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Syntax Development in Adolescents and Adults with Down Syndrome

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SYNTAX DEVELOPMENT IN ADOLESCENTS AND ADULTS
WITH DOWN SYNDROME

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Masters of Science.

Rehabilitation Institute
in the Graduate School
Southern Illinois University Carbondale
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Approved by:

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Graduate School
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Introduction

Trisomy 21, commonly known as Down syndrome, is a genetic disorder in which there is an extra copy of the 21st chromosome (Centers for Disease Control and Prevention [CDC], 2013). Down syndrome is the most common genetic disorder and affects approximately one in every 691 live births with estimated 6,037 cases annually in the United States (CDC, 2013). Down syndrome causes several developmental and cognitive deficits as well as medical problems (CDC, 2013). Because of the prevalence of this syndrome, there is large evidence examining the various areas of deficits associated with Down syndrome.

Language

One of the areas that is significantly affected in these individuals is speech and language. Language is divided into the following five aspects: pragmatics, phonology, semantics, morphology and syntax. Pragmatics encompasses the social aspect of language or how language is used within communication contexts (Owens, 2008). It includes recognizing and conveying communication intentions, constructing different types of discourse such as jokes and narratives, and establishing conversational rules and principles (Owens, 2008). Pragmatics combines all the other aspects of language into a functional whole (Kaderavek, 2011). Phonology is the sound system of language. This area encompasses the rules for combining, sequencing, and distributing phonemes and syllables (Kaderavek, 2011; Owens, 2008). The next aspect of language is semantics and is the system that determines word meanings. This aspect could be summed up by the word *vocabulary* (Kaderavek, 2011). The fourth language aspect is morphology. Morphology includes the rules that govern word construction and

formation. This is the aspect of language that determines at what point a sound carries significant meaning (Kaderavek, 2011; Owens, 2008). The final aspect of language is syntax. This area is the focus of this paper and will be discussed in the following section.

Syntax

Syntax, commonly known as grammar, encompasses the rules that govern how words are put together to form sentences (Kaderavek, 2011; Owens, 2008). This includes elements such as word order, parts of speech, sentence organization, and word relationships (Owens, 2008; Roberts, Price, & Malkin, 2007). Individuals with Down syndrome may exhibit significant impairments with syntax (Chapman 1997; Chapman, Hesketh, & Kistler, 2002; Hesketh and Chapman, 1998; Roberts et al. 2007).

Current Research Evidence

Although a large body of research examining language skills for individuals with Down syndrome is available, the majority focuses on the language abilities of children, especially young children (Kernan & Sabsay, 1996). This research has been extremely important for providing these children the best foundation possible. However, as medical practice has drastically improved over the past decades, the medical problems associated with Down syndrome, such as heart defects, can be more effectively treated (Krinsky-McHale & Silverman, 2013). Because of this, individuals with Down syndrome have begun experiencing longer lifespans than previously expected (Krinsky-McHale & Silverman, 2013). As the age expectancy increases, there is a heightened need to evaluate how their language skills continue to develop into the adolescent and adult years.

The purpose of this research paper is to determine if syntactic development continues into adolescence and adulthood and discuss various methods available to measure this skill. In addition, this paper will examine factors impacting syntactic language abilities after childhood.

Continued Development

In the early 1990s, a hypothesis emerged regarding the development of syntax in individuals with Down syndrome after early adolescence (Chapman, Schwarts & Kay-Raining, 1998). This hypothesis stated that once an individual with Down syndrome reached early adolescence he or she would plateau at the level of simple syntactic structures. The authors of this hypothesis believed that individuals with Down syndrome were incapable of developing syntactic language structures beyond the simple syntax they had utilized during their childhood years. (Chapman et al., 1998) It is important for speech-language pathologists (SLPs) to know whether or not this ceiling exists, in order to provide appropriate intervention. In response to the claim that syntax development plateaus, several researchers conducted studies to examine syntactic development for adolescents and young adults with Down syndrome. These studies utilized multiple methods to measure syntactic development: mean length of utterance (MLU), T-units, and measurement of specific syntactic structures. An additional method of addressing the question of a ceiling is to examine the results of studies focused on therapeutic interventions for syntax.

Mean Length of Utterance

Mean length of utterance (MLU) is a quantitative measurement used to determine functional language levels; it is an average of the number of morphemes

used in a phrase (Kaderavek, 2011). Morphemes are the smallest units of language which carry meaning without altering the meaning or becoming useless units of sounds strung together. There are free morphemes, which can stand on their own, and bound morphemes, which require a free morpheme to convey meaning (Owens, 2008). An example of a free morpheme would be the word *dog*. This word cannot be broken any further and still convey meaning. An example of a bound morpheme would be the *-s* at the end of the word *dogs*. This *-s* carries meaning that signals the plurality of the word, but it means nothing on its own. The *-s* requires the assistance of the free morpheme, *dog*, to become a meaningful unit of language (Owens, 2008).

As individuals develop, they gradually use additional morphemes in their sentences leading to an increase in MLU (Kaderavek, 2011). These increments were categorized into stages by Brown in 1973 (Kaderavek, 2011, Owens, 2008). Each stage is characterized by specific developmental markers (Owens, 2008). The first three stages (stages I-III) are defined by simple syntax forms. It is not until stage IV that complex forms typically emerge and begin to be used spontaneously on a regular basis (Owens, 2008). Therefore, individuals who obtain an MLU corresponding to stage IV or greater, are considered as having achieved a level of complex syntactic forms.

In 1998, Chapman et al. conducted a cross-sectional study to investigate the possibility of a syntactic ceiling in adolescence for individuals with Down syndrome. The study utilized MLU to determine if a plateau in syntax occurred. The researchers hypothesized that narrative samples would not plateau after early adolescence and would in fact see an increase, thereby indicating a probable increase in use of complex syntax. The participants were divided into four age groups ranging from age five to age

twenty. The two younger groups of participants who had not yet reached adolescence exhibited a MLU of 3.0 or less, indicating that they were most likely not yet using the complex syntactic forms and were still within Brown's stages I-III. However, several participants in the adolescent age groups (12;6-16;5 and 16;6-20;5) showed a mean MLU of greater than 3.0. (Chapman et al., 1998) indicating that an MLU of greater than 3.0 corresponded with stages IV and V of Brown's stages of development. As these later stages are characterized by more complex sentence development (Owens, 2008), the authors concluded that the findings of their study were not consistent with the hypothesis of a simple syntax ceiling. They did acknowledge that the exception to this finding would be if the individuals with Down syndrome were using atypical simple syntax patterns within the longer utterances.

In consideration of the discrepancies between their findings and the findings of the initial study indicating a plateau, Chapman et al. (1998) noted differences in methodology. The participants evaluated by Chapman et al. (1998) study were older than those examined in the initial study. Chapman et al. (1998) also noted that the contexts used to evaluate syntax production were different. While the initial study examined syntax in conversation samples, Chapman et al. (1998) also studied syntax during oral narrative production in addition to conversational samples. Although this study did not examine the specific syntactic structures used, the results of measuring the MLU's of individuals with Down syndrome suggested that there is not a syntactic ceiling at which acquisition of syntactic structures stops.

Chapman et al. (2002) investigated MLU in adolescents with Down syndrome. The researchers examined linear data over several years using the same individuals in

contrast to the cross-sectional data of the previous study. As with cross-sectional data (Chapman et al., 1998), the results indicated that, for most of the individuals in the study, MLU continued to increase throughout adolescence. These results indicated that individuals with Down syndrome can continue to exhibit evidence of growing syntactic skills past early adolescence.

T-Units

Another qualitative method to measure expressive syntactic skills is through t-units. A t-unit has one main clause along with the subordinate clauses and nonclausal phrases either attached or embedded in the sentence (Kaderavek, 2011). This method of measurement can be used once an individual has an MLU of greater than four. T-units are more sensitive to language differences seen in more advanced individuals (Owens, 2010) and are therefore more able to identify whether or not the individual's syntactic complexity is appropriate or not (Kaderavek, 2011). As of the composition of this paper there have been no research studies that utilized t-units to determine syntactic development for adolescents and adults with Down syndrome. This is an area in need of further research.

Measurement of Specific Syntactic Structures

A study of the specific syntactic structures used by adolescents with Down syndrome was conducted by Thordardottir, Chapman, and Wagner (2002). The sentences in these samples were examined for ten specific syntactic constructions which would classify the sentence as complex. These constructions were the following: conjoined sentences, simple infinitive clauses with equivalent subjects, full propositional complements, simple noninfinitive wh- clauses, infinitive clauses with different subjects,

sentences with relative clauses, sentences with gerund clauses, unmarked infinitive clauses, wh- infinitive clauses, and quotes as full clauses. In addition, six other syntactic constructions were coded as well: conjoined embeddings, multiple embeddings, multiple conjoining, relative clauses without a complete sentence, quotes without a full clause, and conjoined verb phrases. These six were not considered to be complex syntax, but were considered to be indicators of possible emerging complex forms. Results revealed that, as hypothesized in the previous studies, the MLU's of adolescents with Down syndrome indicated the use of complex syntax structures. Thordardottir et al. (2002) found that, when compared to a control group of typically developing preschoolers matched with MLU, adolescents with Down syndrome showed corresponding levels of type and frequency of complex syntactic forms. In addition, although there was variety in both of the groups, it was found that the individuals with Down syndrome actually had a slightly higher mean average than the typically developing controls with regards to complex syntax use.

Of importance to note with regard to the study conducted by Thordardottir et al. (2002) is that, although MLU was found to correspond to use of complex syntax, the longer phrases did not always contain the complex syntax. The authors reported that, when comparing length and complexity of the phrases, the individuals with Down syndrome were more likely to use one of the ten specific constructions in shorter phrases and less likely to do so in longer phrases. This finding was opposite of what was seen in the preschool control group. In the control group, longer phrases were more likely to contain complex constructions (69-89%). The Down syndrome group only produced 42-68% of utterances 10-13 or more morphemes long. The authors concluded

that the individuals with Down syndrome appeared to be mastering the complex forms at lower MLUs than the preschool control group. A hypothesis for the reason behind this trend is that the individuals with Down syndrome typically produced a greater number of utterances during their language samples and therefore had more opportunities to use the complex syntactic constructions than the preschool group. Chapman et al. (2002) also observed that the individuals with Down syndrome appeared to be attempting more complex syntactic than was typical for their MLU during narrative tasks. This would be consistent with the results found by Thordardottir et al. (2002).

Results of Therapeutic Intervention

In addressing the question of whether or not individuals with Down syndrome reach a ceiling in their ability to acquire syntactic language structures in early adolescence, it is beneficial to inspect studies assessing the success of intervention targeting syntax. A study conducted by Hewitt, Hinkle, and Miccio (2005) recorded the results of an intervention for adults with Down syndrome targeting their syntactic development. This study focused on the syntactic language of three individuals with Down syndrome ranging in age from 29 year to 52 years. Through the use of a hybrid approach to therapy in which both the naturalistic environment and a structured instructional setting were used, all the individuals in the study showed an increase in their specific targeted area. These improvements were marked by spontaneous use of the targeted syntactic forms by the participants. Although this was a case study design, which does not bear the weight of an experimental design, it is important to note that improvement was seen in these individuals. As these individuals were able to learn and spontaneously use syntactic forms which were previously beyond their skill level, the

results indicate the lack of a syntactic ceiling. This is especially true considering the ages of the participants. All of the individuals who participated in this therapy were well beyond the early adolescent range (Hewitt et al, 2005).

Based on the data presented in these studies, it can be concluded that there is no ceiling at which individuals with Down syndrome stop acquiring syntactic language forms (Chapman, 1997; Roberts et al., 2007). It now becomes important to examine factors, both external and internal, which impact syntactic development in these individuals.

Factors Impacting Syntax Development

Now that it has been established that syntax does continue to develop past the age of early adolescence, it becomes necessary to examine the factors which could impact development in this population. These factors fall into two main categories: external and internal. External factors are those which are not inherent in the actual makeup of the individual, but instead come from their surroundings. Internal factors, which could also be called cognitive factors, are those which come from within the individuals themselves.

External Factors

Language context. When examining factors impacting syntactic language it is important to analyze language used in various contexts which require different syntactic language skills. One of the contexts that can be examined for syntactic language structures is the narrative context. Narrative context can be further divided into two different types: oral and written.

Oral narrative. Defined as a context that does not necessarily involve a storytelling format, and is also distinct from typical conversation (Thordardottir et al., 2002). There are a large number of studies regarding expressive syntactic skills which utilize narratives when obtaining a language sample to analyze. Many of the studies discussed previously regarding MLU employed narratives in order to obtain their language samples (Chapman et al. 1998; Chapman et al. 2002; Thordardottir et al. 2002).

While investigating the possibility of a syntax ceiling, Chapman et al. (1998) collected multiple language samples from the individuals with Down syndrome in their study. These samples were taken from both conversational and narrative contexts controlled by the authors. The contexts were compared to each other with regards to MLU, use of different words, and number of total words used. Results revealed that, for all three areas the narrative samples contained significantly higher levels than the conversational samples (Chapman et al., 1998). However, there are some limitations to this study that must be taken into account. The most significant one is the lack of analysis of specific syntactic structures. The authors used MLU as the measure by which they answered the question of whether or not the samples exhibited syntactic differences. And while it is obvious that there are differences between the two contexts, it is unknown what actual syntactic structures of those samples were utilized. It is also important to note that the conversational samples were obtained during a free play setting which some researchers have found tend to produce lower MLUs than a conversation (Miles, Chapman, & Sindberg, 2006). In addition, a free play context may

not be the most appropriate setting in which to obtain a conversation sample for adolescent and young adult individuals (Miles et al. 2006).

Being mindful of the context of the conversation sample, Miles et al. (2006) chose to conduct an interview-type conversation study to obtain their spontaneous language samples. This allowed the authors to evaluate the spontaneous language of adolescents in a more age-appropriate setting. These samples could then be compared to the narrative samples obtained through the use of wordless picture books. The results of this comparison showed that the adolescents produced a greater MLU in the narrative context than in the interview context. This was not the case for the typically developing control group which had been matched to the Down syndrome group based on receptive syntax. The control group exhibited no differences in their MLUs in the interview and the narrative samples (Miles et al. 2006).

Additional information regarding syntactic abilities for these individuals has also been obtained through use of oral narratives. When compared to the narrative language samples of typically developing, receptive vocabulary age matched children, it was found that adolescents and adults with Down syndrome were far more likely to exclude verbs during their narratives. This was especially true for verbs that were associated with more than one argument. (Michael, Ratner, & Newman, 2012) This indicates that there is a deficit involving verb production for these individuals. In addition, it was discovered that, individuals with Down syndrome expressed plot, theme, and episodic events at higher rates than typically developing children matched on MLU and mental age. (Miles & Chapman, 2002) In fact, their expression of these elements corresponded more closely to the control group matched on syntactic comprehension, indicating that

these individuals may possess some skills in narrative production that is not reflected in their MLU. This is important to note as MLU is often used as a measure of syntactic ability.

Another use of oral narratives is in the comparison of individuals with different syndromes. A study conducted by Keller-Bell and Abbeduto (2007) found that, when compared to adolescents and young adults with fragile X syndrome, individuals with Down syndrome produced less grammatically correct sentences. However, the individuals with Down syndrome used other language elements such as exclamations and onomatopoeia with higher frequency. This indicated that, although the syntactic and morphological aspects of language were impaired, other advanced language elements were present in the narratives. These results correspond with a study referring to more advanced language skills in other areas being utilized by these individuals despite the difficulty with syntax (Miles et al. 2002). A review by Chapman and Hesketh (2000) reported similar findings.

Written narratives. Narrative contexts can also encompass written models. As seen in a by Miles et al. (2006), different contexts can result in different syntactic production. Kay-Raining Bird, Cleave, White, Pike, and Helmkey (2008) conducted a study that compared the results of eliciting oral and written narratives from children and adolescents with Down syndrome. This study found that the written narratives did not have as many different words as the oral narratives. The results also indicated that there were more t-units as well as better episodic structure in the oral narratives. This was true for both the Down syndrome group and the typically developing, reading matched, control group. An interesting finding of this study was that the overall length of

the oral narratives for the Down syndrome group was actually greater than that of the typically developing control group. However, the authors caution that, just because it is longer, does not necessarily mean better. They noted that typical development shows a decrease in the length of narratives as the age increases due to production of tighter, more cohesive narratives. In addition, the groups were not different with regard to the measures of linguistic complexity or episodic structure. This could indicate a measure of repetition by the individuals with Down syndrome. Alternatively, it could have been indicative of a greater amount of descriptive language used by these individuals. The study did not examine the narratives for these elements. Despite these difficulties, the overall results of this study indicate that written narratives do not elicit the same level of complex syntax seen in oral narratives (Kay-Raining et al. 2008).

Visual stimuli. Another interesting factor revealed by Kay-Raining et al. (2008) was the results of measuring MLU in two different narrative contexts. During a spontaneous language sample utilizing an interview format, there were times when the individual slipped into an oral narrative context (Kay-Raining et al. 2008). During analysis, these instances were isolated and compared to an oral narrative language sample of the individual. This comparison examined the impact of visual stimuli on the MLU. During the oral narrative sample, a picture book was used to elicit responses. However, no visual stimuli were given during the interview sample when the individual switched to narrative patterns. This allowed the authors to examine the effect of visual stimuli on narrative language contexts. The results of this analysis indicated an even more significant MLU increase in the context with the visual stimuli (Kay-Raining et al. 2008).

Internal Factors

As research into the language delays of individuals with Down syndrome has progressed, it has become evident that there is a specific cognitive profile for these individuals (Kernan & Sabsay, 1996). There are areas of cognition that are typically impacted in the majority of these individuals (Roberts et al. 2007). Understanding what this cognitive profile looks like as it impacts syntactic language development is essential for all clinicians seeking to address this area with their clients. Research has shown that visual-motor skills are stronger than auditory skills (Wang, 1996). This was shown to hold true in both sequential memory and perception tasks (Wang, 1996). In addition, studies have shown that short-term memory is often impaired in these individuals. Wang (1996) reported that short-term memory appears to be the basic foundation for many cognitive functions. Therefore, it is crucial to understand this aspect of cognition and how it affects syntactic development.

Short-term/working memory. Short-term or working memory is essential for any element of language development. Any information that is learned must first be processed and stored in short-term memory before it can be transferred into long-term memory and learned for spontaneous use (Owens, 2008). Therefore, it makes sense that it is important to determine if short-term memory is impaired for individuals with Down syndrome. In addition, it is important to figure out if all types of short-term memory are equally impaired or if only certain types are more impaired than others for these individuals. The first type of short-term memory examined will be auditory short-term memory.

Auditory short-term memory. Auditory short-term memory refers to the portion of memory associated with auditory input. This includes all information taken in through auditory channels and affects any teaching strategies that utilize oral instructions given to the client. Impaired auditory short-term memory also affects the length and complexity of the sentences that could be produced by individuals. Hesketh and Chapman (1998) suggested that difficulty with verb acquisition, which they reported to be linked to the syntactic difficulties noted in individuals with Down syndrome, may be linked to difficulties with auditory short term memory. Specifically, these authors reported that the ability to understand the contexts of verbs and be able to use these contexts correctly in complex syntax was linked to auditory short-term memory. This is due to the fact that there must be adequate short-term memory ability to remember the verb and to process the context for comprehension in order to then produce the syntactically appropriate response to the verb's context. The results of Hesketh and Chapman's (1998) study indicated that individuals with Down syndrome had significantly reduced verb use in their language samples. The authors linked the reduction of verb use to performance on auditory short-term memory tasks and concluded that there was evidence of a link between the two measures. However, the authors noted that further research was necessary to confirm their findings (Hesketh & Chapman, 1998).

An additional examination of the effect of auditory short-term memory was a study focused on predicting longitudinal change in individuals with Down syndrome (Chapman et al. 2002). This study provided additional support for the link between syntactic language and auditory short-term memory. The authors found that one of the greatest

predictors of syntactic change over time was syntactic language comprehension. In addition, comprehension was found to be linked to auditory short-term memory. However they also reported that the impact of auditory short-term memory appeared more indirect than originally anticipated. Overall, the results of the study indicated that auditory short-term memory does play a role in the production and comprehension of syntax in individuals with Down syndrome although it appeared that auditory short-term memory was not the only factor affecting syntactic language development (Chapman et al. 2002).

Miolo, Chapman, and Sindberg (2005) studied the effect of auditory short-term memory by using the Test for Auditory Comprehension of Language to measure language comprehension. Comprehension had been found in previous studies to be a predictor of syntactic growth (Chapman et al. 2002). Through the study by Miolo et al. (2005), it was determined that auditory short-term memory plays a significant part in comprehension of more complex sentences for individuals with Down syndrome. This was especially true in passive sentence structures where the individuals with Down syndrome had a higher rate of semantic role reversal. This showed that these individuals were using auditory memory of the word order as a strategy for comprehension of the sentences. This semantic role reversal in passive sentences indicated that the strategy for comprehension had to do more with remembering the words than remembering the context appropriately (Miolo et al., 2006).

The results of formal cognitive testing showed that auditory and sequential cognitive tasks were weaker in relation to visual and simultaneous cognitive tasks (Kernan & Sabsay, 1996). The authors of this study found that correlations between the

cognitive measures and expressive language for all areas except semantics were significant (Kernan & Sabsay, 1996). Because of the weakness of auditory cognition and the link between cognition and expressive language, it follows that auditory short-term memory would be both impaired and an important predictive factor for syntax. This correlates with the significance of auditory short-term memory evidenced in the above studies.

Visual short-term memory. Another form of short-term memory is visual. This deals with all information received through visual channels such as pictures and writing. Cognitive testing mentioned in the previous section indicated that visual cognitive tasks were stronger in relation to auditory cognitive tasks (Kernan & Sabsay, 1996). In another study it was discovered that auditory short-term memory appeared to play a crucial role in the strategy employed by the individuals to comprehend the information in complex sentences (Miolo et al. 2005). This study also examined the effect of visual short-term memory on sentence comprehension. The results showed that there was no evidence of a significant contribution to comprehension during the tasks targeting visual short-term memory. A potential reason for this could have been the number of visual cues available to the individual. The authors noted that the large amount of foil items could have compromised the visual short-term memory as the primary information could not be processed before secondary information was presented. Thus, further research is needed to verify the results of the study.

An additional study examining the impact of visual short-term memory indicated that, as with auditory short-term memory, visual short-term memory was a predictor of syntax comprehension (Chapman et al. 2002). These results indicate that visual short-

term memory is linked to increase in syntactic language over time. Overall, however, the research regarding the impact of visual short-term memory is inconclusive and needs additional studies to fully examine its' effect on syntactic comprehension and production.

Conclusion

In conclusion, this paper has examined whether syntax continues to develop past early adolescence for adolescents and adults with Down syndrome. It has also discussed internal and external factors affecting syntactic development. Although the syntactic language abilities of these individuals have not been examined to the degree that children's skills have been, there are some conclusions that can be made regarding their development.

The first portion of this paper examined continuing syntactic development. Through the use of MLU and analysis of specific syntactic structures, evidence has shown that syntax development continues throughout the adult years and is possible even in late adulthood.

Once it was determined that development does continue, it was then necessary to examine factors which impact development, both external and internal. External factors found to be significant included context and stimuli. Oral narrative context showed increased evidence of complex syntactic structures over both written narratives and spontaneous conversation. In addition, the presence of visual stimuli further increased the use of complex syntax in oral narratives.

Internal factors were examined for significance relating to syntax. In the studies utilized for this paper, the only factor found to be significant to syntax in this population

was short-term, or working, memory. This factor was further broken down into auditory and visual short-term memory. Auditory short-term memory was found to be more impaired for individuals with Down syndrome, while visual short-term memory was stronger. Based on the findings of this paper, some directions for future research have been illuminated.

Implications for Future Research

Because it is now known that syntax does continue to develop, future research should focus on intervention strategies that are successful for these individuals. Improved syntactic skills would allow individuals with Down syndrome an even greater opportunity to interact meaningfully with their world. Further research is also needed to determine specifics regarding syntactic development throughout the lifespan past the point of young adulthood. There is still much unknown about later development and language abilities past approximately 35 years of age. This is especially important considering that indications of dementia and Alzheimer's are present in individuals with Down syndrome over 35 years old (Krinsky-McHale & Silverman, 2013).

Adolescents and adults with Down syndrome have a lot to offer their worlds. Even though syntax continues to be challenging for them, these individuals have shown the ability to learn long past childhood. It is important for professionals, family members, and friends to understand this and endeavor to help them continue learning throughout their lives.

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