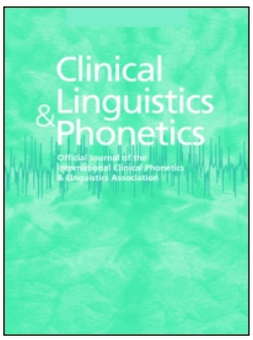

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Narrative abilities of Mandarin-speaking children with and without specific language impairment: macrostructure and microstructure

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ABSTRACT

This study analyzed narratives from 18 Mandarin-speaking children with specific language impairment (SLI) and 18 typically developing children matched on chronological age. The narrative data were based on *Frog, where are you?* Participant's narratives were analyzed at the macrostructure and microstructure levels. Regarding the macrostructure, the results revealed that the narratives of children with SLI included significantly less story grammar components, less evaluative comments, and were less coherent than those of TD controls. With respect to the microstructure, the two groups of children exhibited no significant differences in measures such as story length, syntactic complexity, and use of conjunctions; on the other hand, the SLI group employed significantly less variety of words. The outcomes underscore the merit of conducting a wide array of macrostructural measures in narratives, and evince the potential of the causal network model to assess the macrostructure of narratives in SLI. Overall, this study demonstrated the utility of macrostructure and lexical diversity in differentiating Mandarin-speaking children with and without SLI.

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SLI; narrative; macrostructure and microstructure; Mandarin-speaking children

People of all ages represent experience in their lives through narratives. Because narrative discourse requires the integration of social-emotional, cognitive, and linguistic abilities, it has been seen as a useful means to observe strengths and weaknesses of individuals with varied developmental challenges (Justice et al., 2006; Reilly, Losh, Bellugi, & Wulfeck, 2004). Many studies of specific language impairment (SLI, now also known as Developmental Language Disorder) have been conducted with children speaking Indo-European languages (e.g., English: Colozzo, Gillam, Wood, Schnell, & Johnston, 2011; Dutch: Duinmeijer, de Jong, & Scheper, 2012; Greek: Tsimpli, Peristeri, & Andreou, 2016). However, the narrative abilities of children with SLI speaking Mandarin Chinese, a typologically different language, are relatively underexplored. To understand more about Mandarins-speaking children with SLI, the current study aimed to examine their narrative abilities at both macro- and micro-structural levels.

Narrative abilities in children with SLI

Children with SLI, characterized by a marked impairment in developing language, despite normal non-verbal IQ and neurological function, present weaknesses in many language

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domains, including lexical, phonological, and pragmatic abilities (Leonard, 2014). These language problems have been carried over into their narrative production. As noted in previous research (Manhardt & Rescorla, 2002; Merritt & Liles, 1987), children with SLI display difficulties in constructing oral narratives at macrostructural and/or microstructural levels. The macrostructure draws upon temporal or causal relations to build the global structure of the plot line that integrates information about characters, events, and activities into a coherent whole. The microstructure concerns a more local level of language measures such as lexical diversity, syntactic complexity and inter-sentential cohesion.

Macrostructure

A number of studies have documented a poorer macrostructure of narratives of children with SLI, in comparison to typically-developing (TD) children, as evidenced by fewer story elements, fewer complete episodes, or fewer evaluative comments (e.g, Duinmeijer et al., 2012; Liles, 1987; Manhardt & Rescorla, 2002; Merritt & Liles, 1987; Olley, 1989), while other studies (e.g., Boudreau & Hedberg, 1999; Kaderavek & Sulzby, 2000; Norbury & Bishop, 2003; Tsimpli et al., 2016) noted that SLI and TD children do not differ significantly on macrostructural measures.

Most of the studies on narratives and SLI measured macrostructure in terms of episodic components based on Stein and Glenn's (1979) story grammar (SG), which represents a conceptual framework underlying narrative comprehension and production. The SG framework specifies essential parts of a story and relations among them. According to the framework, a well-formed story contains six main parts, including setting, initiation, internal response, attempt, outcome, and reaction. The SG-based studies, however, yielded inconsistent results. Some studies (e.g., Manhardt & Rescorla, 2002; Merritt & Liles, 1987; Olley, 1989) revealed that children with SLI produced significantly fewer SG components than the TD children did, whereas others (e.g., Boudreau & Hedberg, 1999; Kaderavek & Sulzby, 2000; Norbury & Bishop, 2003) reported no significant differences in SG components between the SLI and TD groups.

Closer scrutiny of these studies, however, revealed variations in analytic metrics and elicitation tasks employed. Regarding metrics, for instance, Merritt and Liles's SG metric comprised six story components, while Kaderavek and Sulzby used a proto-story-grammar consisted of only three story components. It is plausible that the proto-story-grammar might be insufficiently complex to reflect the language-impaired children's limitation in macrostructure, and thus rendered the performance of the two groups seemingly comparable. With respect to elicitation tasks, the studies (e.g., Manhardt & Rescorla, 2002; Olley, 1989) that supported the SG analysis mostly employed story generation tasks. On the other hand, several studies (Boudreau & Hedberg, 1999; Kaderavek & Sulzby, 2000) that identified no significant differences on SG measurement used retell or emergent reading tasks, which are considered less cognitively and linguistically demanding than the story-generation tasks (Pearce, James, & McCormack, 2010). As such, further research is needed to explore the sensitivity of the SG analysis to language impairment by stipulating more SG components in metrics and using more complex tasks.

Narratives relate a series of actions and events temporally and causally. As Graesser, Golding, and Long (1991) stated, the predictions of SG about narrative structures could

mostly be explained by world knowledge such as causality. The importance of causal connectedness in narratives gains further support in Tomai, Thapa, Gordon, and Kang's (2011) corpus-based study of TD children's oral narratives, which revealed that the narrative events mentioned in story retelling are mostly causally significant. Recently, Fichman, Altman, Voloskovich, Armon-Lotem, and Walters (2017) examined narratives of children with SLI by analyzing not only SG components but causal relations between these components. They suggested that causal relations would be a more sensitive indicator than SG measures in distinguishing children with SLI from TD children. More noteworthy, they proposed that the analyses on causal relations within and across episodes should be included in the investigation of macrostructure.

To investigate causal relations among story events, Trabasso and Sperry's (1985) causal network model could be a potentially useful tool. According to the model, a causal network assesses causal connectedness among information in a narrative by means of causal chains and causal connections, examining causal connectivity within and across episodes, and taking into account both explicit and implicit causal relations. A causal chain refers to the sequence of events that form the gist of a story; a causal connection is established between a pair of story events. Rather than being confined to semantic relations between propositions, causal relations are inferred based on the criterion of necessity (Hart & Honoré, 1985; detailed explanation in Section 4.4). Research has shown that, compared with SG measures, causal networks serve as a more sensitive window revealing how narratives are comprehended, represented, and recalled (Trabasso & Sperry, 1985; Trabasso & van den Broek, 1985; Trabasso, van den Broek, & Suh, 1989; for a comprehensive review, see Cevasco & van den Broek, 2019). In addition, this model has been used in the intervention research of struggling readers (e.g., McMaster, Espin, & van den Broek, 2014), and applied to assess narrative coherence in children with and without developmental disorders (Diehl, Bennetto, & Young, 2006; Sah, 2015; Sah & Torng, 2015). In light of these, it would be informative to explore whether the causal network model could distinguish children with SLI from TD children.

Another integral part of narrative is evaluation, which provides elaboration of narrative content and interprets the causal links among story events. In addition, evaluative comments reflect a narrator's perspective on the significance of an event, and serve as a means to maintain listeners' attention (Bamberg & Damrad-Frye, 1991; Labov & Waletzky, 1967). In spite of its significance, the use of evaluation is seldom examined in children with SLI.

Among the rare endeavors, Manhardt and Rescorla (2002), and Reilly et al. (2004) reported that children with SLI used significantly fewer evaluative devices than did TD children, whereas Norbury and Bishop (2003) noted that the two groups were comparable in this regard. Although all three studies used the same picture book, *Frog, where are you?* (Mayer, 1969), to elicit children's storytelling during story generation tasks, there exist several methodological variations that might contribute to the inconsistent results. To begin with, Manhardt and Rescorla focused on children at ages 8 and 9; however, the participants covered wider age ranges in Reilly et al.'s (ages 3–12), and Norbury and Bishop's (ages 6–10) studies. The coverage of wide age ranges is likely to increase the heterogeneity of the SLI and comparison groups; moreover, the changes in narrative abilities over the long course of narrative development would be potential confounding factors. The issue is further complicated by different metrics for measuring evaluation across studies. Manhardt and Rescorla, and Norbury and Bishop adopted Bamberg and

Damrad-Frye's (1991) five-category coding scheme (including frames of mind, character speech, hedges, negative comments, and causal conjunctions), whereas Reilly et al. used a more elaborated system by including additional devices like various types of attention getters (e.g., exclamations) and intensifiers (e.g., the emphatic marker 'very' in 'The boy is very, very sad'). It leads us to speculate whether a more fine-grained examination such as the latter would be more effective at distinguishing children with SLI from TD peers. Another issue is that it is unclear whether the above-mentioned studies were consistent in contextual constraints of the story-telling tasks, as presence or absence of shared knowledge and joint attention between children and experimenters would have potential impacts on the narrative performance of children with and without language impairment (Liles, 1985). As can be seen, more research is required to address these issues.

Microstructure

Research has shown that SLI children were distinguishable from TD children by measures of microstructure, such as lexicon, syntax, and cohesion, independently of macrostructure. Accumulated research across languages has suggested that lexical diversity be a sensitive marker of SLI (e.g, for English: Boudreau & Hedberg, 1999; Hewitt, Hammer, Yont, & Tomblin, 2005; for Cantonese: Klee, Stokes, Wong, Fletcher, & Gavin, 2005; for Greek: Tsimpli et al., 2016; for children with various bilingual statuses: Rezzonico et al., 2015). With respect to syntax, existing evidence suggests that children with SLI have reduced syntactic complexity (Boudreau & Hedberg, 1999; Colozzo et al., 2011; Manhardt & Rescorla, 2002; Norbury & Bishop, 2003; Reilly et al., 2004). In addition, syntactic complexity has been found positively related to evaluation and story components, respectively (Colozzo et al., 2011; Manhardt & Rescorla, 2002; Norbury & Bishop, 2003).

Most studies on cohesion and SLI followed Halliday and Hasan's (1976) framework and identified five types of cohesive ties, including reference, ellipsis, conjunction, substitution, and lexis. Analysis based on this full range of cohesive ties revealed that children with SLI had less effective use of cohesion as compared to TD controls (Baltaxe & D'Angiola, 1992; Liles, 1985; Liles, Duffy, Merritt, & Purcell, 1995). However, not all these types of cohesive ties are equally sensitive in distinguishing SLI from TD (Baltaxe & D'Angiola, 1992). Specifically, reference (e.g., *he* and *you*) and conjunction (e.g., *and* and *but*) were found to be preferred over other types in narratives of children with and without language impairment (Liles, 1985). Following this, several studies with SLI (e.g., Adams & Bishop, 1989; Norbury & Bishop, 2003; Pearce et al., 2010) indexed cohesion solely based on reference ties; however, relatively less attention in the literature has been given to the use of conjunction words in SLI.

Although Liles (1987) suggested that measures of cohesive conjunctions can differentiate the SLI and TD groups, Baltaxe and D'Angiola (1992) did not find significant differences between the two groups in this regard. These studies, however, may be not directly comparable due to methodological variations. For one thing, they differed in subject selection criteria (age-matched in Liles versus language-matched in Baltaxe and D'Angiola). For another, the language samples were elicited by different types of discourse tasks (a story-telling task in Liles versus conversation in a play setting in Baltaxe and D'Angiola). A further report is of note. Tribushinina, Dubinkina, and Sanders (2015) also found that the SLI and TD groups were comparable in the number of conjunctions used.

Nevertheless, their analysis was confined to only two additive conjunction words, rather than examining all the subtypes of conjunctions (i.e., additive, causative, adversative, and temporal conjunctions). It is therefore uncertain whether the insensitivity of conjunctions to SLI would be attributable to the limited instances in their language sample. In view of all these, it is not conclusive whether children with SLI have deficits in using conjunctions in narratives.

Narrative abilities of Mandarin-speaking children with SLI

A growing body of research on narratives and SLI has focused on children speaking Indo-European languages (e.g., English: Boudreau & Hedberg, 1999; Colozzo et al., 2011; Manhardt & Rescorla, 2002; Merritt & Liles, 1987; Norbury & Bishop, 2003; Dutch: Duinmeijer et al., 2012; Greek: Tsimpli et al., 2016). However, as the official language of the world's most populous nation, Mandarin Chinese is relatively under-explored in the realm of SLI (Leonard, 2014).

Linguistic features of Mandarin Chinese and narrative measures in SLI

There are some linguistic features that make Mandarin Chinese an interesting testing ground to advance our knowledge of narrative abilities in SLI. First, Mandarin is abundant in homonymous and polysemous words. For instance, the word *zhìfú* 'conquer' in *zhìfú dírén* 'conquer the enemy' and *zhìfú* 'uniform' in *xīn zhìfú* 'new uniform' are homographs and homonyms. For another instance, the word *tōngzhī* 'notice' in *fā tōngzhī* 'send a notice' and *tōngzhī* 'notify' in *tōngzhī tóngshì* 'notify colleagues' are homographs and homophones, representing the associated meanings of a polysemous word. Second, unlike languages such as English or French, morphological markings of case and gender distinctions are not obligatory for person pronouns in Mandarin. In spoken Mandarin, for instance, the same pronoun *tā* can be used to refer to male and female genders, and for subject and object case roles. Third, without verb conjugations, Mandarin marks aspectual distinctions by means of aspect markers, such as *le, zhe*, and *guo*, which are often used repeatedly in discourse (Wu, Huang, & Tsai, 2019). Jointly, these features might obscure the variety of words children produced and render lexical diversity underestimated. Fourth, previous studies with English speakers (e.g., Reilly et al., 2004) included coordinate sentences in syntactic measures. However, as Haspelmath (2004) indicated, the characteristic of zero-marking in Mandarin renders the accurate identification of coordination rather difficult. This thus leads us to speculate whether syntactic complexity would be sensitive to the presence of SLI in Mandarin, and, equally intriguingly, whether it would be related to the macrostructural measures, as revealed in previous research (Colozzo et al., 2011; Manhardt & Rescorla, 2002; Norbury & Bishop, 2003). Finally, languages like English use causal conjunctions, such as *because*, as the canonical device to indicate causality and to achieve coherence (Schiffrin, 1987). However, as Chang and Su (2012), and Sah (2015) noted, when the causal relation between utterances is self-evident, Mandarin speakers tend not to mark the relation explicitly with a causal conjunction. Similarly, when marking temporality, Mandarin speakers are more likely to rely on discourse-pragmatic contexts than to use temporal conjunctions (Huang, 2003). Given

such discourse preferences, it would be interesting to test whether the use of conjunctions can distinguish Mandarin-speaking children with and without SLI.

Previous studies on Mandarin SLI

Previous studies (e.g., Chen & Liu, 2014; Chien, 2006; He & Yu, 2013; Zhang, 2011) on Mandarin SLI have looked at children's language abilities from aspects such as word learning, and phonological as well as syntactic processing. Among the studies, Chien (2006) reported that children with SLI showed limited vocabulary size; He and Yu (2013) revealed the language-impaired children's difficulty in processing relative clauses. Because these studies were restricted to the sentential level, it is uncertain whether the observed difficulties would also manifest in the extended discourse of this population.

To our knowledge, four studies (Cheung, 2009; Hao et al., 2018; Tsai & Chang, 2008; Zhang, 2013) have particularly focused on the extended discourse produced by Mandarin-speaking children with SLI. To begin with, Cheung (2009) observed two SLI children and two TD children matched on MLU scores, and examined children's abilities in using microstructural features such as classifiers and complex sentences in free-play contexts. Different from the literature on SLI children speaking western languages, he found that children with SLI were more advanced than TD controls in using complex sentences. This unexpected result, as Cheung explained, indicates that the feasibility of using MLU as a matching criterion in studies of Chinese SLI needs to be reconsidered. More comprehensive investigations of narrative abilities in SLI were conducted by Tsai and Chang (2008), and Zhang (2013), which looked at both macrostructural and microstructural features, despite excluding syntactic complexity. Both studies reported that children with SLI scored significantly worse than TD children in measures of story components, evaluation, lexical diversity, and conjunctions, which are in accordance with previous studies (e.g., Duinmeijer et al., 2012; Liles, 1987; Manhardt & Rescorla, 2002; Reilly et al., 2004; Tsimpli et al., 2016). A similar picture of group differences in story components and lexical diversity was displayed by Hao et al.'s (2018). Nevertheless, Tsai and Chang's and Zhang's findings of significant group differences in story length are somewhat in contrast to Hao et al.'s research and several studies on English SLI (Boudreau & Hedberg, 1999; Norbury & Bishop, 2003). Care should be taken in comparing the results here, as there are differences in narrative genres across studies (personal narratives in Tsai & Chang, and Zhang; fictional narratives in Hao et al., Boudreau & Hedberg, and Norbury & Bishop). Perhaps more noteworthy, findings for syntactic complexity in Hao et al. and Cheung are contradictory. Inconsistent as this may seem, these two studies, however, are not directly comparable. One issue resides in the methodological variations in elicitation tasks and matching criteria (language-matched in Cheung versus age-matched in Hao et al.) selected by the two studies. The other issue is that Hao et al. did not state specifically what syntactic structure were included in the metric, rendering comparison between studies unfeasible. In view of the mixed results, more studies are necessary to advance our knowledge of narrative abilities of Mandarin-speaking children with SLI.

In brief, previous studies have endeavored to understand whether children with SLI have problems at the macro- and/or micro-structural levels. At the macrostructural level, though the results from different studies are somewhat contradictory, particularly given

variability in methodological choice, comparisons across studies suggest that comprehensive scoring metrics and demanding elicitation tasks, such as story-generation tasks, would be more likely to capture the insufficiency of SLI concerning SG components and evaluation. Additionally, examining causal relations in terms of causal networks would be warranted for understanding narrative abilities of children with SLI. At the microstructural level, the literature on SLI children speaking western languages has shown that lexical diversity and syntactic complexity seem sensitive to the presence of SLI. On the other hand, the impacts of the linguistic characteristics of Mandarin on the sensitivity of the microstructural measures are unclear; moreover, studies on Mandarin SLI have yielded mixed results concerning story length and syntactic complexity. These all warrant further investigation.

Purpose of the study

Prior studies have led to some unresolved questions and interesting speculations concerning narrative abilities in SLI. To replicate and extend previous findings, the current study examined narratives measures at the macrostructural and microstructural levels. The primary goal was to explore whether the narrative measures can differentiate Mandarin-speaking children with and without SLI. The other major goal was to examine the relationships between narrative measures within/across the two levels. Specific questions to be addressed include:

(1) Do Mandarin-speaking children with SLI and TD children differ significantly on macrostructural measures of SG component, causal network, and evaluation?
(2) Do the two groups of children differ significantly on microstructural measures of story length, lexical diversity, syntactic complexity, and conjunction?
(3) What is the relationship among these narrative measures?

Method

Participants

Two groups of Mandarin-speaking children participated in this study, including 18 children with SLI (ages 4;11–5;10) and 18 TD children (ages 4;11–5;10) matched on chronological age, with 13 boys and 5 girls per group. All children attended the last year of regular kindergarten at the start of the study, and were required to score above 80 on the Test of Nonverbal Intelligence-3rd edition (TONI-3) (Chinese version; Wu et al., 2006).

To understand children's language abilities, we administered one norm-referenced test: the Language Impairment Checklist for Preschool Children-Revised (LICPC-R[1]; Lin, Huang, Huang, & Xuang, 2008). To be included in the study, the children with SLI were required

[1]LICPC–R has been widely used for clinical screening and assessment in Taiwan. As an individually administered test, LICPC–R assesses receptive and expressive language abilities for children ages 3;5 to 5;11. The reliability of LICPC–R was estimated based on internal consistency, test-retest stability, and inter-scorer decision agreement. Its reliabilities of internal consistency range from .81 to .96; the test-retest correlation ranges from .92 to .98; inter-scorer agreement is .96. The validity scores based on the internal structure are .93 and .95.

to score lower than 1.25 SD below the mean for their chronological age on the language development index and on two performance subtests (Receptive Language Test and Expressive Language Test); the TD children scored 1SD above the age mean. The SLI group achieved significantly lower scores than the TD group on all language measures at the $p < .05$ level. All participants were required to pass a pure-tone hearing screening at 20 dB HL at 500, 1000, 2000, and 4000 Hz in each ear. They had no history of intellectual or learning disability, and were absence of neurological, sensory, or emotional disorder. Prior to testing, informed consent was obtained from all parents and participants. Table 1 lists the participant details.

Material

To control the content of narratives, we used a wordless picture book *Frog, where are you?* (Mayer, 1969) to elicit a narrative from each participant. This book was chosen because it has been widely used to tap narrative abilities of not only TD children from different language backgrounds (Berman & Slobin, 1994), but also a variety of developmentally disordered populations (e.g., Norbury & Bishop, 2003; Reilly et al., 2004). In particular, much of the prior research (e.g., Boudreau & Hedberg, 1999; Manhardt & Rescorla, 2002; Norbury & Bishop, 2003; Pearce et al., 2010) on narrative abilities and SLI has collected narrative data based on this book.

Data collection

The data-collecting session was carried out individually with each participant. A generation task that employed *Frog, Where are You*? was used to collect narrative data. The generation task was chosen here because it was found to be more challenging, as compared to other tasks like story-retelling, and thus would offer a better indication of differences between the SLI and comparison groups (Pearce et al., 2010).

Prior to the story-telling, the experimenter told the participant that she had no knowledge about the particular story book. The participant and the experimenter sat face to face across a table, and only the participant had privileged access to pictures of the book. The participant first looked through the entire book and then told the story aloud, turning the pages as he/she went along. The story was audio- and video-recorded and subsequently transcribed.

Data analysis

Transcription

Children's narratives were transcribed verbatim from recordings by following the transcription format in Human Analysis of Transcripts (CHAT) of the Child Language Data

Table 1. Participant characteristics.

	SLI (N = 18) M (SD)	TD (N = 18) M (SD)
Chronological age	5.37 (0.34)	5.30 (0.34)
TONI-3	89.56 (6.06)	98.06 (7.17)
Receptive language	5.94 (4.63)	57.72 (17.07)
Expressive language	7.94 (6.44)	48.22 (11.14)
Language development	5.28 (5.17)	55.39 (11.83)

Exchange System (CHILDES; MacWhinney, 2000). The transcriptions were then divided into utterances by using prosodic features as segmentation cues. The reason to choose utterances, rather than C-units or T-units, is that prosodic features have been considered more useful than syntactic features in determining boundaries of sentences in the Chinese discourse (Chao, 1968; Tsai & Chang, 2008; To, Stokes, Cheung, & T'sou, 2010). Words within utterances were segmented by following Cheung's (1998) guidelines. Further analyses were conducted in terms of macro- and micro-structural aspects, as detailed below.

SG component

The macrostructure structure in participants' stories was first evaluated based on Trabasso and Rodkin's (1994) adaptation of the SG framework (Stein & Glenn, 1979). Fifteen SG components were identified in the frog story, including two setting components (i.e., introducing the frog and its relationship with the boy), five initiation components (i.e., the frog's escape, the boy's sleep, wake-up, cognizance, and affective response), seven components of attempts (i.e., search for the frog in the bedroom, out of the window, outside the house, in the hole on the ground, in the tree hole, on the top of the rock, and over the log), and one outcome component (i.e., finding the frog or taking it home). This yielded a maximum total score of 15 for each narrative.

Causal network

The causal networks of narratives were measured in terms of causal chains and causal connections (Trabasso & Sperry, 1985). A causal chain refers to a sequence of events that form the gist of a story; therefore, peripheral events (e.g., 'The angry bees attacked the dog') were excluded in the computation of causal chains. A causal connection between a pair of events was identified based on the criterion of necessity which stipulates the test of necessity by using the counterfactual argument of the form: If not A then not B (Hart & Honore, 1985). For instance, in the story, Event A is 'The dog broke the pottery'; the ensuing Event B is 'The boy was mad at the dog.' If the dog had not broken the pottery, the boy would not be mat at the dog. Here, Event A is a cause of, or a condition for, Event B, and thus the two events were judged as causally connected. In the Appendix, each number represents one story event. Circled numbers are the causal-chain events, and arrows represent the causal connections between events. As illustrated, some events have many connections, while other have few or none. For instance, Event 14, 'Then he wants to find someone,' is causally related to Events 15, 19, 25, 33, 42, and 43, presenting search of the frog in many places. This indicates that Event 14 is central to the plot of the story. To obtain densities for the two indices, we divided the total number of causal-chain events and causal connections in each story by the total number of utterances in that story, respectively.

Evaluation

Adapted from previous studies of evaluation (Chang, 2000; Manhardt & Rescorla, 2002; Norbury & Bishop, 2003; Peterson & McCabe, 1983), and developed from the collected data, seven types of evaluative devices were identified in this study, including:

a. Frames of mind, which are expressions referring to characters' affective or cognitive states (e.g., happy, sad, amazed, wondering, finding).

b. Words per se, which are of themselves evaluative (e.g., funny, ugly, accidentally).
c. Negative comments, which reflect that the character's expectation was not met in the situation, as in 'He almost hit the deer'.
d. Hedges, which are a distancing device used to indicate uncertainty, such as the word *probably* in 'The frog is probably under the bed'.
e. Character speech, which includes direct (e.g., 'The boy said, "Doggie, come down now"') and indirect speech (e.g., 'The boy told the dog to leave the beehive').
f. Causal conjunctions, which are used to provide causal links between story events. For instance, 'The boy went to the forest because he wanted to search for the escaped frog.'
g. Attention getters, which include exclamations, sound effects and other phrases used to capture listeners' attention, as in 'Look at that!' or 'Bang! Bang! It was dead'.

Following Reilly et al. (2004), this study used proportion scores to report the use of evaluation, which was obtained by dividing the total number of evaluative devices used in a story by the total number of utterances in that story.

Story length & lexical diversity

For each narrative, the total number of utterances was tallied to index story length, and the number of different words was computed as an index of lexical diversity.

Syntactic complexity

Following previous studies (Cheung, 2009; Li & Thompson, 1981; Lin, 2011b), we identified complex sentences based on six syntactic structures, including relative clause, clausal complement, serial verb construction, pivotal construction, *ba* construction, and *bei* construction. It should be noted that Hao et al. (2018) treated *ba* and *be* as markers of active and passive sentences, respectively, and thus did not categorize the resulting constructions as complex sentences. In contrast, Her (2009) and Huang (1999) have argued that *ba* and *be* are in fact verbs, rather than markers or prepositions. In light of this, the present study regarded *ba* and *be* as verbs, and categorized the *ba* and *bei* constructions as complex sentences. To index syntactic complexity, we divided the total number of complex sentences by the number of utterances in the story to yield a proportional score. Examples for complex sentences are provided as below:

a. Relative clause
guànzǐ lǐ de qīngwā pǎo chūlái
'The frog that was in the jar came out.'
b. Clausal complement
tā fāxiàn qīngwā bùjiàn le
'He found that the frog was gone.'
c. Serial verb construction
xiǎo nánhái pǎo qù zhǎo
'Little boy ran (and) looked for.'
d. Pivotal construction
xiǎo nánhái ràng gǒu pǎo qù wàimiàn
'The little boy let the dog go outside.'

e. *ba* construction
lù bǎ xiǎoháishuāi xiàqù
'The deer threw the child down.'
f. *bei* construction
xiǎogǒu bèi mìfēng zhuī
'The dog was chased by the bees.'

Conjunction

Conjunction words were coded if they link linguistic units by encoding a logical relation such as causality (e.g., *yīnwéi* 'because', *suǒyǐ* 'so'), concession (e.g. *jǐnguǎn* 'although'), hypotheticality (e.g., *rúguǒ … jiù …* 'if … then'), addition (e.g., *háiyǒu* 'and'), and temporality (e.g., *zuìhòu* 'finally'). Discourse markers such as *ránhòu* 'and then' were not included in the analysis if they failed to represent a logical relation unambiguously. The use of conjunctions was assessed based on proportion scores which were obtained by dividing the total number of conjunctions in a story by the total number of utterances in that story.

Reliability

Two trained research assistants, who were blind to group status, independently coded all narratives based on clearly specified coding schemes. Fifteen percent of the narratives were randomly selected with equal representation from both groups for reliability checks. Reliability for each narrative measure was calculated in terms of the total number of agreements divided by the number of agreements plus disagreements. Disagreements were resolved through discussion among the coders and the second author. No reliability score was obtained for lexical diversity, which was generated by the Computerized Language Analysis program (CLAN) of CHILDES. The inter-coder reliability for all other measures exceeded 88%: 90% for SG component, 88% for causal-chain event, 90% for causal connection, 94% for evaluation, 88% for complex sentence, and 91% for conjunction.

Results

To understand the narrative skills of children with and without SLI, a between-group analysis of variance (ANOVA) was applied to all comparisons. For measures indexed in proportion scores, arc sine transformations were first carried out on the percentage data to normalize the distribution.

Macrostructure

Results from the ANOVA displayed significant group effect in scores of SG components, with the SLI group presenting significantly fewer SG components than the TD group did, $F(1, 34) = 23.48$, $p < .001$, $\eta^2 = .41$). Means were 4.22 ($SD = 2.73$) and 9.22 ($SD = 3.49$) for the SLI and TD groups, respectively. Table 2 presents numbers and proportions of participants encoding each SG component. Both groups were equally likely to introduce the frog at the very beginning (88.89%), though more TD children elaborated the relationship between the frog and the boy-protagonist (16.67% for SLI versus 66.67% for TD). Among the initiating events, the boy's sleep, and the frog's escape received most attention from both groups, whereas the boy's affective response was the least mentioned component (5.56% for SLI,

Table 2. Number (N) and proportion (%) of participants, by SG component and group.

	SLI (N = 18)		TD (N = 18)	
SG Component	N	%	N	%
Setting				
Introduce frog	16	88.89	16	88.89
Relationship	3	16.67	12	66.67
Initiation				
Boy sleeps	9	50.00	14	77.78
Frog escapes	9	50.00	17	94.44
Boy wakes up	3	16.67	10	55.56
Boy notices	6	33.33	14	77.78
Boy responds	1	5.56	4	22.22
Attempt (Search episodes)				
In the bedroom	1	5.56	6	33.33
Out of the window	3	16.67	3	16.67
Outside the house	0	0.00	4	22.22
Hole on the ground	2	11.11	4	22.22
In a tree hole	1	5.56	9	50.00
On the rock	0	0.00	4	22.22
Over the log	0	0.00	1	5.56
Outcome				
Find the frog	11	61.11	13	72.22

% relative to total number of participants

22.22% for TD). In addition, compared with the SLI group, the TD group was more likely to delineate the boy's cognizance of the frog's disappearance (33.33% for SLI versus 77.78% for TD). More noteworthy, in comparison with setting, initiation, and outcome, the search episodes which illustrate the protagonist's attempts to solve the problem were much less noted by both groups of children.

Table 3 presents means and densities for causal-chain events, causal connections, and evaluative devices. Compared with the TD group, the SLI group produced significantly fewer causal-chain events ($F(1, 34) = 21.72$, $p < .001$, $\eta^2 = .39$), and fewer causal connections ($F(1, 34) = 28.45$, $p < .001$, $\eta^2 = .46$), suggesting that the causal network model can distinguish the groups in terms of the causal connectedness of narrative information. A significant group effect was also detected for evaluation, displaying that the SLI group used significantly fewer evaluative devices than did the TD group, $F(1, 34) = 12.06$, $p = .001$, $\eta^2 = .26$.

Examples 1 and 2 illustrate the differences between SLI and TD children in elaborating the deer episode of the story. In this episode, to search for his lost pet frog, the boy climbs onto a rock and holds onto a deer's antlers which are mistaken for tree branches. The deer carries the boy, who gets stuck on its antlers, and heads to the edge of a cliff, with the dog

Table 3. Macrostructural measures: Causal-chain event, causal connection, and evaluative device.

	SLI (N = 18)		TD (N = 18)	
	M (SD)	%	M (SD)	%
Causal-chain events	6.28(3.85)	15.31	12.67(4.17)	28.76
Causal connections	8.61(5.86)	20.77	20.22(8.23)	45.22
Evaluative devices	28.17(16.15)	43.27	38.94(12.79)	69.34

chasing after. The deer throws them both into a pond. The deer episode has been regarded as the most complicated episode of the story, a successful interpretation for which is expected to elaborate the transition from the tree branches to the deer's antlers by referring to the boy's misconception (Berman & Slobin, 1994).

As shown in Example 1, the child with SLI wrongly interpreted that the boy wanted to find a moose, and he merely stated that the moose let the boy and the dog fall into the water (line 5), without explaining what motivated it to do so. Similarly, in Example 2, the TD child, CHR, did not mention the transition from the tree branches to the deer's antlers. Despite this, he revealed that the boy's unintentional act (i.e., unto the deer's head) led to the consequence (i.e., falling into a river), and enhanced the causal relation by providing an evaluative comment *hěn shēngqì* 'very angry' (line 4). He further referred to the deer's act by stating *bǎ tā shuǎi dào hé lǐmiàn* 'throw him into the river' (line 5). This is a more specific and vivid elaboration of the deer's behavior than that shown in Example 1 (line 5: *ràng tāmen diào dào shuǐ lǐmiàn* 'lets them fall into the water'). Aside from the causal explanation, CHR employed character speech (line 1), another evaluative device, to add expressive flavor at the start of this episode. Though both children were unsuccessful in interpreting the misconception involved, the TD child's use of evaluative devices renders his elaboration more expressive than that from the SLI peer.

Example 1: LJB, SLI child

1 *tā yīzhí zhǎo*
'He keeps searching for (the frog).'
2 *xiǎngyào zhǎodào yī gè mílù*
'(He) wants to find a moose.' 3 *mílù yīzhí zǒu zǒu zǒu*
'(The) moose keeps walking, walking, and walking.'
4 *zǒudào yī gè shuǐshàng*
'(It) walks to somewhere above the water.'z
5 *nàgè mílù jiéguǒ jiù ràng tāmen diào dào shuǐ lǐmiàn*
'That moose, therefore, lets them fall into the water.'

Example 2: CHR, TD child

1 *tā zài pǎo qù shítóu shàngmiàn jiào "xiǎo qīngwā! xiǎo qīngwā!"*
'He then climbs onto a rock calling out, "Little frog! Little frog!"'
2 *tā pǎo dào yī gè dìfāng*
'He runs to a place.'
3 *pǎo dào mílù de shàngmiàn*
'(He) runs onto a moose.'
4 *jiéguǒ mílù hěn shēngqì dé pǎo pǎo pǎo*
'Therefore, (the) moose gets very angry and (it) runs, and runs, and runs.'
5 *bǎ tā - bǎ tā - bǎ tā shuǎi dào hé lǐmiàn qù*
'Get him-get him-(It) throws him into a river.'

Table 4 presents the distribution of different types of evaluative devices for each group. Within both groups, 'frames of mind' and 'words per se' were used more frequently than

Table 4. Mean (SD) and proportion (%) of evaluative devices, by group.

	SLI (N = 18)		TD (N = 18)	
	M (SD)	%	M (SD)	%
Frames of mind	11.17(4.51)	39.64	11.17(4.00)	28.67
Words per se	8.06(8.39)	28.60	21.11(10.27)	54.21
Character speech	4.72(6.10)	16.77	2.83(2.92)	7.28
Negative comments	2.11(2.30)	7.50	1.89(1.18)	4.85
Attention getters	1.61(2.38)	5.72	1.61(1.61)	4.14
Causal conjunctions	0.50(0.79)	1.78	0.17(0.51)	0.43
Hedges	0(0)	0.00	0.17(0.51)	0.43

% relative to total number of evaluative devices

other types (39.64% and 28.60 for SLI, 28.67% and 54.21% for TD). Interestingly, while over one third of the evaluative devices employed by the SLI group were references to frames of minds, the TD children preferred to use words per se to illustrate their viewpoint. In contrast, causal conjunctions and hedges were used markedly less often by both groups.

Put together, the above-mentioned results revealed that the narratives of children with SLI were less complete, less coherent, and with fewer evaluative comments.

Microstructure

Table 5 presents the frequencies or proportions for microstructural measures. Results from the ANOVA displayed significant group effect in lexical diversity, indicating that the SLI group produced less variety of words than their TD peers did. Except for this, no significant differences between groups were detected for story length, syntactic complexity, or conjunctions, suggesting that the two groups performed comparably in these aspects.

Relationships between narrative measures

Finally, Pearson correlation was used to examine relationships between narrative measures. Table 6 reports Pearson correlation coefficients for all measures. For both groups, there was a relationship between SG component and causal connection (SLI: $r = .78$, $p < .01$; TD: $r = .63$, $p < .01$) at the macrostructural level, such that higher scores on SG components were associated with a higher number of causal connections in narratives. At the microstructural level, a positive correlation was found between story length and lexical diversity for each group (SLI: $r = .90$, $p < .01$; TD: $r = .81$, $p < .01$). In other words, longer stories were associated with a wider variety of words. Regarding relationships between macro- and micro-structural levels, in both groups, no correlations were found between

Table 5. Microstructural measures: Number of utterances, number of different words, complex sentences, and conjunctions.

	SLI (N = 18) M (SD)	TD (N = 18) M (SD)	*F*	*p*	$\eta^2_{partial}$
Number of utterances	62.33 (14.32)	57.72 (10.89)	1.18	.29	.03
Number of different words	99.83 (27.90)	119 (19.75)	5.66*	.02	.01
Complex sentences (%)	16.13 (10.50)	16.07 (6.23)	0.01	.91	.00
Conjunctions (%)	0.53 (1.24)	1.44 (1.52)	3.25	.08	.09

*p < .05

Table 6. Correlation matrix for macrostructural and microstructural measures.

SLI	SG	CCE	CC	EVA	SL	LD	SC	CON
SG	–							
CCE	.69**	–						
CC	.78**	.71**	–					
EVA	.34	−.01	.09	–				
SL	.40	.24	.41	.48*	–			
LD	.46	.36	.38	.62**	.90**	–		
SC	.05	−.22	−.16	.59*	.37	.48*	–	
CON	.09	.05	.13	.04	−.14	−.21	−.07	–
TD	SG	CCE	CC	EVA	SL	LD	SC	CON
SG	–	.34	.63**	.23	.39	.24	.59*	.12
CCE		–	.79**	.54*	−.36	−.21	.07	.17
CC			–	.28	−.04	.01	.14	.28
EVA				–	−.41	−.22	.02	.09
SL					–	.81**	.55*	.15
LD						–	.50*	.07
SC							–	.21
CON								–

SG, SG component; CCE, causal-chain event; CC, causal connection; EVA, evaluation; SL, story length; LD, lexical diversity; SC, syntactic complexity; CON, conjunction.
* $p < .05$; ** $p < .01$

causal network and any of the microstructural measures. Interestingly, correlations were found in the SLI group between evaluation and each of the three microstructural measures, namely story length, lexical diversity, and syntactic complexity; however, this did not appear to be the case in the TD group.

Discussion

This study analyzed narratives at macrostructural and microstructural levels in an attempt to distinguish children with SLI from TD controls. The results demonstrated that all three macrostructural measures were sensitive to the presence of SLI in Mandarin children, while lexical diversity was the only microstructural measure that can serve as a sensitive indicator.

Macrostructure

To begin with, the overall SG scores demonstrated that the SLI group performed more poorly than the TD group did. This is indeed the impairment many investigators have revealed about SLI (Manhardt & Rescorla, 2002; Merritt & Liles, 1987; Olley, 1989). On the other hand, this finding is inconsistent with studies (Boudreau & Hedberg, 1999; Kaderavek & Sulzby, 2000; Norbury & Bishop, 2003) that reported no significant differences in SG components between SLI and TD groups.

This inconsistency in SG performance may arise from the methodological variations in scoring metrics and elicitation tasks. Regarding metrics, first, Kaderavek and Sulzby used a proto-story-grammar metric consisted of beginning, middle, and end. The beginning part incorporates the setting and initiation parts of our SG scheme, while the middle and end parts correspond to attempt and outcome, respectively. If our narrative sample was examined in terms of Kaderavek and Sulzby's metric, a comparable performance between groups would also emerge, because both groups did well in the beginning and end parts,

but poorly in the middle part (Table 2). In contrast, the fifteen-point metric of the current study revealed substantial differences between groups. Therefore, it is likely that the proto-story-grammar metric might be too lenient to reflect the differences between SLI and TD children. Second, Norbury and Bishop's (2003) six-point SG-metric is comparatively stricter than Kaderavek & Sulzby's metric, but it also seems insufficiently complex to reflect the limitation of children with SLI. To illustrate, Norbury and Bishop's metric assigned two points in total to the mention of search episodes of the frog story (i.e., the attempts). Based on this, one point was assigned for the mention of any one of the seven search episodes, while only one extra point would be assigned for the reference of an additional one up to six search episodes. As such, the metric may not be sensitive enough to capture how well a child could elaborate the protagonist's attempts and is thus unlikely to effectively assess the completeness of the narrative. Regarding elicitation tasks, though Boudreau and Hedberg (1999) and the present work are both frog-story based and used equally comprehensive metrics for story components, the results were based on different narrative tasks. Specifically, the retelling task in Boudreau and Hedberg (1999) seemed less demanding and thus less likely to elicit differences between SLI and TD, as compared to the generation task used here (Pearce et al., 2010). Considered together, the lenient metrics of analysis, and the less-demanding task might induce a potential ceiling effect that enabled both groups of children to easily reach the maximum performance in the SG measurement, rendering their performances comparable. It is plausible that the SG analysis would demonstrate its distinguishing power when more SG components are stipulated in metrics, and when it is applied to more demanding narrative tasks. Further empirical inquiry is required to test this hypothesis.

Equally intriguingly, the distribution of SG components suggested that, the attempts seemed to pose challenges for both groups, as compared to setting, initiation, and outcome. This result provides additional support to Sah's (2013) finding that, compared with older children and adults, 5-year-olds were less able to provide satisfactory elaboration for the search episodes of the frog story. To successfully elaborate the search episodes, as Sah explained, an individual needs to infer the protagonist's goals and plans for problem-solving, and continues to encode new attempts as the story unfolded until the problem is solved. From this view, children of the current study were not fully competent in elaborating the attempts, it would be illuminating to follow these children up into adolescence to gain more insights into their ability in this regard and to trace if children with SLI and TD children have different developmental trajectories.

Following Fichman et al.'s (2017) line of inquiry, we analyzed causal relations in terms of causal networks. The results showed that the SLI group produced less causal-chain events and less causal connections than the TD group did, revealing the difficulties of children with SLI in constructing the plotline and in maintaining overall coherence. It should be noted that Fichman et al's narrative sample was based on stories of three episodes, while we used a more complex story consisting of seven episodes. The results obtained here illustrate how story events were causally interconnected in a complex story and provide additional evidence for Fichman et al's argument that children with SLI are impaired in linking narrative events causally. Put another way, our analysis revealed that the language-impaired children's limitations are not only in marking SG components, but in forging underlying causal relations.

With respect to evaluation, this study demonstrated that, compared with the TD group, the SLI group used significantly fewer evaluative devices. This finding is in support of prior

research of Manhardt and Rescorla (2002) and Reilly et al. (2004), but is inconsistent with Norbury and Bishop (2003) observation. The inconsistent findings between Norbury and Bishop's study and the present one may be relevant to differences in the metrics involved. To explicate, Norbury and Bishop adopted a five-category system to measure the use of evaluation, while our metric comprised seven categories, with the above-mentioned five categories as part of our research interest. As can be seen, the metric used here is comparatively more comprehensive because it encompasses a larger range of information. Presumably, this would be more likely to reflect children's limitations in providing evaluative comments. This warrants further investigation. Of note, we elicited narratives in the situation that the experimenter and participants did not share knowledge of the story. As narrators' provision of elaboration may be relevant to contextual constraints such as the presence or absence of shared knowledge, it would be necessary for future research to look at the impact of shared knowledge on the use of evaluation in SLI.

Microstructure

Consistent with previous studies (Boudreau & Hedberg, 1999; Norbury & Bishop, 2003), the two groups of children were comparable in story length. On the other hand, significant difference between groups was found in lexical diversity, with the SLI group using significantly less diverse vocabulary than the TD group did. Considered together, findings for these two measures support Hao et al.'s (2018) argument that lexical diversity is more likely to reflect language deficits in SLI than productivity measures such as story length. Of equal importance, the result of lexical diversity replicates previous findings across different languages (e.g., English: Boudreau & Hedberg, 1999; Hewitt et al., 2005; Cantonese: Klee et al., 2005; Mandarin: Hao et al., 2018; Tsai & Chang, 2008; children with various bilingual statuses: Rezzonico et al., 2015), suggesting that this measure is a useful indicator of SLI.

One surprising finding concerns the similarity in syntactic complexity of the two groups of children. This result contrasts with findings of most existing studies (e.g., Cheung, 2009; Colozzo et al., 2011; Hao et al., 2018; Manhardt & Rescorla, 2002; Norbury & Bishop, 2003; Reilly et al., 2004) that found children with SLI performed more poorly than TD children. Closer scrutiny across studies suggests several plausible explanations for the inconsistent results. First, the reduced syntactic complexity reported in previous studies was mostly based on narrative samples of Indo-European languages like English. However, English and Mandarin Chinese are typologically distinct. For instance, English tense is normally indicated by verb conjugations; in contrast, Mandarin has no grammaticalized tense. English is subject-prominent and head-initial, while Mandarin is topic-prominent and head-final. This difference in head positions renders Chinese relative clauses shorter and reduced in structural complexity, as compared to the English counterparts (Lin, 2011a). Given these, it is unfeasible to assume that syntactic complexity would also be a sensitive marker of Mandarin SLI. Second, there are variations in the ways syntactic complexity was measured across studies. For instance, coordination was used by Reilly et al. (2004) and Colozzo et al. (2011) to index syntactic complexity; in contrast, it was excluded in the present study because of the characteristic of zero-marking in Mandarin. The inclusion/exclusion of serial verb constructions is

another issue. Serial verb constructions constitute an important structure to score in Mandarin; however, they were excluded from the metric of the English data.

Third, regarding Mandarin SLI, Cheung (2009) observed that children with SLI performed better in using complex syntax than did the TD children, Hao et al. (2018) found a reverse pattern, while our finding is not consistent with either of them. These results, however, may not be directly comparable because of methodological variations. For one, the studies selected comparison groups based on different criteria (language-matched in Cheung versus age-matched in Hao et al. and in our study). For another, different metrics of complex sentences were employed across studies. For instance, we regarded *ba* and *bei* structures as complex syntax, whereas Hao et al. categorized them as distinct microstructural features other than complex sentences. Moreover, Hao et al. did not state specifically what syntactic structures were included in the metric, which also renders the comparisons across studies unlikely. As seen above, more informative answers are needed about the ability of Mandarin SLI to use complex syntactic structures in narratives.

As was the case with syntactic complexity, the two groups of children did not differ in numbers of conjunctions. This finding supports previous findings (Baltaxe & D'Angiola, 1992; Tribushinina et al., 2015) that frequencies of conjunctions do not function as a marker of SLI. On the other hand, though also based on Mandarin SLI, our finding is inconsistent with the results of Tsai and Chang (2008), and Zhang (2013). It should be pointed out that the language samples of these two studies were based on personal experiences, while ours were elicited in a more structured storybook context. This raises questions concerning whether the findings obtained in the less structured narrative context, such as narrating personal experiences, may be extended to the more structured one and vice versa (Losh & Capps, 2003). It will be of interest for future work to explore the nature and scope of the interactions between narrative contexts and narrative performance in SLI. Comparison across studies is further complicated by differences in the ways conjunctions were measured. For instance, Tsai and Chang, and Zhang scored discourse markers like *ránhòu* 'then'; in contrast, we excluded such terms in the analysis. In view of these and the limited research by far, it is not conclusive whether Mandarin SLI have deficits in using conjunctions in narratives. Clearly, more studies are needed to address this issue.

Alternatively, the findings of comparable abilities of the two groups to employ conjunctions may be relevant to the discourse preference reported in the literature indicating that explicit linguistic forms may not be the first choice for Mandarin speakers to mark causality or temporality (Chang & Su, 2012; Huang, 2003; Sah, 2015). Such a discourse preference for other means over explicit linguistic expressions may presumably lead to the scarce instances of conjunctions found in this study, and thus limit the statistical power to detect group differences. Compared with cohesive conjunction, causal network, which examines implicitly as well as explicitly marked connections between adjacent and non-adjacent events, appears to be a better marker of Mandarin SLI. This study thus extends previous research (Diehl et al., 2006; Sah & Torng, 2015) by demonstrating the merit of the causal network model in differentiating narrative abilities of children with and without language impairments.

Relationships between narrative measures

Aside from examining individual narrative measure, this study also looked at relationships between these measures. On the one hand, we noted that some correlations are rather informative. For instance, at the macrostructural level, positive correlations were found for both groups between SG components and causal connections, displaying that a well-developed sense of story structure was associated with one's ability to convey underlying causal relations. Across the macro- and micro-structural levels, evaluation was related to syntactic complexity in the SLI group, which is consistent with previous studies (Manhardt & Rescorla, 2002; Norbury & Bishop, 2003). Another positive correlation was detected between evaluation and lexical diversity, also only for the SLI group. Taken together, the results suggest perhaps the use of evaluation would benefit from well-developed lexical and syntactic abilities. In other words, better linguistic abilities would equip the language-impaired children with necessary means to express their viewpoints in narrating stories.

On the other hand, our results provide an interesting picture of dissociations in narrative abilities. First, the language-impaired children's abilities at macrostructural and microstructural levels seemed dissociable. For instance, they showed deficits in constructing causal networks of narratives but good performance in using conjunctions, suggesting a dissociation between the ability to achieve narrative coherence and that to mark cohesive ties. Additional support to this came from the correlation analysis that yielded no correlation between the two measures. Second, dissociations were also found among microstructural measures. One possible interpretation is to relate the observed dissociations to processing difficulties in SLI, such as limitations in processing capacity and in verbal working memory (Leonard et al., 2007; Miller, Kail, Leonard, & Tomblin, 2001). As previous studies (Colozzo et al., 2011; Fichman et al., 2017) suggested, children with SLI may have limited resources to cope with the complexity of a narrative task. When processing capacity is inadequate for the task, efforts made in one aspect of narrative performance may constrain attempts elsewhere. It is, therefore, possible that children with SLI showed comparable performances in story length, syntactic complexity, and conjunctions, while they struggled with lexical diversity. Intriguing as this processing account may seem, it is beyond the scope of the current discussion and warrants further investigation.

Implications and limitations

As reported above, this study displayed that story macrostructure and lexical diversity might be specific areas of underachievement for Mandarin children with SLI. These are also the areas that clinicians should directly target. Specifically, therapeutic activities can focus on supporting children to organize essential story components, to develop coherent stories based on causal relations, and to learn a wider variety of words. Equally importantly, children's skill of evaluation would benefit from extended instructions that guide them to express their viewpoints by using more diverse vocabulary.

Although this study provided interesting observations about narrative abilities of children with SLI, two limitations are worth mentioning. First, differences in selection criteria for SLI and control children might have led to different results across studies. This consideration invites caution when drawing conclusions based on only comparisons

between SLI and age-matched controls. Future research will be beneficial to include both language- and age-matched controls to gain a clearer picture about the narrative abilities in SLI. This may also help to determine whether narrative deficits in SLI arise from immaturities or core linguistic deficits. Second, questions have been raised concerning whether the outcomes obtained within one specific narrative context could be generalized to other types of narrative contexts. To understand whether our results would be definitive, future studies will have to assess a wide range of narrative contexts to illuminate the challenges to children with SLI posed by different social interactions.

Conclusions

To recapitulate, with this work we examined macro- and micro-structure in oral narratives of Mandarin-speaking children with SLI and age-matched TD children. The SLI children demonstrated poorer performances in all three macrostructural measures, while the only microstructural measure that the SLI group had difficulty with was lexical diversity. Equally intriguingly, the results suggest that the causal network model provides an alternative for assessing macrostructure of narratives in SLI. Overall, this study showed the utility of macrostructure and lexical diversity in differentiating Mandarin-speaking preschool children with and without SLI.

Conflicts of interest

The authors declared no potential conflicts of interest.

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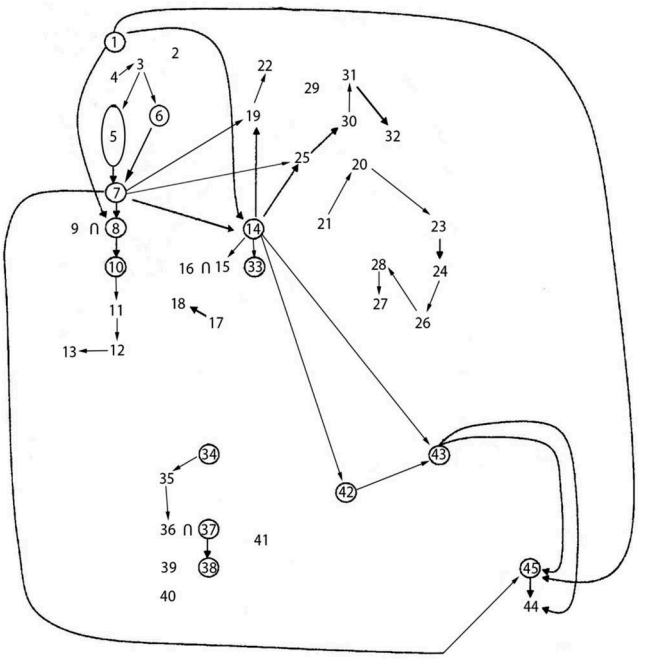
Appendix

The causal network and story events of the story narrated by one TD child.



Note: Each number in the map represents one story event. Circled numbers are the causal-chain events; arrows between events stand for causal connections; arches connect co-occurring events. The corresponding events are presented below.

1. xiǎo nánhái yǒu yī gè qīngwā
   'A little boy has a frog.'
2. qīngwā kāixīn de zuò zài nàlǐ
   'The frog was sitting there happily.'
3. ránhòu xiǎogǒu hěn nánguò dé shuō "qīngwā guān zài zhèlǐ yīdìng huì sǐ de"
   'Then the dog said sadly, "The frog is going to die if (we) keep it here."'
4. "yě méiyǒu hūxī de dìfāng"
   '"And there's no room (for it) to breathe."'
5. ránhòu qīngwā jiù tōutōu pǎozǒu le
   'Then the frog sneaks out.'
6. ránhòu tāmen qǐchuáng kàn píngzǐ
   'Then they wake up and look at the jar.'
7. qīngwā bùjiàn le
   'The frog is gone.'
8. tāmen jiù xié zǐ zhǎoyīzhǎo
   'They look into (their) shoes.'
9. kàn yǐzǐ háiyǒu chuáng xià
   '(They) look at the chair and under the bed.'
10. ránhòu tāmen jiù yīzhí zài jiào qīngwā

'Then they keep calling for the frog.'
11. tā jiù dòng
'It moves.'
12. tā diàoxiàqù
'It falls down.'
13. tā diàoxià zhīhòu dǎpò le bōlí
'It falls and breaks the jar.'
14. ránhòu tā yào qù zhǎorén le
'Then he wants to find someone.'
15. tāmen jiù yīzhí jiào
'They keep calling.'
16. jiào nà yīgè xiǎo qīngwā
'(They) call for that little frog.'
17. ránhòu mìfēng fēi fēi lái fēi qù
'Then bees fly and fly around.'
18. fēidào zìjǐ de jiā le
'(They) fly back to their own home.'
19. jiéguǒ xiǎo nánhái zhǎo dòng
'Then the little boy looks into (a) hole.'
20. xiǎogǒu zài zhǎo mìfēngwō
'The dog is looking for the bee hive.'
21. nàgè xiǎogǒu jiù shì yòu bèi dīng de
'That dog then gets stung.'
22. xiǎo nánhái bèi yǎo le
'The little boy gets bitten.'
23. xiǎogǒu jiào tāmen
'The dog barks at them.'
24. mìfēng jiù shēngqì dì yào dīng tā
'The bees get angry and want to sting it.'
25. dào zuìhòu xiǎo nánhái yào qù shùdòng zhǎo
'In the end the little boy wants to search (inside) a tree hole.'
26. mìfēng xiǎngyào dīng xiǎogǒu
'The bees want to sting the dog.'
27. xiǎogǒu méiyǒu dīng dào
'The dog does not get stung.'
28. tā jiù pǎo hěn kuài
'It runs very fast.'
29. ránhòu xiǎo nánhái jiù tǎng zhe
'Then the little boy lies down.'
30. tā jiù yùdào yī gè māotóuyīng
'He runs into an owl.'
31. māotóuyīng jiù yào zhuā tā de shíhòu
'When the owl wants to catch him,'
32. tā jiù dūnxiàlái
'he squats down.'
33. pádào yī gè shítóu shàngmiàn zhǎo
'(He) climbs onto a rock to look for (the frog).'
34. tā dào yī gè shù lù shàng
'He gets onto a tree, a deer.'
35. lù jiù dài tā qù yī gè dìfāng
'The deer carries him to a place,'
36. qù tuī xiǎogǒu xiàqù
'to push the dog down.'
37. ránhòu tā jiù shuǎi shuǎi xiǎo nánhái xiàqù

'Then it throws, throws the little boy down there.'
38. diàodào shuǐ lǐmiàn
'(He) falls down into the water.'
39. tā jiù yǐwéi shì yǐwéi shì shēn de shuǐ
'He then thinks, thinks that the water is deep.'
40. háihǎo shì qiǎn de shuǐ
'(It) turns out to be shallow water.'
41. tā jiù shuō xiǎogǒu ānjìng
'He tells the dog to be quiet.'
42. dào zuìhòu tā jiù tōukàn hòumiàn de mùtóu
'In the end, he peeks over the log behind,'
43. zhǎo dào tāmen liǎng gè
'finds them both.'
44. tā jiù gēn tāmen shuō bāibāi
'He then says goodbye to them.'
45. ránhòu zhè yī gè nánshēng de qīngwā jiù dàizǒu le
'Then this boy's frog is brought away.'