Language and Cognition: Insight from Exceptional Cases

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Abstract

The understanding of the world in the human mind is accomplished through cognitive processing and articulated through linguistic processing. Undoubtedly, there is a significant connection between language and cognition because of how intricately they work together to create and express meaning. Researchers from a variety of fields have sought to discover the specifics of these domains to determine what kind of relationship exists between them and how the involvement between language and cognition should be best represented. Though they obviously interact, the different characteristics of each domain provide evidence that linguistic processes and cognitive processes may be distinct. Rather than considering language as a part of cognition or cognition as a part of language, the modular view considers language and cognition as separate modules of the mind. The atypical development of individuals with cognitive or linguistic deficits such as Williams Syndrome (WS) and Specific Language Impairment (SLI) support the hypothesis of modularity. By analyzing the linguistic and cognitive competencies of both of these types of disabilities, the impact of language on cognition and vice versa will be shown.

Language and Cognition: Insight from Exceptional Cases

The study of language and the mind has always been a vast and complex issue. Knowledge, language, and communication are so strongly connected that it is difficult to imagine one existing without the other. Language is essential to the expression of the human experience. Without expression through language, knowledge would only be minimally communicated. Without knowledge through cognition, language would have little to express. The understanding of the world in the human mind is accomplished through cognitive processing and articulated through linguistic processing. There is a significant connection between language and cognition. Researchers from a variety of fields have sought to discover the specifics of these domains to determine what kind of relationship exists between them.

When it comes to the analysis of linguistic and cognitive abilities, individuals with unusual capacities can provide information about the human mind. Williams Syndrome (WS) is a rare genetic disorder which causes mild or moderate intellectual disability, even though those who have the disorder still exhibit a strong linguistic ability. Their atypical development plays a significant role in the debate over whether language abilities are independent of other cognitive skills. Specific language impairment (SLI) is another disorder which may provide insight into the autonomy of these abilities. Children with SLI have a delayed mastery of language skills, but cognitive abilities are intact. The cause of this disorder is unknown as these children have no hearing loss, no other learning disability, and no intellectual difficulties. However, because language affects other areas of learning, some researchers suggest restricted development of language in

SLI may hinder growth in other areas of cognition. The relationship between language and cognition will be investigated through an analysis of the impact of disabilities on each domain. In pursuit of the best description of that relationship, this research will demonstrate how the principles of the mind and of language interact in order to provide insight into the classifications of the two domains within the fields of psychology and linguistics.

Approaches to the Relationship between Cognition and Language

Cognition and language are such important aspects of the human experience that it is difficult to determine the way in which they interact. Over the years, much has been discovered about each of these two capacities, but not necessarily enough to undoubtedly determine their relationship. Based on perspectives from current literature, four possible representations of the relationship between language and cognition are suggested, as presented in Figures 1-4.

Traditionally, language has been considered a part of cognition. Under this cognitive dominance view, linguistic ability is an important cognitive ability that aids in the processing of information. According to the Oxford Dictionary of Psychology, cognition is "the mental activities involved in acquiring and processing information" (Colman, 2015, Cognition). Because language is the means through which much information is processed and learned, language can be considered a significant part of the process of cognition. The large umbrella of cognition is generally considered to include a wide range of abilities including perception, attention, memory, thinking, learning, problem solving, and decision making. Cognitive linguists want to include language

among these mental abilities (Evans & Green, 2006). Cognition is the ability to store, retrieve, and process meaning in the mind and is often considered the essential connection between the mind and the world. Without the ability to take in information from the world, remember it, and make connections between external concepts, humans would have difficulty expressing any thought. Therefore, because language is a process of the mind, it is considered to be a part of cognition. As an expression of the concepts of the world, language is an essential part of the formation of meaning. For this reason, some scholars consider language to be a sort of manifestation of cognition into words and sentences. Without language, cognition would just be a set of mental entities with no ability to develop, organize, or express them. Therefore, as represented in Figure 1, language is placed under the domain of cognition.

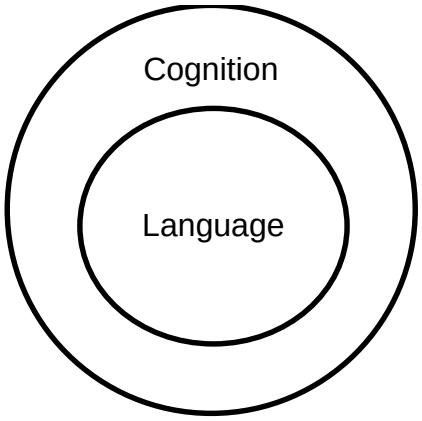

Figure 1. The cognitive dominance view.

Under this approach, language cannot fully develop if cognition is not intact. Some scholars look to those with autism as evidence for this view. Because those with autism have a below average ability to use language to communicate, some believe this suggests that their struggle with meaning and use is caused by their mental deficits.

Others also argue that feral children, who grow up isolated from the world without proper language input, have trouble developing linguistic skills due to their lack of cognitive development. It does seem that the pragmatics and semantics of language rely on the ability to connect and manipulate information in the brain. Without a cognitive capacity to understand, store, and retrieve ideas, humans would not be able to properly use language to communicate.

Another approach to the relationship considers cognition under the umbrella of language. Scholars who adhere to the language dominance view argue that language is more than just the means through which cognition is expressed. Because language is the most essential part to an understanding of the world, it may have the ability to influence thought. Linguistic determinism is the idea that the language shapes the way individuals process information. For example, research supporting the Sapir-Whorf hypothesis discovered that different spatial representations in languages lead speakers of different languages to form different spatial reasoning.[1] Languages appear to have different frames of spatial references: egocentric, based on the viewer, and allocentric, focused on the

[1] The Sapir-Whorf Hypothesis is the theory that the structure of language influences the modes of thought and behaviors of the individuals who speak that language. It includes the principle of linguistic determinism which leads to the principle of linguistic relativity. Linguistic relativism is the idea that language differences lead to differences in reasoning (Whorf, Carroll, Levinson, & Lee, 2012).

landmark or external object. In languages that utilize only one of these frames of reference, people will use the same frame of reference as their native language in non-linguistic tasks (Brown & Levinson, 1993). This research suggests that the human mind may perceive the world differently based on language. As represented in Figure 2, language governs cognition.

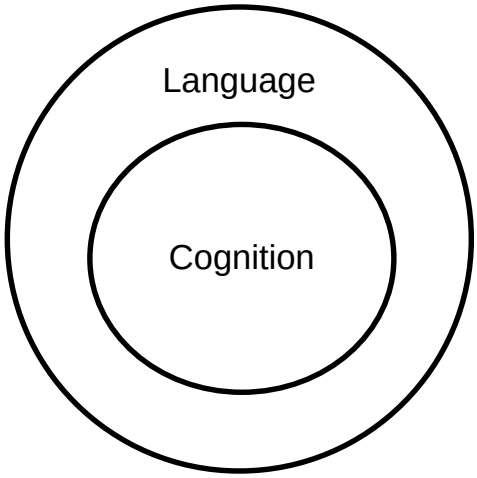

Figure 2. The language dominance view.

Under this view, cognition cannot develop without the use of language and there is some empirical data supporting the idea that language scaffolds the cognitive capacities during development. Researchers have found that young children who verbalize their thoughts are often more successful in problem-solving (Diaz & Berk, 1992). When reasoning and thought process are extended over time, language can off-load or enhance memory. The idea is that the use of language can ease some of the heavy burdens of working memory, providing a wider range of complexity in cognitive processes. At some level, it seems that language does in fact assist the development of the mind. In support of

the linguistic view, cognition seems to develop more smoothly when language can provide internalization of concepts and ideas.

Contrary to the first two approaches, many scholars also believe that language and cognition are two separate entities. Even though language and cognition have a close relationship, one does not necessarily have authority over the other. Yet even as distinct modules, it is undeniable that they interact in some way.

Some scholars argue that language and cognition overlap. As represented in Figure 3, there are certain aspects of cognition and language which are connected. Proponents of this view often look to spatial abilities as evidence of this overlap. Individuals who have difficulties processing the world spatially also have trouble using spatial language to convey information. This view attributes communication and understanding problems to an overall processing difficulty in both language and cognition as overlapping domains. In some areas of language use, cognitive understanding and linguistic understanding work together to construct and articulate meaning. Proponents of this view suggest that even as distinct entities certain areas of language and cognition develop together as one process.

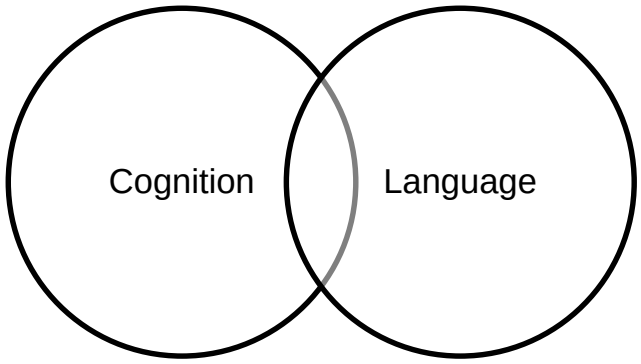

Figure 3. The connectionist view.

The final approach to the relationship of language and cognition is one that argues for completely distinct modules of the mind. Under the modular view, these two areas still have an interacting relationship in which they need each other to communicate and understand. However, they are considered to be modules that develop and function separately. As shown in Figure 4, proponents of this view argue that the two domains are in an interactive relationship but remain unattached because they are characteristically distinct. Those who adhere to this view recognize that linguistic abilities are quite unlike other abilities of the mind. Under this view, the development of language is a process separate from the development of cognition.

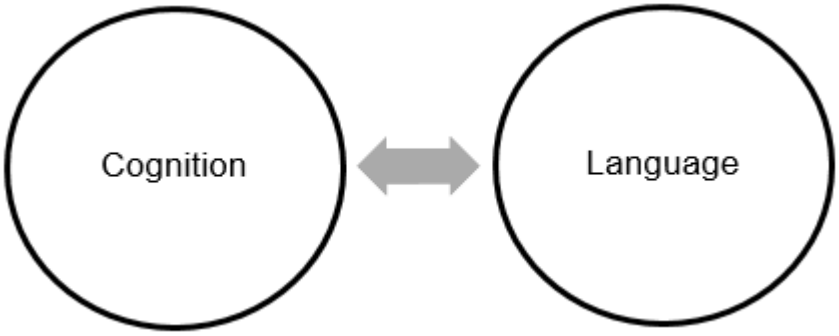

Figure 4. The modular view

An Argument for Modularity

The basic premise of the modular view emphasizes that language and cognition are characteristically distinct. Even though cognition is the ability to store and retrieve meaning, it does not necessarily require language. Concepts are often encoded in the brain through language; however, just because language adds meaning to understanding, it does not follow that linguistic ability must be just another part of cognitive ability. The

modular view instead recognizes that the innate structural nature of language distinguishes it from other abilities.

Humans are born with a complex set of abilities which enable language learning. Research points to an innate language faculty which guides the acquisition of language. This faculty is a theoretical construct of the human brain available from birth which processes language. It allows humans to learn language easily through a set of natural abilities based on the universals of language. According to Chomsky's theory of Universal Grammar (UG), there are principles which are found in all languages in the world (Chomsky, 1995).[2] UG guides the acquisition of the underlying structure of language. The initial state of the language faculty consists of the principles and parameters of language universals (Gass, 2003). This innate language knowledge provides the basis for constructing the underlying system of grammatical rules. Because the basic structure of language seems to be fundamental inherent knowledge, it is likely separate from other cognitive knowledge. Humans master language with little effort and

[2]According to the Oxford Concise Dictionary of Linguistics, universal grammar is "Chomsky's term for a set of principles and parameters seen as determined by the human genome and as both facilitating and constraining the development of speech" (Matthews, 2014, Universal grammar). Properties of human language are the basis of all languages and believed by many to be an innate part of the human mind. Throughout this paper, Universal Grammar is used to refer to the universal principles of language which form part of the mental structure of language.

are quite unaware of the general principles that govern speech. Because of the structural nature of grammatical rules, it is much different from other abilities of the mind. This dependency on structured units in language processing sets it apart from cognitive processing.

In contrast with other areas of development, language acquisition has its own specific characteristics. Language is acquired through active construction of rules by using innate principles and exposure, not just through imitation or reinforcement. All children follow similar predictable patterns of development, but this is not necessarily determined by intelligence or influenced by error correction. According to the Poverty of the Stimulus argument, the input that children receive is too variable and underspecified to ensure that all children acquiring the language could form the correct grammar (Gass, 2003). The limitations of the input necessitates the assistance of inherent knowledge. The lack of reliance on input to know how to form rules of grammar is evidence that innate linguistic knowledge is likely guiding development. Language development is essentially the construction of a linguistic system. Children subconsciously hypothesize rules to account for the hierarchical organization of language. It is expected that children gradually modify rules and learn exceptions in normal development of linguistic ability (Mintz, 2009). Unlike language, other cognitive abilities require reinforcement of behavior or are developed through imitation, whereas these have little influence on language acquisition. Language and cognition develop quite differently, suggesting that they are distinct modules.

Through the lenses of neuroscience, language is a function of the brain. The traditional view of the brain was that functioning was distributed throughout the whole brain. Recent advances in the technology of this field have provided new information about the different areas of the brain which handle different processes, contradicting the holistic view. Neuro-imaging techniques have discovered support for the localization hypothesis in which language is located in distinct areas of the brain. These advances have shown that language is predominantly lateralized to the left hemisphere of the brain (Ingram & Chenery, 2007). Most of the areas of language are also in the cerebral cortex, the outer membrane which also controls higher cognitive functioning as seen in Figure 5.

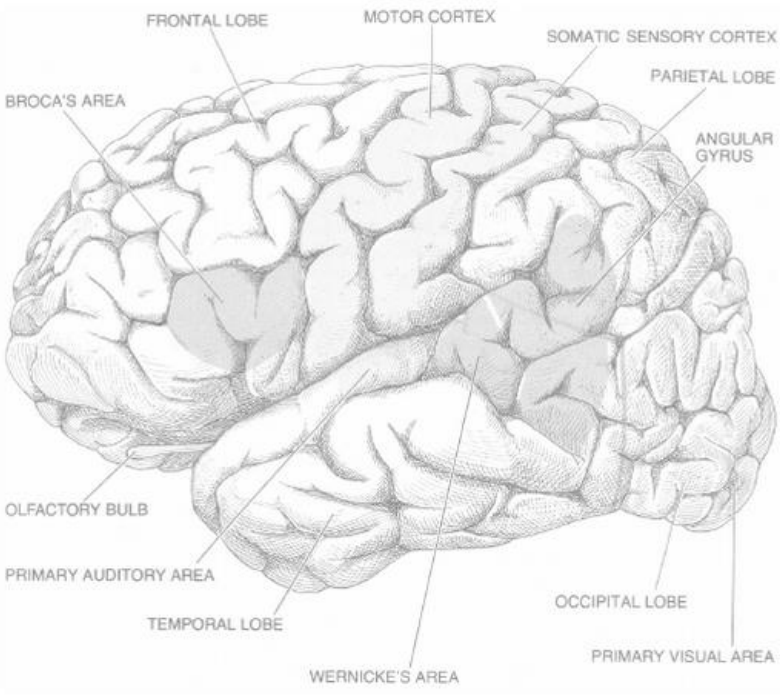

Figure 5. The cerebral cortex: The language areas and major anatomical landmarks (Ingram & Chenery, 2007, 11).

Though neuroscience has not revealed one particular physical construct of the language faculty, there are several areas of the brain which influence language. Broca's area, located at the base of the motor cortex in the frontal lobe, is thought to have the most control over the production of language (Mihalicek & Wilson, 2011). It directs the movement of the mouth and tongue in speech and organizes the articulation of sounds. It also seems responsible for the use of inflectional morphemes and function words. The other language center in the brain, Wernicke's area, handles perception and comprehension and is responsible for the selection of words from lexicon. Located at the back of the auditory cortex in the temporal lobe, Wernicke's area is next to the angular gyrus, which converts between visual stimuli and auditory stimuli to allow a match between spoken and written words and visual perception of objects. Because the brain is extremely complex, there is still much to discover about its areas and processes. However, the distinct language centers of the brain suggest that language is processed separately from other cognitive processes.

Though no clear view of the representation of language and cognition can be proven with empirical evidence, the modular view is supported by current research and theories in neuroscience and language acquisition. Language is an ability of the brain that is distinct from other cognitive abilities, though language still remains a significant part of human development as its function contributes to an understanding of the world. Therefore, the relationship between cognition and language must be one in which the two separate domains interact. As distinct modules, language and cognition assist each other in understanding the world and expressing that understanding.

Case Studies

By analyzing the abilities of groups of individuals with atypical cognitive and/or linguistic development, the relationship between cognition and language can be further evaluated. The strength in one ability contrasted with weakness in the other seems to show that cognition and language are indeed distinct modules. In the analysis of such disabilities, researchers seek to discover whether difficulties in one area have any impact on the functionality of other. The influence of disabilities on both types of processing will provide insight into the essential characteristics of each capacity and how they interact.

Williams Syndrome

Williams Syndrome (WS) is a rare neuro-developmental genetic disorder caused by the deletion of a specific gene on chromosome 7. Most individuals with this disorder have an unusually strong linguistic ability in spite of significant cognitive deficits, suggesting modularity. Though they often show mild or moderate intellectual disability, they have an uneven cognitive profile, also known as a *peaks and valleys* profile, meaning they have varying strengths and weaknesses within different domains (Cuccio, 2011). For example, their vocabulary knowledge and use remain strong but drawing, building designs, and reproducing figures and patterns are examples of severe deficits in their visual-spatial processing. These, along with motor-planning difficulties, may be caused by representational issues in working memory. Researchers have sought to examine their uneven profile in hopes of discovering whether their linguistic abilities are truly intact when certain cognitive abilities are severely impaired.

Spatial language and spatial cognition in individuals with WS have been of particular interest to researchers because these are areas in which language and cognition appear to interact. There have been a number of studies analyzing how individuals with WS encode spatial concepts of language, in spite of impairment in visual-spatial processing. This research discovered that those with WS are still able to acquire meaning of spatial language even with impaired spatial cognition, but sometimes their use of spatial terms is impeded. In a study conducted by Landau and Hoffman (2005), a group of ten children and thirteen adults with WS showed fragility in encoding directions on both linguistic and non-linguistic tasks. However, many were able to compensate by using other general terms such as *near* or *far* to still provide a vague answer. Even though individuals with WS have the ability to semantically understand spatial language, it seems then that their language still reflects a non-linguistic spatial breakdown. This failure could imply that cognition is a part of language because their language is affected only in areas where cognition is impaired. Their inability to use spatial language is likely due to the difficulty they have in creating mental models of spatial relations. Even though spatial language can sometimes function without the cognitive aspect, problems retaining spatial information in working memory affected the use of spatial language (Cuccio, 2011).

Despite these conclusions, research on the use of spatial language is not necessarily analyzing linguistic ability because it focuses more on the semantic use of spatial terms than on the underlying structure of grammar. Most researchers would agree that spatial language is based in non-linguistic concepts in the brain (Li & Gleitman,

2002) making it reasonable to conclude that problems with spatial language stem from non-linguistic deficit. In effect, the linguistic ability of those with WS, as in their underlying grammatical structure of language, remains unaffected by spatial cognition, even if the expression of language is affected.

In order to truly capture the linguistic competence of WS, it would be more appropriate to analyze grammatical ability. In measurements of grammar, those with WS excel on linguistic tasks, with the exception of spatial language. Phillips, Jarrold, Baddeley, Grant and Karmiloff-Smith (2004) conducted two tests on 32 individuals with WS ages 8 to 38 evaluating their comprehension of grammatical structures. On the TROG (Test for Reception of Grammar), WS individuals made errors only on the spatial components of the test when compared to the control group. On the TRUST (Test for Receptive Understanding of Spatial Terms), the participants again made significant errors in the comprehension and use of spatial terms. Because other components of their grammar were intact, it is reasonable to conclude that their linguistic ability is in fact separate from their cognitive ability. Cognitive deficits may impede the use of certain terms but it does not affect the underlying rules of grammar.

Even though visual-spatial impairment may cause selective issues with use of language, it does not imply an overall problem with semantic ability. In an analysis of spatial suffixes and prepositions, subjects with WS still expressed understanding the semantics of spatial language but had difficulty only when spatial language had to be applied to make representations of the real world (Lukacs, Pleh, & Racsmany, 2007). On purely linguistic tasks, those with WS were more effectively able to use spatial terms.

Though there is often a need to create a mental model to be able to describe what is seen, spatial language does not seem to be completely reliant on these models. The semantics of spatial language can still function without cognitive understanding which suggests that language ability does not depend on cognitive ability. Even though language is sometimes used to convey cognitive information, an inability to express cognitive connections in WS is caused by issues with working memory and mental representations not by issues with language. Spatial concepts is considered by some to be one of the areas in which language and cognition interact.

Underlying linguistic abilities in individuals with WS remain unaffected by cognitive deficits. The gap between their abilities, which seems to indicate modularity, is also evidence for an innate autonomous mechanism in the brain for the acquisition of language. Those with WS are still able to fully acquire the grammatical structure of language, indicating that their language faculty guiding their acquisition is not subservient to cognitive development.

Specific Language Impairment

If analyzing those with cognitive deficits contributed to a better understanding of the relationship of language and cognition, those with linguistic deficits and intact cognition will also provide insight. Though most children learn language with little effort, those with language disorders have significant difficulty learning language even though they have no other obvious problems. Such language disorder, also often referred to as language delayed or developmental dysphasic, is called Specific Language Impairment (SLI). With no cognitive, neurological, or sensory deficits, the reason for such

impairment has been of particular interest to researchers. In order to be diagnosed with SLI, children must have a non-verbal IQ of at least 85 and tested to make sure there are no underlying causes of language difficulty (Botting, 2005).[3] Researchers have had difficulty determining the exact number of those with this impairment since SLI can refer to a number of linguistic problems which may or may not be persistent into adulthood. Because cognition and language interact so strongly, research has sought to determine the possibility of cognitive deficit impairing language or language delay causing cognitive impairments.

Though the cause of the disorder is unknown, there are various attempts hypothesizing an explanation. From a biological standpoint, SLI is often explained genetically, as the disorder is commonly associated with a genetic abnormality. Nonetheless, even if the specific genes in question do play a role in impairment, the question of whether the abnormality is a cognitive impairment or a linguistic impairment remains. The essential issues lead to two different approaches to an explanation of SLI, one which interprets the disorder as a linguistic deficit and one which interprets it as a cognitive deficit. The linguistic approach attempts to explain impairment under a view that aligns with the idea of an innate language faculty separate from cognition. It seeks to

[3] The most common measurements of cognition are standardized intelligence tests such as the Stanford-Binet Intelligence Scale and the Wechsler scales which assess memory, vocabulary skills, and basic arithmetic skills. A score below 70 is usually considered intellectually disabled (Harris, 2006).

find specific aspects of Universal Grammar which are impaired by analyzing the grammar of dysphasics. This research extends beyond the surface representation of their language to examine the structure of their language and determine whether certain innate principles of language are missing or impaired.[4] Other explanatory models of SLI take a nonlinguistic approach by claiming that the atypical development of language arises from a problem with processing mechanisms. These views contrast with a modular view of the representation of language and cognition. By arguing that language impairment is a cognitive issue, it places language under cognition. However, research reveals that the major difficulty lies in their morphological ability.

One cognitive approach in particular claims that the individual with SLI cannot properly process their auditory input. Even though those with SLI do not have hearing problems, proponents of this explanation attribute their impairment to an inability to process rapidly changing auditory information (Tallal & Piercy, 1978). Additionally, some also claim that if the morphemes are not phonologically salient at the surface level, the individual will not be able to process the morpheme's underlying representation, thus

[4] Language knowledge is more than a string of segments that is heard from the mouths of speakers. There are different levels of representation of language knowledge (Gass, 2003). First, there is the underlying representation of grammar which involves the basic components of words and morphemes. Then, after the phonological and morphosyntactic rules are applied, it leads to the surface structure of language, which is spoken and heard.

preventing them from forming the proper rules involving those markers (Leonard, Bortolini, Caselli, McGregor, & Sabbadini, 1992).[5] If this were the case, these individuals would have trouble with certain sounds, not just with certain morphemes. Studies show that unsalient final word endings are often omitted in SLI but not when they are a part of the root word (Menyuk, 1978). For example, the [s] in content words such as *nose* remains intact while the plural marker [-s] is frequently omitted. Dysphasics can process the phoneme [s] at the end of words, whether it is acting as a morpheme or not. It seems that their difficulty is an issue of morphology, not an issue of perceptual saliency. Those with SLI instead have trouble with constructing and applying grammatical rules for the use of morphemes.

A better explanation of SLI is one that explains the language disorder in linguistic terms. Those with SLI can produce words with morphological markers, but they struggle to articulate the underlying principles. The linguistic ability of those with SLI demonstrates an absence of certain constructs of grammar and cannot simply be determined by errors in their speech output. The surface structure of their language only shows basic information about their areas of difficulty. Instead, their linguistic

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[5] Linguistically, saliency refers to the prominence of a certain sound or morpheme within the larger context of a sentence (Gass, 2003). Typically affixes and grammatical words are not prominent compared to content words. Even though morphemes and function words provide grammatical information, content words provide lexical information that contributes to the meaning of the sentence.

competence should be analyzed based on the principles underlying acquisition. Those with SLI have an impaired system of grammar which can produce both correct forms and errors at the surface level (Gopnik & Crago, 1991). The errors caused by impairment are not random; even when they do produce correct form, certain principles may still be missing in their underlying representation.

In an analysis of three generations of a family with numerous individuals with SLI, Gopnik and Crago (1991) provided a linguistic account of the underlying language abilities of 20 family members with SLI in comparison with other family members with normal language development. Gopnik and Crago analyzed the interrelated patterns of SLI output in order to understand the mechanisms which were producing this output. Based on fourteen administered tests, those with SLI demonstrated impairment of abstract morphological features, which led the researchers to propose the feature deficit hypothesis. These features included morphemes of number, gender, animacy, mass/count, proper names, tense, and aspect. On assessments of number marking, those with SLI were able to perceive the difference between words with and without the plural marker [-s]. However, they were unable to apply the rules for the English plural marker to nonsense words. When given words for imaginary animals such as *zoop* and *zash*, most could not determine how to appropriately mark plural. Even when they answered correctly, it was because they explicitly stated a basic rule of adding /s/. However, this also led to incorrect application of [s] instead of [ez] to words which end in sibilants like *zash*. Though they may have attempted to explicitly learn a basic rule for pluralization, this evidence suggests that these individuals have memorized feature marked words as

separate lexical items. For example, *books* would be entered into their lexicon as *multiple books* rather than constructed from *book* + plural marker [s]. This shows how the dysfunction of language impairment is essentially a problem forming the rules of language implicitly; any form or rule regarding morphological features is likely memorized explicitly.

Impairment of other morphological features further supports the feature deficit hypothesis. On the part of the test analyzing tense, those with SLI did not seem to understand that the point of the test was to manipulate tense marking and were frequently unable to produce the desired response. Instead, they either produced an ungrammatical form of the verb or a semantically similar but correct response. Dysphasics also show an interesting difference in their ability to use irregular verbs and regular verbs. Their use of irregular verbs is more likely to be correct, likely because irregular verbs are not rule-generated. On data drawn from school notebooks from these subjects, impaired children seem to learn regular past tense verbs individually only after the teacher introduced each correct from (Gopnik & Crago, 1991). Further research suggests that those with SLI are unable to construct rules and instead learn each verb form as a separate lexical entry (Pinker & Prince, 1988). In support of the feature deficit hypothesis, evidence shows that the primary difficulty in SLI is morphological. Because a specific aspect of language is shown to be impaired, language ability can be considered distinct from cognitive ability.

The use of pronouns in individuals with SLI also suggests that impairment is caused by a linguistic difficulty in rule formation. Dysphasics can easily match sentences with pronouns to the correct picture but the results of their performance on a narrative

task show that their use of pronominal reference may not be fully developed. In the same study by Gopnik and Crago (1991), those with SLI more frequently used full noun phrases instead of pronominal anaphora when compared to non-SLI participants, which can also be explained by the feature deficit hypothesis. Rather than constructing a grammatical paradigm of feature marked pronouns, they learn each word as a separate entry in the lexicon. For example, *he* would be remembered as an unidentified male instead of understood as a pronoun with male gender feature and singular feature. Most of the surface errors that those with SLI produce can be attributed to an underlying grammatical problem in marking for feature. They do not have an inability to process information, but instead cannot conform language into any sort of rules.

This feature deficit that appears in SLI leads to significant problems with inflectional morphology and further grammatical difficulties. For example, number is marked with a morpheme on a lexical item but also influences determiners, verb markings, and pronoun referents. Feature impairment can lead to problems with using correct determiners, checking for progressive, and eliminating subject pronouns before untensed verbs (Gopnik & Crago, 1991). Because linguistic constructs are so intertwined at the surface level, impairment with features can cause further issues. SLI is best explained as an underlying disability in recognizing and constructing rules of language. It appears that the innate language faculty is impaired rendering those with SLI incapable of creating paradigms of language.

Research on the derivational morphology of dysphasics provides further insight into the nature of the deficit. Because derivational affixes are characteristically more

lexical, some thought that derivational morphology may not be as significantly impaired in SLI.[6] However, the impairments of the participants in the research of Gopnik and Crago (1991) revealed that dysphasics had significant difficulty producing predicted derivational affixes. Similar to the results on the inflectional assessments, they did not understand that the point of the derivational test was to manipulate a grammatical rule. When given a blank space to create a word with derivational affixes, they would either produce incorrect forms or provide a semantically relevant response that was grammatically correct. These results demonstrate that their difficulty may also extend to the application of rules for word-formation. Dysphasics may know the meaning of derivational affixes, but are unable to create or determine how those affixes are applied through rules and structural paradigms.

The pragmatic aspects of language seem unaffected in cases of SLI. Dysphasics use language just as any other person would and fully understand the meaning of words. When talking with the adults in the family, their language appears unimpaired because they have learned strategies for coping with their difficulty (Gopnik & Crago, 1991). However, testing shows the impairment of their underlying grammar is still significant. Even with years of intentional speech intervention and routine grammar instruction, language problems persist in true cases of SLI. It is not for lack of input that these

[6] Derivational morphology changes the meaning of the word through the formation of new words from a root word. Inflectional morphology consists of affixes which add grammatical meaning to the word.

linguistic deficits occur and reinforcement of linguistic rules does not seem to aide in their development. Instead, there is an issue with their ability to form these rules which cannot be helped which provides significant evidence that their innate language faculty is impaired. Despite years of explicit instruction, their disability prevents them from subconsciously understanding the structure of language and instead they must compensate by learning each word with all its morphemes as a separate lexical entry. The possibilities of language utterances is infinite, making it difficult for individuals with SLI to compensate for their impairment by explicit learning. Because they cannot memorize all those possibilities, linguistic ability remains impaired into adulthood.

In order for cognitive hypotheses of SLI to be upheld, then a particular part of cognition would also have to be impaired. Adherents to these views would also have to explain how only some aspects of language are impaired. Cognitive explanations would need to posit separate cognitive processes for certain components of language to compensate for the fact that some of those processes are impaired and others are intact. Even if this were possible, it would not undermine the fact that there is a deficit with particular linguistic constructs. The problem with the cognitive explanations is that the theories cannot account for the missing underlying constructs of the grammar in those with SLI.

Another cognitive explanation tries to account for these problems by emphasizing the processing of language in the brain. The procedural deficit hypothesis claims that language impairments are the result of an abnormality in the procedural memory system (Ullman & Pierpont, 2005). This hypothesis seeks to explain how individuals with poor

linguistic competence could have cognitive strengths in non-verbal intelligence by searching for weaknesses in mental imagery and working memory. Under this view, difficulties in grammar and lexical retrieval are influenced by cognitive processing. Many studies on individuals with SLI have focused on verbal short-term memory and working memory with the goal of seeking evidence for a larger cognitive processing deficit responsible for language impairment. Because most dysphasics have a difficult time with these types of tasks, researchers posit that the impairment is actually a larger issue with short-term memory or working memory (Montgomery & Evans, 2009).

Short-term memory involves storage capacity and working memory involves both storage and processing demands. According to the working memory model, short-term memory tasks involve the retention of series of verbal material through the phonological loop and working memory involves the phonological loop and processing of the central executive (Baddeley & Hitch, 1974). Those with SLI show significant issues with both of these tasks, most prominently with non-word repetition studies (Archibald & Gathercole, 2006). However, difficulty in word repetition could be a difficulty in memory retention or in activation of long-term lexical knowledge. Additionally, it seems that non-verbal memory and lexical ability are actually quite intact in cases of SLI. Though items are stored long-term, the issue with serial repetition tasks may instead be phonological encoding.

Some propose that the primary function of short-term memory is to aid the learning of phonological paradigms (Baddeley, Gathercole, & Papagno, 1998). However, just because the nature of phonological input is brief does not necessarily mean it should

be considered a part of short-term memory. Phonological encoding does involve working memory, but this does not necessarily imply a linguistic or cognitivist view of language and cognition. Because phonological awareness is quite integral to the processes of attention and memory, a problem with this ability would naturally prevent success in verbal memory tasks. Yet this is still not to say that language impairment causes cognitive impairment. Studies on non-verbal working memory show whether the developmental language impairment is caused by a cognitive processing issue or by an underlying phonological problem.

There have been few studies on visuospatial short-term memory in SLI. In hopes of finding an overall cognitive deficit, Archibald and Gathercole (2006) set out to comprehensively assess the verbal and non-verbal memory abilities of the language impaired. Similar to previous studies, those with SLI performed poorly on verbal memory tasks. Though advocates of the procedural deficit hypothesis argued that poor short-term memory prevents their learning of phonological forms and working memory prevents the processing and storing of these forms, those with SLI overall performed in the normal range on visuospatial memory tasks. These results strongly suggest that memory deficits are specific to tasks based in language. Additionally, of the individuals studied, less than half of the group showed impairments in phonological awareness (Archibald & Gathercole, 2006). The lack of this type of impairment suggests that awareness of phonological components might not be the exact issue; rather, an understanding of the underlying interaction of phonemes could be problematic. Because basic phonetic understanding seems to be intact, the difficulty may be encoding these segments into

phonological paradigms. Inability is not caused by memory deficits but by an inability to understand the phonological structure of words and the paradigms of sounds and the relationship between individual units. Language impairment seems to be a deficit in constructing rules and paradigms of language.

Conclusion

These disabilities suggest a distinction between the linguistic and cognitive modules in the mind. Though a disability in one area may affect the final output of the other, it seems that deep within the mind, language and cognition are distinct processes. The linguistic ability of the mind, whether impaired or intact, is much more than just the ability to speak and understand. Though language is used for a variety of purposes and particularly to communicate, language itself is a system involving many different components (Mihalicek & Wilson, 2011). Native speakers do not even realize they utilize such systematicity in their language knowledge, no matter how socially proper their grammar. Linguistic ability is then the construction of well-formed sentences using the components of language. This definition goes beyond basic grammar recognized by speakers and seeks to understand the underlying structures of language.

At times those with WS may struggle with use of language, but this may be attributed to their cognitive deficit. Their linguistic competence shows that language is both form and use. It is collectively the use of all components of language to effectively communicate including syntax, morphology, phonetics, phonology, pragmatics, and semantics. Those with WS show that the underlying principles of language can function quite adeptly without complete cognitive functioning. Additionally, those with SLI may

struggle with verbal memory tasks, but this can be attributed to their linguistic deficit. When considering linguistic ability, the underlying components of language are important. It is the rules that determine the surface structure that should be analyzed, not the surface structure itself. In making these clarifications, it is more clearly seen that language impairment is a structural issue caused by a disability in the underlying grammar. Though language problems cause issue with verbal cognitive tasks, since visual-spatial memory remains unaffected, cognition is distinct from language. Further research into pattern recognition and other areas of cognitive functioning in SLI may provide more information on their cognitive processing system.

Despite the distinction of language and cognition, these modules are constantly interacting in the human mind. Though the modular view tends to separate these abilities, in almost every facet of life, humans rely heavily on both. The significant interaction between the two should not be minimized in light of modularity. Language and cognition work together as the mind practically process, integrates, and expresses meaning automatically. The simultaneous automaticity of linguistic and cognitive ability makes it difficult to distinguish the effects of each domain, no matter how the relationship between language and cognition is represented. It is simply difficult to analyze and articulate the processing mechanisms in the human brain. Despite recent advances in neuroscience, it is still difficult to quantify and assess inner processing mechanisms. The relationship between implicit processes is difficult to research empirically. The wide issue of language and cognition still remains a vast area of research.

Further research on the linguistic and cognitive skills of all different types of exceptional cases such as autism, aphasia, or feral children would provide more insight into the relationship. In cases where both language and cognition are impaired, searching for correlations between specific dysfunctions of the each domain may reveal more about the interaction between the two abilities. It would also be of interest to study the physiology of the brain of those with disabilities to look for unusual configurations and functions. Analyzing and comparing disabilities in even more detailed terms regarding language acquisition and cognitive development may have important implications for assisting and teaching those with such impairments.

References

Archibald, L. M., & Gathercole, S. E. (2006). Short-term and working memory in specific language impairment. *International Journal of Language & Communication Disorders*, *41*(6), 675-693.

Baddeley, A. D., Gathercole, S. E. & Papagno, C. (1998). The phonological loop as a language learning device. *Psychological Review, 105*, 158–173.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. Bower (ed.), *The psychology of learning and motivation.* New York, NY: Academic Press, 47–90.

Botting, N. (2005). Non-verbal cognitive development and language impairment. *Journal of Child Psychology and Psychiatry*, *46*(3), 317-326. doi:10.1111/j.1469-7610.2004.00355.x

Brown P., & Levinson, S. C. (1993). *Linguistic and nonlinguistic coding of spatial arrays: Explorations in Mayan cognition*. Nijmegen: Cognitive Anthropology Research Group, Max Planck Institute for Psycholinguistics.

Chomsky, N. (1995). *The minimalist program.* Cambridge, MA: MIT Press.

Colman, A. (2015). Cognition. In *A Dictionary of Psychology*. Oxford University Press. Retrieved from http://www.oxfordreference.com/view/10.1093/acref/9780199657681.001.0001/acref-9780199657681-e-1594

Cuccio, V. (2011). Language and cognition: Insights from Williams syndrome. *US - China Foreign Language, 9*(1), 1-8. Retrieved from http://search.proquest.com/docview/1465009190?accountid=12085

Diaz, R. M., & Berk, L. E. (1992). *Private speech: From social interaction to self-regulation*. New York, NY: Psychology Press.

Evans, V., & Green, M. (2006). *Cognitive linguistics: An introduction*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Gass, S. (2003). *Second language acquisition* (4th ed.). New York, NY: Routledge.

Gopnik, M., & Crago, M. B. (1991). Familial aggregation of a developmental language disorder. *Cognition*, *39*(1), 1-50.

Harris, J. C. (2006). *Intellectual disability: Understanding its development, causes, classification, evaluation, and treatment*. New York, NY: Oxford University Press.

Ingram, J. C. L., & Chenery, H. (2007). *Neurolinguistics: An introduction to spoken language processing and its disorders.* Cambridge University Press. Retrieved from http://www.ebrary.com

Landau B., & Hoffman, J. E. (2005). Parallels between spatial cognition and spatial language: Evidence from Williams syndrome. *Journal of Memory and Language, 53*, 163-185.

Leonard, L. B., Caselli, M. C., Bortolini, U., McGregor, K. K., & Sabbadini, L. (1992). Morphological deficits in children with specific language impairment: The status of features in the underlying grammar. *Language Acquisition, 2*(2), 151-179.

Li, P., & Gleitman, L. (2002). Turning the tables: Language and spatial reasoning. *Cognition, 83*, 264-294.

Lukacs, A., Pleh, C., & Racsmany, M. (2007). Spatial language in Williams syndrome: Evidence for a special interaction? *Journal of Child Language, 34*(2), 311-343.

Matthews, P. (2014). Universal grammar. In *The concise Oxford dictionary of linguistics.* Oxford University Press. Retrieved from http://www.oxfordreference.com/view/10.1093/acref/9780199675128.001.0001/acref-9780199675128-e-3545.

Menyuk, P. (1978). Linguistic problems in children with developmental dysphasia. In M.A. Wyke (Ed.). *Developmental dysphasia.* New York: Academic Press.

Mihalicek, V., & Wilson, C. (2011). *Language files: Materials for an introduction to language and linguistics* (11th ed.). Columbus, OH: Ohio State University Press.

Mintz, T. (2009). Language development. In H. Whitaker (Ed.), *Concise encyclopedia of brain and language*. Oxford, United Kingdom: Elsevier Science & Technology.

Montgomery, J. W., & Evans, J. L. (2009). Complex sentence comprehension and working memory in children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *52*(2), 269-288.

Phillips, C. E., Jarrold, C., Baddeley, A. D., Grant, J., & Karmiloff-Smith, A. (2004). Comprehension of spatial language terms in Williams syndrome: Evidence for an interaction between domains of strength and weakness. *Cortex, 40*, 85-101.

Pinker, S., & Prince, A. (1988). On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. *Cognition, 28,* 73-193.

Tallal. P., & Piercy. M. (1978). Defects of auditory perception in children with developmental dysphasia. In M.A. Wyke (Ed.). *Developmental dysphasia*. New York: Academic Press, 63-84.

Ullman, M. T., & Pierpont, E. I. (2005). Specific language impairment is not specific to language: The procedural deficit hypothesis. *Cortex, 41*(3), 399-433.

Whorf, B. L., Carroll, J. B., Levinson, S. C., & Lee, P. (2012). *Language, thought, and reality: Selected writings of Benjamin Lee Whorf*. MIT Press.

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