RUNNING HEAD: LANGUAGE IMPAIRMENT IN AUTISM

# Language Impairment in Autism[1]

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Autism is a severe, lifelong, neurological disorder that occurs in as many as 1 in 500 individuals and causes a complex developmental disability. Autistic characteristics and symptoms may be present at birth or develop during the first three years of life, and may create difficulties in verbal and non-verbal communication, social interactions, sensory perception and leisure or play activities. In the early days of autism diagnoses, they were applied to children who had grown up in the wild or been confined by abusive parents. However, further experience has taught us that psychological and emotional environments cannot create autism. Autism spectrum disorders affect typical development of the brain and may lead to severe delays in language development, peculiar speech patterns, severe social delays and uneven patterns of intellectual functioning.

Individuals who fall under the Autism Spectrum Disorder category exhibit commonalties in communication and social deficits, but differ in terms of severity, number of symptoms or age of onset. Most autistic children have normal nonverbal intelligence (Rice, et al., 2005). Some autistic children have normal language skills while others lag far behind and may be non-verbal (Bono, et al., 2004). Sixty-seven-percent of verbal autistic children have some language impairment (Rice, et al., 2005) yet show no differences in receptive and expressive language skills (Bono, et al.). Higher functioning autistic individuals typically have structurally normal language with pragmatic deficits as their only identifiable impairments (Young, et al., 2005). However, 14-20% of 9 year-old autistic children are non-verbal and are considered to have deviant

language systems (Rice, et al.). Most autistic individuals are considered to have language delays similar to specific language impairment.

Delayed language acquisition is usually the primary referral concern for children eventually diagnosed with autism (Rice, et al., 2005). Yet, the exact nature of language impairments experienced by autistic individuals remains unclear. This paper aims to identify the language deficits associated with autism, identify the causes of these deficits and determine what they tell us about the nature of the disorder.

**Overview**

Before attempting to answer the primary question, a survey of the diagnostic challenges regarding autism is presented. This first section forms a context within which autism research should be viewed. Second, the research question is examined by beginning with the identification of language deficits (perceived and real) faced by individuals with autism. Third, the intriguing patterns of autistic language development are explored, followed by a fourth section on language testing and a fifth discussing unique individuals with autism. The sixth section examines brain structures related to autism and is followed by a seventh section on the genetic story of autism. Finally, the paper wraps up by examining theories associated with autism.

**Diagnostic Challenges**

The DSM-IV criteria for pervasive developmental disorders (see Appendix A), although detailed, does not provide specific identifying characteristics that ensure

consistent diagnosis. Walker, et al. (2004) found that the examination of files by expert clinicians did not lead to clear classifications within the autism spectrum and have recommended revisions to improve differentiation between the very similar yet seemingly different etiologies found along the spectrum of autistic disorders. Sciutto and Cantwell (2005) performed a similar study using fictional data and found considerably more agreement among clinicians regarding their diagnoses.

The primary source of confusion in autistic diagnoses seems to lie in the degree of language impairment. Although language and communication impairments are central to the diagnosis of autism spectrum disorders the profile of language competency is uneven and not related to the variation in other characteristics (Charman, 2004). Plus, the current criteria do not allow for early diagnosis of autism even when parents report a fully autistic profile. Michelotti, et al. (2002) assessed 18 preschool children with an initial diagnosis of severe receptive language delay. When evaluated four years later all of the children met the criteria for autism, even the ones whose language skills had been relatively recovered (Michelotti, et al., 2002). Diagnostic criteria needs to be developed to provide interventions for these children at a younger age.

Language delays lead to a greater chance of an autism diagnosis instead of pervasive developmental disorder - not otherwise specified (Charman, 2004). A higher IQ combined with a desire to engage others in social interaction and no language delay increases the likelihood of an Asperger's diagnosis (Sciutto & Cantwell, 2005). However, a delay in language milestones decreased the likelihood of an Asperger's

diagnosis but did not rule it out. Identifying specific language impairments and development patterns is a necessary step in clearing up these diagnostic difficulties.

**Language Deficits in Autism**

Individuals with autism spectrum disorders face a variety of language related deficits including receptive vocabulary, comprehension of extensive directions or stories, focusing attention and processing information at speed. They may experience deficits in initiating and engaging in reciprocal conversations, may be less likely to respond to requests for clarification, may struggle with conversational management and may make references that are not clear to their listeners (Hale, & Tager-Flusberg, 2005). Autistic children use neologisms and idiosyncratic language significantly more than both age-matched and language-matched controls (Volden & Lord, 1991 in Hale, & Tager-Flusberg). The effect of all these weaknesses is that intelligent people are working with consistently incomplete and incorrect information. Autistic individuals are usually aware that they are missing part of the conversation which leads to a great deal of stress and anxiety and, in turn, causes a further decrease in functional comprehension skills.

Overall, autistic children with impaired language skills have a similar language impairment profile to children with specific language impairment (De Fossé, et al., 2004). There seem to be many deficits that interact with each other in order to produce the variety of language difficulties observed in autistic individuals (Martin & McDonald, 2004). The full picture of autistic language deficits remains unknown

(Martin & McDonald, 2004) but many researchers are working to unravel the puzzle. This section with examine pragmatic language deficits, conversational repair, non-contingent utterances, joint attention, referential word learning and idiom comprehension.

*Pragmatic Language Deficits*

Individuals with Asperger's Syndrome generally have no deficiencies in terms of verbal intelligence and have intact language abilities yet fail to use these abilities to engage interactive communication and are documented as having language impairments (Martin & McDonald, 2004). For this reason, individuals with autism spectrum disorders are described as having deficits in pragmatic language. Specific areas of difficulty include understanding non-literal language devices, such as irony, echoing others, and speech that fails to conform to social convention and may be disorganized, tangential, egocentric and detached. Foxx, et al., (2004) noted that even though it may appear to be functional, the immediate and involuntary repetition of words just spoken by others will interfere with language learning but can be corrected through cue-pause-point language training.

Martin and McDonald (2004) studied the performance of participants with Asperger's Syndrome on a wide variety of pragmatic language skills. They found that participants with Asperger's performed poorly on indirect pragmatic interpretation questions, joke questions, and when asked to make non-mental inferences. Both Asperger's participants and controls recalled meaningful sentences more easily than

random word lists. However, when participants with Asperger's were told stories involving ironic jokes they more likely to conclude that the protagonist was lying and to miss the irony. They were also more likely to process puzzles in a local manner, failing to utilize contextual information or meaning in the solution of simple puzzles (Martin & McDonald). Pragmatic impairments are not a secondary result of language impairment, but rather a defining feature of autism (Rice, et al., 2005).

*Conversational Repair*

Given the predilection towards tangential speech, conversational repair in response to requests for clarification is very important for individuals with autism. Volden (2004) simulated communicative breakdowns where experimenters repeatedly asked for clarification. High-functioning autistic participants performed similarly to language matched controls. They recognized the experimenter's signals for conversational repair and used a range of strategies to overcome the communication barrier. Although it is possible that the simulated breakdowns do not accurately predict authentic conversational failures, participants seemed to assume that that listener was just really dense.

Since participants were matched according to language skill, the autistic participants were older than the controls and may have had a non-verbal cognitive advantage. If the ability to repair communicative breakdown is acquired during a specific stage of language development then it may be "acquired very early by typically developing children and somewhat later by those with autism spectrum disorders"

(Volden, 2004). Thus, both groups can repair conversation but the skills may be less automated for people with autism.

*Non-Contingent Utterances*

A secondary result from Volden's (2004) study was that participants with autism spectrum disorders were more likely than controls to respond with a bizarre topic shift or discontinue the interaction. Several theories have been proposed to explain these non-contingent utterances. Autistic individuals may become more easily overloaded when processing information and seek to change the subject in order to get a break. Or, perhaps the "relevant cognitive complexity lies in the social cognitive or executive processing skills that underlie pragmatic performance" (Volden). Further investigation in this area is important to identify the responsible underlying deficits (Hale, & Tager-Flusberg, 2005).

In real-life situations these off-topic statements may cause more difficulties than Volden's (2004) study indicates. Since the participants were matched according to language skill, a real-life situation would involve an older, apparently capable speaker shifting topics without warning in a manner analagous to a younger child. Although a young child's behaviour would be attributed to curiosity and a short attention span, the older child with autism would be more likely seen as violating the listener's expectations and the non-contingent utterances would meet with disapproval (Volden).

*Joint Attention in Autism*

Joint attention is one of the most important skills for learning and one in which autistic children show profound deficits. The coordinated and shared visual attention between two people on an object or event is necessary for the development of new language skills and the success of interventions (Bono, Daley & Sigman, 2004). Joint attention helps children understand referential cues, organize perceptual information and develop language skills. In typical development, children begin responding to external bids for joint attention in early infancy and begin to initiate joint attention experiences within the first 18 months of life. Due to neuropathologically based social-orienting deficits, autistic children demonstrate impairment in their development of joint attention skills, rarely initiating joint attention episodes and responding inconsistently to adult bids for joint attention (Bono, et al.). Intriguingly, for autistic children their own initiation of joint attention with follow-in linguistic mapping from adults seems to improve language outcomes (McDuffie, Yoder, & Stone, 2005).

Preissler & Carey (2005) designed experiments comparing autistic children to normally developing toddlers in order to confirm these attention monitoring deficits. Experimenter's took two unfamiliar objects, handed one to the child and retained the second for themselves. To create a *follow-in condition*, the experimenter uttered a novel word (e.g. 'peri') while looking at the child's item. Or, to create a *discrepant condition*, the experimenter uttered a novel word while looking at their own item. In both cases, the two unfamiliar items were added to a bag already containing two familiar items and the children were asked to select the peri (i.e. the newly named item). Although the

autistic children's results were not statistically different from the normal toddlers in the *follow-in* condition they were unsuccessful in the *discrepant condition*. Overall, the autistic children chose the object they had been looking at 64% of the time, supporting the theory that their language skills will improve most rapidly when adults follow their lead in order to overcome attentional difficulties (Preissler & Carey, 2005).

*Joint Attention & Language Development*

Actual performance of autistic children on joint attention tasks varies widely with some appearing unaware of the request and others responding readily. The level and consistency of joint attention skills is correlated with the level of early receptive and expressive language abilities and to later language levels (Bono, et al., 2004). Over time, children who respond most frequently to other's bids for joint attention seem to make the largest gains in language abilities. More initiation of joint attention also correlated to better language skills, higher language age at initial assessment and to gains in language skill (Bono, et al.).

When autistic children were assessed one year apart the relationship between the amount of intervention they had received in the intervening year and their language gains depended upon their individual ability to respond to bids for joint attention from others and their initial language skill (Bono, et al., 2004). Without joint attention as a moderator there was no correlation between the amount of intervention children received and their language skills. Autistic children who began with matched language skills differed in their response to interventions based on their joint attention skill

levels. Children with the highest initial language skills and highest joint attention skills benefited the most from interventions (Bono, et al.).

In a similar longitudinal study, McDuffie, et al. (2005) studied four prelinguistic behaviours as possible predictors for language development. Results were adjusted to compensate for language delay in autistic children. The only unique predictor of later language comprehension they found was the initiation of joint attention. Initiating joint attention and motor imitation of actions were unique predictors of language production. Initiating joint attention and motor imitation also simultaneously accounted for unique variance in vocabulary production. McDuffie, et al.'s suggestion is that motor imitation and joint attention allow autistic children to engage in social interactions that scaffold the acquisition of object names.

*Referential Intent in Word Learning*

Young children are assumed to use prior knowledge and referential intent to match new names to unknown stimuli. It is often assumed that autistic children are unable to identify a speaker's referential intentions and therefore struggle with word learning. In a second experiment, Preissler and Carey (2005) presented the same autistic children with two pictures or objects where one was familiar and one was unfamiliar. Children were asked to show the experimenter a 'blicket' (or other unfamiliar word). Children with autism were 89% correct on the baseline trials and 82% correct on the test trials. This result indicates that autistic children use their own prior knowledge to guide labelling.

Although attentional deficits interfere with word learning in autistic children, Preissler and Carey's (2005) experiments indicate that inferences regarding a speaker's intentions are not necessary for the mapping of new words to novel stimuli. Words may be learned through the use of prior internal knowledge. Autistic children struggle with inferences regarding a speaker's intentions, yet can succeed at novel word mapping without the inference requirement. This may mean that autistic children solve word learning puzzles differently from non-autistic children (Preissler & Carey, 2005).

*Idiom Comprehension*

Idiom comprehension requires contextual processing and semantic analysis and has received limited research in terms of autism. Norbury (2004) assessed figurative language and idiom comprehension for 93 children with communication impairments. Children with deficits in structural language did not benefit as much from context as their normally developing peers. Intriguingly, autistic children without structural language deficits were able to use context as effectively as their normal (non-autistic) peers. Overall language skill and memory for stories seemed to be more suggestive, than autistic diagnosis, of idiom skill.

**Language Development**

Patterns of language development in autistic individuals is heavily studied, yet barely understood. "According to a social-pragmatic approach, language development first depends on qualities of the structured social world and the child's capacity to tune

into and become engaged with the proximal environment" (Bono, et al., 2004). Thus, joint attention skills, and social engagement challenges may interfere with language development in autistic children. Intriguingly, studies have shown that autism may go beyond standard language delays and change the order in which skills are acquired. In typically developing children, word comprehension comes before word production. Yet, word production comes before word comprehension and before phrase comprehension in autistic children (Charman, 2004). Even in disorders, language does not remain static and must therefore be studied over time (McCardle, et al., 2005).

Sigman and McGovern (2005) assessed language skills in 48 autistic adolescents who had been previously assessed during preschool and middle-school. In the earlier period (from preschool to middle-school) one-third of participants had made dramatic gains in language skills. This new assessment as adolescents and young adults found that cognitive and language skills had remained stable or declined since middle-school. Language abilities in adolescence were predicted by language ability and non-verbal communication in middle-school, and by functional play years, responsiveness to other's bids for joint attention, the frequency with which joint attention was initiated, nonverbal communication and play skill in preschool (Sigman & McGovern, 2005).

These findings suggest that there may be a "sensitive period for children with autism to gain elementary cognitive and language skills" (Sigman & McGovern, 2005). Thus, even though the language impairments associated with autism are generally referred to as delays, the delays may end up preventing full language development.

**Language Testing, Assessment & Evaluation**

Language and communication impairments are central to the diagnosis of autism spectrum disorders but there is an uneven profile of language competency (Charman, 2004). Thus, measures of language need to be adapted in order to directly assess different areas of strength and weakness (McCardle, et al., 2005). Underestimation of a child's abilities may prevent intervention strategies from achieving success (McCardle, et al.) and overestimation of a child's language comprehension may keep their challenges from being properly identified remediated (Young, et al., 2005).

Many autistic preschoolers display very low language competence. Yet, most standardized language testing norms begin at 18-24 months so these low language levels may not be properly measured by the existing tests (Charman, 2004). There are few assessment tools that effectively identify pragmatic language disorders (Young, et al.) and this limitation is compounded by the fact that the tools do not always successfully pick out autistic individuals.

Young, et al. (2005) set out to determine whether or not two standard tests could successfully differentiate pragmatic language disorders in children with autism spectrum disorders. Autistic and non-autistic participants who were matched on verbal IQ and language fundamentals took both the Strong Narrative Assessment Procedure (SNAP), developed by Strong in 1998 and the Test of Pragmatic Language (TOPL) developed by Phelps-Teraski & Phelps-Gunn in 1992. The SNAP test could not clearly differentiate language problems between autistic and control groups. Autistic children performed similarly to controls on syntax, cohesion, story grammar, and completeness

of episodes. Control participants only performed better when asked to answer inferential questions. However, the TOPL test was effective in differentiating pragmatic language disorders since the control children performed significantly better than the autistic children. The TOPL elicits functional communicative interactions by using situations that occur in familiar settings and assesses physical setting, audience, topic, purpose, visual-gestural cues, and inferential thinking (Young, et al., 2005). Based on this finding, the TOPL successfully separates pragmatic language skills from overall language ability and can be used when assessing language deficits in autistic individuals.

**Unique Insights from Unique Individuals**

In educational circles, Temple Grandin is frequently cited as a source of information about autism. Her book, *Thinking in pictures: and other reports from my life with autism* (1995), is recommended as a source for those who wish to understand the autistic experience. Because she was autistic, early expectations for Grandin were lower than her intellect might have suggested and she began her adult life as a meat-packer. However, her brilliance prevailed and she ended up restructuring the industry with new methods and designs that were not only more efficient but improved animal welfare. She obtained her Ph.D. in animal science and has divided her time between her chosen profession and educating others about autism.

What is most interesting about Grandin's story is that it is less unique than suggested at first glance. Roughly 10% of autistic people can be classified as autistic

savants (Johnson, 2005) with autistic deficits and concomitant genius. These unique individuals, many of whom can describe their life experiences, allow the rest of the world to gain insights into the language and communication deficits of autism.

A high-functioning engineer with autism spectrum disorder refers to himself as "seeing blind and hearing deaf" (Van Dalen, 1994 in Noens, & van Berckelaer-Onnes, 2005). Although he can see what is going on in the world around him and can listen to conversation, the incoming stimuli is too rapid for him to keep up with and distill to essential information. In this sense, his language difficulties are not related to language itself, but rather to his processing ability. Van Dalen lives with pragmatic language deficits. His functional language skills are well below his internal language skills. If information is received, processed step-by-step, and then responded to all at his own pace few language deficits would be evident. However, society moves much faster and with greater variety than he can adjust to. As a result, his communication mimics greater language disorder than is actually present.

The most interesting example for those investigating the language challenges associated with autism is a British man named Daniel Tammet. Tammet draws attention because of his skills with numbers. He can perform complex calculations rapidly and accurately and describes the process he uses in a manner similar to Grandin's. When asked to multiply two numbers, he sees two pictures in his head, that morph into a third shape which is the answer (Johnson, 2005). The processing similarities shared by Grandin and Tammet may be evidence of a unique visual processing language system associated with autism. Tammet, who already speaks

seven languages, is developing his own language, Manti, which may lead to even more interesting insights into the nature of language in general and the processing of language by the autistic mind.

## Brain Structure

There was a time when people hypothesized that differences in brain structure were responsible for everything from handedness to feminism. In the modern era of fMRI (functional magnetic resonance imaging), PET (positron emission tomography), EEG (electroencephalography), and MEG (magnetoencephalography) scans many of these theories can be tested. Handedness has been shown to be correlated with language processing and researchers believe that electrophysiological techniques hold considerable promise for future studies of language processing because of their ability to track brain processes without an extrinsic risk (Phillips, 2005). Many recent studies have identified structural differences in autistic brains. Some of the structural differences in autism are similar to those in specific language impairment. Identifying the overlapping regions of brain anomalies and determining the language deficit similarities will help researchers to eventually match brain structures to specific aspects of language.

### *Asymmetrical Brains*

Several studies of brain structure have examined symmetries and asymmetries between the right and left hemisphere. Overall, brain asymmetries are masked when

analyzed in larger units but become apparent when studies focus on smaller units (Foundas, 2004). The greatest asymmetries are found in higher order associations of the cerebral cortex (Herbert, et al., 2005). Seventy-percent of people with normal language function have leftward asymmetry (left side is larger than the right side) in Brodmann's areas 22 and 45 and in the superior temporal gyrus and tend to have language lateralized within the left cerebral hemisphere (Foundas). Broca's area is similarly, larger in the left hemisphere than in the right in most right-handed, typically developed individuals (De Fossé, et al., 2004).

Autism is considered a neurodevelopmental disorder and atypical symmetry has been connected to neural risk for atypical functioning (Foundas). Thus, unusual brain symmetry in autistic individuals may their explain language (and other) deficits. A recent study by Herbert, et al. (2005) found no asymmetries in the cerebral hemisphere, grey matter, white matter and the cortical lobes of children with autism. However, when they examined specific cortical parcellation, more pronounced asymmetry (both right and left) was found in autistic children than in the control subjects. Overall, autistic children showed a tendency towards rightward asymmetry in cortical regions. One hypothesis is that the rightward asymmetry "may be a consequence of early abnormal brain growth trajectories" (Herbert, et al.) in language related disorders and that "higher-order association areas may be most vulnerable to connectivity abnormalities associated with white matter increases" (Herbert, et al.).

The unusual asymmetry of the autistic brain creates a reversal in the language associated cortex for autistic children (Herbert, et al.). Thus, the majority of autistic

children have language lateralized to the right cerebral hemisphere. Studies of people with developmental language disorders have found reduced or reversed asymmetry patterns in Broca's area (De Fossé, et al., 2004) leading to rightward language lateralization. These patterns of cerebral symmetry are similar in the brains of autistic children and in non-autistic children with developmental language disorders (Herbert, et al.). Despite apparent surface similarities, the two sides of the brain may have different aptitudes for language processing.

*Cortical Column Abnormalities*

According to Chandana, et al. (2005) "there are significant differences in minicolumn organization between the left and right sides of the human brain." Minicolumns on the left-side of the brain should be wider and more widely spaced than those on the right-side. Autopsies of people with autism have found abnormalities in cortical columns, an increased number of minicolumns and fewer cells per column. This atypical minicolumn organization may have a profound influence on language and other hemispheric specializations. The smaller, more closely spaced minicolumns may be a type of damage requiring compensatory changes (Chandana, et al.) such as reversed language lateralization. Tammet's autism began following a seizure at the age of three (Johnson, 2005) and others have suggested that autism may be the result of early brain damage since most autistic children develop normally during the first year of life. If atypical autistic brain structures are the result of early damage it is possible that the language deficits could be prevented with early detection and intervention.

*Brain Volume*

The increased specialization and lateralization of function in autism may be associated with larger brain volume (Herbert, et al., 2005). Overall measures of brain volume can identify autism, and separate high-functioning individuals from low-functioning individuals (Akshoomoof, et al., 2004). The brains of children with autism tend to be larger than normal and have non-uniformly distributed white matter enlargement (Herbert, et al.). Brain and white matter enlargement in autism occurs postnatally in areas that myelinate later rather than in the earliest developing areas of the brain.

Despite the overall larger brain volumes, the patterns of enlargement are uneven. One study with autistic children noted larger left planum temporale volume than of controls, whereas another study with autistic adults noted smaller left planum temporale volume than of controls (De Fossé, et al., 2004). Similarly, regions with lower grey matter density have been reported in adults with autism (De Fossé, et al.) and the white matter volume increase driving the larger total brain volume has increased radiate white matter and decreased deep white matter (Herbert, et al., 2005). This may mean that intrahemispheric corticocortical fibres are increased, whereas interhemispheric connections are decreased. Thus, brain enlargement may create an efficiency reducing bottleneck in interhemispheric linkages (Herbert, et al.).

Delays associated with interhemispheric communication may encourage intrahemispheric specialization and increase lateralization. Reinforcing this idea,

autistics have been reported as having small to normal sized, or corpus callosums. Since interhemispherical communication passes through the corpus callosum the disproportionate sizes (between overall brain size and the corpus callosum) may favour increased lateralization and lead to greater asymmetry of brain activity (Herbert, et al., 2005). Poor coordination between different regions of the brain may force autistic children to specialize regions of their brains for specific tasks. This idea also supports the theory that individuals with autism are using non-optimal regions of their brain for language processing.

*Brain Activation*

Theories of atypical brain activations have been supported by several studies. Meresse, et al. (2005), found that hypoperfusion (low blood flow) was related to the severity of autistic behaviours. The more severe the autistic syndrome, the lower the cerebral blood flow measured at rest was in the left hemisphere of the brain. Just, Cherkassky, Keller & Minshew (2004) studied brain activation for language processing during both word and sentence comprehension. They found that, when compared to a control group, the autistic group had greater activation in Wernicke's area and less activation in Broca's area and that activation between areas was less synchonized.

These activation abnormalities could arise from decreased grey matter density causing simultaneous disruptions of local and distant circuit organization (Just, et al.). Or, white matter abnormalities, which may be caused by a growth dysregulation or

excessive preservation of unneeded connections, may make it harder for different regions of the brain to coordinate activation (Just, et al.)

Synchronization deficits in autism may form a neural basis for disordered language, explain off-topic utterances, and create less information integration in language processing (Just, et al., 2004). This explanation justifies the standard autistic performance spectrum where individuals are more successful on tasks requiring limited cortical coordination and less successful on tasks requiring larger-scale cognitive integration. Just, et al. (2004) propose that "autism is a cognitive and neurobiological disorder marked and caused by underfunctioning integrative circuitry that results in a deficit of integration of information at the neural and cognitive levels."

*Serotonin Levels*

Another possible explanation for disordered brain activation is neurotransmitter levels. Several studies have shown that blood serotonin levels are elevated in autistic children and it is commonly understood that autistic children have global and focal abnormalities in serotonin synthesis. A recent study by Chandana, et al. (2005) has attempted to quantify these abnormalities and assess their influence on language impairment. Non-autistic young children have brain serotonin levels that are double that of adults. Starting at the age of five, these levels slowly decline to adult values. Autistic children show an opposite pattern with serotonin levels increasing slowly from the age of 2 to 15 where they eventually rest at 1.5 times the normal adult levels (Chandana, et al.). Some children with autism also show focal abnormalities with

asymmetries of brain serotonin in the frontal cortex, thalamus and cerebellum. Different patterns of cortical abnormality in serotonin synthesis seem to be related to hemispheric dysfunction, and thus language deficits, in autistic children. Left-sided serotonin shortages were related to a higher prevalence of severe language impairment (Chandana, et al.).

**Investigating Genetics**

It has been proposed that autism and specific language impairment may have a common genetic linkage (Foundas, 2004). These theories are driven by the higher incidence of autism, or autistic symptoms, within families that have at least one previously diagnosed autistic individual. However, many researchers caution against relying on genetic explanations. Müller (2005) notes that even though morphosyntax is impaired in many situations of language impairment it is affected differently in different ways and to different degrees of consistency. She warns that looking for etiological intersections to account for language impairments in multiple disorders may provide inaccurate explanations. Phillips (2005) notes that the effects of specific genetic disorders on language are surprisingly nonspecific. Morphosyntactic difficulties associated with verb inflection occur in autism and in many other developmental language disorders presumed to have different genetic causes. Studies indicate that multiple genes influence language disorders (Tager-Flusberg, 2005). Yet, the effects of genetic disorders on language can also be seen as highly specific since only certain components of language are affected (Phillips, 2005). This may mean that the

underlying cause of the deficits is not related to language at all. Or, it might be that certain aspects of language are simply more vulnerable than others (Phillips, 2005).

*Findings to Date*

Despite the cautionary concerns, several researchers have found intriguing evidence of genetic links to autism. Fisher (2005) discusses FOX2P mutations as part of a complex puzzle causing speech and language disorders. Chandana, et al. (2005) indicates that the elevated blood serotonin levels found in autistic children is shared by their first degree relatives and proposes that genetic coding may influence serotonin metabolism in autistic individuals. Studies of maternal genotypes have shown connections between autism susceptibility and IQ (Chandana, et al.). A nonparametric quantitative trait locus genome scan in 152 families with autism pinpointed chromosomes associated with 'age at first word' and 'age at first phrase' (Alarcón, Yonan, Gilliam, Cantor, & Geschwind, 2005). Mutations within these chromosomes could create susceptibility for autism.

*Research Design*

Smith & Morris (2005) describe two standard approaches to identifying genetic factors in autistic language disorders. A top-down approach uses observable characteristics to discover genes that influence language processing. A bottom-up approach compares the resultant effects of genes that are already known to cause language deficits. Regardless of the method used, the goals of genetic research,

according to Tager-Flusberg (2005), should be to identify the developing characteristics of specific disorders, identify precursors and predictors of language acquisition in children with developmental language disorders, identify contributing genes, and identify environmental factors that influence language trajectories.

## Theories of Autism

There are a variety of theories regarding the experience of autism. One of the most popular theories is referred to as mindblindness, or an absence of a theory of mind. The theory of weak central coherence has also found several supporters. A recent theory, based on neurobiological research, posits an underconnectivity for signals within the autistic brain. When all three of these theories are taken together they provide a viable picture. This section examines them as individual theories but the possibility that one may feed and explain another should not be overlooked.

### *Theory of Mind*

The theory of mind hypothesis assumes that autistic children do not consider the state of mind of others. This theory explains how social relationships would be seriously disadvantaged and autistic individuals would have a difficult time participating in small talk. If the theory of mind is valid then autistic individual would require explicit teaching of language, social skills, and the provision of extra information in interpersonal communication.

One explanation for the tendency of autistic individuals to make non-contingent utterances is that their theory of mind deficits prevent them from following the logical path of a conversation (Hale, & Tager-Flusberg, 2005). Similarly, this theory can explain the problems that autistic individuals have with non-literal language since we form representations of the speaker's mental states in order to understand their intentions (Martin & McDonald, 2004).

Yet, recent studies suggest that the acceptance of the theory of mind explanation for autism may be premature. Young, et al. (2005) has found that the development of language skills may precede the development of theory of mind. The fact that autistic individuals changed their strategies when attempting to repair conversational breakdowns indicates that they must have been assessing something about the listener's state of knowledge (Volden, 2004).

Even more intriguingly, a recent study (Whitehouse & Hird, 2004) matching autistic children with non-autistic children of comparable verbal age found that they were able to perform standard theory of mind, belief and not-belief tasks involving reasoning about a character's actions based on explicit knowledge of their beliefs and desires. This study confirms the strong relationship between language ability and belief-desire reasoning. A seed of hope does remain for theory of mind supporters since autistic children still experienced difficulties with higher level theory of mind tasks. Overall, children with autism had equivalent formulator skills, and poorer conceptualizer functions than verbally matched comparisons. This indicates that autistic

individuals may have the syntactical aptitude for theory of mind representations but find no need for the inclusion of this structure (Whitehouse & Hird, 2004).

*Weak Central Coherence Theory*

The theory of weak central coherence proposes that autism is connected to a cognitive processing style that favours segmental over holistic processing. This means that individuals will only absorb some of the available information and not fully benefit from contextual support. For most individuals with autism spectrum disorders, pragmatic skills are specifically impaired, whereas formal and semantic aspects are relatively spared (Noens, & van Berckelaer-Onnes, 2005). The central coherence hypothesis has been described as an explanation for these inconsistencies by focusing on limited intentionality and symbol formation.

However, the bulk of the research does not support this theory. Martin and McDonald (2004) found that central coherence was not related to pragmatic language ability. Changing conversational repair strategies suggest that autistic individuals are making decisions based on the whole interaction rather than just the immediately preceding utterance (Volden, 2004).

*Underconnectivity Theory*

A newer theory suggests that autistic language deficits are caused by underconnectivity in the brain. Most neurobiological studies seem to support this theory although they cannot yet explain it. Asynchronous activation of related brain

regions suggests that the communication between regions is neither efficient nor effective which could be explained by poor connectivity.

**Conclusion**

In order to continue pursuing their goals, researchers (those searching for genetic causes and those investigating intervention strategies) need to find focused measures for individual language components that are specific to the language profile of autism (Mervis & Robinson, 2005). Language deficits associated with autism are mostly pragmatic or due to delayed acquisition. Although they do not seem as skilled as non-autistic individuals, people with autism can engage in multiple strategies for conversational repair, use context to decode idioms and apply prior knowledge to the acquisition of new words. Joint attention plays an important role in language development for the autistic child. When adults watch for initiations of joint attention and follow-in to provide the child with learning opportunities their language skills improve. Targeted changes in particular behaviours may lead to secondary indirect changes and response to joint attention can be a pivotal moderator of intervention effects (Bono, et al., 2004).

Future studies should aim to refine the understanding of these strengths and weaknesses as well as investigate other possible areas of impairment. A clearer picture of the variations within the autism spectrum could allow for changes to the DSM criteria and clearer diagnoses. Unique individuals who have an awareness of their own autism may provide insight that can only be found from within. Crosslinguistic

investigations have shown different developmental language disorder manifestations across languages (Tager-Flusberg, 2005) so studies examining cross-cultural autistic deficits may tell us more about the nature of language itself.

The brains of autistic individuals differ from typical brains in terms of symmetry, volume, language lateralization, blood flow, and neural transmitter levels. Identifying the atypical brain usage in autistic individuals only provides a small piece of the puzzle towards understanding their language difficulties. Yet, this piece, when combined with behavioural and functional studies may help to make sense of the proposed theories for the autistic experience and may help to pinpoint language deficits for early detection and intervention.

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**Appendix A**

**DSM-IV Criteria, Pervasive Developmental Disorders**

**299.00 Autistic Disorder**

- A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

1. qualitative impairment in social interaction, as manifested by at least two of the following:

1. marked impairment in the use of multiple nonverbal behaviors, such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
2. failure to develop peer relationships appropriate to developmental level
3. a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
4. lack of social or emotional reciprocity

2. qualitative impairments in communication, as manifested by at least one of the following:

1. delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)

2. in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
3. stereotyped and repetitive use of language or idiosyncratic language
4. lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

3. restricted, repetitive, and stereotyped patterns of behavior, interests, and activities as manifested by at least one of the following:

1. encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
2. apparently inflexible adherence to specific, nonfunctional routines or rituals
3. stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting or complex whole-body movements)
4. persistent preoccupation with parts of objects

- Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.
- The disturbance is not better accounted for by Rett's disorder or childhood disintegrative disorder.

**299.80 Pervasive Developmental Disorder, Not Otherwise Specified**

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills, or when stereotyped behavior, interests, and activities are present, but the criteria are not met for a specific pervasive developmental disorder, schizophrenia, schizotypal personality disorder, or avoidant personality disorder. For example, this category includes "atypical autism" --presentations that do not meet the criteria for autistic disorder because of late age of onset, atypical symptomatology, or subthreshold symptomatology, or all of these.

**299.80 Asperger's Disorder**

A Qualitative impairment in social interaction, as manifested by at least two of the following:

(1) marked impairment in the use of multiple nonverbal behaviors, such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction

(2) failure to develop peer relationships appropriate to developmental level

(3) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people)

(4) lack of social or emotional reciprocity

B Restricted, repetitive, and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:

(1) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus

(2) apparently inflexible adherence to specific, nonfunctional routines or rituals

(3) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)

(4) persistent preoccupation with parts of objects

C The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.

D There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).

E There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behavior (other than in social interaction), and curiosity about the environment in childhood.

F Criteria are not met for another specific pervasive developmental disorder or schizophrenia.

**299.80 Rett's Disorder**

A All of the following:

(1) apparently normal prenatal and perinatal development

(2) apparently normal psychomotor development through the first 5 months after birth

(3) normal head circumference at birth

B Onset of all of the following after the period of normal development:

(1) deceleration of head growth between ages 5 and 48 months

(2) loss of previously acquired purposeful hand skills between ages 5 and 30 months with the subsequent development of stereotyped hand movements (i.e., hand-wringing or hand washing)

(3) loss of social engagement early in the course (although often social interaction develops later)

(4) appearance of poorly coordinated gait or trunk movements

(5) severely impaired expressive and receptive language development with severe psychomotor retardation

**299.10 Childhood Disintegrative Disorder**

A Apparently normal development for at least the first 2 years after birth as manifested by the presence of age-appropriate verbal and nonverbal communication, social relationships, play, and adaptive behavior.

B Clinically significant loss of previously acquired skills (before age 10 years) in at least two of the following areas:

(1) expressive or receptive language

(2) social skills or adaptive behavior

(3) bowel or bladder control

(4) play

(5) motor skills

C Abnormalities of functioning in at least two of the following areas:

(1) qualitative impairment in social interaction (e.g., impairment in nonverbal behaviors, failure to develop peer relationships, lack of social or emotional reciprocity)

(2) qualitative impairments in communication (e.g., delay or lack of spoken language, inability to initiate or sustain a conversation, stereotyped and repetitive use of language, lack of varied make-believe play)

(3) restricted, repetitive, and stereotyped patterns of behavior, interests, and activities, including motor stereotypes and mannerisms

D The disturbance is not better accounted for by another specific pervasive developmental disorder or by schizophrenia.