follows that separate assessments are needed to assist in the discovery of the type of language disorders presented and any neural patterns associated with those disorders.

A Final Word

I have tried to explain why I developed a series of tests to measure each of the language structure categories in both expressive and receptive processes. Remembering that I believe that language is a multiprocess activity that uses a multifaceted structure for multipurpose intentions, one can understand why a series of tests is needed to provide the information desired. It is also clear that I believe that language tests, in order to have validity in describing a language disorder, should be based on language theory and should provide a means of obtaining as much information as possible about the various factors that interact with and are essential to verbal communication. Such an approach will assist in determining language difficulties and will also add to the information available for understanding the relationship between language and the brain.

unlocking potential

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