ARTICLE

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Preschool children's narratives and performance on the Peabody Individualized Achievement Test – Revised: Evidence of a relation between early narrative and later mathematical ability

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ABSTRACT
In this study, different measures derived from 41 3- to 4-year-old children's self-generated picture-book narratives and their performance on a general measure of language development (TELD-2, Hresko, Reid & Hammill, 1991) were evaluated with respect to their possible predictive relation two years later with 5 areas of academic achievement (General information, Reading recognition, Reading comprehension, Math, Spelling) assessed using the Peabody Individualized Achievement Test – Revised (PIAT-R, Markwardt, 1998). Children's TELD-2 scores were significantly predictive of their General information scores. The narrative measures of conjunction use, event content, perspective shift, and mental state reference were significantly predictive of later Math scores. *Post-hoc* analyses revealed that, for the same children, the observed relations with Math achievement did not arise with nonspontaneous adult-prompted narrations.

KEYWORDS
Academic achievement; frog story; longitudinal study; MLU; narrative cognition; picture-book reading

> Narrative ability is the single most important language ability for success in school. (Feagans & Appelbaum, 1986: 359)

> The main activity that prepared the human brain for being able to do mathematics, I will suggest … was keeping track of interpersonal relationships in an increasingly complex society. (Devlin, 2000: 3)

Within the speech and language clinical literature, the view that children's narrative skills are important to their later academic performance in school is frequently expressed (e.g., Aram & Nation, 1980; Dickinson & McCabe, 1991; Feagans, 1982; Feagans & Appelbaum, 1986; Feagans & Short, 1984; Gee, 1991; Hemphill, Picardi & Tager-Flusberg, 1991; McCabe & Rollins, 1994; Orum, 1986; Stein & Glenn, 1979; Westby, 1984) and often cited as a major reason for assessing and providing intervention to develop children's narrative ability (e.g., Owens, 1995; Paul, 1995). For example, Paul (1995: 372) observes:

> Research on narrative skills (Bishop & Edmundson, 1987; Feagans & Appelbaum, 1986) has demonstrated that narrative skills are very important in predicting success in school. The development of narrative skills, then, would seem to be quite important in maximizing the chances for academic accomplishment in students with LLD [Language Learning Disabilities].

With respect to typical cognitive development in general, narrative cognition (as it is often referred to in the cognitive development literature) has also been argued, most forcefully by Jerome Bruner, to represent one of the most fundamental means by which we come to understand the world. As Bruner (1990: 97) states, 'our capacity to render experience in terms of narrative is not just child's play, but an instrument for making meaning that dominates much of life in culture'. He asks the question: What is the nature of narrative and its principal properties? It is this question that initially motivated the present study. If narrative ability is important to children's later academic achievement, what is it about narrative that is important? That is, what specific narrative abilities are important predictors of children's performance on tests of academic achievement? Are certain narrative abilities stronger predictors of performance on tests of academic achievement than general language ability (as assessed, for example, by a standardized language measure)?

A review of the literature reveals four studies investigating the predictive relation between narrative and one or more areas of academic achievement (we will refer to these as the 'prediction' studies: Fazio, Naremore & Connell, 1996; Feagans & Appelbaum, 1986; Menyuk, Chesnick, Liebergott, Korngold, D'Agostino & Belanger, 1991; Snow, Tabors, Nicholson & Kurland, 1995) and three additional studies investigating, more specifically, whether a relation exists between narrative ability and reading achievement when they are assessed concurrently (Feagans & Short, 1984; Klecan-Aker & Caraway, 1997; Snyder & Downey, 1991). The methodologies vary considerably, as do the findings (see also Roth, Speece, Cooper & De La Paz (1996) for a review), but they do provide a starting point for asking what aspects of narrative ability may demonstrate a significant predictive or concurrent relation to one or more areas of academic achievement. A detailed summary of the methodologies and

findings of these seven studies is provided in Tables 1 and 2 to accompany the brief discussion of their findings here. Note that we will use the term academic *achievement* rather than *ability* or *competence* when discussing this literature, given that most of these studies assessed this variable, as we did, using standardized achievement tests.

Of the four studies investigating the predictive relation between narrative ability and one or more areas of academic achievement (see Table 1), Feagans & Appelbaum (1986) were interested specifically in predictors of reading and mathematics achievement and had the goal, most similar to ours, to investigate the contribution of narrative versus more general language abilities. They hypothesized that children with greater deficits in narrative discourse ability (as assessed by a comprehension and paraphrase – i.e., retelling – measure, not analysed separately), relative to syntactic and semantic language skills, would be more at risk for general academic problems than children showing the opposite pattern. Cluster analysis was used to identify subtypes of learning disabilities among 55 6- to 7-year-old learning-disabled (LD) children and to examine these in relation to children's scores on Reading recognition, Reading comprehension, and Math subtests of the Peabody Individualized Achievement Test (PIAT; Dunn & Markwardt, 1970) up to three years later. The two clusters of children demonstrating stronger narrative skills as compared with their syntactic or semantic skills (accounting for 44% of the learning-disabled sample) performed better on all three academic measures in Year 1, on the Math subtest in Year 2, and on the Math and Reading comprehension subtests in Year 3 than the clusters demonstrating weaker narrative skills. The authors concluded that 'the ability to understand and paraphrase narratives appears to be a critically important skill for academic functioning for LD children, and it may be much more important than the traditional building blocks of language skills, such as vocabulary and syntax' (p. 364).

A significant predictive relationship was also found by Fazio *et al.* (1996) among 34 low-income children initially classified at age $5^1/_2$ to $6^1/_2$ into one of three groups (at-risk for SLI, age-matched normal control, language/cognitive delay). By second grade, 15 of the children had received academic remediation and it was found that the best kindergarten predictors of which children later received academic remediation were story retelling (accounting for 16% of variability) and rote memory (accounting for 5%).

Menyuk *et al.* (1991) and Snow *et. al.* (1995) specifically examined the predictive relation between narrative ability and reading ability and reading problems. Their findings stand in contrast to those of Feagans & Appelbaum (1986) and Fazio *et al.* (1996). Menyuk *et al.* (1991) studied 130 children possibly at-risk for reading problems, who prior to beginning kindergarten were administered a battery of 10 standardized language tests and language metaprocessing measures that included a story recall task (see Table 1). Two years later, when the children were largely in first and second grade (around a mean age of 7 years), their reading ability was assessed using three standardized tests, and 67% of the children were classified as potential problem readers. The best predictors of children's reading scores were found to be their syllable and phonological segmentation scores. Their scores on the story proposition recall were not found to be a predictor of their reading scores.

Similarly, Snow *et al.* (1995) concluded that their narrative measure was not a strong predictor of literacy outcome. Seventy-five 5-year-old low-income children were

Table 1 Summary of methodologies and findings of previous studies investigating narrative predictors of academic achievement

Study	*Demographic description and age of participants at Time 1*	*Narrative task(s) administered*
Feagans & Appelbaum (1986)	55 6- to 7-year-old learning disabled children	Children were told 3 stories and number of trials needed to act out with props scored as comprehension measure. Paraphrase (retell) measure was ability to communicate content of stories. Paraphrases also coded for number of words and measure of sentence complexity (subordinate clause use).
Fazio *et al.* (1996)	34 low-income children ($5^1/_2$ to $6^1/_2$) (a) at-risk for SLI (b) age-matched normal (c) language/cognitive delay	Story retelling task scored as to how many complete episodes (consisting of an initiating event, an attempt, and a consequence) it contained.
Menyuk *et al.* (1991)	3 groups of children; mean age 61 months (a) 22 specific language impairment (b) 79 early language delay or disorder (c) 29 premature children	Story recall task to puppet. Scored for number of propositions recalled. (Part of battery of language metaprocessing measures.)
Snow *et al.* (1995)	75 5-year-old low-income children	Story comprehension task, picture description task, and narrative production task in which children told story after viewing a sequence of 3 slides and stories scored for number of words per clause and complicating actions (not analysed separately).

(continued)

Other language tasks administered	*Achievement measure(s) and timing*	*Conclusion*
Syntax measure and semantic measure (vocabulary subtest of WISC–R).	PIAT Reading recognition, Reading comprehension and Math subtests in Years 1, 2 and 3.	Children with stronger narrative skills (relative to syntax and semantics) scored higher on all subtests at Year 1, Math subtest at Year 2, Math and Reading comprehension at Year 3.
TOLD-2P, rote memory task, invented morpheme task.	Academic records examined to determine if had received academic remediation up to 2 years later.	Story retelling and rote memory were best predictors of academic remediation.
10 standardized tests to measure receptive, expressive and phonological aspects of language (e.g., PPVT-R; ITPA Grammatical Closure Subtest; TOLD-P Auditory Discrimination) and measures of language metaprocessing (e.g., syllable and phoneme awareness, word recall, rapid autonomic naming (RAN), sentence completion and comprehension).	Reading ability assessed with WRAT, Gray Oral Reading Test, and Test of Reading Comprehension 2 years later.	Metalinguistic measures other than narrative task best predicted later reading ability and reading problems, especially syllable and phonetic segmentation.
Battery of language and literacy tasks including PPVT-R; 5 subtests of emergent Literacy strand of ECDI, and word definition task.	Reading subtest of WRAT-R, Gray Oral Reading Test, and 8-word spelling test 1 year later.	Narrative production measure correlated with all measures at Time 1, but not strongly correlated with any academic measure at Time 2.

Note. Tasks described are nonstandardized tests unless otherwise stated. ECDI: Mason & Stewart, 1989; Gray Oral Reading Test: Wiederholt & Bryant, 1986; ITPA: Kirk, McCarthy & Kirk, 1968; PPVT-R: Dunn & Dunn, 1981; RAN: Denckla & Rudel, 1976; Test of Reading Comprehension: Brown, Hammill & Wiederholt, 1978; TOLD-P: Newcomer & Hammill, 1982; TOLD-2P: Newcomer & Hammill, 1988; WISC-R: Wechsler, 1974; WRAT: Jastak & Jastak, 1976; WRAT-R: Jastak & Wilkinson, 1984.

given a battery of language, literacy and narrative tasks (see Table 1). Children's scores on the tasks in this battery were compared with their scores on two standardized reading measures and a spelling test administered a year later when the children were in Grade 1. The authors concluded that their narrative production measure did not show 'strong or consistent relationships to literacy outcomes' and that skill at formal definitions was instead 'the oral language measure most robustly associated with contemporaneous and future literacy skill' (p. 47).

Three other studies (Feagans & Short, 1984; Klecan-Aker & Caraway, 1997; Snyder & Downey, 1991) investigated the concurrent (rather than predictive) relation between oral narrative ability and reading achievement. (For reasons of lack of space and an emphasis on preschool- and early elementary school-aged children, studies that have investigated the relation between *written* narrative retellings among older children and areas of academic achievement such as reading are not reviewed here; but see, for example, Cameron, Hunt & Linton, 1988; Geva & Olson, 1983.) The results across these three studies are also mixed (see Table 2). Among a group of 49 reading-disabled 6- to 7-year-old children followed longitudinally for three years, Feagans & Short (1984) found moderate relations between a measure of the total number of words produced in a story-retelling task and reading achievement on the Reading recognition and Reading comprehension subtests of the PIAT (Dunn & Markwardt, 1970), but not between any of their other narrative measures (i.e., number of action units, proportion of complex utterances, sequencing errors). Furthermore, among a control group of typically developing children, no significant correlations were found between any measures of narrative and reading ability in Years 2 and 3. Similarly, among 80 fourth and sixth grade African-American children asked to create or make up an original story given a picture, Klecan-Aker & Caraway (1997) found that only two of their narrative measures, number of clauses and story level, were significantly correlated with reading achievement. In a third study, Snyder & Downey (1991) found that their non-narrative measure of sentence completion best accounted for the variance they observed in typically-developing and reading-disabled children's reading comprehension scores.

Our review of previous research on the question of whether narrative ability is related to academic achievement leads to the following general observations.

1. *Research investigating relations between narrative ability and academic achievement has most often focused on reading achievement, and results are mixed* When considering the results for reading achievement alone, only one of the four prediction studies found evidence of a positive predictive relation, specifically with reading comprehension (Feagans & Appelbaum, 1986). Two of the three studies assessing this relation concurrently found moderately strong correlations between some of their narrative measures and reading achievement (Feagans & Short, 1984; Klecan-Aker & Caraway, 1997).

2. *Relations of narrative ability to areas of academic achievement other than reading have not been extensively studied* Of the four prediction studies, only two incorporated measures of academic achievement other than reading (PIAT Math subtest in Feagans & Appelbaum, 1986; spelling test in Snow *et al.*, 1995). Intringuingly, however, Feagans & Appelbaum did find that children with stronger narrative ability relative to their semantic and syntactic ability performed better on the

PIAT Math test at Year 1 and at follow-up in Years 2 and 3. It is noteworthy that the existence of a relation between mathematical thinking and our ability to use language has recently been argued for, on theoretical grounds, by mathematician Keith Devlin (2000). Indeed, we will return to consider Devlin's argument in more detail in our discussion section, given the findings we report in this paper supporting a predictive relation between certain aspects of narrative ability and mathematical achievement.

3. *Little is known about the relation between narrative ability and academic achievement among typically developing children* In all four prediction studies, non-typically developing children were the focus, including LD children (Feagans & Appelbaum, 1986), children with language disorders (Menyuk *et al.*, 1991), and low-income children possibly at risk with respect to language or academic achievement (Fazio *et al.*, 1996; Snow *et al.*, 1995). Thus no evidence exists (positive or negative) to determine whether narrative ability is predictive of later academic achievement among typically developing children. In all three studies investigating the concurrent relation between oral narrative and reading achievement, control groups of typically-developing children were included, but a significant relation was found in only one study (Klecan-Aker & Caraway, 1997).

4. *Nothing is known about the relation between narrative ability and academic achievement in children under age 5* The youngest children in any of the seven reviewed studies were 5 years of age. No studies have addressed the possibility that measures of narrative ability at younger ages may be predictive of later academic achievement. Given the enormous interest of researchers and the public in early indicators of children's potential to make a successful transition to school and perform well in areas of academic achievement, studying this relation in younger children is timely and important.

5. *Studies of the relation between narrative ability and achievement have involved few unprompted story generation tasks and few analyses specifically comparing different narrative measures* Of the four prediction studies, only one (Snow *et al.*, 1995) required children to generate a story (given a sequence of pictures) without a prior telling of the story by the experimenter. Story retell/recall tasks, used in the other studies, have been criticized for confounding narrative ability with memory skills (Berman & Slobin, 1994). Measures derived from children's self-generated stories can also be argued to reflect children's actual ability to construct a story better than those derived from story retell/recall tasks, where the story told may be heavily influenced by the organization and elements included in the original adult telling. In none of the four prediction studies, furthermore, was the contribution of the different narrative measures used analysed separately. Only two of the concurrent studies incorporated such analyses (Feagans & Short, 1984; Klecan-Aker & Caraway, 1997).

6. *Studies of the relation between narrative ability and achievement have not included any narrative measures capturing aspects of how the storyteller conveys perspective* It has been argued that the fundamental function of narrative is 'not to report a chronological sequence of events, but to signal a perspective on events …' (Gee, 1991: 20). In this vein, Bruner (1986: 25) has argued that narrative 'must depend

Table 2 Summary of methodology and findings of studies investigating concurrent relation between oral narrative ability and reading achievement

Study	*Demographic description of participants and age at assessment(s)*	*Oral narrative task(s) administered*
Feagans & Short (1984)	49 reading-disabled 6- to 7-year-olds followed for 3 years. Control group of 49 typically-developing children.	Two story retelling tasks scored for total number of trials to act out all action units, number of action units recalled verbally, total number of words, proportion of complex utterances, sequencing errors.
Klecan-Aker & Caraway (1997)	80 4th- and 6th-grade African-American children.	Asked to create original story from picture. Scored for complexity (number of t-units, words/t-unit, words/clause, clause/t-unit), story grammar components, developmental story level.
Snyder & Downey (1991)	93 reading-disabled and 93 typically-developing 8- to 14-year-olds.	Two story retelling tasks scored for proportion of propositions recalled and responses to probe questions about main story ideas and inferences.

(continued)

Other language tasks administered	*Measure(s) of reading achievement*	*Conclusion*
None	PIAT Reading recognition and Reading comprehension subtests.	Significant correlation with reading achievement found only with measure of total number of words among reading disabled children for all 3 years. Significant correlation found only in Year 1 among typically-developing children.
None	Reading subtest of Iowa Tests of Basic Skills.	Significant correlation with reading achievement found only with clauses per t-unit and story level.
WISC-R; Confrontation naming task subtest of CELF; phonological awareness, sentence completion.	Reading subtest of Metropolitan Achievement Test.	Variance in reading scores in younger (exact ages not given) reading-disabled and typically-developing children best accounted for by sentence completion scores.

Note. Tasks described are nonstandardized tests unless otherwise stated. CELF: Wiig & Semel, 1980; Iowa Tests of Basic Skills: Hieronymus, Hoover & Lindquist, 1986; WISC-R: Wechsler, 1974.

on forms of discourse that recruit the reader's imagination'. He suggests three features of discourse are crucial to this process:

> [1] the triggering of *presupposition*, the creation of implicit rather than explicit meanings … [2] *subjectification*: the depiction of reality not through an omniscient eye that views a timeless reality, but through the filter of the consciousness of the protagonists in the story … [3] *multiple perspective:* beholding the world not univocally but simultaneously through a set of prisms each of which catches some part of it. (pp. 25–26)

In the studies reviewed here, narrative ability was assessed using a variety of measures such as the number of story propositions recalled, the number of words per clause, and the inclusion of story grammar components. None of the previous studies, however, included measures of the child's ability to incorporate aspects of perspective-taking into their stories. Given the arguments of Bruner (1986, 1990) and other narrative theorists (e.g., Gee, 1991), such measures should be included as they represent a fundamental component of narrative ability. Indeed, the incorporation of perspective-taking measures is supported by many studies in the literature on narrative development that have examined aspects of perspective-taking in children's early narratives (Bamberg & Damrad-Frye, 1991; Berman & Slobin, 1994; Bokus & Shugar, 1996; Hewitt & Duchan, 1995; Richner & Nicolopolou, 2001; Peterson & McCabe, 1983; Reilly, 1992; Wolf & Hicks, 1989) and the arguments of many researchers that narrative ability does not solely express linguistic ability, but also reflects developments in cognitive, social and pragmatic knowledge (e.g., Berman & Slobin, 1994; Fox, 1991; Hemphill, Picardi & Tager-Flusberg, 1991; Peterson & McCabe, 1991; Tager-Flusberg, 1995).

In the light of these concluding observations regarding the results of previous studies investigating the relation between narrative ability and academic achievement, the present study was specifically designed to meet the following methodological criteria and to address the following questions.

1. *Is the narrative ability of typically-developing preschool-age children predictive of later academic achievement?* In this study, at Time 1, the participants were 3- to 4-year-old children who were given a narrative task. Two years later, these children were followed-up and administered a standardized achievement test, the Peabody Individual Achievement Test – Revised (Markwardt, 1998). In an effort to examine the relation to academic achievement more broadly than in previous studies, all five subtests were administered and analysed separately: General information, Reading recognition, Reading comprehension, Math and Spelling.

2. *Are certain aspects of narrative ability more strongly related to academic achievement than others?* To address this question, we used a variety of different narrative measures. We included several measures (mean length of utterance, vocabulary diversity, syntactic complexity, event content) commonly used in past research studies such as those reviewed in the introduction, a new measure developed for the purposes of this study to assess the ability of children to shift perspective among characters in the story, and a measure of mental state reference similar to those used in studies examining children's ability to talk about the mental states of other people (e.g., Bartsch & Wellman, 1995). The contribution of each of these aspects of narrative was analysed separately.

3. *Is narrative ability specifically, as opposed to language ability more generally, uniquely predictive of aspects of later academic achievement?* That is, does narrative ability demonstrate a stronger correlation with academic achievement than general language ability? To address this question, children were administered the standardized Test of Early Language Development – 2nd Edition (TELD-2; Hresko, Reid & Hammill, 1991) as a measure of general language ability at Time 1 along with the narrative task.

4. *Does the type of narrative task matter?* To avoid problems associated with story recall/retell tasks (e.g., confounds with memory ability), the narrative task presented to children in our study required them to generate a story while looking at a picture book. The picture book was novel to all the children, and they were not first told the story. Similar picture-book story generation tasks have been employed in many studies investigating children's narrative development (e.g., Berman & Slobin, 1994). As described later, the methodology we used afforded us the opportunity to carry out a secondary set of analyses as a *post-hoc* investigation of whether similar correlations to those found with the story generation task would be found with the less spontaneous narratives told by the children while being regularly prompted to talk about each page by an adult (i.e., the initial familiarization narrative task).

PART 1: PUPPET NARRATIVE TASK

METHOD

Participants: Time 1 and Time 2

Forty-eight children participated at Time 1 (25 girls, 23 boys, mean age 3;11, range 3;5–4;11). Six additional children were tested but dropped because of a refusal to tell the story ($N = 4$); a refusal to complete the TELD-2 ($N = 1$) and camera problems ($N = 1$). At the end of Time 1, the intention to follow-up the children was not conveyed to parents as it had not been our focus. Parents were re-contacted for the first time two years later and asked if they would agree to participate again. We were able to locate all the original 48 participants, but six families had moved too far away to be able to participate and one family declined to participate as their child was having speech-language difficulties and was already undergoing numerous assessments. Thus 41 children in total participated at Time 1 and 2. At Time 1, the mean age of this group was 3;11 (range 3;5–4;11; 18 boys and 23 girls). At Time 2, the mean age was 6;2 (range 5;4–7;1). At Time 2, with respect to school status, one child was at home, two children were in preschool, one child was in junior kindergarten, 30 children were in senior kindergarten, six were in Grade 1 and one child was in Grade 2. The children were of varied west and east European descents, and also included one child of Arab descent. This sample is representative of the largely middle-class university town in which the laboratory is located. Parents were recruited from the general population via advertisements in newspapers, grocery stores, malls and community centres. All the

children had acquired English as their first language.

Procedure: Time 1

All children were tested individually while sitting at a small table with an experimenter. The entire session was videotaped. The narrative task and the TELD-2 (Hresko *et al.*, 1991) were administered to children at Time 1 originally as part of a study looking at relations between language skill and measures of visual attention (Cohen, 1998). At that time, however, children's narratives were not transcribed or coded or analysed for any of the measures used in the current study.

Narrative task

The picture book presented to children was a 12-page adaptation of Mercer Mayer's (1974) picture book entitled *Frog goes to dinner*, which was shortened so that it was more suitable in length for 3- to 4-year-old children yet maintained a cohesive story line. A brief synopsis of the story is provided in Appendix A. No text accompanied the pictures. It should be noted that in Mayer's original version some pages contained two separate pictures and we did not alter the presentation of these pages. The pages were copied to a size of 14 x 28.5 cm, laminated, and spiral bound into a book form that the children could easily manipulate. *Frog goes to dinner* was chosen for use in this study – as opposed to the more frequently used *Frog, where are you?* (Mayer, 1969) or *A boy, a dog and a frog* (Mayer, 1967) – because it includes many more instances of human characters interacting and expressing different viewpoints and different mental states such as puzzlement, surprise, desire (wanting the frog back), anger and amusement. It was therefore judged to be a more ideal Mayer story from which to derive measures of children's ability to shift perspective between characters and to reference the mental states of characters. None of the children had seen or heard this story before.

What's happening familiarization task To familiarize children with the story, the experimenter went page by page through the book with each child, asking the child to look at each page and to say what was happening in the picture. On page 1, the experimenter introduced the story by telling children that this was a story about a boy who went to a fancy restaurant with his family and pet frog and some funny things happened when they got there. For all remaining pages, only the prompt 'What's happening in this picture?' was used, and at no time did the experimenter provide any text for the story. Previewing a picture story in this manner has been shown to facilitate preschoolers' production of cohesive narratives (Shapiro & Hudson, 1991).

Puppet narrative experimental task Following the familiarization task, the experimenter brought out a Sesame Street doll – Big Bird or Ernie based on the child's preference – and told the children that Big Bird/Ernie loved stories and that he had never heard this story before. The children were asked to tell Big Bird/Ernie the story. On the stomach of the dolls, we had attached a strip of velcro that allowed them to be affixed to the edge of the table between the child and the book. In this manner, the doll was 'looking' at the pictures from the same perspective as the child (i.e., not upside down from the opposite

side) and his position did not impede the child from turning the pages easily. The use of a 'naive listener' was crucial to the procedure of this study for motivating children with a pragmatically natural (and indeed enjoyable) story-telling situation. Previous research also suggests that children tell more complete and less confusing stories to listeners whom they believe to be naive rather than knowledgeable about the content of the story (Liles, 1993; Menig-Peterson & McCabe, 1978; Pelligrini, 1982). During the child's narrative, the experimenter did not intervene in any manner, and children were free to say as much or as little about each page as they wanted. The entire narrative task took approximately ten minutes to complete.

General language measure: TELD-2

As a standardized measure of general language ability, the TELD-2 (Hresko *et al*., 1991) was administered to all children. The TELD-2 is an untimed test comprised of 68 questions assessing receptive, expressive, semantic and syntactic language skills. Children must provide short verbal answers or point to one of several pictures. Example items include: 'Tell me how old you are' (expressive language), 'Show me the picture of the word I say – plant' (receptive language), 'Show me the child who is first in line' (semantics), and 'This is a shoe. These are ___ [children are shown picture of shoes]' (syntax). Items are scored pass/fail. A composite raw score of general language ability (number of correct responses) was calculated from the TELD-2 questionnaire for each child as instructed in the manual. The TELD-2 was chosen because it has been standardized on children between the ages of 3 and 7 years and possesses good test-retest reliability and internal consistency. It has also been the test most frequently adopted to assess general language ability in recent studies investigating theory of mind development in preschoolers (e.g., Astington & Jenkins, 1995; Jenkins & Astington, 2000).

Transcription of narratives

Children's utterances during the experimental task were transcribed using the conventions of the CHAT (Codes for the Human Analysis of Transcripts) transcription system (MacWhinney, 1995; MacWhinney & Snow, 1985, 1990). Speech by the experimenter and speech by the child not related to telling the story (e.g., a child's comments about the room) were transcribed, but were excluded from the analyses reported here. In addition to transcribing children's verbal utterances, two further non-linguistic aspects of children's narrations, *character speech* (speaking in a character's voice) and *gestures*, were included in our transcriptions. Further details regarding the coding and analyses of these nonverbal aspects are provided in O'Neill & Holmes (2002). The narratives, including children's utterances, instances of voicing, and gestures, were transcribed independently by two research assistants. Disagreements over wording, voicing or gestures were resolved through discussion if possible. Uninterpretable verbal utterances were transcribed following the conventional use of the symbols *xx* (one word) or *xxx* (more than one word).

Coding of narrative measures

Seven measures of narrative ability were derived from children's stories. These included

measures typically incorporated in studies of narrative development (mean length of utterance, vocabulary diversity, two measures of complex syntax – conjunctions and subordinate clauses – event content) and theory of mind understanding (mental state reference). A final measure of perspective-taking, perspective-shift, was newly developed for the purpose of this study. The coding of each of these measures will now be described in detail.

Mean length of utterance (MLU)

MLU was calculated using the Computerized Language Analysis program (CLAN) developed for use with CHAT transcripts (MacWhinney, 1995). The program computes MLU as the ratio of morphemes to utterances and omits uninterpretable material (*xx* or *xxx*) and all words or phrases coded in the transcript as material repeated within an utterance (i.e., false stops, corrections).

Vocabulary diversity (VOCD)

Vocabulary diversity was calculated using the VOCD program (McKee, Malvern & Richards, 2000) provided within the CLAN program (MacWhinney, 1995). It provides a measure of the level of lexical diversity. It is based on the older measure of type/token ratio (ratio of different words/total number of words) but corrects for typical variation in type/token ratio over a range of text lengths.

Conjunctions

This measure of conjunction use, and the following measure of subordinate clause use, represented the two measures of complex syntax. The procedure for their coding followed that outlined in the Strong Narrative Assessment Procedure (Strong, 1998) which is based on use of the Mayer frog stories. For the conjunction measure, the number of different types of co-ordinate and subordinate conjunctions was tallied (e.g., and, but, or, because, after).

Subordinate clauses

All instances of nominal, adverbial and relative clauses were tallied according to the procedures outlined in the Strong Narrative Assessment Procedure (Strong, 1998).

Event content

As presented previously in O'Neill & Holmes (2002), to score this variable, 19 main events in the story were identified by the first two authors in discussion with each other (see Table 3). In three cases (events 2, 9 and 19), two alternative descriptions were judged possible. The validity of including these 19 main events was confirmed in an adult control study as described below. Each child received a score out of 19 depending on how many of the identified events they included in their narrative. To be credited with including an event, a child did not need to state an event exactly as described in Table 3, but did need to capture the main action. For example, a child who produced the utterance 'jumping out' to describe event 11 (Frog jumps out) was scored as including this main event. If two events were mentioned out-of-order, the children were given a score of 1 for the first event mentioned, but the second event received a score of 0. That is, if event 6 was described before event 5, only event 6

Table 3 Event analysis of adapted *Frog goes to dinner* story

Event no.	*Description of event*
1	Family goes to restaurant
2	Frog jumps out of boy's pocket / Frog jumps into (musician's) instrument
3	Musician can't play
4	Musician looks in instrument
5	Frog falls out
6	Musician falls in drum
7	Frog jumps into salad
8	Lady receives salad
9	Lady sees frog / Frog peeks out
10	Lady reacts
11	Frog jumps out
12	Lady yells at manager
13	Waiter takes frog
14	Boy wants frog back
15	Boy gets frog back
16	Waiter kicks family out
17	The family is mad at boy (in car as drive home)
18	Boy sent to his room (to go to bed)
19	Boy and frog are laughing in room about what happened / Boy and frog are laughing instead of going to bed

Note. Events 2, 9 and 19 could be described by either of the two alternatives given.

earned a score of 1. Because of the nature of the *Frog goes to dinner* story events, achieving a high score on this measure required children to take numerous actions and reactions of different characters into account.

Adult control study for event content measure To ensure that the 19 main events identified by the authors were indeed events that would be included in the narratives of adult narrators, 14 adults (4 men, 10 women) ranging in age from 23 to 33 years were presented with the picture book given to children and instructed to tell the story, describing its main events. Their narratives were tape-recorded. An undergraduate research assistant blind to the hypothesis of the study transcribed these recordings. The first author and the research assistant independently coded these transcripts with respect to the number of events included in each adult's narrative (including either alternative form for events 2, 9 and 19). Reliability was excellent (kappa = 0.94). Of the 19 events, 13 were mentioned by all 14 adults (events 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 17 and 18). For the remaining six events, the number of adults mentioning them was: 13 (events 14 and 16), 12 (events 3 and 11) and 11 (events 15 and 19).

Table 4 Coding of narratives with respect to perspective-shift

Sequence	*Story event no.*	*Event description*	*Perspective-shift*
1	2	Frog jumps out of boy's pocket/ into (musician's) instrument	frog
	3/4	Musician can't play/Muscian looks in instrument	musician
	5	Frog falls out	frog
	6	Musician falls in drum	musician
2	7/9	Frog jumps in salad/Frog peeks out	frog
	9/10	Lady sees frog/Lady reacts	lady
	11	Frog jumps out	frog
	12	Lady yells at waiter	lady

Note. Story event no. corresponds to event numbers in Table 3.

Perspective-shift

This measure was developed specifically for this study to provide a measure of children's ability to capture certain sequences of events in the story in which the action shifts consecutively from one character to another character. We chose the two longest sequences of events in the story that involved two characters and in which the child had to shift their perspective sequentially from one character to another to capture accurately the sequence of main events taking place. These two sequences are shown in Table 4 in the order in which they occurred in the story. Sequence 1 was depicted on pages 2–4 and included four events in which the action switched back and forth between the frog and the musician. Note that the second shift in this sequence could be described either with event 3 or event 4. Sequence 2 was depicted on pages 5–7 and included four events in which the action switched back and forth between the frog and the lady. Note that the first event of this sequence (about the initiating actions of the frog) and the second event (concerning the subsequent actions of the lady) could each be described using one of two possible events. In coding for perspective-shifting, unlike the event coding, children did need to specify the acting agent (i.e., frog, lady or musician). Thus a child describing event 11 as 'jumping out' would not have received credit for shifting perspective to the frog. But if the child specified 'frog/he jumped out,' he or she did receive credit for shifting perspective to the frog for this event in the sequence.

Children's perspective-shift score depended on the number of consecutive events described in order within each of the three sequences identified above. If, in either

sequence, children mentioned two consecutive events (i.e., switched reference once from one character to another), a score of 1 was given. If three consecutive events were mentioned, children received a score of 2 (i.e., representing two switches in reference), and if four consecutive events were mentioned, they received the maximum score of 3 (i.e., representing three switches in reference). Over the two sequences, children could accumulate a maximum total score of six (3 + 3). A score of zero was obtained if children only mentioned one event or two non-consecutive events only in a sequence.

Mental state reference

As has been done in other studies investigating measures of mental state understanding in children's narratives (e.g., Astington, 1993; Charman & Shmueli-Goetz, 1998), we tallied the number of mental state references uttered in each child's narrative. Mental state references were defined as including those to perceptual states (e.g., see), emotional states (e.g., sad), desire states (e.g., want), and belief states (e.g., think, know). We did not include (very rarely occurring) references to mental states that bore no relation to the main events of the story. For example, in describing the event in which the family was driving home, one child described the boy as being 'afraid of the moon.' In this instance 'afraid' was not scored as an instance of mental state reference. To be included in the tally, the mental state also needed to be referenced directly in the child's utterance, and not just implied. For example, the utterance 'that's my frog' (event 14) was not coded as an instance of mental state reference even though it might be argued to imply the mental state of desiring the frog to be given back. Repetitions of a single emotion for one event (e.g., 'he's mad, she's mad, he's mad') were only counted once so as not to inflate the tally artificially. However, if the emotion was repeated in reference to a different event or picture, it was tallied twice.

Reliability for narrative measures

Two undergraduate research assistants blind to the hypotheses of the study independently scored each transcript (that is, 100% of all narratives) with respect to each narrative measure apart from MLU and VOCD. Reliability was very good overall. There were no disagreements with respect to children's scores for conjunctions and subordinate clauses. Kappa values were 0.94 for event content and 0.88 for perspective-shift. In addition, there were only three instances of disagreement with respect to the occurrence of a mental state reference**.** Cases of disagreement were resolved in discussion with the first author.

Procedure: Time 2

Academic Achievement Measure – PIAT-R

To assess academic achievement, children were administered the Peabody Individualized Achievement Test – Revised (PIAT-R; Markwardt, 1998) by a graduate student trained in administering this test. The PIAT-R is designed to be used with students in kindergarten through grade twelve and to provide a wide-range measure of academic

achievement in five content areas: (1) *General information* (verbal items assessing general knowledge), (2) *Reading recognition* (items measuring recognition of sounds associated with printed letters and the ability to read words aloud), (3) *Reading comprehension* (children choose one of four pictures that best illustrates a sentence they have read silently), (4) *Mathematics* (items testing knowledge and application of mathematical concepts and facts), and (5) *Spelling* (items measuring recognition of letters from their names or sounds and correct word spelling). (A sixth subtest, *Written expression* (testing pre-writing skills) is optional and more appropriate for older children and thus was not administered.) The PIAT-R's reliability and validity has been well established (for a review, see Markwardt, 1998).

All the five subtests were administered to the children in the above order as instructed in the manual. Children were administered the Reading comprehension subtest only if they achieved a score above 18 on the Reading recognition subtest as instructed in the manual. All the children were administered the PIAT-R while sitting at a small table with the experimenter. Apart from the General information subtest, in which the experimenter read a question aloud and children responded with a verbal answer, in all the remaining subtests children had to respond by choosing the correct response from one of four alternative pictures/letters/numbers or, in the case of part of the Reading recognition test, by reading the presented word. The PIAT-R is an untimed test. The items on each subtest are given in a fixed order. Administration of each subtest ends when a child has failed five questions in a row. As instructed in the manual, a raw score for each of the five subtests was calculated for each child. In our sample, its administration averaged around 25 to 30 minutes. In between the subtests, children were presented with a sticker to thank them for their continued participation.

RESULTS

Preliminary analyses for sex differences

To identify any significant sex differences, *t*-tests (with a Bonferoni correction applied) were conducted comparing boys' and girls' scores on the TELD-2, all five subscales of the PIAT-R and all seven measures derived from the narratives. No significant sex differences were found for any measure. Thus, all further analyses were conducted on the group of children as a whole.

Descriptive statistics for Time 1 and Time 2 measures

Table 5 shows the mean score and standard deviation for all measures assessed at Time 1 and Time 2 for the entire sample of children. For the measure of VOCD, 5 children's stories were too short to permit computation by the computer program. For conjunction use, all but one child had a score of 3 or under, most often reflecting the use of the three conjunctions 'and', 'but' and 'because'. All subordinate clauses produced were nominal or adverbial; no relative clauses were found in the children's stories.

With respect to children's Reading comprehension scores, it should be noted that only 19 children attained a score of 18 on the Reading recognition subtest which

Table 5 Mean score and standard deviation (SD) for all measures assessed at Time 1 and Time 2

Time and measures	*Mean score*	*SD*
Time 1		
TELD-2	48.61	5.92
Narrative measures: story to the puppet		
MLU	4.99	1.49
VOCD[a]	22.59	7.22
Conjunctions	1.44	1.07
Subordinate clauses	1.15	1.51
Event content	7.05	3.29
Perspective-shift	2.20	2.17
Mental state	3.37	2.99
Time 2: PIAT		
General information	21.85	7.48
Reading recognition	18.98	12.33
Reading comprehension	18.71	10.72
Total reading composite	37.68	22.67
Math	18.27	7.00
Spelling	22.32	9.26

[a] $N = 36$

results in further administration of the Reading comprehension subtest (for which children's scores begin at 19). When scoring the Reading comprehension subtest, children who did not attain a score of 18, were assigned their score on the Reading recognition subtest as instructed in the manual (Markwardt, 1998).

Correlational analyses

Zero-order correlations of TELD-2 and narrative measures with PIAT-R subtests

As indicated by the zero-order correlations shown in Table 6, the TELD-2 scores were predictive of children's academic achievement two years later: children's TELD-2 scores were significantly correlated with their scores on all five PIAT-R subtests. Significant correlations were also found between children's scores on four of the narrative measures – VOCD, event content, perspective-shift, mental state reference – and their scores on the PIAT-R's Math subtest. Children's VOCD scores were also found to be significantly correlated with their Reading recognition and Reading comprehension scores in this analysis. On the initial analysis, the zero-order correlations would appear

Table 6 Zero-order correlations between TELD-2 and narrative measures with subtests of PIAT-R

	General knowledge	*Reading recognition*	*Reading comprehension*	*Math*	*Spelling*
TELD-2	0.47**	0.49***	0.43**	0.50***	0.53***
Narrative measures					
MLU	–0.01	–0.04	–0.09	0.19	0.06
VOCD	0.24	0.41*	0.38*	0.45**	0.28
Conjunctions	0.01	–0.15	–0.18	0.09	–0.15
Subordinate clauses	–0.14	–0.12	–0.10	–0.03	–0.08
Event content	0.08	0.21	0.20	0.41**	0.28
Perspective shift	0.12	0.18	0.13	0.39*	0.23
Mental state reference	0.19	0.10	0.06	0.33*	0.11

*$p \leq 0.05$, **$p \leq 0.01$, ***$p \leq 0.001$

to suggest that TELD-2 scores are a better predictor than the narrative measures of later academic achievement.

Partial correlations of TELD-2 and narrative measures with PIAT-R subtests

Several subtests of the PIAT-R contained items that were similar in nature. For example, the Reading recognition, Spelling and Math subtests all contained items where children had to match a letter or number shown to one of four letters or numbers shown. Indeed, it is reported in the manual for the PIAT-R (Markwardt, 1998) that intercorrelations between, for example, the Spelling subtest and the two Reading and Math subtests (among children in our age range) ranged from 0.72 to 0.79 in the standardization sample. Given the possibility, therefore, that the subtests of the PIAT-R may share variance, we recomputed the correlations between children's scores on the five PIAT-R subtests and their scores on the TELD-2 and narrative measures, partialling out their performance in each case on the remaining four PIAT-R subtests. This analysis provided a clearer picture of the extent to which children's TELD-2 or narrative scores were correlated with the unique construct measured by each PIAT-R subtest.

The results of this analysis, shown in Table 7, revealed a pattern very different from that found with the zero-order correlations. When children's performance on each PIAT-R subtest was considered, controlling for their performance on the other four subtests, children's TELD-2 scores were significantly correlated only with their later performance on the General information subtest. This result is indeed not unexpected, given that the questions asked of children on this PIAT-R subtest (such as 'What do you hear with?' and 'What hides the sun on a rainy day?') are quite similar to the types of questions asked on the TELD-2 (such as 'Show me your mouth' or 'Tell me what you

Table 7 Partial correlations between TELD-2 and narrative measures with individual subtests of PIAT-R, partialling out the remaining 4 PIAT-R subtests

	General knowledge	*Reading recognition*	*Reading comprehension*	*Math*	*Spelling*
TELD-2	0.36*	–0.01	0.01	0.04	0.22
Narrative measures					
MLU	–0.07	–0.11	– 0.02	0.28	0.03
VOCD	0.02	0.08	0.08	0.31	–0.26
Conjunctions	–0.04	–0.07	0.00	0.34*	–0.20
Subordinate clauses	–0.13	–0.11	0.07	0.13	–0.01
Event content	–0.09	–0.24	0.20	0.40*	0.03
Perspective-shift	–0.04	–0.11	0.05	0.36*	–0.02
Mental state reference	0.07	–0.10	0.06	0.38*	–0.14

*$p \leq 0.05$

do with a pencil'). The TELD-2 scores were not significantly correlated with the remaining four PIAT-R subtests in this analysis. Similarly, the significant zero-order correlation found between children's VOCD scores and their performance on the Math subtest was no longer found to be significant in the analysis of partial correlations.

In contrast, children's scores on the three narrative measures of event content, perspective shift and mental state reference remained significantly correlated with their scores on the PIAT-R Math subtest, even increasing slightly in strength for mental state reference. In addition, a significant correlation between children's conjunction use and their performance on the Math subtest emerged with this analysis.

Regression analyses

To further analyse the predictive relation between all our measures and the PIAT-R Math subtest, multiple regression analyses were carried out in which children's scores on all narrative measures, the TELD-2 and the other four remaining PIAT-R subtests were entered as additional predictors. Just as found with the partial analyses, the individual narrative measures of event content, perspective shift, mental state reference and conjunction use emerged as the only statistically significant (all $ps \leq 0.04$) predictors of children's performance on the Math subtest of the PIAT-R.

Given the significant correlations found in this study with the PIAT-R Math subtest, the reader may be curious as to the exact nature of the items on this test. Appendix B provides a description of the first 30 items on this subtest (only one child was scored beyond the 30th item). Examination of these 30 items reveals that they include items requiring children to have semantic and linguistic knowledge of such things as shapes,

money, telling time, and terms such as 'shorter' and 'tallest'; the ability to count verbally and to recognize a pictorial depiction of a certain quantity (e.g., 3 trucks); the ability to recognize the written form of a number stated orally by the experimenter; and knowledge of addition and subtraction operations as presented in word problems.

DISCUSSION

If we revisit the three main hypotheses we set out to examine in this study, the findings of Part 1 suggest an answer to each. The results do suggest that among typically-developing preschool-age children, narrative ability is predictive of academic achievement two years later, but that this predictive relation is not observed for all areas of academic achievement, or for all types of narrative measures assessed. The predictive relation was evident only with respect to children's later performance on the Math subtest of the PIAT-R (Markwardt, 1998), a finding that proves to be similar to that of Feagans & Appelbaum (1986) described earlier. Moreover, this predictive relation with mathematical achievement was found only for the narrative measures of conjunction use, event content, perspective-shift and mental state reference. It was not found with what might be considered the more syntax- and vocabulary-based measures of MLU, vocabulary diversity and subordinate clause use.

Second, with respect to our question of whether there is something special (i.e., uniquely predictive) about narrative ability as compared with general language ability, the answer from our data is *yes*. When partial correlational analyses were carried out, children's TELD-2 scores (a measure of general language ability) were found to be significantly correlated with the PIAT-R's General information subtest (which is quite similar in semantic content) but not with children's scores on any of the PIAT-R's other subtests, including the Math subtest for which the narrative measures were uniquely predictive. Similarly, in multiple regression analyses, children's conjunction use, event content, perspective-shift and mental state scores, but not their TELD-2 scores, emerged as significant predictors of their PIAT-R Math performance.

We will postpone further discussion of the findings and implications of Part 1 of our study, in order to present a secondary analysis of children's narratives from this study that allowed us to examine in more detail, in a quasi-experimental fashion, whether the type of narrative task influences the relations we observed between narrative ability and mathematical achievement. Recall that when children were presented with the narrative task in this study, before they told the story to the puppet, they were given an opportunity to familiarize themselves with the story. As described above (under 'Procedure: Time 1'), in the What's happening familiarization task the experimenter previewed each page of the story with the child, prompting the child to talk about each page by asking 'What's happening in this picture?' Children's narratives in this What's happening task provided us with a within-subjects control narrative. As this was originally designed as a familiarization task, and not an independent variable, the order of the two narrative tasks was not counterbalanced. Nevertheless, analyses of these stories provides a preliminary means of examining whether different narrative tasks tap a child's narrative abilities to differing extents. For example, the inclusion of more adult prompting per page in the What's happening narrative task could result in

more local descriptions, less coherence across pages, and provide a less sensitive measure of children's actual level of narrative competence, on a measure such as conjunction use, than the Puppet narrative task in which children had to generate the story on their own. This, in turn, could potentially affect the strength of the correlations observed between the narrative task scores and those on the PIAT-R subtests.

In testing children in this study, it was clear that they enjoyed the task of telling the story to the naïve puppet more than responding to the experimenter's prompt to discuss what was happening on each page. Indeed, the original Puppet narrative task was designed to be maximally engaging to children. This difference in engagement level might have also translated into differences with respect to how sensitively each task tapped a child's narrative ability, perhaps most so for aspects of perspective-taking that might be more likely to arise in more involved tellings of the story. It should be noted, however, that we did not hypothesize that children's What's happening narratives would be uniformly 'worse' than their narratives told to the puppet. For example, because of the prompting in the What's happening task, children had to attend to each picture and say something about it, which they did not have to do when telling the story to the puppet. This could therefore have led to more complete stories.

The decision was made therefore to transcribe the What's happening narratives of all 41 children who took part at Time 1 and Time 2 and to code these narratives with respect to all the same measures as the Puppet narratives. Our hypothesis was that, given the many reasons to believe that these narratives would *not* capture as sensitively as the Puppet narratives the ability of children to tell a story, children's narrative measures as derived from the What's happening narratives would *not* correlate to the same extent, or would correlate differently, with children's academic achievement. As the participants, procedure, transcription and coding were all identical to that of Part 1, we will proceed directly to the results of this second part of our study.

PART 2: ANALYSIS OF WHAT'S HAPPENING NARRATIVES

RESULTS

Reliability

Two undergraduate research assistants independently scored each transcript with respect to each narrative measure apart from MLU and VOCD. Reliability was excellent. There were no disagreements with respect to children's scores for conjunctions and subordinate clauses. Kappa values were 0.95 for event content and 0.92 for perspective-shift. There were no disagreements with respect to the occurrence of a mental state reference**.** Cases of disagreement were resolved in discussion with the first author.

Table 8 Mean score and standard deviation (SD) for What's happening narrative measures

	Mean score	*SD*
MLU	5.01	1.25
VOCD	30.35_a	12.49
Conjunctions	1.39	1.00
Subordinate clauses	1.34	1.42
Event content	7.61	2.63
Perspective-shift	1.95	1.52
Mental state	4.22_a	3.07

Note. Means with subscript *a* differ significantly from those measured in the Puppet narrative.

Preliminary analyses for sex differences

To identify any significant sex differences, *t*-tests (with a Bonferoni correction applied) were conducted to compare boys' and girls' scores on all seven measures derived from the narratives. No significant sex differences were found for any measure. Thus, all further analyses were conducted on the group of children as a whole.

Descriptive statistics for Time 1 and Time 2 measures

Table 8 shows the mean score and standard deviation for all seven measures derived from children's What's happening narratives. For conjunction use, all children had a score of 3 or under, most often reflecting the use of the three conjunctions 'and', 'but', 'because'. All subordinate clauses produced were nominal or adverbial; no relative clauses were contained in children's stories. Paired *t*-tests were conducted to compare children's scores on each measure for the Puppet versus What's happening measures. *T*-tests revealed only two measures for which children's scores differed at the mean level between the two types of narratives: both their vocabulary diversity (VOCD) and mental state reference scores were significantly higher in the What's happening narratives, $t(35) = 4.67$, $p < 0.001$ and $t(40) = 2.64$, $p < 0.05$, respectively.

Correlational analyses

Zero-order correlations between What's happening narrative measures and PIAT-R subtests

From the zero-order correlations shown in Table 9, the major difference compared with the results of the Puppet narratives (cf. Table 6) was that children's VOCD scores were found to correlate significantly with their performance on all five PIAT-R subtests to a similar extent as their TELD-2 scores. In the analysis of the Puppet narratives, children's

Table 9 Zero-order correlations between What's happening narrative measures and subtests of PIAT-R

	General knowledge	*Reading recognition*	*Reading comprehension*	*Math*	*Spelling*
MLU	–0.02	–0.04	–0.08	0.11	0.09
VOCD	0.41**	0.48**	0.32*	0.52**	0.31*
Conjunctions	0.12	0.22	0.18	0.40**	0.19
Subordinate clauses	0.09	0.11	0.12	0.25	0.17
Event content	0.09	0.26	0.15	0.35*	0.19
Perspective-shift	0.05	0.19	0.14	0.20	0.13
Mental state reference	0.14	–0.04	–0.08	0.11	–0.02

*$p \leq 0.05$, **$p \leq 0.01$

VOCD scores were significantly correlated with only three of the subtests, Math, Reading recognition and Reading comprehension. Two further differences were found when the results of this zero-order correlational analysis were compared with those of the Puppet narratives. First, children's conjunction use scores were found to be significantly correlated with their Math subtest scores which was not previously observed. Second, only children's event content scores, but not their perspective-shift or mental state reference scores, were found to be significantly correlated with their Math subtest scores.

Partial correlations between What's happening narrative measures and PIAT-R subtests

Next we examined the correlations of the What's happening narrative measures with children's scores on each PIAT-R subtest, partialling out their performance in each case on the remaining four subtests, as was done in Part 1 for the Puppet narratives. This analysis provides a clearer picture of the extent to which children's narrative scores were correlated with the unique construct measured by each PIAT-R subtest.

The results of this analysis revealed both similarities and differences compared with the pattern of results found with the zero-order correlations and with the Puppet narratives (see Table 10). First, children's VOCD scores remained positively and significantly correlated with their Reading recognition subtest scores. This was not the case in the partial analysis conducted on the Puppet narrative VOCD scores, where the correlation was not significant. Children's VOCD scores also remained significantly correlated with their Spelling and Reading recognition subtest scores, but the direction of this relation was reversed in a negative direction compared with that observed in the zero-order analysis. Children's VOCD scores were no longer significantly correlated with their Math subtest scores, as was also found in the corresponding analysis of the Puppet narratives. At this point, we do not want to place undue emphasis on this fairly difficult-to-interpret pattern of results with children's VOCD scores, which would require further research and no doubt careful consideration of the types of words being used by children.

Table 10 Partial correlations between What's happening narrative measures and individual subtests of PIAT-R, partialling out the remaining 4 PIAT-R subtests

	General knowledge	*Reading recognition*	*Reading comprehension*	*Math*	*Spelling*
MLU	–0.04	–0.08	–0.04	0.11	0.15
VOCD	0.21	0.44**	–0.34*	0.26	–0.36*
Conjunctions	–0.08	0.00	0.06	0.40*	–0.19
Subordinate clauses	0.00	–0.20	0.17	0.25	0.04
Event content	–0.10	0.23	–0.20	0.22	–0.20
Perspective-shift	–0.06	0.13	–0.09	0.10	–0.11
Mental state reference	0.11	–0.06	–0.01	0.18	–0.04

*$p \leq 0.05$, **$p \leq 0.01$

Second, children's event content scores were no longer significantly correlated with their Math subtest scores. Thus, none of the significant correlations between event content, perspective-shift and mental state reference found in the partial correlation analysis with children's Puppet narratives were observed in this analysis with children's What's happening narratives.

The remaining significant correlation in this analysis did not differ between the narrative tasks – in both cases, children's conjunction use was found to be significantly correlated with their Math subtest score.

Regression analyses

To further analyse the (lack of) predictive relations found between our narrative measures derived from the What's happening narratives and the PIAT-R Math subtest, multiple regression analyses were carried out in which children's scores on all narrative measures, the TELD-2 and the other four remaining PIAT-R subtests were entered as additional predictors. Just as found with the partial analyses, the narrative measure of conjunction use emerged as the only statistically significant ($p = 0.015$) predictor of children's performance on the Math subtest of the PIAT-R.

GENERAL DISCUSSION

The results of Part 1 and 2 of this study strongly support our argument that, when considering the predictive relation between narrative cognition and later academic achievement, both domains need to be differentiated in greater detail in order to understand better the particular component abilities of narrative cognition that may impact performance on one or more areas of academic achievement.

In our study, we considered seven narrative measures – MLU, vocabulary diversity, conjunction use, subordinate clauses, event content, perspective-shift and mental state reference. In addition, we administered the TELD-2 (Hresko *et al.*, 1991) to children to obtain a measure of general language ability in order to examine specifically whether aspects of narrative ability would correlate more strongly with later academic achievement than would a measure of a child's general level of language development. Typically-developing children were the focus, as the relation between narrative ability and academic achievement has not yet been studied in any depth among these children. In addition, academic achievement was assessed in a broader manner than in previous studies: children were administered all five subtests of the PIAT-R (Markwardt, 1998) – General information, Reading recognition, Reading comprehension, Math and Spelling.

The results indeed suggest that certain narrative abilities are more powerful predictors of particular areas of later academic achievement than general language ability as assessed by the TELD-2. That is, when performance on each PIAT-R subtest was considered (controlling for the variance contributed by each of the remaining subtests), children's performance on the TELD-2 was significantly predictive only of their performance on the General information subtest, and not any other subtest assessing specific domains of academic achievement such as reading, spelling or mathematics. This significant correlation was most likely due to the fact that the General information subtest assesses general encyclopedic knowledge and its content is quite similar to the TELD-2, which taps general semantic knowledge in its assessment of language development.

In contrast, the narrative measures of conjunction use, event content, perspective-shift and mental state reference as derived from children's narratives to a puppet were found to be significantly predictive of children's performance on the Math subtest of the PIAT-R in the partial correlation analyses and multiple regression analyses. Our study is not the first to observe a predictive relation between measures of narrative ability and mathematical achievement, but it is the first to do so with typically-developing preschool-aged children. As reviewed in our introduction, Feagans & Appelbaum (1986) found that two clusters of learning-disabled children demonstrating stronger narrative than syntactic or semantic skills at age 6–7 performed better on the Math subtest of the PIAT (Dunn & Markwardt, 1970) given two years later, and on the Math and Reading comprehension subtests given three years later, than children demonstrating weaker narrative skills relative to their syntactic or semantic skills. Their finding can be viewed as consistent with our finding that only children's scores on our narrative measures were uniquely predictive of their Math subtest scores, whereas their TELD-2 scores were not. However, our finding that children's conjunction use scores (one of our syntax measures) were also significantly correlated with their later Math scores appears in contradiction to Feagans & Appelbaum's (1986) findings with respect to syntax measures. One possible explanation for the positive relation we observed with conjunction use is that this measure reflected not only grammatical knowledge but also causal knowledge when children incorporated conjunctions such as 'because' in their narratives. Therefore, it may be that it was use of causal explanation that accounted for the relation we observed. More research is clearly necessary, however, to elucidate the basis of this significant relation between conjunction use and mathematical achievement.

Our study is unique in specifically examining the separate contribution of several

different narrative measures and demonstrating clearly that not all narrative measures hold equal predictive power – in our case, with respect to later Math achievement. Moreover, our results demonstrate the necessity of considering narrative measures in conjunction with the narrative task from which they are derived. Certain narrative tasks may more sensitively tap certain narrative abilities than others. Thus, as we found, the same measures derived from different narrative tasks may demonstrate a weaker or stronger relation to later academic achievement in certain areas. Overall, our results suggest that the more spontaneous Puppet narratives provided a more sensitive measure of a child's ability to convey all the main events of the story (event content) and to offer a perspective on events in the story (perspective-shift and mental state reference). We believe this is due to the greater engagement children demonstrated in telling the stories to the puppet than when responding to the prompts of an adult to talk about each page of the story. Conjunction use appeared to be an element of narrative ability captured to a similar extent in both children's Puppet and What's happening narratives, as it was the only narrative measure to demonstrate a significant correlation with mathematical achievement for both narrative tasks. We would caution, however, that the reason for this may be the very young age of the children in this study and the limited range of conjunctions they produced, which, regardless of narrative task type, tended to be produced to link events at a more local page-to-page level (e.g., starting a page with 'And …'). With older children, a greater range of conjunctions reflecting more sophisticated causal and temporal reasoning abilities (e.g., so, when, before, after) might have been used more differentially across the two tasks, due to developments in connective use already documented by narrative researchers (e.g., Berman, 1996; Peterson & McCabe, 1991).

Our narrative measure of vocabulary diversity (VOCD) was the only measure to demonstrate a significant predictive relation to an area of academic achievement other than mathematics, namely Reading recognition, and to do so as derived from the What's happening narratives. A reasonable explanation for this is that, because of the prompting to discuss each and every page of the picture book in this task, children were forced to talk more, resulting in greater vocabulary use, greater variance in children's scores, and the observed significant correlation with their Reading recognition scores. This finding, indeed, does echo the previous finding of Feagans & Short (1984) who observed a significant correlation between children's total number of words in a story retelling task and their reading achievement as assessed by the PIAT (Dunn & Markwardt, 1970). However, vocabulary diversity could easily be measured outside a narrative task (and indeed perhaps more sensitively so), and thus our finding can also be viewed as consistent with the findings of Snyder & Downey (1991) who concluded that their non-narrative language measures such as word retrieval and sentence completion better accounted for variance in reading scores than their narrative measure assessing the proportion of story propositions recalled. Indeed, the fact that we observed a negative correlation between children's VOCD and Reading comprehension scores, and no significant predictive correlations between all our other narrative measures and children's reading achievement scores is consistent with the previous studies of Menyuk *et al.* (1991) and Snow *et al.* (1995). Nevertheless, it should be kept in mind that our findings pertain to young preschool-aged children with emerging narrative and reading skills, and do not preclude the possibility of significant correlations being

found between these two domains in older children, for whom the measures of narrative and reading being examined (e.g., comprehension) may tap more overlapping abilities (e.g., Feagans & Appelbaum, 1986; Klecan-Aker & Caraway, 1997)

The lack of any significant correlations observed with MLU may be due to the older age of the children in our sample, for whom MLU evaluations may not be as appropriate as for children under 48 months of age (e.g., Klee, Schaffer, May, Membrino & Mougey, 1989). Indeed, some researchers such as Scott (1988), who reviewed measures used to evaluate school-children's narratives, have concluded that broad quantitative measures such as story length or number of utterances are insensitive measures of narrative skill because only small increases are observed over the school-age years despite considerable development in other aspects of narrative ability (e.g., Klecan-Aker & Hedrick, 1985). However, this is a topic of considerable debate, as other researchers have found MLU to correlate highly with children's ages well within the range of our study and beyond (Miller, 1991).

Finally, just as we did not find any narrative measures to be significantly correlated with children's spelling achievement, neither did Snow *et al.* (1995) in the only other study to include a measure of spelling.

We conclude by returning to discuss briefly what we consider to be the most intriguing finding of this study: that there may exist a relation between early preschool narrative abilities – in particular, in our study, the ability to relate the main events of the story through use of conjunctions, to convey the main events of the story, to shift between the actions and perspectives of characters, and to talk about the mental states of characters in the story – and later mathematical achievement. What might account for the significant predictive relation observed between these narrative abilities and mathematical performance? It is clear that much more work needs to be done to understand this relation. However, as mentioned briefly in our introduction, the existence of exactly such a relation has been posited, on theoretical grounds, by Devlin (2000). Devlin distinguishes mathematical ability from arithmetic ability, the latter including number sense (distinguishing and comparing small numerosities), numerical ability (counting) and algorithmic ability (learning sequences of operations on numbers). In contrast, fundamental to mathematical ability, he argues, are the abilities to handle abstraction, cause and effect reasoning, the ability to follow a causal chain of events or facts, logical reasoning ability, spatial reasoning ability and relational reasoning ability. In defining the latter, Devlin (2000: 12) states that 'reasoning about mathematical relationships between mathematical (abstract) objects is no different from reasoning about … human relationships between people'. He proposes that 'the features of the brain that enable us to do mathematics are the very same features that enable us to use language …' (p. 2) and suggests that 'the main activity that prepared the human brain for being able to do mathematics … was keeping track of interpersonal relationships in an increasingly complex society' (p. 3).

We would suggest that one reason why we observed a significant relation between the particular narrative measures and later mathematical achievement is that the design of our study, from the outset, had as its goal to assess in a more sensitive manner children's emerging abilities to capture the actions and reactions of characters interacting in a narrative and to shift their point-of-view and adopt the perspectives of the different characters. Indeed, this was the reason for our decisions to use the *Frog goes to dinner*

story rather than one of the other Mayer stories, to have children tell the story to a 'naïve' puppet, to use the event-content and mental state reference measures, and to develop the perspective-shift measure. In retrospect, given the arguments of Devlin (2000, published after our study was completed), this goal most likely increased our chances of finding the relation that we observed between children's performance on the narrative measures of conjunction use, event content, perspective-shift and mental state reference, and their mathematical performance two years later. In contrast, a similar relation was not found for the narrative measures of MLU and VOCD, we suggest, because these measures did not capture relational reasoning ability to the same (or any) extent.

With respect to our measure of subordinate clause use, we do not make any firm conclusions as to why a significant relation with mathematical achievement was not observed, and whether one could potentially be observed in future research. Only nominal and adverbial subordinate clauses were produced by the children. In the partial correlation analyses we did go one step further and look at the correlations of nominal versus adverbial clauses separately. No significant correlations with any PIAT-R subtest emerged, but for both narrative types the correlation with mathematical achievement was stronger for the use of adverbial clauses (partial correlations in range 0.30–0.32) than the use of nominal clauses (partial correlations in range 0.01–0.13). Adverbial clauses of reason were the most common, reflecting the children's use of 'because' which was also captured in the conjunction use measure. According to the Strong Narrative Assessment Procedure (Strong, 1998), the use of adverbial clauses of reason reflects an understanding of causation. Given the young age of these children, the coding of adverbial reason clauses may just not have been as sensitive a measure of their causal reasoning ability as it might be among older children, for whom we would predict that a relation with mathematical achievement might well be observed with this narrative measure. Indeed, in future research, studies with older children could include assessments of academic achievement at Time 1 and further assessments of general language and narrative ability at Time 2 to explore further the stability of these relations over time. Future work could also address whether there are individual differences bearing on the relation between narrative ability and areas of academic achievement.

Without doubt, this study represents only a first step in the direction of elucidating the relation that may exist between narrative and mathematical cognition. But given that almost all children will or can experience the world of narrative before they begin their journey into the world of mathematical thinking, the possibility that providing children with experience with narrative may later enhance their ability to tackle problems in the mathematical arena is tantalizing, and worthy of exploration. In doing so, we will also come closer, not only to determining whether narrative ability is – as Feagans & Appelbaum (1986) have argued – the most important ability for success in school, and for what domains of academic achievement this may be the case, but, more importantly, *why* this might be the case.

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NOTE

1. Michelle Pearce is now a doctoral student at Yale University. Jennifer Pick is now a masters student at the University of Western Ontario.

REFERENCES

Aram, D. M. & Nation, J. E. (1980). Preschool language disorders and subsequent language and academic difficulties. *Journal of Communication Disorders*, *13*, 159–170.

Astington, J. W. & Jenkins, J. M. (1995). Theory of mind development and social understanding. *Cognition and Emotion, 9,* 151–165.

Balow, I. H. (1993). *Metropolitan Achievement Test – Primary*. Orlando, FL: Harcourt Brace, Inc.

Bamberg, M. & Damrad-Frye, R. (1991). On the ability to provide evaluative comments: Further explorations of children's narrative competencies. *Journal of Child Language*, *18*, 689–710.

Bartsch, K. & Wellman, H. M. (1995). *Children talk about the mind.* Oxford: Oxford University Press.

Berman, R. A. (1996). Form and function in developing narrative abilities. In D. I. Slobin, J. Gerhardt, A. Kyratzis & J. Guo (Eds), *Social interaction, social context, and language: Essays in honor of Susan Ervin-Tripp* (pp. 343–367). Mahwah, NJ: Erlbaum.

Berman, R. A. & Slobin, D. I. (1994). *Relating events in narrative: A crosslinguistic developmental study.* Hillsdale, NJ: Erlbaum.

Bishop, D. V. M. & Edmundson, A. (1987). Language-impaired 4-year-olds: Distinguishing transient from persistant impairment. *Journal of Speech and Hearing Disorders*, *52*, 156–173.

Bokus, B. & Shugar, G. W. (1996). The child as narrator: Choice of content known or unknown to the listener. *Polish Psychological Bulletin*, *27*, 217–230.

Brown, U., Hammill, D. & Weiderholt, J. (1978). *Test of Reading Comprehension: A method of assessing the understanding of written language*. Austin, TX: Pro-Ed.

Bruner, J. (1986). *Actual minds, possible worlds*. Cambridge, MA: Harvard University Press.

Bruner, J. (1990). *Acts of meaning.* Cambridge, MA: Harvard University Press.

Cameron, C. A., Hunt, A. K. & Linton, M. J. (1988). Medium effects on children's story rewriting and story retelling. *First Language*, *8*, 3–18.

Charman, T. & Shmueli-Goetz, Y. (1998). The relationship between theory of mind, language, and narrative discourse: An experimental study. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, *17*, 245–271.

Cohen, R. (1998). Investigating the relationship of attention with general and pragmatic language skills in typically developing preschoolers. Unpublished doctoral dissertation, University of Waterloo, Ontario, Canada.

Denckla, M. & Rudel, R. (1976). 'Rapid automatised naming': Dyslexia differentiated from other reading disabilities. *Neuropsychologia*, *14*, 471–479.

Devlin, K. (2000). *The math gene: How mathematical thinking evolved and how numbers are like gossip.* New York: Basic Books.

Dickinson, D. K. & McCabe, A. (1991). A social interactional account of language and literacy development. In J. Kavanough (Ed.), *The language continuum* (pp. 1–40). Parkton, MD: York Press.

Dunn, L. & Dunn, L. (1981). *Peabody Picture Vocabulary Test – Revised*. Circle Pines, MN: American Guidance.

Dunn, L. M. & Markwardt, F. C. (1970). *Peabody Individual Achievement Test.* Circle Pines, MN: American Guidance Service.

Fazio, B. B., Naremore, R. C. & Connell, P. J. (1996). Tracking children from poverty at risk for specific language impairment: A 3-year longitudinal study. *Journal of Speech and Hearing Research*, *39*, 611–624.

Feagans, L. (1982). The development and importance of narratives for school adaptation. In L. Feagans & D. C. Farran (Eds), *The language of children reared in poverty* (pp. 95–116). New York: Academic Press.

Feagans, L. & Appelbaum, M. I. (1986). Validation of language subtypes in learning disabled children. *Journal of Experimental Psychology*, *78*, 358–364.

Feagans, L. & Short, E. J. (1984). Developmental differences in the comprehension and production of narratives by reading-disabled and normally achieving children. *Child Development*, *55*, 1727–1736.

Fox, R. (1991). Developing awareness of mind reflected in children's narrative writing. *British Journal of Developmental Psychology*, *9*, 281–298.

Gee, J. P. (1991). Memory and myth: A perspective on narrative. In A. McCabe & P. Peterson (Eds), *Developing narrative structure* (pp. 1–25). Hillsdale, NJ: Erlbaum.

Geva, E. & Olson, D. (1983). Children's story-retelling. *First Language*, *4*, 85–110.

Gray, W. & Robinson, T. (1963). *Gray's Oral Reading Test.* Los Angeles, CA: Western Psychological Services.

Hemphill, L., Picardi, N. & Tager-Flusberg, H. (1991). Narrative as an index of communicative competence in mildly retarded children. *Applied Psycholinguistics*, *12*, 263–279.

Hewitt, L. E. & Duchan, J. F. (1995). Subjectivity in children's fictional narrative. *Topics in Language Disorders*, *15*, 1–15.

Hieronymus, A. N., Hoover, H. D. & Lindquist, E. F. (1986). *Iowa Tests of Basic Skills.* Chicago, IL: Riverside.

Hresko, W. F., Reid, D. K. & Hammill, D. (1991). *Test of Early Language Development – 2nd edition*. Austin, TX: Pro-Ed.

Jastak, S. & Jastak, S. (1976). *Wide Range Achievement Test*. Wilmington, DE: Guidance Associates.

Jastak, S. & Wilkinson, G. (1984). *Wide Range Achievement Test – Revised.* Wilmington, DL: Jastak Associates, Inc.

Jenkins, J. M. & Astington, J. W. (2000). Theory of mind and social behavior: Causal models tested in a longitudinal study. *Merrill-Palmer Quarterly*, *46*, 203–220.

Kirk, S., McCarthy, J. & Kirk, W. (1968). *Illinois Test of Psycholinguistic Ability*. Urbana, IL: University of Illinois Press.

Klecan-Aker, J. S. & Caraway, T. H. (1997). A study of the relationship of storytelling ability and reading comprehension in fourth and sixth grade African-American children. *European Journal of Disorders of Communication*, *32*, 109–25.

Klecan-Aker, J. S. & Hedrick, D. L. (1985). A study of the syntactic language skills of normal school-age children. *Language, Speech, & Hearing Services in Schools*, *16*, 187–198.

Klee, T., Schaffer, M., May, S., Membrino, I. & Mougey, K. (1989). A comparison of the age-MLU relation in normal and specifically language-impaired preschool children. *Journal of Speech and Hearing Disorders*, *54*, 226–233.

Liles, B. Z. (1993). Narrative discourse in children with language disorders and children with

normal language: A critical review of the literature. *Journal of Speech and Hearing Research*, *36*, 868–882.
MacWhinney, B. (1995). *The Childes Project: Tools for analyzing talk* (2nd ed.). Hillsdale, NJ: Erlbaum.
MacWhinney, B. & Snow, C. (1985). The Child Language Data Exchange System. *Journal of Child Language*, *12*, 271–296.
MacWhinney, B. & Snow, C. (1990). The Child Language Data Exchange System: An update. *Journal of Child Language*, *17*, 457–472.
Markwardt, F. C. (1998). *Peabody Individual Achievement Test – Revised.* (Normative update). Circle Pines, MN: American Guidance Service.
Mason, J. & Stewart, J. (1989). *Early Childhood Diagnostic Instrument.* Iowa City, IA: American Testronics.
Mayer, M. (1967). *A boy, a dog and a frog*. New York, NY: Dial Press.
Mayer, M. (1969). *Frog, where are you?* New York, NY: Dial Press.
Mayer, M. (1974). *Frog goes to dinner*. New York, NY: Dial Press.
McCabe, A. & Rollins, P. R. (1994). Assessment of preschool narrative skills. *American Journal of Speech-Language Pathology*, *3*, 45–56.
McKee, G., Malvern, D. & Richards, B. (2000). Measuring vocabulary diversity using dedicated software. *Literary and Linguistic Computing*, *15*, 323–337.
Menig-Peterson, C. & McCabe, A. (1978). Children's orientation of a listener to the context of their narratives. *Developmental Psychology*, *14*, 582–592.
Menyuk, P., Chesnick, M., Liebergott, J. W., Korngold, B., D'Agostino, R. & Belanger, A. (1991). Predicting reading problems in at-risk children. *Journal of Speech and Hearing Research*, *34*, 893–903.
Miller, J. F. (1991). Quantifying productive language disorders. In J. F. Miller (Ed.), *Research on child language disorders: A decade of progress* (pp. 211–220). Austin, TX: Pro-Ed.
Newcomer, P. & Hammill, D. (1982). *The Test of Oral Language Development – Primary.* Austin, TX: Pro-Ed.
Newcomer, P. & Hammill, D. (1988). *The Test of Oral Language Development – 2 Primary.* Austin, TX: Pro-Ed.
O'Neill, D. K. & Holmes, A. (2002). Young preschoolers' ability to reference story characters: The contribution of gesture and character speech. *First Language*, *22*, 73–103.
Orum, L. (1986). *The education of Hispanics: status and implications.* Washington, DC: National Council of La Raza.
Owens, R. F. (1995). *Language disorders: A functional approach to assessment and intervention.* Needham Heights, MA: Allyn & Bacon.
Paul, R. (1995). *Language disorders from infancy through adolescence: Assessment and intervention*. St Louis, MI: Mosby.
Pelligrini, A. D. (1982). The construction of cohesive text by preschoolers in two play contexts. *Discourse Processes*, *5*, 101–108.
Peterson, C. & McCabe, A. (1983). *Developmental psycholinguistics: Three ways of looking at a child's narrative*. New York: Plenum Press.
Peterson, C. & McCabe, A. (1991). Linking children's connective use and narrative macrostructure. In A. McCabe & C. Peterson (Eds), *Developing narrative structure* (p. 29–53). Hillsdale, NJ: Erlbaum.
Reilly, J. S. (1992). How to tell a good story: The intersection of language and affect in children's narratives. *Journal of Narrative and Life History*, *2*, 355–377.
Richner, E. S. & Nicolopoulou, A. (2001). The narrative construction of differing conceptions of the person in the development of young children's social understanding. *Early Education and Development*, *12*, 393–432.
Roth, F. P., Speece, D. L., Cooper, D. H. & De La Paz, S. (1996). Unresolved mysteries: How do

metalinguistic and narrative skills connect with early reading? *The Journal of Special Education*, *30*, 257–277.
Scott, C. M. (1988). A perspective on the evaluation of school children's narratives. *Language, Speech, and Hearing Services in Schools*, *19*, 51–66.
Shapiro, L. R. & Hudson, J. A. (1991). Tell me a make-believe story: Coherence and cohesion in young children's picture-elicted narratives. *Developmental Psychology*, *27*, 960–974.
Snow, C. E., Tabors, P. O., Nicholson, P. A. & Kurland, B. F. (1995). SHELL: Oral language and early literacy skills in kindergarten and first-grade children. *Journal of Research in Childhood Education*, *10*, 37–48.
Snyder, L. S. & Downey, D. M. (1991). The language-reading relationship in normal and reading-disabled children. *Journal of Speech and Hearing Research*, *34*, 129–140.
Stein, N. & Glenn, C. (1979). An analysis of story comprehension in elementary school children. In R. O. Freedle (Ed.), *New directions in discourse processing* (pp. 53–120). Norwood, NJ: Ablex.
Strong, C. J. (1998). *The Strong Narrative Assessment Procedure*. Eau Claire, WI: Thinking Publications.
Tager-Flusberg, H. (1995). Once upon a ribbit: Stories narrated by autistic children. *British Journal of Developmental Psychology*, *13*, 45–59.
Wechsler, D. (1974). *Wechsler Intelligence Scale for Children – Revised*. New York: Psychological Corporation.
Westby, C. (1984). Development of narrative language abilities. In G. Wallach & K. Butler (Eds), *Language learning disabilities in school-age children* (pp. 103–127). Baltimore, MA: Williams & Wilkins.
Wiederholt, J. & Bryant, B. (1986). *Gray Oral Reading Test*. Austin, TX: Pro-Ed.
Wiig, E. & Semel, E. (1980). *The Clinical Evaluation of Language Function*. Columbus, OH: Charles C. Merrill.
Wolf, D. & Hicks, D. (1989). The voices within narratives: The development of intertextuality in young children's stories. *Discourse Processes*, *12*, 329–351.

APPENDIX A

Synopsis of abridged version of *Frog goes to dinner*

A boy and his family arrive at a fancy restaurant, with the boy's pet frog in his pocket. While the family is ordering dinner, the frog jumps out of the boys' pocket and into the saxophone of a musician playing with a band in the restaurant. The musician tries to blow, but can't, and looks into his saxophone to see what is inside. The frog falls out onto the musician's head, and the musician falls backwards into the drum of the drummer in the band. The frog jumps away into a salad being carried by a waiter. The waiter hands the salad to a lady diner, unaware that the frog is inside the salad and, as the woman is eating the salad, the frog peeks out from under the salad. The woman reacts with great surprise, falling backwards in her chair, and then yells at the manager. The waiter catches the frog and proceeds to take the frog outside. The boy asks for his frog back and is given it back, but the waiter orders the family to leave the restaurant. In the car on the way home, the boy's father, mother and sister are all very angry with him. Once they are at home, the father tells the boy to go to his room. In his room, the boy and the frog laugh about what happened.

Note. Each sentence describes one of the 12 pages of the story. Omitted was one further episode involving the frog and another couple that takes place while the woman is yelling at the manager. Omitting this episode did not reduce the comprehensibility or coherence of the story.

APPENDIX B

Description of the first 30 PIAT-R Math subtest items

PIAT-R item no.	*Item description*
1	Visual match of written number 9 to one of 4 numbers
2	Identify shorter
3	Identify tallest
4	Count and recognize numeral 3
5	Identify square
6	Identify clock as object telling time
7	Identify triangle
8	Word problem: 2+1 (identify 3 objects as answer in picture)
9	Word problem: 3–1 (identify 2 objects as answer in picture)
10	Count and recognize numeral 6
11	Recognize 'thirteen' as numeral 13
12	Recognize numeral 7 as being between 6 and 8
13	Count number of eggs to fill carton
14	Identify a dime
15	Count third in line
16	Identify birthday cake for youngest child
17	Count to seventh letter
18	Identify bar in graph representing 'the most'
19	Recognize numeral 7 as number of days/week
20	Word problem: 9–5 = (identify 4)
21	Word problem: 10+7 = (identify 17)
22	Word problem: 6+2 = (identify 8)
23	Count and recognize numeral 6
24	Recognize five pennies equals one nickel
25	Identify time from traditional clock face
26	Recognize 782 as being between 728 and 836
27	Recognize amount of dimes and nickels
28	Word problem: 5+X = 12 (identify 7)
29	Recognize numeral 3752
30	Word problem: (5×10)+4 = (identify 54)

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