Abstract

Background: Children with Down syndrome (DS) exhibit below average nonverbal intelligence and impaired language skills; however, their spoken narrative production is a relative strength. **Aims:** We examined expressive language skills produced during fictional narrative retells and analyzed the unique contribution of expressive language skills to word-level reading and reading comprehension of children with DS. **Methods and Procedures:** The microstructure and macrostructure of fifteen, 8- to 18-year-old children with DS's narrative retells were analyzed. Receptive vocabulary, word-level reading, and reading comprehension also were measured. **Results:** Narrative microstructure analyses revealed restricted syntactic and semantic diversity. Further analyses of sentence complexity using the Narrative Assessment Protocol revealed that children with DS predominately produced prepositional phrases and produced more verbs than nouns. Narrative macrostructure analysis revealed participants use of episodic components; however, their stories did not include mental state references. Narrative microstructure contributed unique variance to word-level reading, whereas narrative macrostructure contributed unique variance to word-level reading and reading comprehension. Additionally, strong correlations were found between narrative skills and literacy skills. **Conclusions and Implications:** Findings from this study support the use of narrative microstructure and macrostructure analyses as a valuable clinical tool to guide assessment and intervention planning for school-aged children with DS.

Keywords

Down syndrome; Reading; Expressive language; Narrative

Spoken fictional narrative and literacy skills of children with Down syndrome

1. Introduction

Down syndrome (DS) is the most common chromosomal cause of intellectual disability (Patterson & Lott, 2008). Children with DS exhibit below average nonverbal intelligence and impaired expressive and receptive language (Chapman & Hesketh, 2000). Despite overall impairment of expressive and receptive language, researchers report that children with DS exhibit relative language strengths when compared to typically-developing children matched for age, nonverbal intelligence, and word-level reading (e.g., Kay-Raining Bird, Cleave, White, Pike & Helmkay, 2008; Keller-Bell & Abbeduto, 2007; Thordardottir, Chapman, & Wagner, 2002). Of interest is children with DS's expressive language skills produced during the narrative genre. Several researchers report that children with DS produce more complex narratives when compared to typically developing children matched for mean length of utterance (MLU; Boudreau & Chapman, 2000; Cleave, Kay-Raining Bird, Czutrin, & Smith, 2012; Finestack, Palmer, & Abbeduto, 2012; Miles & Chapman, 2002).

Spoken narrative production relates to children's word-level reading and reading comprehension (e.g., Cain, 2003; Catts, Herrera, Nielsen, & Bridges, 2015; Penning & Raphael, 1991; Roth, Speece, & Cooper, 2002). Thus, given that children with DS exhibit a relative strength in spoken production of narratives, it is possible that the expressive language skills produced during a narrative also relate to their word-level reading and reading comprehension. The purpose of this study was to analyze the microstructure and macrostructure skills of spoken narratives produced by children with DS and determine whether these skills relate to their word-level reading and reading comprehension.

1.1 Language, Word-level Reading, and Reading Comprehension

Word-level reading and reading comprehension are supported by language (Hoover & Gough, 1990; Scarborough, 2001). Hoover and Gough's (1990) simple view of reading and Scarborough's (2001) model of reading denote that word-level reading is supported by phonological awareness, decoding, and sight word recognition whereas reading comprehension is supported by language skills such as syntax and semantics. Other theories such as the lexical restructuring hypothesis suggests that children's vocabulary supports phonological awareness, which in turn supports word-level reading (Walley, Metsala, & Garlock, 2003). Kintsch (1998) proposed the construction integration theory suggesting that children need structural knowledge of language (i.e., syntax and semantic) in building propositional knowledge (i.e., the construction of idea units) to successfully comprehend written text. Thus, there are several language skills that support word-level reading and reading comprehension.

The majority of researchers who report that language skills contribute to word-level reading and reading comprehension of typically developing children and children with DS have measured receptive language skills (e.g., Catts, et al., 2015; Foorman, Herrera, Petscher, Mitchell, & Truckenmiller, 2015; Kendeou, van den Broek, White, & Lynch, 2009; Laws, Brown,& Main, 2016; Næss,Melby-Lervåg, Hulme, & Lyster, 2012). However, researchers also report that expressive language skills contribute to word-level reading and reading comprehension (e.g., Adlof & Catts, 2015; Cain, 2003; Griffin, Hemphill, Camp, & Wolf, 2004). Cain (2003) reported that children with average reading comprehension produced spoken narratives with more event structures (i.e., causally related sequence of events) than children with below-average reading comprehension. Griffin et al. (2004) found that the narrative production of 5-year-old typically developing children elicited through play significantly predicted reading comprehension at 8-years-old.

Measuring expressive language skills produced during the narrative genre may provide distinct information that is different from measuring expressive language during a conversation or when using norm-referenced assessments. Researchers argue that the narrative genre elicits specific vocabulary and syntax to represent important events of a story and measures a child's ability to connect those events in an organized manner (e.g., Peterson & McCabe, 1994; Roth, et al., 2002). Nippold and colleagues (e.g., Nippold, Frantz-Kaspar, Cramond, Kirk, Hayway-Mayhew, & MacKinnon, 2014) found that adolescents produced longer sentences and more complex sentences in the narrative genre when compared to conversational discourse. It seems then that the narrative genre may elicit expressive language skills that support word-level reading and reading comprehension.

1.2 Spoken Narrative Skills of Children with Down syndrome

The narrative genre refers to the spoken or written accounts of connected events that can be presented in a variety of ways including scripts, personal events, or fictional stories (Boudreau & Chapman, 2000; Hedberg & Westby, 1993). Children's narrative discourse is often examined by analyzing two levels: microstructure and macrostructure. Narrative microstructure refers to the productivity and complexity of language at the sentence level (Justice, Bowles, Kaderavek, Ukrainetz, Eisenberg, & Gillam, 2006). Microstructure analyses include measuring the total number of words (TNW), number of different words (NDW), total number of utterances, and/or mean length of utterance (MLU). Although not as widely utilized, the Narrative Assessment Protocol (NAP; Justice, Bowles, Pence & Gosse, 2010) also measures microstructure by analyzing the sentence, phrase, and word use (i.e., noun, modifier, and verb) within the narrative genre. Macrostructure refers to the overall coherence and organization of the necessary events of a narrative (Hughes, MacGillivray, & Schmidek, 1997). For example, macrostructure analysis includes measuring the use of episodic or event components such as: (a) initiating event, or the complication that happens to the main character, (b) internal response, or how the main characters feel about the initiating event, (c) attempt, or what the main characters do in response to the initiating event, and (d) conclusion, or the outcome of the attempt (Ukrainetz, 2015). Macrostructure also can be analyzed by measuring whether events in the story sequentially lead to a climax, called a highpoint analysis (Peterson & McCabe, 1983).

The microstructure and macrostructure of spoken narratives of children with DS have been widely studied (e.g., Boudreau & Chapman, 2000; Cleave et al., 2012; Kay-Raining Bird, et al., 2008; Keller-bell & Abbeduto, 2012; Miles & Chapman, 2002; Segal & Pesco, 2015). Children with DS produce narratives with shorter MLUs, lower NDW, and more grammatical errors than children matched for age and MLU (Boudreau & Chapman, 2000; Hesketh & Chapman, 1998; Kay-Raining Bird, et al., 2008). However, the macrostructure of their narrative production is comparable or more complex when compared to typically developing children matched for cognitive or language abilities (Boudreau & Chapman, 2000; Cleave, et al., 2012; Finestack, et al., 2012; Miles & Chapman, 2002). Miles and Chapman (2002) found that children with DS produced more episodic components than children matched for MLU. The children matched for receptive syntax produced more episodic components than children with DS, but the difference was not significant. The age-matched children produced significantly more episodic components than children with DS. Cleave et al. (2012) examined the spoken narrative production of children with DS (aged 5 to 16-years-old) at three different time points across three years. Children with DS produced a higher number of different words across the three time points. However, there were no significant changes in the total number of words or syntactic complexity. Children with DS also increased their complexity of episodic structure over the three time points.

It is evident from previous research that the macrostructure of spoken narratives produced by children with DS is a strength when compared to their microstructure. However, researchers have primarily analyzed MLU and NDW to measure the microstructure of spoken narratives. For this study, we also used the NAP (Justice, et al., 2010) to measure the microstructure skills of spoken narratives produced by children with DS. The NAP provides information about sentence and phrase structures, modifiers, nouns, and verbs. We hypothesized that the NAP analysis would identify expressive language skills, beyond MLU and NDW, of children with DS that contribute to their word-level reading and reading comprehension.

1.3 Spoken Narrative and Literacy Skills of Children with Down syndrome

Very few studies have analyzed the relation between the microstructure and macrostructure of spoken narratives and word-level reading and reading comprehension of children with DS (e.g., Barton-Hulsey, Sevcik, & Romski, 2017; Boudreau, 2002; Van Bysterveldt, Westerveld, Gillon, & Foster-Cohen, 2012). van Bysterveldt et al. (2012) reported that the microstructure of personal narratives produced by children with DS (aged 5 to 13-years-old) was moderately correlated with word-level reading (r = .45 (MLU); r = .38 (NDW)) and reading comprehension (r = .48 (MLU); r = .51 (NDW)). Correlation analyses were not included for macrostructure and reading skills; however, the researchers reported that children who produced a highpoint personal narrative, or a narrative with events in a logical sequence, also demonstrated the highest scores on word-level reading and reading comprehension assessments. Boudreau (2002) reported that reading comprehension was strongly correlated with the microstructure (MLU) of conversational samples (r = .65) and the macrostructure (number of episodic components) of narrative retells of *One Frog Too Many* (Mayer, 1973) produced by children with DS (aged 5 to 17-years-old). No significant relation was found for either microstructure or macrostructure and word-level reading. In a recent study, Barton-Hulsey et al. (2017) found that the microstructure and macrostructure of narrative generations of *Frog Goes to Dinner* (Mayer, 1969) produced by children with mild levels of intellectual disability due to a range of etiologies were moderately correlated with reading comprehension (r = .44 (MLU); r = .35 (NDW); r = .50 (number of episodic components)). Barton-Hulsey et al. (2017) also used hierarchical multiple regression analyses to determine the amount of unique variance microstructure (MLU and NDW) and macrostructure (number of episodic components) accounted in reading comprehension of their sample of children. Barton-Hulsey et al. (2017) reported that microstructure (NDW only) and macrostructure contributed to reading comprehension after controlling for word-level reading. Interestingly, the contribution of NDW was negative suggesting that the increase in the NDW was associated with a decrease in reading comprehension. It is possible that the range in the NDW (0-141) contributed to the negative association.

The findings from these studies suggest that macrostructure and microstructure of narratives are related to word-level reading and reading comprehension of children with DS. Measuring expressive language in the narrative genre seems to elicit expressive language skills that support word-level reading and reading comprehension. It is possible that producing more words and using those words to produce longer sentences during a narrative is a positive indicator that children with DS have or will develop good word-level reading. Children with DS who use many different words and have longer utterances have good semantic knowledge.

Proficiency in semantic knowledge may indicate a strength in phonological awareness, which supports proficient word-level reading (Walley, et al., 2003). It also is possible that expressive semantic and syntactic skills and the ability to produce events in a story in a logical sequence is supporting their ability to build propositional knowledge (Kintsch, 1998), which leads to successful reading comprehension.

Although previous researchers provide some evidence of the relation between expressive narrative skills (i.e., microstructure and macrostructure) and literacy skills of children with DS, van Bysterveldt et al. (2012) used personal narratives to measure microstructure and macrostructure and Boudreau (2002) used the conversational discourse to measure microstructure. Barton-Hulsey et al. (2017) measured microstructure and macrostructure in spoken fictional narratives; however, their sample of children included a wide range of etiologies. Also, all three studies measured microstructure by analyzing NDW and MLU. It is possible that another measure of narrative microstructure, such as the NAP, would measure specific language skills that may uniquely relate to their word-level reading and reading comprehension. Therefore, the purpose of the study was to analyze the relation between microstructure and macrostructure of spoken fictional narratives and word-level reading and reading comprehension of school-age children with DS.

Specifically, the following research questions were addressed:

1. What is the microstructure, as measured by the NAP, and macrostructure, as measured by the Narrative Scoring Scheme (NSS), of spoken narratives produced by children with Down syndrome?

2. Are there significant correlations between the microstructure and macrostructure of spoken narratives and word-level reading and reading comprehension of children with Down syndrome?
3. Does microstructure account for unique variance in (a) word-level reading after controlling for receptive vocabulary and (b) reading comprehension after controlling for receptive vocabulary and word-level reading?
4. Does macrostructure account for unique variance in (a) word-level reading after controlling for receptive vocabulary and (b) reading comprehension after controlling for receptive vocabulary and word-level reading?

2. Method

The study procedures were approved by the Texas Christian University Institutional Review Board.

2.1 Participants

Fifteen school-aged children from the North Texas metropolitan area, aged 8 to 18-years-old (*M* = 13;6, *SD* = 3;0, male = 5) participated in the study. Participants were recruited through the Down Syndrome Partnership of North Texas and from a local school for individuals with DS and similar intellectual disabilities. Eighty percent of the sample attended a local private school and the remaining participants were home-schooled. All of the children were receiving speech and language and/or reading services. Children whose primary mode of communication is speech and who were behaviorally able to attend for 20-30 minutes at a time based on parent and teacher report were included in the study. The mean nonverbal IQ of the children was 53.67 (*SD* = 14.17) as measured by the matrices subtest of the Kaufman Brief Intelligence Test-2 (KBIT-2;

Kaufman & Kaufman, 2004) or a review of the school cumulative file where nonverbal IQ was documented. Descriptive statistics for individual participants' age and assessment data on language measures and narrative production are presented in Table 1.

2.2 Procedures

Children in the study were administered a spoken narrative retell task and reading comprehension, word-level reading, and receptive vocabulary assessments during one, approximately 60-minute testing session at their school or a university clinic. Assessment order was counterbalanced across children to control for order effects. Children were given breaks between tasks as needed to maintain attention and on-task behavior. Receptive vocabulary, a known predictor of literacy skills, was measured to isolate the specific effect of expressive language at the microstructure and macrostructure levels on word-level reading and reading comprehension (Catts, et al., 2015; Foorman, et al., 2015; Kendeou, et al., 2009). Receptive vocabulary was assessed using the Peabody Picture Vocabulary Test, 4th Edition (PPVT-4; Dunn, 2007). In this assessment, the children pointed to the picture (out of a field of four) that corresponded with the word the examiner said out loud.

To assess narrative microstructure and macrostructure, children produced a single spoken fictional narrative retell. Each participant looked at the wordless picture book *Frog Goes to Dinner* (Mayer, 1969) while the examiner provided a model of a fictional spoken narrative based on the pictures. The narrative presented by the researcher was an abridged version of the story script available from the Systematic Analysis of Language Transcript website (SALT; Miller & Chapman, 1990) containing a pre-determined portion of the episodic components (five out of eight original episodes) related to the picture sequences. See Appendix A for the story script. Once the modeled narrative was complete, the child was asked to retell the story using the same book containing all pictures from the abridged version. The examiner prompted the child to look at the pictures and retell the story. If the child produced a limited response such as only a few utterances or simply listing the characters, the examiner provided nonspecific prompts to encourage expansion of the story (e.g., *"What happened next?", "Can you tell me more?"*). Spoken narrative retells were audio and video recorded.

To assess word-level reading and reading comprehension, the Word Identification and the Passage Comprehension subtests of the Woodcock Reading Mastery Test-III (WRMT-III; Woodcock, 1987) were administered. The Word Identification subtest requires the child to read aloud isolated, real words. The raw scores reported reflect the number of words read following the application of basal and ceiling rules. The Passage Comprehension subtest uses a cloze procedure where the child reads either a sentence or a paragraph with a missing word, and he or she was required to provide an appropriate word to complete the meaning of the sentence or paragraph. Beginning test items are sentence length and contain pictures related to the text allowing for passage comprehension skills to be assessed at a lower age or skill level. Administration of the norm-referenced assessments followed the published examiner's manual, including guidelines to establish the basal and ceiling. The guidelines reflect the assumption that a child would answer the items below the basal correctly and answer the items above the ceiling incorrectly. To maintain the variability in performance across participants, as floor effects were apparent, raw scores were used for analyses.

2.3 Transcription Procedures

This study utilized a non-experimental research design to examine the relation between spoken narrative ability and literacy skills in children with DS. Narrative samples were transcribed using SALT (Miller & Chapman, 1990) conventions. The narratives were segmented into C-units, defined as one independent clause with all subordinate clauses attached to it. Portions of the narrative were transcribed as unintelligible if the transcriber was unable to determine the production after listening three times. All utterances, including those that contained unintelligible words, were included in the analysis set. Given that the narrative task involved the retell of a modeled story with picture supports, overall speech intelligibility for the transcripts (76-100%) was higher than what might be expected for this population. All microstructure and macrostructure measures described below were examined from these narrative transcripts.

2.3.1 Microstructure analysis. Narratives were coded and analyzed at the microstructure level which included mean length of utterance in morphemes (MLUm), NDW, and the NAP (Justice et al., 2010). These measures have been validated in previous research as adequate measures of microstructure (Miles & Chapman, 2002; Kay-Raining Bird et al., 2008; van Bysterveldt et al., 2012). MLUm reflects syntactic complexity and NDW reflects vocabulary use or lexical diversity. The NAP is used to describe individual differences in narrative language abilities for children and children's development in narrative language across time (Justice, et al., 2006). Using the NAP provided information beyond MLUm and NDW through examination of 18 items across the following areas of language within the narrative genre: 1) sentence structure, 2) phrase structure, 3) modifiers, 4) nouns, and 5) verbs. The NAP protocol was adapted so that the total number of occurrences, or frequency of use, was reported for each of the 18 items (e.g., complex sentences, prepositional phrases, tier two nouns and verbs). A composite or total NAP score was reported.

2.3.2 Macrostructure analysis. Spoken narratives were entered into the SALT program and coded using the NSS (SALT; Miller & Chapman, 1990). The NSS uses a 6-point scale (0-5) with five points awarded for "proficient" use, three points for "emerging/inconsistent" use, and one point for "immature/minimal" use. Four, two and zero points also were awarded for narrative skills falling between the anchor points. Each area of the NSS was coded and a composite NSS score was created. Scores were given for seven characteristics: 1) Introduction: the presence, absence, and qualitative description of character and setting components; 2) Character development: acknowledgement of characters and their purpose throughout the story; 3) Mental state: the frequency and diversity of vocabulary used to convey character emotions and thought processes; 4) Referencing: the consistent and accurate use of antecedents and clarifiers, as well as use of correct pronouns and proper names; 5) Conflict/resolution: the presence or absence of conflicts and resolutions necessary to the story as well as how thoroughly each was described; 6) Cohesion: the sequencing and transitions between each event; and 7) Conclusion: the conclusion of the final event as well as the wrap-up of the entire story.

2.4 Reliability

2.4.1 Transcriptions and narrative coding. Each narrative sample was transcribed and coded by two graduate students who were experienced in language transcription and who received additional training on c-unit segmentation and microstructure and macrostructure analysis. The mean percentage of word-by-word transcription agreement was 85% and 76% for segmentation into C-units. Each pair of transcripts was compared by a third examiner, a PhD-level clinician with expertise in language transcription, who identified transcription or coding discrepancies. The coders then reviewed the discrepancies between the transcripts and made the final transcription or coding decision. Thus, all transcripts were transcribed and coded at least three times resulting in 100% agreement following consensus coding. The same two graduate students coded all of the transcripts and compared their scores and noted discrepancies. NAP inter-scorer reliability was 87% (range: 67-100%) point-by-point agreement across all language structures and NSS inter-scorer reliability was 80% (range: 66-95%) point-by-point agreement across the proficient, emerging, and immature categories before consensus for narrative measures. A third independent coder resolved all scoring discrepancies resulting in 100% agreement for NAP and NSS coding.

2.4.2 Norm-referenced assessments. Two graduate students with formal training in psychoeducational assessment as well as experience administering and scoring the instruments used in the study scored 100% of the norm-referenced assessments administered (i.e., K-BIT, PPVT-4 and WRMT-3). Inter-rater agreement for norm-referenced assessments was 95% with all discrepancies resolved before analysis.

2.5 Statistical Analyses

To answer the first research question, mean scores and standard deviations were computed for measures of narrative microstructure and macrostructure. Pearson correlations were used to evaluate the relation between narrative language—microstructure and macrostructure—and word-level reading and reading comprehension. One-way repeated measures analyses of variance (ANOVA) and planned post hoc pairwise comparisons were used to determine if differences between narrative microstructure domains were significant. An ANOVA and post hoc pairwise comparisons were also used to evaluate differences between each of the NSS categories.

Hierarchical regression analyses were used to answer the last two research questions. To determine the effects of microstructure on word-level reading, receptive vocabulary was entered in the first step to control for receptive language, which is a known predictor of word-level reading (Catts, et al., 2015; Foorman, et al., 2015; Kendeou, et al., 2009). All three microstructure variables (NDW, MLU, NAP) were entered into the second step. To determine the effects of microstructure on reading comprehension, receptive vocabulary was entered in the first step and word-level reading was entered in the second step because vocabulary and word-level reading are known predictors of reading comprehension (Hoover & Gough, 1990; Scarborough, 2001). In this model, microstructure variables (NDW, MLU, and NAP) were then entered into the third step. NDW and MLU are frequently used to measure microstructure, specifically semantic diversity and syntactic complexity. The NAP was used as an additional measure because it provides further detail about children's microstructure at the sentence and phrase level. Previous research has not reported which microstructure measure best predicts word-level reading and reading comprehension; therefore NDW, MLU, and NAP were entered together into the regression analysis. To determine the effects of macrostructure on word-level reading, receptive vocabulary was entered in the first step followed by the NSS in the second step. To determine the effects of macrostructure on reading comprehension, receptive vocabulary was entered in the first step, word-level reading was entered in the second step, and the NSS was entered in the third step. For all regression analyses, variables that did not explain additional significant variance were excluded from the models.

3. Results

Spoken narratives produced by children with DS were collected and analyzed at the microstructure and macrostructure levels. Children's scores were entered into SPSS to analyze the microstructure and macrostructure of spoken narratives.

3.1 Microstructure and Macrostructure Analyses

Descriptive statistics for NAP, MLUm, and NDW are displayed in Table 2. The modeled story was analyzed for microstructure elements to serve as a basis for comparison (see column in

Table 2). Upon further analysis using the NAP, trends in strengths and weaknesses for microstructure performance emerged. The children with DS used more phrase structures (i.e., noun or prepositional phrases) than sentence structures (i.e., compound, complex, negative, and interrogatory). They used more prepositional phrases than any other language structure such as compound or complex sentences. Children with DS also used more verbs than modifiers and nouns. To determine if differences in performance between the narrative microstructure elements were significant, each of the NAP categories were evaluated using a one-way repeated measures ANOVA. It should be noted that Mauchly's test of sphericity indicated that the assumption of sphericity was violated, ($\chi^2(9) = 66.48, p < .001$), therefore Greenhouse-Geisser estimates of sphericity were used ($\epsilon = .38$). Significant differences in performance between narrative microstructure categories were found, $F(1.51, 21.10) = 27.65$, $p < .001$. Similar significant results were observed when differences in microstructure categories were analyzed using the Kruskal-Wallis nonparametric analysis to account for unequal variances. Figure 1 displays box plots for participants' performance on each microstructure domain as measured by the NAP. Post hoc pairwise comparisons revealed that phrase structure was used significantly more than modifiers, nouns, or sentence structures (*ps* < .001). Verbs were used significantly more than modifiers, nouns, and sentence structures (*ps* < .001). There were no significant differences between children's use of sentence structures, modifiers, or nouns (*ps* = .999), as participants demonstrated the lowest performance across these microstructure domains.

Macrostructure was measured by examining inclusion of the seven characteristics outlined in the SALT NSS protocol (Miller & Chapman, 1990). Macrostructure analysis results are displayed in Table 3. Overall, children with DS did not differentiate between main and sub characters and did not include information about the various settings presented throughout the story in their spoken narratives. They did not describe what the characters were thinking (i.e., mental state verbs) and did not provide clear references to previously established characters. Their spoken narratives also lacked key conflict/resolution pairings and instead emphasized minor events in an illogical order. However, children included concluding statements in their spoken narratives. A one-way repeated measures ANOVA was conducted to determine if differences in performance between narrative macrostructure elements were significant. Mauchley's test ($\chi^2(20) = 18.37$, $p = .579$, did not indicate any violation of sphericity. Significant differences in performance between narrative macrostructure elements were found, $F(6, 84) = 5.21$, $p < .001$. Figure 2 displays box plots for participants' performance on each macrostructure element as measured by the NSS. Post hoc pairwise comparisons revealed that participants performed significantly greater on the element of conclusion than mental state references ($p = .027$). See Appendix B for two narrative samples (lowest and highest scoring) produced by the children with DS.

3.2 Relations between Microstructure, Macrostructure & Literacy Skills

Strong correlations were found between word-level reading and reading comprehension and narrative microstructure and macrostructure. Table 4 shows significant positive correlations between word-level reading and reading comprehension and each narrative microstructure (MLU, NDW, NAP) and macrostructure (NSS) measure. The assumptions of independent errors, multicollinearity, and homoscedasticity were met for each regression model. To check the assumption of independent errors, the Durbin-Watson statistic was evaluated. Durbin-Watson values that were less than one and greater than three are considered problematic (Field, 2009). For models that predicted word-level reading, the Durbin-Watson statistics were 2.48 for microstructure (NAP) and 2.04 for macrostructure (NSS). For models that predicted reading comprehension, the Durbin-Watson statistic was 2.00 for macrostructure (NSS). Microstructure variables did not contribute significant variance to reading comprehension and thus, the Durbin-Watson statistic was not reported. To check the assumption of multicollinearity, the variance inflation factor (VIF) and the tolerance statistic were evaluated. VIF values greater than 10 and tolerance values below 0.2 are considered problematic (Field, 2009). For models that predicted word-level reading, the VIF and tolerance values were 2.07 and 0.48 for microstructure (NAP) and 2.35 and 0.43 for macrostructure (NSS). For models that predicted reading comprehension, the VIF and tolerance values were 3.34 and 0.30 for macrostructure (NSS). Microstructure variables did not contribute significant variance to reading comprehension and thus, VIF and tolerance values were not reported. To check the assumption of homoscedasticity, standardized residuals were plotted against standardized predicted values. Histograms and scatterplots were judged to have normally distributed residuals and randomly dispersed residual points.

Based on the results of the regression analyses, microstructure accounted for unique variance in word-level reading, but did not account for unique variance in reading comprehension. Receptive vocabulary and the NAP accounted for 61% of the variance in word-level reading ($R^2 = .61$, $F(1,12) = 9.19$, $p = .004$). Of the microstructure variables entered in the second step, NDW and MLU were excluded from the model because these measures did not improve the ability of the model to predict word-level reading ($t = 1.03$, $p = .327$; $t = .09$, $p = .930$, respectively) and multicollinearity was a concern (VIF/Tolerance = 33.76/.03 and 6.37/.16, respectively). Receptive vocabulary and word-level reading accounted for 84% of the variance in reading comprehension ($R^2 = .84$, $F(1,12) = 31.15$, $p < .001$). All of the microstructure measures entered in the second step (NDW, MLU, and NAP) were excluded from the model because these measures did not improve the ability of the model to predict reading comprehension ($t = .91$, $p =$

.382; $t = .64$, $p = .538$; $t = 1.02$, $p = .331$, respectively). VIF and tolerance values indicated that multicollinearity was not a concern (VIF/Tolerance = 4.81/.21, 5.48/.18, and 3.61/.28, respectively). However, the partial correlations were small ($r = .27$, -.19, and .29, respectively) after controlling for receptive vocabulary and word-level reading. See Table 5.

Macrostructure accounted for unique variance in word-level reading and reading comprehension. Receptive vocabulary and the NSS accounted for 52% of the variance in word-level reading ($R^2 = .52$, $F(1,12) = 6.62$, $p = .004$). Receptive vocabulary, word-level reading, and the NSS accounted for 89% of the variance in reading comprehension ($R^2 = .89$, $F(1,12) = 30.99$, $p < .001$). After controlling for receptive vocabulary and word-level reading, the NSS contributed an additional 6% of the variance in reading comprehension ($t = 2.41$, $p = .035$). See Table 6. Multicollinearity was not a concern among the variables entered into the models examining the effects of macrostructure on word-level reading and reading comprehension, therefore no variables were excluded in the stepwise regression analyses.

4. Discussion

The purpose of this study was to analyze the microstructure and macrostructure of spoken fictional narrative retells of children with DS and to explore whether expressive language skills at the microstructure and macrostructure levels were related to their word-level reading and reading comprehension. The NAP (Justice, et al., 2010), in addition to MLUm and NDW, were used to analyze the microstructure of the spoken narrative retells. The MLUm (3.14-11.11) and NDW (22-90) of children with DS varied. The NAP analysis revealed that children with DS produced more phrase structures than modifiers, nouns, and sentence structures. Children with DS produced prepositional phrases (e.g., Then the frog got out and went on his face) often and produced a wider range of elaborated noun phrases (e.g., There was some music playing) and verbs (e.g., And this guy got surprised and fell in a drum) than modifiers, such as adverbs (e.g., It's really hard to blow out) or advanced modifiers (e.g., A fancy restaurant). Children with DS rarely produced compound or complex sentences. Narrative macrostructure of children's narrative retells, analyzed using NSS, also varied (7-27; max score of 35). Children with DS produced many essential episodic components (e.g., main characters, conflict/resolution pairings) but did not provide sufficient detail (e.g., modifiers, elaborated noun phrases) about these components. These results reflect mastery over concrete ideas presented in picture books but a diminished ability to produce abstract concepts such as characters' thoughts or emotions. Narrative microstructure and narrative macrostructure significantly contributed to word-level reading; however, narrative macrostructure was the only variable that uniquely contributed to reading comprehension.

The average microstructure and macrostructure of narratives produced by children with DS reported in this study are consistent with findings from previous research using a similar narrative elicitation technique (Hulsey, et al., 2017; Kay-Raining Bird et al., 2008; Miles & Chapman, 2002). A much lower average MLU was reported by van Bysterveldt et al. (2012) who utilized personal narratives; however, NDW reported in their study is consistent with the current study. Fictional narratives elicited following a model may facilitate the production of narratives with longer sentences and more complex expressive language compared to personal narratives generated by children with DS. Fictional narratives also may elicit literate language that resembles the language skills utilized in an academic setting (Gillam & Ukrainetz, 2007). Future research needs to confirm this hypothesis.

To date, no known study has investigated the microstructure of spoken narratives of children with DS using the NAP. Microstructure analysis using the NAP allows for more detailed analysis of sentence structure and goes beyond the commonly reported microstructure measures, such as MLU and NDW. Children with DS varied considerably on all measures of narrative microstructure, but overall analysis reflects that their spoken narratives lacked complex language structures. NAP results may be helpful for identifying areas of strengths and weakness that can be used in identifying intervention targets.

Expressive language at the microstructure and macrostructure levels of spoken narratives contributed unique variance to word-level reading. After controlling for receptive vocabulary, the NAP was the only microstructure variable that accounted for unique variance in word-level reading. It is not surprising that all of the microstructure measures (NDW, MLU, and NAP) did not contribute unique variance because they are highly correlated; however, the NAP was found to best correlate with word-level reading. The NAP is unique because it provides specific information at the sentence and phrase levels that MLU and NDW do not. Despite being highly correlated, analyzing narrative microstructure using the NAP can assist in identifying strengths and weaknesses in the expressive language of children with DS, whereas NDW only provides a measure of lexical diversity. Macrostructure also was a unique predictor of word-level reading.

From our results, it is evident that children with DS who have good expressive language skills at the microstructure and macrostructure levels also have good word-level reading. The microstructure and macrostructure of language produced in a narrative may be capturing the children's overall semantic knowledge. Children with good semantic knowledge are probably producing long sentences, many phrases, and many episodic components when retelling a story. Thus, according to the lexical restructuring hypothesis, children with DS's semantic knowledge is potentially supporting their phonological awareness skills, which is supporting their word-level reading (Walley, et al., 2003). Although more research is needed to confirm these findings, expressive language skills at the microstructure and macrostructure levels are indicators of good word-level reading of children with DS.

Expressive language at the macrostructure level of a spoken narrative produced by children with DS was the only significant predictor of reading comprehension. The number of NSS elements may be measuring the text structure knowledge of children with DS. Children with more knowledge of story structure demonstrate better reading comprehension than children with less knowledge of story structure (Stevens, Van Meter, & Warcholak, 2010). Roth et al. (2002) suggest that children bring and apply knowledge of text structure (i.e., episodic component knowledge) to comprehend text. The number of NSS elements also may be measuring the expressive syntax and semantic knowledge needed to create propositional knowledge, or idea units, that are necessary to comprehend written text (Kintsch, 1998). Previous research confirms that the macrostructure of narratives is important for reading comprehension of children without DS (e.g., Cain, 2003; Catts et al., 2015). The results from this study and the results from previous researchers (i.e., Boudreau, 2002; Barton-Hulsey et al., 2017) support that the macrostructure of narratives is important for reading comprehension of children with DS. Thus, assessing and treating the macrostructure of spoken narratives is important for children with DS. However, future studies should consider the efficacy of intervention strategies to improve the narrative skills of children with DS and determine whether improvement of narrative macrostructure also improves their reading comprehension.

4.1 Limitations and Suggestions for Future Directions

Limitations of the present study provide future directions for this line of inquiry. First, the current study included receptive vocabulary to control for receptive language in the regression analyses, but did not include receptive syntax. Future research should include receptive syntax as a control variable when examining the contribution of expressive language at the microstructure and macrostructure levels to word-level reading and reading comprehension. Second, the information collected on the participants did not include the home language of the children, thus it is possible that the children were not all monolingual English speakers. Lastly, the sample of children in this study varied considerably in age and ability level and reflected a rather small sample size ($n = 15$) overall. A post hoc power analysis was utilized to determine the power to detect significant estimates using regression analyses because the sample size was small. Given the sample size of 15, a medium effect size (0.15), and an alpha level of .05, the likelihood of detecting significant estimates was small (0.11). Replication of the current findings with a larger sample size is recommended to increase power and strength of regression analyses.

4.2 Summary and Clinical Implications

Although future research is warranted, the findings from this study provide evidence that can guide assessment and intervention related to narrative production among school-aged children with DS. Word-level reading and reading comprehension are necessary skills for children with DS not only to achieve academic standards, but also to widen employment opportunities and increase independence (Miller, Leddy, & Leavitt, 1999). Speech-language pathologists who are trained to assess and intervene on expressive language skills can support educators to consider evidence-based teaching methods to facilitate improvement of the microstructure and macrostructure skills produced by children with DS. Identifying areas of relative strength and weakness through NAP analysis also may help in goal selection and intervention planning. The current findings provide initial evidence to warrant the development of interventions targeting narrative microstructure and macrostructure as these skills relate to word-level reading and reading comprehension of children with DS. This study begins to identify linguistic complexity and organization as important narrative components and intervention targets for children with DS.

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Appendix A

Frog Goes To Dinner Story Script for Retell Task

Page	Script
1	A boy was getting dressed in his bedroom. His pet dog, frog and turtle watched as he put on his best clothes.
2	While the boy was petting the dog, the frog jumped into his coat pocket. The boy didn't know he was there.
3	As the boy left with his family, he waved and said "Goodbye" to his pets. The frog waved goodbye too.
4-5	When the boy and his family arrived at a fancy restaurant, the doorman helped them out of the car. The frog peeked out of the boy's pocket but no one noticed him.
6-7	The boy and his family sat down at a table in the restaurant. While they were looking at the menus, the frog jumped out of the boy's pocket towards the band.
8	The frog landed right in the man's saxophone! "Squeak" went the saxophone.
9	The man looked inside the saxophone to see why it made that awful noise.
10	Then the frog fell out of the horn and landed right on the saxophone player's face!
11	The saxophone player was so surprised that he fell backwards into the drum.
22-23	The waiter, who had caught the frog, was going to throw him out of the restaurant. But the boy saw the waiter carrying his frog and shouted, "Hey, that's my frog!" The boy's mother told him to be quiet.
24	The boy asked the waiter to give him back his frog.
25	The angry waiter told the boy and his family, "Take your frog and get out of this restaurant at once. Don't you ever bring that frog in here again!"
26-27	On the way home the boy's family was angry with him. The frog has ruined their dinner!
28-29	When they got home the boy's father scolded him, "You go to your room and stay there!" The dog and the turtle peeked around the corner to see what was going on.
30	When they got in his room, the boy and the frog laughed about everything that had happened at the restaurant. The more they thought about it, the more they laughed.

Appendix B

Example Narrative Retells by the Children with Down syndrome

Example 1:

E: You can just talk normal.
C: A frog, turtle, dog, turtle
C: X call the turtle but we out.
C: mommy dad boy kept coming.
C: Frog, boy X X a giant uh jump.
C: A boy a frog X boy jump.
C: Man frog may fall.
C: Fall bump and jump or jump up.
C: The band and the boy.
C: Both they fall.
C: Then the boy X X.
C: Mama sad.
C: The mom was "shh"ing.
C: A chair but mama sad.
C: mommy daddy car sit back.
C: they got out.
C: Start yelling.
C: The turtle.

Example 2:

C: The boy was getting dressed.
C: He was petting the dog.
C: Then he waved to his pets.
C: He went to his room.
C: And while he was facing the dog the frog jumped into his jacket pocket.
C: The helper was helping him in the car.
C: They went to a fancy restaurant.
C: While he and his family were ordering the frog jumped into the saxophone.
C: Then the frog was in the saxophone.
C: Then it squeaked.
C: And then he checked what was wrong with that awful noise.
C: The frog was on him.
C: He fell into the drums.
C: He grabbed the frog .
C: Threw him out the restaurant.
C: And he says "no that's my frog".
C: Then his mom says "shh".
C: Can you give me the frog please?
C: And that's the nice way to say the boy did.
C: Then he threw it out the restaurant.
C: And never come back again with the frog.
C: His family was so mad.
C: And the boy was upset.
C: With the rest of his family.
C: Because he was a little embarrassed at the restaurant.
C: When they got home he said to the boy "go back to your room until you learn your lesson".
C: Then they laugh bout the restaurant.
C: The end.

Table 1.

Characteristics of the children with Down syndrome

Participant	Age (years; months)	WRMT Raw Score: Passage Comprehension	WRMT Raw Score: Word ID	PPVT Raw Score	PPVT Standa rd Score	PPVT Age Equivalent	NVIQ	MLUm	TNU	TNW	NDW	% Intell	NAP	NSS Total Max score: 35
1	8;1	5	14	84	73	5;3	73	8.42	21	67	67	100%	50	22
2	9;1	5	12	68	54	4;3	68	4.13	17	61	34	100%	13	16
3	10;0	1	3	92	63	5;8	40	5.13	18	75	46	100%	25	11
4	11;10	3	1	81	48	5;0	53	3.14	17	40	27	88%	15	8
5	12;8	13	21	129	74	8;0	78	7.91	23	156	64	100%	47	25
6	13;2	15	31	133	74	8;4	74	8.35	26	198	89	100%	62	25
7	13;4	3	7	75	39	4;8	58	4.94	21	85	34	95%	18	15
8	13;8	6	3	80	40	5;0	41	6.29	18	98	47	100%	28	18
9	14;10	2	4	62	25	3;11	40	4.31	17	52	36	76%	13	10
10	15;9	5	9	82	34	5;1	48	5.64	17	76	42	88%	30	14
11	16;4	6	14	96	42	5;11	40	7.57	15	97	46	93%	24	16
12	16;9	12	35	128	59	8;0	63	10.91	24	234	90	100%	76	24
13	17;1	1	7	47	20	3;4	47	3.50	18	49	22	82%	3	7
14	17;4	10	14	170	82	12;5	40	11.11	21	199	84	95%	50	25
15	18;3	10	13	121	52	7;5	42	7.57	30	197	90	97%	69	27
Mean	13;7	6.47	12.53	96.53	51.93	6;2	53.67	6.59	20.20	112.27	54.53	94%	34.87	17.53
SD	3;0	4.49	9.95	32.95	18.88	2;3	14.17	2.50	4.11	65.58	24.17	8%	22.58	6.78
Range	8;1-18;3	1-15	1-35	47-170	20-82	3;4-12;5	40-78	3.14-11.11	15-30	40-234	22-90	76-100%	3-76	7-27

Note. WRMT=*Woodcock Reading Mastery Test-III*; PPVT = *Peabody Picture Vocabulary Test;* NVIQ = nonverbal intelligence quotient, MLUm = mean length of utterance in morphemes; TNU = total number of utterances, TNW = total number of words; NDW = number of different words; % Intell = percentage of intelligible utterances from narrative retell; NAP = Narrative Assessment Protocol composite score; NSS = Narrative Scoring Scheme.

Table 2.
Descriptive Statistics-Microstructure

		Child Retells		
Variables	Frequency in Modeled Story	Mean	SD	Range
MLUm	11.27	6.60	2.50	3.14-11.11
NDW	143	54.50	24.20	22-90
NAP Total Score	111	34.90	22.60	3-76
Sentence structure	11	1.93	2.49	0-7
Compound sentence	1	0.33	0.72	0-2
Complex sentence	8	0.73	1.58	0-5
Negative sentence	2	0.67	1.18	0-4
Interrogative	0	0.20	0.41	0-1
Phrase structure	37	16.00	7.97	3-30
Elaborated noun phrase	3	2.47	2.48	0-9
Compound noun	6	1.93	1.49	0-4
Prepositional phrase	28	11.60	7.64	0-25
Modifiers	7	1.87	1.85	0-6
Adverb	4	1.00	1.00	0-3
Advanced modifiers	3	0.87	1.30	0-4
Nouns	8	1.53	1.13	0-4
Pluralized noun	1	1.00	0.85	0-3
Possessive form	7	0.53	0.64	0-2
Tier-two noun	0	0.00	0.00	0-0
Verbs	48	13.47	11.75	0-36
Auxiliary verb	5	1.53	1.77	0-5
Copula	4	3.73	3.58	0-12
Irregular past tense	14	4.20	4.02	0-14
Regular past tense	21	3.47	3.64	0-10
Tier-two verb	3	0.47	0.83	0-3
Compound verb	1	0.07	0.26	0-1

Note. SD = standard deviation, MLUm = mean length of utterance in morphemes, NDW = number of different words, NAP = Narrative Assessment Protocol.

Table 3.
Descriptive Statistics-Macrostructure

Variables	Scores for Modeled Story	Mean	SD	Range
NSS Total Score (out of 35)	35	17.5	6.80	7-27
Introduction	5	2.2	0.96	1-4
Character	5	2.5	0.99	1-4
Mental State	5	2.1	1.06	1-5
Referencing	5	2.3	1.10	1-4
Conflict	5	2.4	1.55	0-5
Cohesion	5	2.3	1.49	1-5
Conclusion	5	3.6	1.40	1-5

Note. SD = standard deviation, NSS = Narrative Scoring Scheme. Each NSS component score is out of 5 points.

Table 4.
Summary of Intercorrelations

	1	2	3	4	5	6	7
1. Word-level Reading	1	0.85**	0.63*	0.74**	0.76**	0.78**	0.72**
2. Passage Comprehension		1	0.83**	0.77**	0.85**	0.84**	0.89**
3. Receptive Vocabulary			1	0.86**	0.86**	0.80**	0.81**
4. MLUm				1	0.89**	0.86**	0.86**
5. NDW					1	0.97**	0.92**
6. NAP						1	0.90**
7. Total NSS							1

Note. ** = $p<.01$; * $p<.05$

Table 5.

Hierarchical Regression Analyses for Microstructure

Model Predicting Word-Level Reading

	Entry Block 1			Entry Block 2		
Predictor	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	-2.19	6.42		0.56	5.15	
Receptive Vocabulary	0.20	0.08	0.56*	0.00	0.09	0.00
NAP				0.34	0.12	0.78*
R^2			0.32			0.61
F			5.97*			9.19*
ΔR^2			0.32			0.29
ΔF			5.97*			8.83*

Model Predicting Reading Comprehension

	Entry Block 1			Entry Block 2			Entry Block 3		
Predictor	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	-2.51	2.28		-1.90	1.47		-1.90	1.47	
Receptive Vocabulary	0.12	0.03	0.76*	0.07	0.02	0.41*	0.07	0.02	0.41
Word-Level Reading				0.28	0.06	0.62*	0.28	0.06	0.62
R^2			0.58			0.84			0.84
F			17.59*			31.15*			31.15*
ΔR^2			0.58			0.26			0.26
ΔF			17.59*			19.58*			19.58*

Note. MLU = mean length of utterance, NDW = number of different words, NAP = narrative assessment protocol, $*p < .05$. MLU and NDW were excluded from Entry Block 2 in model predicting word-level reading. MLU, NDW, and NAP were excluded from Entry Block 3 of model predicting reading comprehension.

Table 6.

Hierarchical Regression Analyses for Macrostructure

Model Predicting Word-Level Reading

	Entry Block 1			Entry Block 2		
Predictor	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	-2.19	6.42		-6.29	5.84	
Receptive Vocabulary	0.20	0.08	0.56*	0.01	0.11	0.03
NSS				1.03	0.45	.70*
R^2			0.32			0.52
F			5.97*			6.62*
ΔR^2			0.32			0.21
ΔF			5.97*			5.30*

Model Predicting Reading Comprehension

	Entry Block 1			Entry Block 2			Entry Block 3		
Predictor	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	-2.51	2.28		-1.90	1.47		-3.23	1.36	
Receptive Vocabulary	0.12	0.03	0.76*	0.07	0.02	.41*	0.03	0.02	0.19
Word-Level Reading				0.28	0.06	.62*	0.19	0.06	.43*
NSS							0.29	0.12	.43*
R^2			0.58			0.84			0.89
F			17.59*			31.15*			30.99*
ΔR^2			0.58			0.26			0.06
ΔF			17.59*			19.58*			5.79*

Note. NSS = narrative scoring scheme, $^*p < .05$.

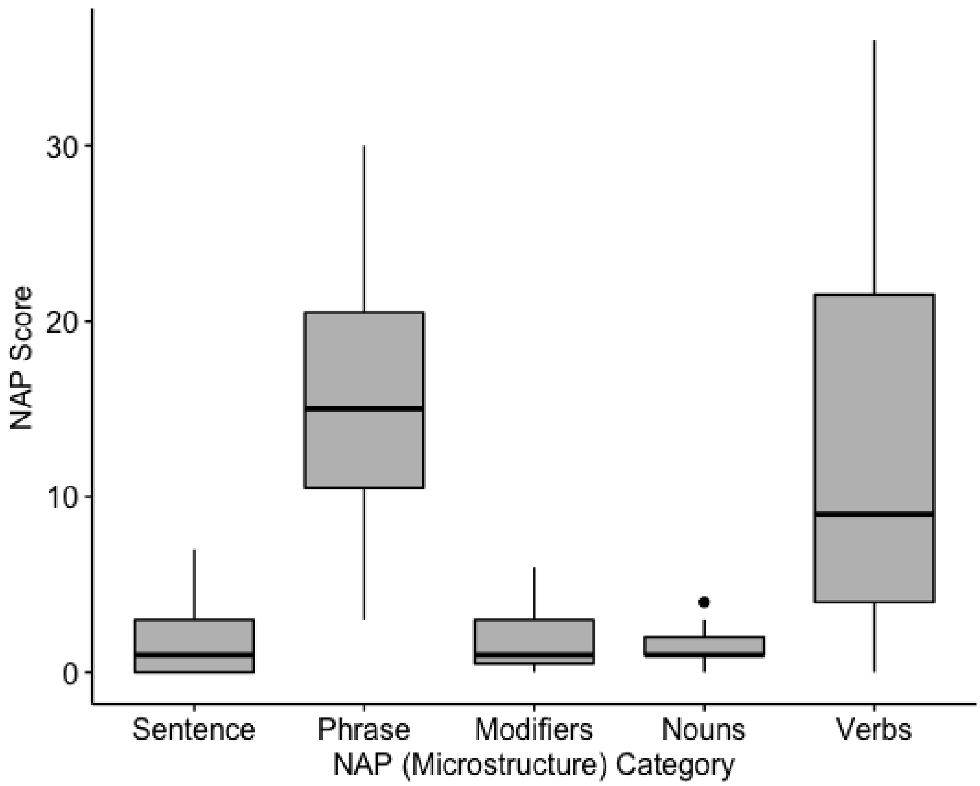

Figure 1. Box plots of participant's performance on categories of narrative microstructure. The top and bottom of the boxes represent the first and third quartiles, with the median shown by the line in the middle. The whiskers extend from the boxes to the minimum or maximum value observed and outliers are represented as points beyond the whiskers. NAP = Narrative Assessment Protocol.

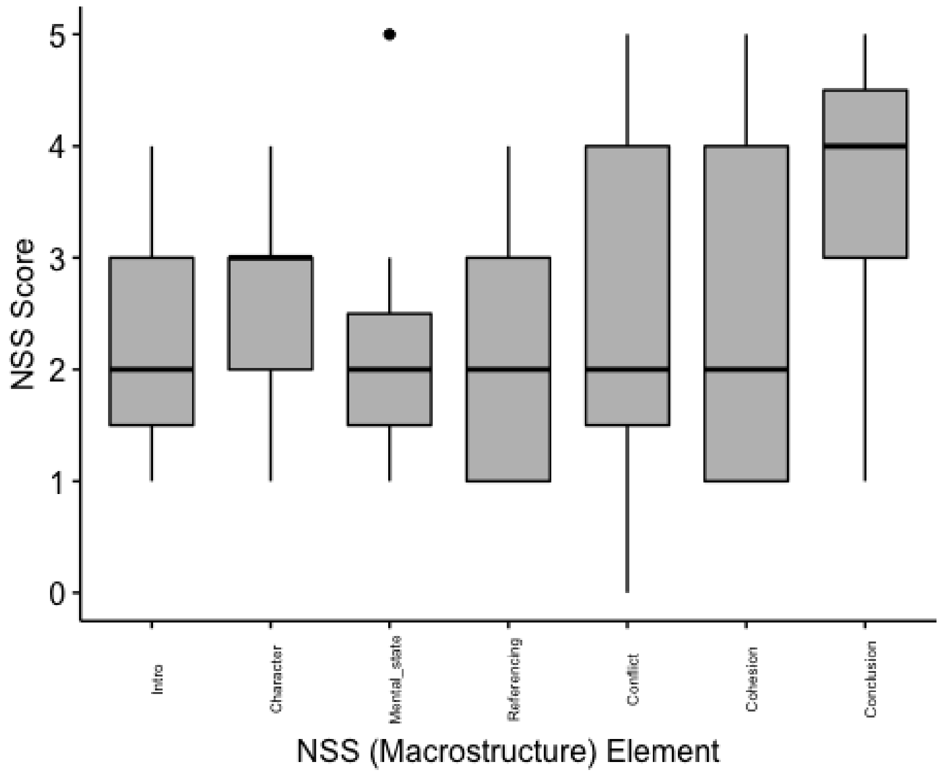

Figure 2. Box plots of participant's performance on categories of narrative microstructure. The top and bottom of the boxes represent the first and third quartiles, with the median shown by the line in the middle. The whiskers extend from the boxes to the minimum or maximum value observed and outliers are represented as points beyond the whiskers. NSS = Narrative Scoring Scheme.