

THE EFFECT OF TELEVISION EXPOSURE ON COMPLEX SYNTAX USE IN
CHILDREN WITH DOWN SYNDROME

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THE EFFECT OF TELEVISION EXPOSURE ON COMPLEX SYNTAX USE IN
CHILDREN WITH DOWN SYNDROME

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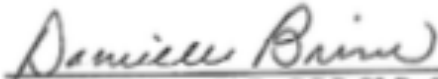
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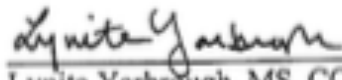
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TABLE OF CONTENTS

Acknowledgements.....	iii
List of Figures.....	v
List of Tables	vi
I. Introduction.....	1
II. Research Question.....	3
III. Hypothesis.....	3
IV. Method.....	3
a. Participants.....	3
b. Setting	6
c. Materials.....	6
d. Experimental Design	6
e. Response Definitions and Measurement system.....	7
f. Experimental Design and Procedures.....	7
g. Procedural Fidelity.....	10
V. Results.....	11
VI. Discussion and Implications.....	16
VII. Limitations and Conclusions.....	18
References.....	vii
Abstract.....	x

List of Figures

Figure 1. Participant Results on Infinitive Clause Task measure across time.....12

Figure 2. Participant results on relative clause task measure over time.....14

Figure 3. Participant MLU, Number of total words, and number of different words
measured over time.....15

List of Tables

Table 1.	Expressive One Word Picture Vocabulary Test Results.....	4
Table 2.	Performance on Schuele Complex Syntax Tasks.....	5
Table 3.	Daniel Tiger’s Neighborhood Episodes used for Intervention.....	8
Table 4.	Intervention Schedule.....	9
Table 5.	Procedural Fidelity Data from TV Watch Logs.....	10

Introduction

Television and Learning

Electronic media, including television, has become increasingly prevalent in the lives of young children across the past several decades. The Nielsen Report from 2015 estimates that 97% of children between the ages of 2 and 7 watched live television during the month of March. Of the genres watched by that age group, 90% of television viewing is of children's programming. Three to seven-year-old children are estimated to watch at least two hours of television each day in the United States, and many watched more than the recommended amount (Cespedes et al., 2014).

Although the American Academy of Pediatrics recommends limiting television viewing to two hours (2001), it also recognizes that television can have beneficial effects. Prominent studies indicate that allowing young children to spend excessive time viewing television can be developmentally detrimental (e.g., Ling-Yi et al., 2014), but research also indicates that children benefit socially and academically from certain educational shows. The television show *Daniel Tiger's Neighborhood*, for example, is associated with increased empathy, self-efficacy, and emotion recognition in preschoolers who were typically developing (Rasmusen et al., 2016). Preliminary evidence indicates that a show like *Daniel Tiger's Neighborhood* can improve social thinking in children with Autism Spectrum Disorder (Dotson et al., 2017). The academic merits of the show *Sesame Street* also have been well documented in children with typical development (Mares & Pan, 2013).

The linguistic content of children's television, as compared to social and academic content, has been minimally explored. A content analysis of the vocabulary in the show *Sesame Street* indicated that vocabulary instruction could be improved within the television show (Larson & Rahn, 2015). Burnett and Lund (2017) raised the question of whether or not different television shows aimed at a preschool audience contained different levels of complex syntax. They sought to explore language content within two popular children's television shows, *Daniel Tiger's Neighborhood* and *Paw Patrol*. They found that *Daniel Tiger's Neighborhood*, overall, presents more complex syntax during episodes than does *Paw Patrol* (Burnett & Lund, 2017). However, to date, there has been minimal study of specific programming (i.e., particular television shows) on language learning.

Complex Syntax

Children begin to produce complex syntax, utterances with more than one verb phrase, in preschool (Barako Arndt & Schuele, 2013). Complex syntax proficiency has an impact on academic success: it would be challenging to engage with any academic material using only simple sentences (Scott & Windsor, 2000). However, children with language learning difficulties often demonstrate delays in complex syntax development (e.g., Barako Arndt & Schuele, 2012; Hesketh, 2006; Owen Van Horne & Lin, 2011).

One group at risk for complex syntax delays as a result of language impairment is children with Down syndrome. Price and colleagues (2008) sought to compare syntactic skills of boys with Down syndrome to the skills of boys with Fragile X syndrome with and without Autism Spectrum Disorder. They measured syntactic skills by calculating Mean Length of Utterance (MLU) for each child as well as evaluating the Index of Productive Syntax total scores for each child. They determined that children with Down syndrome show great delays in the area of complex syntactic development as compared to typically developing peers (Price et al, 2008). Additional studies have confirmed that when children with Down syndrome tell narrative stories, they are unlikely to use particularly complex utterances (Kay-Raining Bird et al., 2008).

Typical intervention targeting complex syntax use includes direct instruction (Eisenberg, 2014). This method is particularly time intensive and is dependent on cooperation of the child and time constraints of scheduling. Children with Down syndrome have deficits in multiple areas and may require intervention from many different professionals, in turn creating even more of a time constraint on speech and language therapy. It would be reasonable to think about how increased varied exposure could be a means to improve outcomes to lots of forms of a target (i.e., increased exposure to dense variety of relative clauses might lead to learning gains such as use or comprehension of relative clauses). In her study, Plante and colleagues (2014) contrasted the use of high-variability recasted grammatical input versus repeated low-variability grammatical input to children with language impairment. They found that “children who received high-variability input during a conversational recast treatment outperformed those who received low-variability input” (Plante, Ogilvie, Vance, Aguilar, Dailey, Meyers, Burton 2014).

Complex Syntax and Television

Despite cautions about television exposure, it appears that most preschool-aged children engage in watching television during the week. Thus, it may be time to ask: how can television viewing assist with child development? Some works indicate that typically developing children

learn linguistic information (e.g., vocabulary; Mares & Pan, 2013) from children's programming. This study will explore whether children with atypical language development, in this case, children with Down syndrome, can also learn from television. In particular, television seems to be a medium with ample opportunity for highly variable grammatical input (Burnett & Lund, 2017). If television shows with dense complex syntax can produce changes in the grammatical output of children with language impairment secondary to Down syndrome, this information could help parents plan ways to maximize learning from electronic media. On the other hand, if children with Down syndrome do not learn from television, this information is also important knowledge for professionals working toward improving linguistic outcomes for this population. This pilot study will help provide preliminary evidence to answer this question.

Research Question

Will repeated exposure to (a) infinitival clauses and (b) embedded relative clauses in the form of episodes of *Daniel Tiger's Neighborhood* improve the comprehension and use of (a) infinitival clauses or (b) embedded relative clauses in the language of children with a language impairment secondary to Down syndrome? And in the case of children who have a mean length of utterance lower than two words per utterance, will exposure to episodes of *Daniel Tiger's Neighborhood* increase mean length of utterance?

Hypothesis

Our hypothesis is that repeated exposure to a television show with high complex syntax density will improve the use of embedded clauses such as infinitival clauses and relative clauses in children with Down syndrome. Additionally, it is hypothesized this exposure may have an impact on the mean length of utterance of children with Down syndrome.

Method

Participants

Participants included six children with Down syndrome and a peer-model who did not have Down syndrome but participated in the designated preschool class and had grammatical errors in his speech (this child is designated as Mathew). All children participated daily in a single pre-school class in a university lab preschool for children with developmental delays. At

the start of the study, children ranged in age from 5 years 3 months to 6 years 5 months. The primary spoken language of the participants was English. Their vision and hearing were within limits sufficient to watch a TV show for 15 minutes per parent report.

Children attended one pre-intervention visit to complete an assessment of their expressive language abilities. One participant, Jonathan, entered into the study after the other participants and therefore did not participate in a pre-intervention assessment. His language skills were discussed with his teacher and the school’s speech-language pathologist, who estimated that his expressive vocabulary and grammatical skills were below the average expected for his age (mean length of utterance was less than two words per utterance).

The children’s language was assessed via the Expressive One-Word Picture Vocabulary Test (EOWPVT; Martin, Brownell, 2010a). Children were also assessed using the Schuele complex syntax tasks, which create elicited, obligatory contexts for use of complex syntax (Schuele, unpublished; referenced in Schuele & Tolbert, 2009). The infinitive clause, object relative clause, subject relative clause, and the full propositional clause and WH clause tasks were administered. The children’s language proficiency levels were also discussed with the child’s teacher and the child’s speech-language pathologist at the school. Results of testing in the clinical setting were consistent with teacher and speech-language pathologist observations.

Table 1
Expressive One Word Picture Vocabulary Test Results

Participant	Age	Standard Score	Percentile Rank
Caroline	6;1	85	16
Peter	6;5	64	1
Margaret	6;3	64	1
Ellie	5;3	66	1
Matthew	6;1	89	23
James	5;7	62	1
Jonathan	5;5		

The participants’ scores for the EOWPVT are displayed in TABLE 1. All participants’ scores, with the exception of Caroline and Matthew, were more than two standard deviations below the expected mean for children who are typically developing.

The third person singular verbs probe and the past tense probe of the TEGI were administered. Three participants (Caroline, Peter, Ellie, and Matthew) completed the third person singular verb probe task. Caroline marked the morpheme 56% of the time, scored with 56% accuracy, Peter marked the morpheme zero times, Ellie with 25% accuracy, and Matthew with 100% accuracy. Matthew was the only one to complete the past tense probe task and achieved 64% accuracy on regular verbs and 14% accuracy on irregular past tense verbs. James and Jonathan did not complete the probe because they each had a mean length of utterance that was less than two words per utterance.

The Schuele complex syntax tasks were given in order of increasing difficulty (infinitive clause, full propositional and WH clause, object relative clause, and subject relative clause). Administration was discontinued for each participant once they achieved 50% or below on one of the task measures to avoid over-testing children on structures that appeared too difficult. The purpose of this assessment was to identify structures to target via television episode for each child. TABLE 2 shows the child's scores for each probe.

Table 2

Performance on Schuele Complex Syntax Tasks

<i>Participant</i>	Infinitive Clause	Full Propositional and WH clause	Object Relative	Subject Relative
<i>Caroline</i>	14%	N/A	N/A	N/A
<i>Peter</i>	29%	N/A	N/A	N/A
<i>Margaret</i>	0%	N/A	N/A	N/A
<i>Ellie</i>	14%	N/A	N/A	N/A
<i>Matthew</i>	100%	56%	grammatically correct: 0%; used "what"/"that": 71%	grammatically correct: 0%; used marked "what"/"that": 43%
<i>James</i>	0%	N/A	N/A	N/A
<i>Jonathan</i>	0%	N/A	N/A	N/A

Setting

Data collection occurred at the preschool where the child was enrolled in and testing took place in a quiet portion of the hallway outside of the child's classroom or in a small, private room down the hall from the child's classroom. The child was seated on the floor across from the examiner, or in a chair next to the examiner at a child-sized table. The examiner had the toys used for the probe measure in a bin out of reach of the child.

Intervention was implemented in the child's home. Television viewing was left to the discretion of the parent: parents were asked to allow their child to watch episodes at least once a day for five days, the child could do so alone or with others, at whatever time that most convenient for the family. They were asked to report back via written television watching log on the frequency of viewing.

Materials

For intervention, materials included recorded episodes of *Daniel Tiger's Neighborhood* (Morrison & Santomero, 2012) provided via login to an online streaming system, *Amazon Prime Video*. For probe administration, the Schuele Complex Syntax Elicitation Task was used. The infinitival clause task and the subject and relative clause task measures were used (Schuele, unpublished; referenced in Schuele & Tolbert, 2001). Additional task items were created by the researcher to allow for 4 different task measures with 7 items for each complex syntax structure. For the one child being probed on relative clauses, each task combined subject and object relative clause tasks.

These tasks require toys to elicit complex syntax measures. To increase motivation for participant, *Daniel Tiger* character figurines were used to elicit tasks. Additional toys and pictures included various animals (i.e. horses, cows, frogs, etc.), household items (i.e. small beds, chairs, a whistle, photo of swing set, etc.), and play food (carrots, grapes, cookies, etc.).

Experimental Design

The study design was a multiple probe single case design (Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf, & Shadish 2010). This design allows for replication across participants to show preliminary data that the evaluated treatment can work for the larger population. Additionally, this design allows for detection of the following threats to internal validity: history, maturation, and statistical regression. By controlling the point at which each

participant enters into intervention, the researchers monitored for history, or any interaction from co-occurring events that could cause an observed effect (Kratochwill et al, 2010). In a similar way, staggering entry controls for maturation or “naturally occurring changes over time [that] could be confused with an intervention effect” (Kratochwill et al, 2010).). By using repeated assessment rather than pretest and posttest only, regression is controlled (Kratochwill et al, 2010).

Response Definitions and Measurement System

Probe assessments. The dependent variable was the child’s score on the Complex Syntax Elicitation Task(s) (Schuele, unpublished). Matthew was scored via the relative clause task, and Caroline, Margaret, Ellie and Peter were scored via the infinitive clause task. Four different versions of each complex syntax probe were used, consisting of seven items each. The task tests the child’s use of clauses by setting up an obligatory context for the clause. For example, for the infinitive clause task, the examiner sets up a Daniel Tiger toy sitting and a Miss Elaina toy standing. The examiner says, “Daniel and Miss Elaina are playing school. Miss Elaina is the teacher.” The examiner raises Daniel’s hand and says, “Can I stand up?” The examiner then says, “Daniel wants – you finish the story – Daniel. . .” Correct responses included, “Daniel wants to stand up” “wants to stand up” or “to stand up.” Incorrect responses included off-topic responses, no response, or a response of “stand up.” Each probe took approximately 10 minutes to complete; probes administered two times per week. The relative clause also provided an obligatory context. For this task, an additional adult needed to be present for the participant to give an instruction to. On days when an additional adult could not be present, a baby doll was used. For example, the examiner set up two dogs stuffed animals and used the Daniel Tiger toy to “pet” one of the dogs the examiner said, “Look, Daniel is petting this dog.” Then she would point to the other dog, and say, “Daniel did not pet this dog.” Then, the examiner told the participant, “Tell the baby to point to *this* dog” while pointing to the dog that Daniel pet. A correct response was “point to the dog that Daniel pet” or “point to the dog that Daniel is petting.” For this participant, we found he would generally respond by marking two clauses in a sentence by saying “Point to the dog what Daniel is petting.” So, this response was counted correct for marking two clauses, but counted grammatically incorrect.

For two participants, MLU across time was measured. During the time the researcher completed weekly probe assessments with participants on the complex syntax measure, the

researcher collected a five minute, play-based language sample with the manipulatives from the relative clause probe assessment for that day, including the *Daniel Tiger’s Neighborhood* toys. The researcher audio recorded the language samples. Due to low intelligibility, the researcher glossed all productions from each participant.

Interobserver Agreement. The researcher and trained assistants administered probes. A trained research assistant watched approximately 33% of probe sessions. The observer scored the probe (with the child’s response recorded on the data sheet) simultaneously with the examiner. For language samples, the observer transcribed utterances as the researcher was collecting the sample. To calculate overall Interobserver agreement, the researcher and the observer’s response data was compared and the total number of point-by-point agreements was divided by the overall number of target opportunities and multiplied by 100 to determine a percentage of agreement (Ayres & Gast, 2010). Interobserver agreement should be at 80% or above. Interobserver agreement was calculated to be above 85% across all participants and conditions.

Experimental Conditions and Procedures

All children received the television intervention. Episodes of *Daniel Tiger’s Neighborhood* were selected based on density of specific embedded clauses (as determined by Burnett & Lund, 2017). **TABLE 3** shows episodes used for each clause measure in the order that they were introduced for each participant. Episodes were made available via login to the researcher’s Amazon Prime Account. The researcher emailed the participants at the start of every two weeks to inform them of the following two weeks’ episode to be viewed along with a direct link to the episode. On the day the email was sent, the researcher sent home a hard copy of the television watch log with that week’s episode written across the top.

Table 3

Daniel Tiger’s Neighborhood Episodes used for Intervention

Structure Measured	Episode	# of occurrences
Infinitive Clause Episodes (in order of introduction) / MLU Episodes	Season 6, Episode 6	82
	Season 6, Episode 7	87
	Season 6, Episode 5	66
	Season 6 Episode 2	68
	Season 7 Episode 2	39

Relative Clause Episodes (in order of introduction)	Season 6 Episode 10	31
	Season 7 Episode 5	35
	Season 7 Episode 4	42

Intervention proceeded as followed. Episodes were made available through a link, so the parent could show the target episode to the child on any schedule. Parents were asked to allow their children to watch one selected episode five days a week for two weeks (each episode is approximately 15 minutes). This process repeated for a total of four episodes. Thus, intervention lasted for a total of eight weeks for each child. The entire intervention period for the study was 14 weeks. During this time, researchers continued to complete the probe assessment twice each week for each participant.

Participants were introduced into intervention based on when they achieved a stable baseline on the experimental probe measure. The first participant to achieve a stable baseline was Peter. Two weeks later, James was introduced into intervention. **Table 4** shows the treatment introduction schedule. Two students were introduced week 7 and week 9 so that intervention could be finished with all participants, and to allow for a maintenance period for all participants before the end of the lab school year. After the participants had been through all four episodes, television watching will cease, but researchers continued probing child use of clauses through the end of the semester.

Table 4

Intervention Schedule

Week 1 intervention	Peter
Week 3 intervention	James
Week 5 intervention	Ellie
Week 7 intervention	Matthew
Week 9 intervention	Margaret and Jonathan

Procedural Fidelity

To measure procedural fidelity, the parents of each participant used a written log on paper to tell the researchers when the child watched each episode and for how long. Parents were free to vary the intensity but were asked to watch the episode at least once a day five days out of the week for a total of ten viewings per episode. Each episode was 25 minutes long. TABLE 5 contains data from television watch logs.

Table 5

Procedural Fidelity Data from TV Watch Logs

Participant	# of times each episode was watched	Average # of minutes spent watching each episode
Peter	Episode 1: 10	Episode 1: 25
	Episode 2: 7	Episode 2: 25
	Episode 3: 7	Episode 3: 25
	Episode 4: 9	Episode 4: 25
James	Episode 1: 15	Episode 1: 24
	Episode 2: 11	Episode 2: 22.3
	Episode 3: 10	Episode 3: 23.5
	Episode 4: 10	Episode 4: 25
Ellie	Episode 1: 10	Episode 1: 25
	Episode 2: 13	Episode 2: 25
	Episode 3: 12	Episode 3: 15.8
	Episode 4: 10	Episode 4: 25
Matthew	Episode 1: 13	Episode 1: 25
	Episode 2: 9	Episode 2: 25
	Episode 3: no data	Episode 3: no data
	Episode 4: no data	Episode 4: no data
Margaret	Episode 1: 7	Episode 1: 25
	Episode 2: 7	Episode 2: 25
	Episode 3: 8	Episode 3: 25
	Episode 4: 7	Episode 4: 25

Jonathan	Episode 1: no data	Episode 1: no data
	Episode 2: no data	Episode 2: no data
	Episode 3: no data	Episode 3: no data
	Episode 4: no data	Episode 4: no data

No logs were turned in for Jonathan. Per parent report, he watched each episode for the entirety of the episode. He watched each episode approximately 8 times across 2 weeks.

All participants watched each episode at least 7 times. All children watched each episode for an average of at least 22 minutes, with the exception of Ellie who watched the infinitive episode number three (Season 6, Episode 5) for an average of 15.8 minutes each time.

Data Analysis Plan

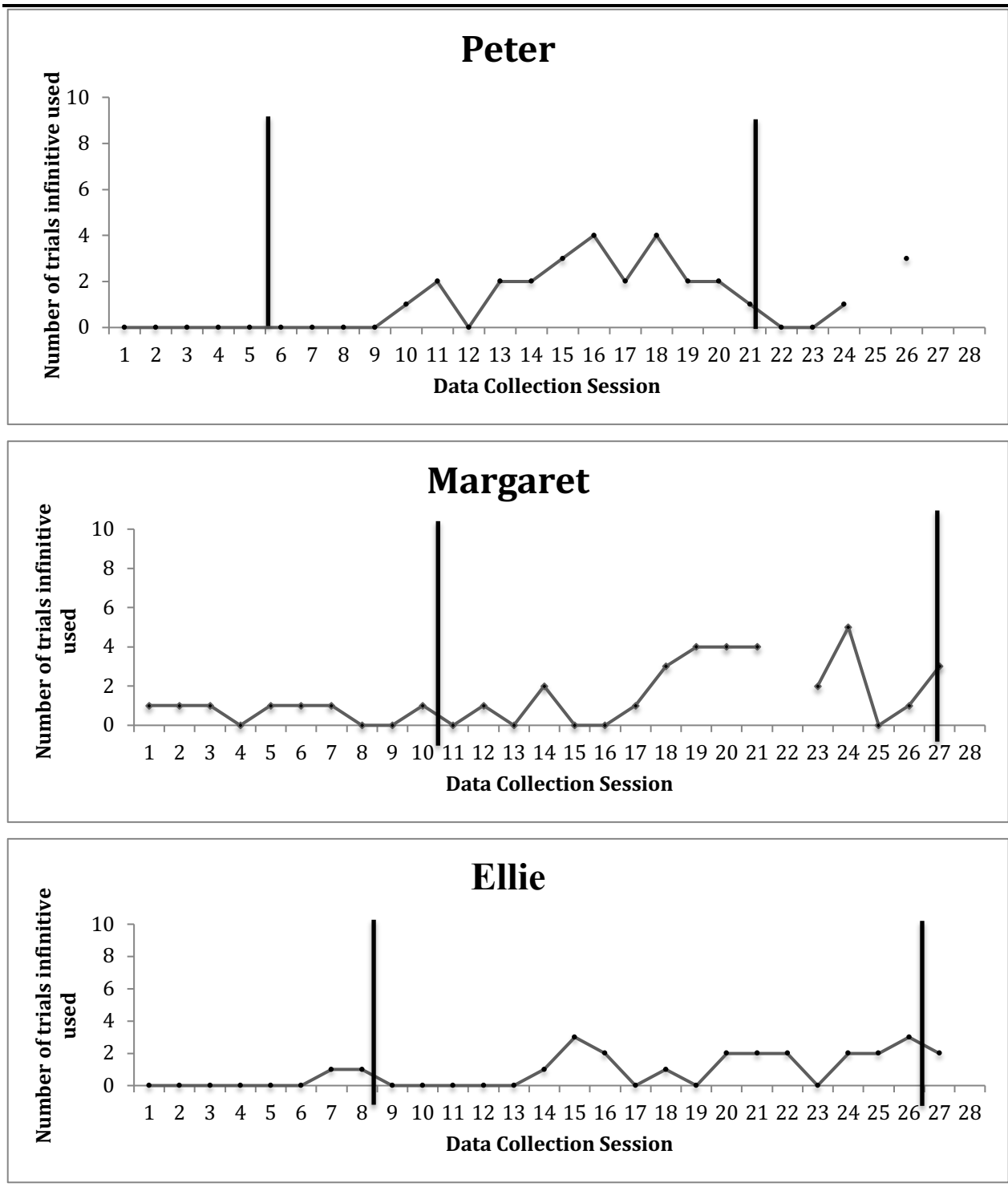
All data were analyzed via visual analysis. All results from probing measures were graphed on a line graph and standard criteria (e.g., percent non-overlapping data, tau-U effect sizes) were calculated between conditions (i.e., pre-intervention, during intervention, and maintenance) to determine if there was a functional relation between intervention and the child's scores on the embedded clause probe measure.

Results

This study investigated the existence of a functional relation between television viewing and complex syntax use in children with Down syndrome. Because this study took place partially at the child's home, there was variability in the amount of intervention received. Additionally, one participant dropped out of the study because the parent had concerns about repeated exposure to a television show.

Complex Syntax Use. Results from the weekly participant probe assessment gathered in baseline, intervention, and maintenance conditions were graphed on a line graph. For children measured on infinitive clause and relative clause use, the number of times the clause was used during play with the complex syntax task measure was analyzed. Figure 1 displays results for all children measure on the infinitive task measures.

Figure 1 – Participant Results on Infinitive Clause Task measure across time



Change in dependent variable was determined via visual analysis. All three participants who were working on infinitive clauses demonstrated a relation between infinitive clause use and the introduction of *Daniel Tiger's Neighborhood* episodes that contained a high-density of infinitive clauses. An additional observer trained in single case design and blind to the purpose of the study confirmed a functional relation for each of the three participants working on use of infinitives. Additionally, percent overlapping data and Tau-U effect size were calculated to support this analysis. Peter had five data points that were at baseline levels during the intervention condition yielding a total of 66.66% non-overlapping data. However, Peter did not demonstrate a shift in behavior until after four sessions in the intervention condition. If only those data points post-shift are evaluated, his percent non-overlapping data jumps to 90.90%. A Tau-U contrast from baseline to intervention for Peter was .65 (where .4 is generally considered a medium/moderate effect; Parker, Vannest, Davis & Sauber, 2011).

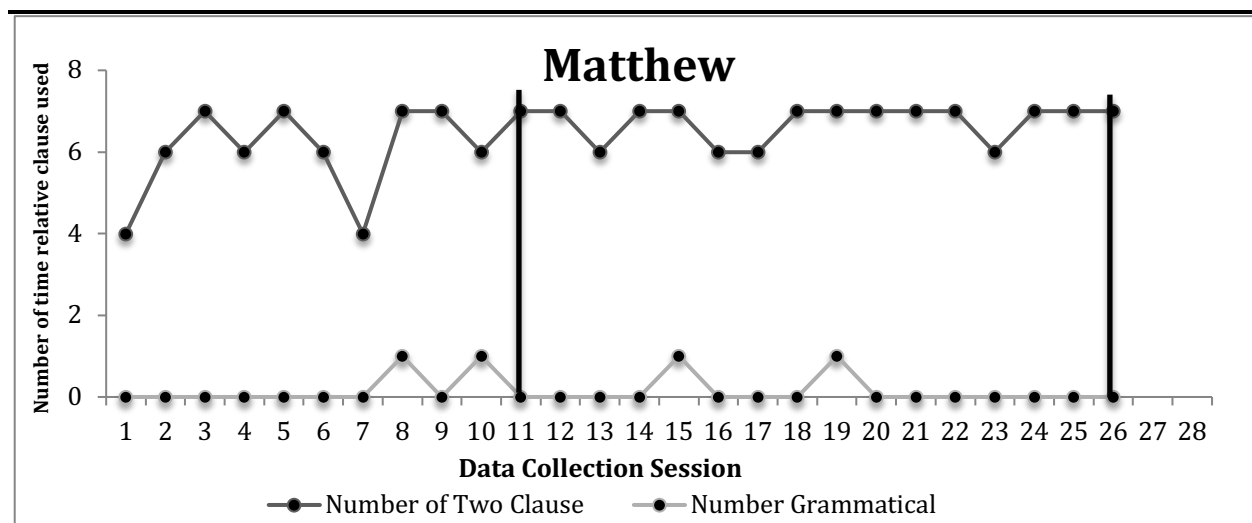
Margaret had seven data points that were within baseline levels during the intervention condition, yielding 46.66% non-overlapping data. Again, if nonoverlapping data are considered only after the first shift away from baseline (after four weeks in intervention for Margaret), percent non-overlapping data jumps to 70%. A Tau-U contrast from baseline to intervention for Margaret was .35.

Ellie had seven data points that were within baseline levels during the intervention condition, yielding 56.25% non-overlapping data. The first shift from baseline levels for Ellie occurred four weeks after the start of the intervention. If only those points are considered, percent non-overlapping data shifts to 69.23%. Ellie did not have generalization data points. A Tau-U contrast from baseline to intervention for Ellie was .61.

Overall, there was a demonstration and two repetitions of a relation between television exposure and infinitive clause use. In accordance with the standards of single-case design (Kratochwill et al., 2010), it was concluded that a functional relation exists. An overall Tau U weighted average for all three participants was .53 ($p < .001$; Parker & Brossart, 2003).

Figure 2 displays the results from Matthew. He was measured on whether or not he marked two clauses in a sentence (i.e. "The fry what Daniel ate") and whether or not his production was grammatically correct (i.e. used "that" instead of "what").

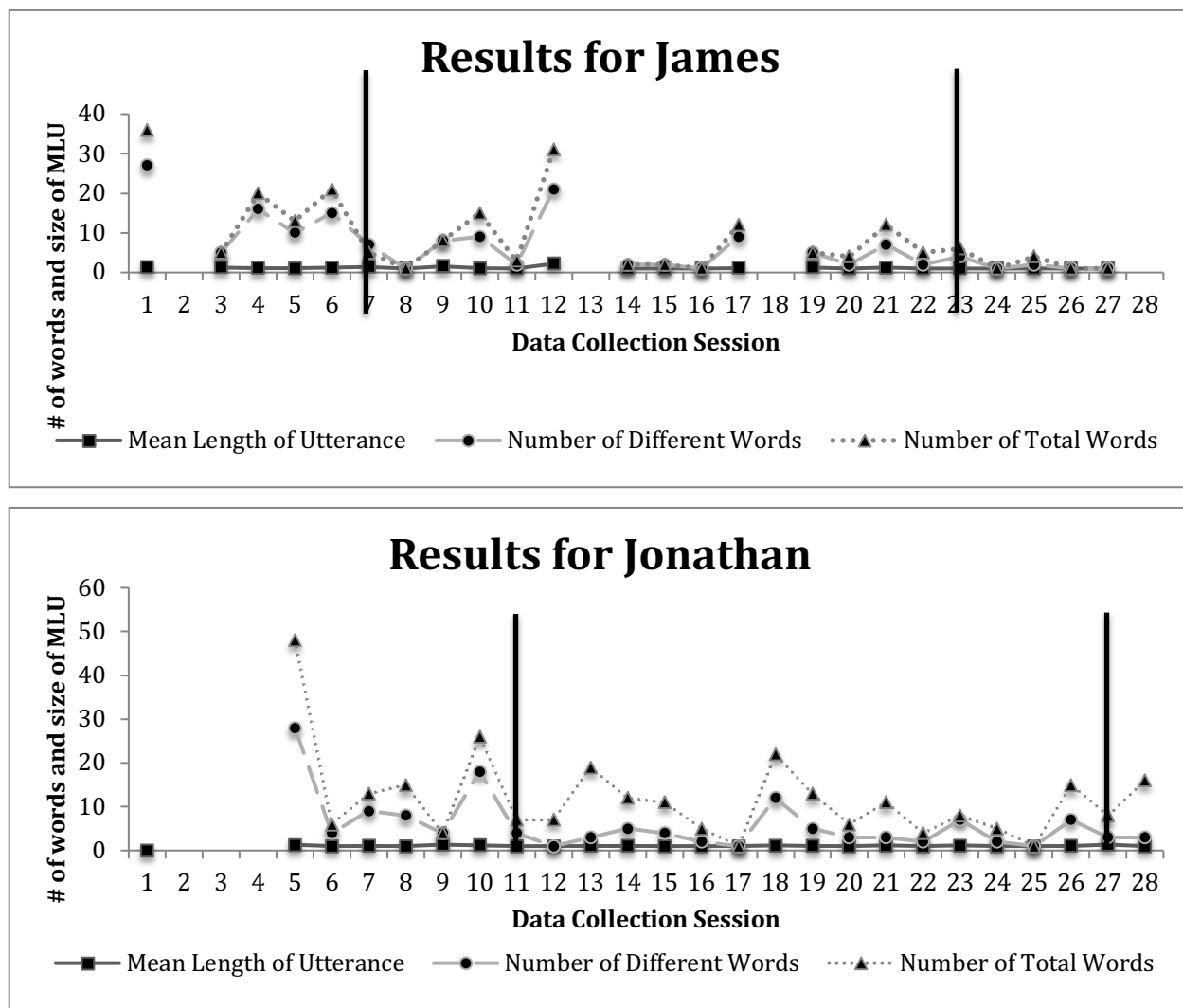
Figure 2 – Participant results on relative clause task measure over time



Per visual analysis, no relation was demonstrated between baseline and intervention data points existed. Thus, we cannot conclude that exposure to *Daniel Tiger's Neighborhood* episodes with a high density of relative clauses increases the use or accuracy of relative clause use (percent overlapping data was 100%), although the trend in the use of two clauses stabilized during intervention. It should be noted that this participant did not have Down syndrome but was age matched with the other participants and had grammatical errors in his speech.

For two participants, James and Jonathan, mean length of utterance was measured over time due to their low verbal output. Figure 3 displays their results over time. Researchers tracked number of total words and number of different words as well as MLU.

Figure 3 – participant MLU, Number of total words, and number of different words measured over time



Per visual analysis, no relation was demonstrated between baseline and intervention data points existed, and again, percent non-overlapping data was 0%.. Thus, we cannot conclude that

exposure to *Daniel Tiger's Neighborhood* episodes increases the MLU, number of words used, or number of different words used of children with Down syndrome.

Discussion and Implications

The purpose of this study was to evaluate the effects of repeated exposure to a television show with high complex syntax density on the comprehension and use of subordinate clauses such as infinitival clauses and relative clauses in children with Down syndrome. With specific types of complex syntax, it is possible that intensive engagement with a television show that has a high density of complex syntax, such as *Daniel Tiger's Neighborhood* (Burnett and Lund, 2017) can increase use of specific complex syntax structures. The study found that increased exposure over a span of eight weeks to a television show with high variability and high density of infinitive clauses increased the use of infinitive clauses in three children with Down syndrome. This exposure did not increase use of relative clauses for a child without Down syndrome, as observed through Matthew. Furthermore, increased exposure to the show did not have an impact on mean length of utterance.

The relation between use of infinitives and episode watching, as compared to a lack of relation between relative clauses or mean length of utterance and television watching, could have many possible explanations. Relative clauses may be more difficult syntactic structures to learn than infinitive clauses, for example. Television could be an appropriate medium for teaching some syntactic structures but not others. It is also possible that the difference between infinitive and relative clause acquisition has to do with participant characteristics: the child attempting to acquire relative clauses did not have Down syndrome and was a higher-level language user than those children working on infinitive clauses. Again, it is possible that television is an appropriate medium for acquiring certain syntactic forms, but not others. The lack of a relation between mean length of utterance and episode watching is also perhaps not surprising. Mean length of utterance is a more distal measure of language acquisition than is use of a particular linguistic structure. The selected television episodes targeted a very specific structure (i.e., infinitives) whereas they could not specifically target mean length of utterance. Further, the children who were assessed for mean length of utterance were in this particular group because they did not have a large enough expressive vocabulary to begin working on using infinitive clauses. A child

who uses a maximum of two words in a sentence is unlikely to produce a multi-clausal utterance. Overall, it appears that television might be useful in specific language learning scenarios.

As a profession, there exists limited research discussing appropriate treatment methodologies for targeting complex syntax in children with Down syndrome. Typical intervention strategies to target complex syntax across several different types of populations include direct instruction (Eisenberg, 2014). There are studies that confirm that children with Down syndrome have delays with complex syntax (Price et al., 2008; Kay-Raining Bird et al., 2008), but none that evaluate the effectiveness of direct instruction for children with Down syndrome. Perhaps a source that is highly motivating for the child that contains high variability input, such as a television show with language content similar to *Daniel Tiger's Neighborhood*, could be supplemental input for these children.

Additionally, we know that families of children with Down syndrome require intervention services from many other professionals, and consequently have limited time to spend in direct intervention. Thus, it is reasonable to evaluate the effectiveness of increased varied exposure could be a beneficial means of input (Plante et al., 2014). Other studies have explored the effects of television shows on development in typically developing children and children with Autism Spectrum Disorder (Dotson et al., 2017; Rasmusen et al., 2016; Mares & Pan, 2013) ;however, no studies to date have evaluated the effects television can have on the language development of children with Down syndrome. This study adds preliminary data that television, in certain contexts, might benefit children with Down syndrome. This could be especially important information for families of children with Down syndrome because this would be an easy addition to their routines. Perhaps they could replace a show or activity that does not provide variable input with a show that does, such as *Daniel Tiger's Neighborhood*, in order to increase the language input their child is receiving beyond what they are getting from their parents, teachers, and therapists.

We know that although the American Academy of Pediatrics recommends limiting television viewing to two hours (2001), children are still watching television on a daily basis. Therefore, it is reasonable for clinicians to make recommendations to parents that a quality television show with a high density and variability of language structure can be used as supplemental input in addition to regular services from a speech-language pathologist (SLP). It should be noted that this study does not seek to replace the need for SLPs, but to provide a

possibility for supplemental input for families of children with Down syndrome that already have numerous commitments to other therapies for their child.

Limitations and Conclusion

Limitations of this study provide avenues for future research. First and foremost, the short-term nature of this study (14 weeks) does not allow the researchers to draw clear conclusions about the changes in complex syntax use of children with Down syndrome over an extended amount of time. It is possible, that some skills, such as the use of grammatically correct relative clauses would have improved with longer study participation. Future studies should consider more directly controlling the amount of time spent watching the television shows.

Another limitation of this study concerned variability in the temperaments of the child participants. During data collection, many participants refused to participate in the task measure and other means had to be implemented to get a verbal response from the child (i.e. use of baby dolls as or assigning a particular researcher with behavioral management experience to collect data for that participant). Although differences in treatment response suggest characteristics of children that could categorically affect response to treatment, the small and varied sample in this study limit conclusions that can be drawn.

Finally, this study has a small sample size, and some data points are missing as a result of absences or refusal to participate. Missing data points limit the conclusions that can be drawn about overall behavior change. Further study should include a larger sample to account for these types of occurrences throughout the course of a study.

Overall, this work provides preliminary evidence that exposure to a television show with high-density and high-variability of complex syntax can be used to help children with Down syndrome increase their use of complex syntax. However, much more work, including long-term, larger scale studies, is needed to characterize the extent to which television exposure can make long-term changes in child outcomes.

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ABSTRACT

THE EFFECT OF TELEVISION EXPOSURE ON COMPLEX SYNTAX USE IN CHILDREN WITH DOWN SYNDROME

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Television, as a medium for language learning, has been only minimally researched. This study, using a multiple-probe design, investigated whether television shows that include high density of complex syntax would improve the accuracy of children with Down syndrome's use of complex syntax or grammatical structures. Participants viewed selected episodes of *Daniel Tiger's Neighborhood* that include high incidences of embedded clauses five days each week according to that participant's own morphosyntax use deficits. The study found that increased exposure to a television show over a span of eight weeks with high variability and high density of infinitive clauses increased the use of infinitive clauses in three children with Down syndrome. This exposure did not increase use of relative clauses, as observed through one child that did not have Down syndrome, but his use of grammatically correct sentences with greater than one clause stabilized over time. Additionally, increased exposure to the show did not have an impact on mean length of utterance for children with particularly low expressive language production.