Language Comprehension in Special Populations

Much psychological research in recent years has revolved around differences between the neurotypical population and special populations in many different developmental aspects. Among this research, language has been a popular topic to study, especially since it is fundamental to our interactions with other people throughout our childhood and into adolescence and adulthood. Studying language in special populations can be extremely important in better understanding the unique challenges faced by these individuals, which can improve the quality of interventions, specifically early in life, to combat the difficulties as much as possible before it's too late. This paper will specifically focus on one aspect of language: language comprehension. Language comprehension is the ability to understand the different elements of spoken or written language (NWEA, 2021).

Specifically, this paper will explore language comprehension in youth and adolescents of three special populations: Autism Spectrum Disorder, Down Syndrome, and Williams Syndrome. The following questions will be answered: (1) What are the unique challenges faced in the realm of language comprehension by children and adolescents of these special populations? and (2) How do these populations differ from neurotypical development? To explore these ideas, several facets of research will be explored, including fMRI studies and language pragmatics studies in children with Autism Spectrum Disorder, the effects of hearing deficits in Down Syndrome children, and figurative language deficits in children with Williams Syndrome.

Autism Spectrum Disorder (ASD) is a developmental disability characterized by brain abnormalities (CDC, 2022). There is not one definitive "cause" of ASD, such as a certain gene being copied incorrectly, but rather a wide range of causes and symptoms. A person with Autism

Spectrum Disorder may range from nonverbal and unable to support themself to living an almost completely normal and independent life. While this range of symptoms makes it difficult to identify a specific deficit in language comprehension in children with ASD, a deficit in language comprehension (and production) may be one of the first symptoms that arise in an ASD child even before their diagnosis. Thus, it is a prevalent symptom that, to some degree, affects almost all children with an ASD diagnosis, though in widely varying ways.

Extensive research has explored the neural differences between ASD and neurotypical children when presented with language comprehension tasks. Researchers conducted a meta-analysis to uncover various areas of the brain that may be more or less active in ASD children during language comprehension (Hua et al., 2023). This study uncovered that both the ASD and neurotypical group showed equal activation in the bilateral superior temporal gyrus (STG), which is located in the temporal lobe and helps the brain connect spoken words to their meanings (Yi, Leonard, & Chang, 2019). This similarity in STG activation suggests that there is some neural mechanism that is essential to language comprehension, and thus is activated equally across special groups and neurotypical populations. However, in the autism groups, there was a reduced activation in the right STG, left middle temporal gyrus, and insula, and no activation in the left superior frontal gyrus (SFG) or the dorsal medial frontal cortex (dmPFC). Regarding the areas of reduced activation, the left middle temporal gyrus (MTG) is a key component of the language comprehension network within the brain (Turken & Dronkers, 2010). The insula is related to Wernicke's Area, meaning that it too is involved in the language comprehension network and deficits in this area could manifest similarly to Wernicke's aphasia (Ardila, Bernal, & Rosselli 2014). Interestingly, the left SFG and dmPFC, areas of no activation in ASD children, are more involved in the psychological aspects of language comprehension. The left SFG is part

of the prefrontal cortex and plays a major role in executive function (Aron, Fletcher, Bullmore, Sahakian, & Robbins, 2003) and the dmPFC is involved in interpreting emotions and understanding the intentions of others (Campbell et al., 2015). Thus, this meta-analysis provides insight into the specific neural areas that are reduced in activation or not activated at all in ASD children during language comprehension tasks. These results suggest that ASD children may have trouble specifically with the complexities of communication, such as the emotional aspects, rather than the actual comprehension of language itself.

Another major area of research into language comprehension challenges of ASD individuals involves prefrontal synthesis (PFS), which is essentially the ability of an individual to connect what they hear to visual objects in their world (Vyshedskiy, 2020). In practice, this means being able to order objects according to a verbal list or understand what it means to put an object on top of another object but not below it (Arnold, Netson, & Vyshedskiy, 2022). In this study, researchers developed their own test, called the MSEC, which specifically targets the level of 3–4-year-olds in their ability to master PFS. Items on the scale included understanding simple stories, understanding possessive pronouns, understanding verb tenses, and other basic grammatical and syntactic structures that a typically developing child would learn over their first years of life (including questions that measured PFS specifically). Results from this study show major deficits in children with ASD in every category measured, suggesting a significant delay in language comprehension development around age 2-7, which specifically revolves around the difficulty of grasping PFS, which is a necessary everyday element in language for all people. Again, this finding suggests that it may not be the simple comprehension of language that is more difficult for ASD children to grasp, but the more complex and implicit parts of language comprehension, such as visualization of words.

Another of these complexities of language comprehension is the understanding of intention and tone in others' voices, especially when presented with an ambiguous situation that requires more complicated processing and understanding of context and emotion. Researchers Abbot-Smith, Williams, & Matthews (2020) studied how ASD children may differ in this aspect of language comprehension compared to neurotypical children. This study was conducted by putting children in an unclear situation, where the experimenter was asking if the child would hand them an object when two of those objects were present in the room. Thus, children had to rely on their knowledge of the situation and what they expected the experimenter to be thinking in order to properly gauge what specific object they were referring to. Results from the study show that autistic children have a significantly more difficult time anticipating the experimenter's intentions and identifying the correct object. Researchers suggest that further research determine whether it was the tone of voice of the experimenter or another factor that made this task more difficult for children with ASD.

As previously mentioned, one of the major difficulties in studying individuals with ASD is the wide range of disabilities that one can have. Little research has gone into the language comprehension of minimally verbal (MV) autistic children specifically, but Chen, Siles, & Tager-Flusberg (2023) studied this special population of autistic individuals to explore how their language comprehension skills compare to their production. Researchers unsurprisingly found that MV autistic individuals had worse language comprehension skills compared to neurotypical individuals, but what surprised researchers was that this gap widens as these individuals grow up, meaning that these MV individuals lag more and more behind their neurotypical peers as they age. Researchers theorize that this is due to the lack of social opportunities available to autistic individuals, specifically those that are minimally verbal, compared to neurotypical individuals.

Especially at a young age when children are first beginning to establish social connections with those around them, the process is much more difficult and often delayed for autistic children. This theory may provide interesting insight for future research, determining whether providing more social experiences to MV autistic children speeds up their language comprehension development throughout their childhood and adolescence.

Much research has looked into language comprehension in ASD children and adolescents, but much more research will be conducted in the future to answer the many pressing questions about the specifics of language deficits in this special population. The future of research in this field could have major impacts in the lives of young individuals with ASD, helping those with major disabilities to lead a more advanced and independent life.

Another disability that is studied extensively with regard to language comprehension deficits is Down Syndrome (DS). Down Syndrome is a genetic condition where an individual has an extra copy of the 21st chromosome (also referred to as Trisomy 21). This disability causes mental and physical challenges, such as low IQ and sleep apnea (CDC, 2023), but like ASD, there is a wide range of symptoms in individuals with Down Syndrome, making it difficult to categorize specific symptoms that would be present in all individuals with Down Syndrome. While extensive research has been conducted regarding language comprehension difficulties in individuals, specifically children, with DS, it has been difficult for researchers to pinpoint an exact cause or reason for these deficits, but one interesting theory explores hearing deficits in children with DS, which may account for this deficit in language comprehension. A study by Carrico et al. (2014) explored hearing abilities in children with DS and found that there were high rates of hearing loss in one or both ears. This finding was consistent and widespread across the DS youth population. This suggests that while there could me a mental challenge that makes

language comprehension more difficult, this physical challenge that many DS youth face could also play a role in this deficit.

A study by Bridges & Smith (1984) attempted to explore whether DS youth processed language differently than neurotypical children in order to determine whether there was some neural mechanism in DS children that caused them to process and comprehend language in a different way, which could explain this deficit. Results of this study showed no significant difference in how DS and neurotypical children comprehended language, suggesting that maybe the auditory difficulties that are faced physically by DS youth could be a main contributor to this phenomenon.

To test this, Marcell (1995) designed a study to explore a relationship between hearing ability and performance on cognitive tasks, specifically tasks that required hearing ability to be successful. Individuals with DS that had demonstrated hearing difficulties performed much worse on all of the tasks, suggesting that it was indeed a major contributing factor to this challenge. Interestingly, since DS encompasses such a wide range of symptoms, DS children that didn't have significant hearing deficits performed better on these comprehension tasks.

Future research can further explore this relationship between physical hearing deficits and language comprehension in DS individuals, but the neural mechanisms that may contribute further to this deficit should be studied further, possibly including fMRI studies to assess whether there are multiple factors affecting language comprehension. Further, while Bridges & Smith found that there were no different strategies used by DS individuals in comparison to neurotypical individuals in language comprehension tasks, it could be further explored whether this changes at different ages in childhood and adolescence, and into early adulthood.

Overall, research has shown significant deficits in DS children's language comprehension, and while there is a known physical contributor to this phenomenon, no major neural explanations have been introduced to further understand why this occurs.

Williams Syndrome (WS) is a genetic disorder that is less well-known than ASD or DS but has been the subject of extensive research regarding language comprehension and development. WS is a disorder that occurs because an individual is missing a part of chromosome 7 (Cleveland Clinic, 2021). It causes unique physical features, challenges in cognition and development, and major health problems, including cardiovascular conditions. It occurs in about 1 out of every 10,000 births in the United States. An interesting aspect of WS is that while there are many developmental delays in individuals, language comprehension and production remains fairly intact. However, more complex language, such as figurative language, is more difficult for a child with WS than a neurotypical child, which has been researched thoroughly over the past few decades.

Researchers have tended to focus on the more commonly used forms of figurative language, such as idioms, metaphors, and metonymies. French researchers examined the comprehension of idioms in children WS compared with neurotypical children (Lacroix, Aguert, Dardier, Stojanovik, & Laval, 2010). These researchers compared 19 children with WS to 38 typically developing (TD) children. To ensure the most accuracy possible, they attempted to use only the most popular idioms in the French language, increasing the likelihood that an average child would be familiar with the phrase. Unsurprisingly, it was discovered that children with WS have greater difficulty in understanding idiomatic expressions, but as their verbal mental age improves, their ability to comprehend these idiomatic expressions also improves.

Similar results were found in a study observing metaphor and metonymy in WS and TD children (Annaz et al., 2008). While metaphor is a commonly understood form of figurative language, metonymy is lesser known, despite being used frequently in colloquial speech. A metonymy is the substitution of a word or name to mean something else (example: in the phrase 'give me a hand,' the word hand is used to mean help or aid, not a physical hand). This study included a sample of 10 children with WS and 11 TD children. Participants were given standardized tests to assess their comprehension abilities. Again, despite having relatively strong language comprehension and production overall, children with WS had much more trouble comprehending metaphors and metonymies. Another interesting finding from this study is that WS children may use different cognitive mechanisms than TD children to comprehend these types of figurative language, although further research will be needed to fully understand this phenomenon.

Another interesting finding by researchers is that WS children tend to use figurative language often in speech (suggesting that they are comprehending these uses of figurative language by others) but that they may not use them in the completely correct way, suggesting a deficit in the higher-level processing needed to fully comprehend the complexity of these phrases and use them properly in colloquial speech (Thomas et al., 2010). This could be due to the potential difference in neural mechanisms suggested by Annaz et al.

While great strides have been made in understanding the language comprehension deficits of WS individuals, specifically regarding the use of figurative language, there are still many questions that remain unanswered, such as the previously mentioned idea that WS children use a different neural mechanism than TD children to comprehend this language. Another shortcoming in WS research is the sample size. None of the mentioned studies include more than

23 individuals with WS, making it difficult to generalize about this entire population. This is made especially difficult because of the individual differences seen in individuals (especially children) with WS, much like those of individuals with ASD and DS. Therefore, future research could attempt to explore these individual differences by including a larger sample of WS individuals, possibly conducting a meta-analysis if it is too difficult to recruit a large number of individuals with this disorder.

This paper has explored major findings in language comprehension research among special populations. In children with Autism Spectrum Disorder, fMRI studies revealed that several areas of the brain that were activated in neurotypical children during language comprehension were not activated in children with ASD. Further, children with ASD were found to have difficulty understanding both the complexities of grammar and the pragmatic side of language (such as tone and emotion). In children with Down Syndrome, it was found that while there were no different neural mechanisms for which a DS child would comprehend language, physical hearing deficits that are common in children with Down Syndrome contribute to difficulties in language comprehension. In children with Williams Syndrome, research extensively shows a deficit in the ability to comprehend figurative language due to the hidden meanings of many common phrases and expressions.

A theme of research in special populations is that the sample sizes are small, which may make it difficult to trust the significance of results in many of these studies. While it can be difficult to find a large sample size in special populations due to many different factors (parental permission, ability to participate in research, etc.), only having 15 or 20 individuals involved in research can make the findings less convincing in the realm of psychological research. Further, the lack of personal information that is provided about the participants of these studies makes it

difficult to know whether these findings would be consistent from individuals on the milder side of the spectrum to those with more severe deficits.

While significant research has already been conducted in this field, there is still significant research to be done in order to learn as much as possible about language comprehension in these special populations in order to provide as much intervention as possible for these individuals. A longitudinal study could be useful in seeing how language comprehension improves throughout childhood and adolescence. Further, a longitudinal fMRI study could help researchers to understand whether the neural deficits seen improve, stay the same, or worsen with age. Other research could focus on the success of intervention programs as they become more prevalent and sophisticated. This could help the constantly changing field of therapies surrounding special populations to improve and become more helpful in the lives of children with major language deficits.

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