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Comprehension of definite expressions by Mandarin-speaking children with suspected developmental language disorder (DLD) and children with autism spectrum disorder and language impairment (ALI)

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An increasing number of studies have shown that there is a subgroup inside children with autism spectrum disorder (ASD) who demonstrates impaired language profiles similar to children with developmental language disorder (DLD). As a discriminative marker, the determiner element is known to be particularly vulnerable in children with DLD, while less is known about the situation in children with ASD who show accompanying language impairment (ALI). The current study therefore investigates whether and how Mandarin-speaking children with DLD and children with ALI differ in their comprehension of definite expressions.

To this end, 28 children with suspected DLD (*Mean* = 5;2, SD = 0;7), 32 children with ALI (*Mean* = 5;3, SD = 0;8), and 28 typically-developing children (*Mean* = 5;3, SD = 0;5) participated in the study. Each child was experimentally tested on a series of picture judgment tasks, in which demonstrative-classifier NPs, third-person pronouns, and bare NPs were examined in the anaphoric environment.

The findings showed that neither of the suspected DLD or ALI groups performed at target-like levels on the three definite expressions. This is most likely caused by the two groups' immature knowledge of the syntax-semantics interface within the DP construction. Nonetheless, there remains a significant difference in the interpretation of third-person pronouns between the suspected DLD and ALI groups, with the worse performance in the latter group presumably resulting from co-occurring processing differences typical of individuals with ASD.

1 Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and interaction, as well as presence of stereotypical and repetitive behaviors and interests (DSM-5) (American Psychiatric Association 2013); however, the language development in children with ASD is heterogenous (Schaeffer et al. 2023): some present normal language, while others either show impaired or minimal language, and even those who have normal intelligence do not develop their language abilities equally. In this case, special attention should be given to the subgroup of children with ASD who present additional language impairment (ALI) while exhibiting normal intelligence, since they are likely to show a language profile that is similar to another developmental disorder, namely the developmental language disorder (DLD)[1] (Tomblin 2011; Tager-Flusberg 2015; Durrleman & Delage 2016). Children with DLD, by definition, are characterized by deficits in language abilities while remaining intact in hearing, neurological status, and non-verbal intelligence (Leonard 2014: 3). The seemingly similar language phenotypes of ALI and DLD can even lead to misdiagnosis within the two groups, if they were measured simply by using standardized diagnostic instruments (Leyfer et al. 2008).

Children with DLD have been found to be vulnerable to impairments in determiner elements (Andreou & Peristeri & Tsimpli 2022: 294), and this vulnerability can manifest in the omission or inappropriate use of articles, with a particular challenge in using definite articles (Leonard 2016: 20). The reasons for the below-average performance on the use of articles can be attributed to cognitive factors like working memory (Polite & Leonard & Roberts 2011) and processing limitations (Blom & Vasić & Baker 2015), or to pragmatic factors like difficulties with integrating discourse properties (Chondrogianni & Marinis 2015) and failure to calculate scalar implicatures (Schaeffer 2018), but the potential weakness in the knowledge of articles has received comparatively less attention. A pragmatic or cognitive account holds true preferably on the condition that children have acquired sufficient morphosyntactic and semantic knowledge of determiners, but the existing literature does not provide a comprehensive understanding of how well children with DLD interpret them. This situation prompts us to consider whether the DLD group's non-target-like performance on the production of articles is also due to concurrent deficits in the knowledge of articles. Besides, it is worthwhile to investigate whether children with ALI demonstrate comparable knowledge of determiners as their peers with DLD, given the significant overlap in language profiles between the two disorders.

Therefore, a comprehension study comparing children in the DLD and ALI groups would allow us to address the doubts. The present research focuses on Mandarin, a language that does not have articles or other morphological devices to indicate definiteness but uses different NP

[1] Traditionally known as specific language impairment (SLI) (Bishop 2017).

types and word order as substitutes. This language characteristic allows for more observation points to study the development of definiteness in children's language, which may provide insights into the linguistic profiles of the two disorders.

2 Definite expressions in Mandarin

Mandarin is known to lack overt articles to mark definiteness distinctions, which is compensated by using various NP types and word order. In this section, we will introduce (i) the NP types that exhibit definiteness either inherently or via word order; and (ii) the syntactic positions where definite expressions are allowed to occur.

2.1 NP types

Demonstrative-classifier NP (Dem-Cl-NP)

Like many other languages, Mandarin Chinese has demonstratives to refer to distal and proximal entities: *zhè* 'this' for proximal objects while *nà*[2] 'that' for distal ones. Structurally, demonstratives are followed by a numeral-classifier noun phrase, like *zhè-sān-běn shū* "this-three-Cl book". When the interpretation is singular, the numeral is preferably omitted (Huang & Li & Li 2009: 296), thus deriving the Dem-Cl-NP construction. For instance, *zhè-yī-běn shū* 'this-one-Cl book' is reduced to *zhè-běn shū* 'this-Cl book', with the numeral *yī* 'one' omitted, and both the complete and reduced forms can be interchangeable. In addition to serving the basic function of deixis in visible situations, *zhè* and *nà* have also developed article-like uses in discourse (Li & Thompson 1981: 131; Tao 1999; Chen 2004; Wu 2017). Consider the anaphoric case in (1),[3] the string of Dem-Cl in fact functions as the equivalent of the definite article in English:

(1)

Wǒ	liǎng	tiān	qián	dìnggòu	le	yī-bù	yīng-hàn	cídiǎn.	**Zhè-bù**
I	two	day	ago	order	PFV	one-Cl	English-Chinese	dictionary	this-CL

cídiǎn	yǐ	shōudào	le.
dictionary	already	arrive	SFP

"I ordered an English-Chinese dictionary two days ago. **The dictionary** has now arrived."

[2] The phonetic spellings for the proximal and distal demonstrative come in two patterns: (1) *zhè* 'this' and *nà* 'that', and (2) *zheì* "this" and *neì* "that". The pattern (2) is the colloquial form of the pattern (1), which derives from the phonological combination of the demonstrative *zhè/nà* "this"/ "that" and *yī* 'one'. Both the two patterns belong to standard Mandarin, but speakers from northern China in most cases prefer the pattern (2) in their colloquial language, while they can understand both patterns. In this paper, we adopt the basic form *zhè* and *nà* to exemplify the use of demonstratives.

[3] This sentence was cited from Wu (2017: 349), who quoted the Chinese translation of an English example sentence for definite articles in *The English-Chinese Dictionary* (Lu 2007: 2101–2102).

Also note that *zhè* and *nà* are not interchangeable in certain cases (readers are recommended to Tao (1999), Chen (2004: 1151–56), and Jiang (2016: 496) for details), but they show little differences in the anaphoric environment that do not indicate a temporal contrast, as the replacement of *zhè-bù cídiăn* 'this-Cl dictionary' by *nà-bù cídiăn* 'that-Cl dictionary' in (1) remains acceptable. Nevertheless, the proximal form is still preferred over the distal one in denoting referents that have most recently been introduced into discourse (Chen 2004: 1152).

Bare NP

In Mandarin, bare NPs can serve as arguments in sentences, though they lack inflections for number, case, and gender features. Unlike bare plurals in English which express generic or indefinite interpretations (Karlson 1980), such a bare NP has either referential or non-referential (generic/kind), definite or indefinite readings (Li & Thompson 1981: 127–129, 131; Cheng & Sybesma 1999; Huang et al. 2009: 283; Li 2013: 86), depending on predicate types and positions they occur in (Li 1997; Kuo 2008). Consider (2a) to (2d):[4]

(2) a. **Gǒu** hěn cōngmíng. (generic)
dog very intelligent
"**Dogs** are intelligent."

b. Wǒ kàndào **gǒu** le. (definite/ specific-indefinite)
I see dog SFP
"I saw **a/the dog(s)**."

c. **Gǒu** pǎo-zǒu-le. (definite)
dog run-away-SFP
"**The dog(s)** ran away."

d. Wǒ xiǎng mǎi **gǒu**. (nonspecific-indefinite)
I want buy dog
"I want to buy **a dog**."

Following Kuo (2008), whose accounts are in turn based on Li's (1997) classification, bare NPs in Mandarin invariably represent a generic/kind reading with individual-level predicates, regardless of preverbal or object positions, as shown in (2a). However, the interpretation of bare NPs varies with stage-level predicates. To be specific, bare NPs in the preverbal position of stage-level predicates usually have a definite interpretation, as demonstrated in (2c), whereas they exhibit either a definite or indefinite interpretation in the object position of the predicate, like the example in (2b). Whether the object bare NP is assigned a definite or indefinite interpretation relies on the speaker's intention (Shi 2016: 227) or contexts (Li & Thompson 1981: 131; Lyons

[4] (2a) to (2c) were adapted from Huang et al. (2009: 283).

1999: 89; Li 2013: 120). To sum up, in the preverbal position, bare NPs always have a definite or generic interpretation; while in the object position, in which definiteness is unmarked, bare NPs can be definite, indefinite, or generic.

(Although both bare NPs and Dem-Cl-NPs can express anaphoric interpretations, the use of bare NPs subjects to more constraints. We put the analysis in **Supplementary File_1** due to word limits, in which we explained why we relied more on Dem-Cl-NPs, instead of bare NPs, in the experiment.)

Third-person pronoun

In Mandarin, the counterparts of *she/her*, *he/him* and *it* all share an identical phonological form *tā*, collapsing gender and case distinctions in the phonetic spelling. It can either refer to the antecedent in the discourse, like the example in (3a), or to the third participant other than the speaker and hearer in the visual situation where the conversation takes place, as illustrated in (3b).

(3) a. Wǒ gāngcái yùdào yī-wèi jiàoshòu, **tā** shì yǔyán zhàngài lǐngyù de
I just meet one-Cl professor he is language impairment field DE
dǐngjiān zhuānjiā. (anaphoric)
top expert
"I just met a professor. He is a top expert in the field of language impairment."

b. Nǐ kàn, **tā** zài nà-lǐ zuò shénme? (situational)
you see, she at there do what
"Look, what is she doing there?"

2.2 Word order

In Mandarin, definiteness can be expressed through different types of NPs, but their distribution is subject to word order. The subject position typically necessitates a definite or generic NP, while the canonical object position remains neutral in terms of definiteness, allowing for the occurrence of both definite and indefinite NPs. This situation is different from Germanic and Romance languages, like English or Italian, in which definiteness does not give rise to the subject/object asymmetry (Cheng & Heycock & Zamparelli 2017). Apart from the subject position, the topic and post-*ba* positions also impose definiteness requirements on the occupying NPs.

As with the subject position, the topic position also exhibits clear prohibition against indefinite NPs, so that NPs that occur in this position must be either definite or generic. As a result, bare nouns, which are known to be unmarked for definiteness, are always interpreted as definite or generic when they are topics (Li & Thompson 1981: 86; Huang et al. 2009: 200).

The post-*ba* position seems to be less demanding on the occupying NPs regarding definiteness, as compared to the subject and topic positions. *Ba* is a special lexical category in Chinese languages, meaning “take” or “hold”. It is treated as a pure case-assigner (Huang et al. 2009: 174), an object marker (Li 2013: 119), or a functional element (Zhang 2019: 181). Structurally, the object NP is placed immediately after *ba* and before the verb, deriving the structure typical of *ba* sentence [NP1 + *ba* + NP2 + V + XP]. The *ba* construction carries a special meaning of “disposal” (Huang et al. 2009: 172), so that the subject of *ba* (NP_1) plays the role of causer while the post-*ba* NP (NP_2) is the target being disposed of. Consider the example in (4):

(4) Tā bǎ shū ná-zǒu le
she BA book take-away SFP
“She took the book away.”

The post-*ba* NP is traditionally considered as definite or generic (Li & Thompson 1981: 465), but more recent research revised that specific-indefinite complex NPs (Num-Cl-NPs and bare Cl-NPs) are also acceptable in this position (Zhang 2019). What seems certain is that bare NPs following *ba* only exhibit definite or generic readings, while Num-Cl-NPs and bare Cl-NPs in the post-*ba* position are also acceptable only if they show specific-indefinite readings.

3 Empirical studies of definiteness distinctions

3.1 Development of definiteness distinctions in Mandarin-speaking children with TD

How Mandarin-speaking children distinguish between definite and indefinite reference so far has been examined mainly by means of elicited-production tasks.

Hickmann & Liang (1990) investigated the development of definiteness contrasts by collecting picture-based narratives produced by children of 4, 5, 6, 7, and 10 years old respectively. The stimuli for eliciting narratives are two sets of picture sequences, and each picture sequence describes an independent story. In the experiment, each child narrated stories to a blind-folded experimenter who cannot see the pictures, so as to eliminate the common ground between the speaker and hearer. The results showed that: (1) For the introduction of referent, it was not until 7-year-old did children make systematic use of numeral-classifier NPs (usually abbreviated to Num-Cl-NP, which is a specialized lexical form for referent introduction in Mandarin); while children under this age tended to indicate indefiniteness ambiguously by bare NPs. Adults used Num-Cl-NPs 86% of the time, while they used bare NPs and Dem-Cl-NPs 9% and 5% of the time. (2) For the subsequent mention of referent, the occurrence of bare NPs ranged between 65% and 82%, while Dem-Cl-NPs account for between 33% and 11%. As for controls, adults made use of bare NPs (52%) and Dem-Cl-NPs (44%) in similar proportions. Note that children at all ages rarely used Num-Cl-NPs for referents maintenance, which only account for 2% to 8%, suggesting that the target-like use of definite NPs was acquired earlier than that of indefinite NPs.

Hickmann et al. (1996) further replicated the same experiment in a larger cross-linguistic study, and the findings confirmed that Mandarin-speaking children still performed comparably to those in Hickmann & Liang (1990). Besides, the more recent research by Wu & Huang & Zhang (2015) also reported similar results in children.

According to the above findings, the target-like production of definite expressions arises earlier than that of indefinite ones in Mandarin-speaking children, and they have already shown mastery of definite expressions prior to the age 5.

3.2 Definiteness contrasts in children with DLD

The literature on definite-indefinite distinctions by children with DLD involves primarily children who acquire Romance and Germanic languages. The mastery of definiteness contrasts therefore can be examined by observing children's performance on articles.

Earlier research mainly focused on the inclusion or omission of articles in children's utterances (see the cross-linguistic review in Leonard (2016)), and the common phenomenon is that children with DLD omitted articles more frequently than both typically-developing children matched on age (TDA hereafter) and typically-developing younger children matched on language abilities (TDY). The inconsistent use of articles and tense morphology has been considered clinical markers of DLD (Rice & Wexler 1996).

Unlike earlier studies that focused on the presence or absence of articles in obligatory contexts, Polite & Leonard & Roberts (2011) investigated the definite-indefinite distinction in the production of articles by English-speaking children with DLD. The experiment was carried out verbally, and no visual stimuli were provided during the whole experiment process. The experimenter first introduced children with a short story (1–3 sentences in length) as background information, and then asked questions designed to elicit articles in the anaphoric-definite and nonspecific-indefinite environments respectively, which was in line with the Condition 2 and 5 in Schafer & de Villiers (2000). According to the results, in the definite condition, children with DLD showed significantly less accurate use of definite articles (19.79%) than children in the TDY (44.44%) and TDA (76.34%) groups; while in the indefinite condition, the three groups did not differ from each other in the use of indefinite articles (DLD: 86.97%; TDA: 89.14%; TDY: 84.32%).

Polite & Leonard & Roberts (2011) explained that the poor performance on definite articles by children with DLD may result from working memory limitations, as they found that the substitution of indefinite articles for definite ones (50 occurrences) occurred more frequently than the omission of definite articles (25 occurrences). They considered that the retention of a previously established referent in mind may impose demands on short-term memory; therefore, children with DLD failed to recall the referents established in previous discourse and then re-introduced them with an indefinite article in the subsequent mention.

Using the same approach, Blom & Vasić & Baker (2015) and Chondrogianni & Marinis (2015) investigated article distinctions by 7-year-old Dutch-speaking and English-speaking children with DLD respectively. Blom et al. (2015) examined indefinite articles in the non-specific condition, while Chondrogianni & Marinis (2015) the nonreferential-predicational, nonreferential-instrumental, and referential-specific conditions. As for definite articles, Blom et al. (2015) included the bridging condition, while Chondrogianni & Marinis involved both the bridging and anaphoric conditions.

Blom et al. (2015) found that article use in Dutch children with DLD is compromised in both definite and indefinite contexts. To be specific, the DLD group was accurate 61% of the time when using definite articles, greater than the data (19.79%) in Polite et al. (2011); whereas the accuracy for indefinite articles dropped to 55%, lower than that (86.97%) in Polite et al. As for error patterns, children with DLD made more omission errors (30%) than substitution ones (8%) in the definite condition, whereas they substituted (20%) and omitted (27%) articles at similar rate in the indefinite condition. Blom et al. (2015) believed that the children with DLD performed better on definite articles because the bridging condition is less demanding than the anaphoric condition, and besides, the participants are two years older in their research. The lower accuracy in indefinite articles, however, was due to the reason that Dutch articles are acquired later. The findings indicated that processing limitations may lead to less stable lexical knowledge of articles, which impedes the successful integration of lexical, syntactic, and pragmatic information necessary for appropriate use of articles.

Chondrogianni & Marinis (2015) found that the English-speaking children with DLD in their research had higher accuracy in the bridging environment (52.4%) than in the anaphoric one (24.3%). The mean score obtained in the bridging environment is close to that reported in Blom et al. (2015) (61%), while the data in the anaphoric condition is almost in line with that in Polite et al. (2011) (19.79%) (Note also that the participants are two years older than those in Polite et al. (2011)). The results suggest that the vulnerability of using anaphoric definite articles found in the pre-school children with DLD may continue into school age. As for indefinite contexts, children in the three groups did not differ from each other in the non-referential predicational (DLD: 84%; TDA: 82.8%; TDY: 81.7%), nonreferential-instrumental (DLD: 63.9%; TDA: 75.3%; TDY: 73.3%), and referential-specific conditions (DLD: 60.7%; TDA: 70.7%; TDY: 71.4%). With respect to error patterns, the children with DLD made an equal number of substitutions and omissions within each definite condition, and they made significantly more substitutions than the TDA controls in both the anaphoric and bridging conditions, whose error types were primarily omissions. In the indefinite contexts, omissions were the predominant error pattern in the three semantic conditions across the groups. Chondrogianni & Marinis argue that children with DLD had difficulties in integrating discourse information.

It can be summarized that children with DLD have difficulties primarily with definite forms, and they appear to have problems more with the anaphoric condition than the bridging one.

3.3 Definiteness distinctions in children with ASD

Definiteness distinctions in ASD are a topic that has not been widely investigated, as compared to the rich literature on children with TD and children with DLD.

Modyanova (2009: 95) examined the comprehension of determiners in a combined group of individuals with ASD. Participants were in the range between 6 to 18 years old and they were not further subdivided in terms of age. The experiment was carried out by children controlling a Velcro-backed toy to stick to an identical or different types of objects that were permanently attached to a page made of felt cloth, in accordance with the experimenter's instructions that contain either indefinite determiners "a" and "another", or definite determiners "that" and "the".

The findings indicated that children with ASD differed from the control group merely on definite determiners, but not on indefinite ones. Variations were observed within the ASD group, because the children with ASD who have normal language (ALN hereafter) and normal IQs (the "Asperger group" in Modyanova (2009)) presented near-perfect knowledge of both definite and indefinite determiners, while the children with ALI and normal IQs (the "PDD-NOS group") and the children with ALI and below-average IQs (the "Autism group") performed poor on definite determiners.

Modyanova believes that children's overall grammatical development is a significant predictor of their knowledge of definiteness, and that the acquisition of the definite determiner is influenced by the computational semantic system of language, rather than solely by pragmatics.

In Schaeffer (2018), article choice was compared between Dutch-speaking children with ALN and children with DLD. The experiment includes an elicited production task with pictures and video clips as stimuli, in which the indefinite article was examined in both specific and non-specific indefinite environments while the definite article was examined in the anaphoric environment. The age range of the individuals in each group was between 5 and 14 years. The mean ages for the ALN, DLD, and TDA groups were 10;00, 9;06, and 9;10 respectively, and no age groupings were made. Note that children in the ALN group exhibited normal intelligence.

The results showed that the three participant groups demonstrated target-like performance on both specific-indefinite (ALN: 96%; DLD: 98%; TDA: 99%) and nonspecific-indefinite conditions (ALN: 96%; DLD: 98%; TDA: 99%). As for the definite condition, both the ALN (80%) and DLD groups (81%) were significantly outperformed by the TDA controls (95%), and no significant differences were found between the two clinical groups. The error pattern in the definite condition found in the DLD and ALI groups is characterized by substitution errors, which aligns with the error pattern identified in Polite et al. (2011).

From the studies above, to conclude, children with ALN who have normal IQs are more likely to perform at a target-level on the comprehension of both definite and indefinite articles, as well as on the production of indefinite articles (but not definite ones). On the other hand, children with ALI, regardless of whether they have normal IQs or not, demonstrate clear problems with understanding definite articles, but not with indefinite ones.

3.4 Research questions for the current study

Based on previous studies and the characteristics of Mandarin, our research questions are formulated: (1) Do pre-school children with ALI and children with DLD show difficulties in the comprehension of definite expressions? (2) Are the three definite expressions equally interpreted within the DLD and ALI groups respectively? (3) If there is a significant difference in comprehending one or more definite expressions between the two clinical groups, what are the contributing factors?

4 Method

4.1 Participants

The recruitment and screening of participants took place in mainland China. A total of 88 Mandarin-speaking children were recruited in the current study: 28 children with suspected DLD, 32 children with ALI, and 28 children with typical language. In addition, there were 8 children who had to be excluded for unwillingness to cooperate. The children in the DLD group were defined as having suspected DLD because they did not receive a medical diagnosis of DLD by speech-language pathologists. Parent/guardian consent forms have been obtained for all children. **Table 1** provides detailed information of the participant groups.

Groups	**N (*female and male*)**	**Range (*year; month*)**	**Mean (SD)**
ALI	32 (3 and 29)	3;9–6;5	5;3 (±0;8)
DLD	28 (12 and 16)	4;3–6;4	5;2 (±0;7)
TDA	28 (11 and 17)	4;7–6;6	5;3 (±0;5)

Table 1: Descriptive characteristics of the participant groups.

Each child was administered a battery of standardized tests to assess their receptive vocabulary knowledge, language abilities, and nonverbal intelligence: (1) the receptive vocabulary was assessed with *Peabody Picture Vocabulary Test–Revised Chinese Version* (PPVT-R) (Sang & Miao 1990); (2) *The rating scale for pre-school children with language disorder–Revised* (RSPCLD-R) (Lin et al. 2008) or *The rating scale for school children with language disorder–Revised* (RSSCLD-R) (Lin et al. 2009) was administered to assess the language abilities of children below or above 6 years old respectively, and each scale consequently provided three indicators, namely the overall language, receptive language, and expressive language; (3) children's IQs were measured by using *Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition* (WPPSI-IV Chinese Version) (Li & Zhu 2014), and three resulting indicators — full-scale IQ, nonverbal IQ, and verbal comprehension index (VCI) — were included as the criteria for selecting children.

The children at risk for DLD[5] were screened from kindergartens and rehabilitation centers. Specifically, 16 children came from 4 kindergartens in Jiaozuo (Henan Province), 7 children from 2 kindergartens in Guangzhou (Guangdong Province), 3 children from 1 rehabilitation center in Qingdao (Shandong Province), and 2 children from 1 rehabilitation center in Hefei (Anhui Province). Before the process of screening took place, the teachers or headmasters first selected a larger group of children, by using a screening inventory for the criteria described in Leonard (2014: 15). A child was included into the DLD group if they (i) scored 1.25 standard deviations or more below the norm for their age on at least 2 out of the 4 language indicators (the inclusion criteria for at least two indicators is based on Tomblin & Records & Zhang (1996)), namely PPVT-R, overall language, receptive language, and expressive language; (ii) had a full-scale IQ of at least 75 and a nonverbal IQ of at least 70 (Plante 1998); (iii) did not have a diagnosis of additional developmental disorders (such as autism).

The children in the ALI group were all recruited from special schools and rehabilitation centers. 14 children were recruited from the rehabilitation center in Qingdao, and the remaining 18 children from 7 distinct rehabilitation centers in Hefei. Each child received a medical diagnosis of autism by qualified hospitals, and they were admitted if they fulfilled criteria (i) and (ii) in defining DLD.

As for TDA controls, 16 children were recruited from the affiliated kindergarten of Guangdong University of Foreign Studies, 4 children from the kindergartens in Jiaozuo, and 8 children from the offspring of the staff in the rehabilitation centers in Hefei. None of the participants have symptoms of ASD, mental impairment, or physiological damage. They were included if they scored above the control mean for their age across the four language indicators obtained in the PPVT-R and RSPCLD-R/RSSCLD-R assessments.

Table 2 presents children's scores on standardized assessments. The three groups were matched on age in months, and the DLD and ALI groups were further matched on VCI and non-verbal IQs. We used one-way ANOVA to compare non-verbal IQs, and non-parametric tools (Kruskal-Wallis tests) to compare ages[6] and VCI due to the non-normally distributed data in the ALI group (p = .027 for ages and p = .011 for VCI, as ascertained by the Shapiro-Wilk test), and the lack of homogeneity of variance in VCI (p = .023, as confirmed by the Leven's test).

[5] There is only one child (labeled DLD-19) showed normal receptive language in the two clinical groups.

[6] If we still use one-way ANOVA given the slight skewness of data distribution, the result is $F(2,85)$ = .340, p = .713.

Indicators	DLD	ALI	TDA
Full scale IQ	89.68 (±8.1; 75–104)	91.84 (±11.57; 76–124)	107.43 (±7.71; 97–127)
Nonverbal IQ	93.89 (±9.79; 73–110)	97.78 (±11.82; 81–128)	107.57 (±9.25; 91–132)
VCI	85.36 (±6.48; 69–96)	87.5 (±11.35; 71–114)	106.93 (±8.05; 90–126)
PPVT-R	30.71 (±14.12; 14–63)	45.63 (±19.45; 17–85)	76.82 (±15.61; 48–119)
RSPCLD-R/ RSSCLD-R			
Overall language	44.75 (±7.48; 31–57)	45.09 (±9.71; 21–58)	73.43 (±3.57; 67–81)
Receptive language	18.11 (±5.17; 9–29)	18 (±5.53; 6–27)	32.32 (±2.09; 28–37)
Expressive language	26.57 (±4.79; 18–34)	27.09 (±5.73; 12–38)	41.14 (±2.22; 36–45)

Table 2: The participants' scores* (Mean (±SD; range)) on the standardized assessments of IQs and language abilities.
* The indicator scores of Full-scale IQ, Nonverbal IQ, and VCI are standard scores taken from the reports generated by the scoring system of WPPSI-IV, and the maximum score for each indicator is 160; the scores of PPVT-R are raw scores, and the maximum score of which is 175; the scores of overall language, receptive language, and expressive language are raw scores, for which the maximum scores are 83, 37, and 46 respectively.

The Kruskal-Wallis test revealed that there was no significant difference in age among the DLD, ALI, and TDA groups ($H(2) = 1.802$, $p = .406$). The one-way ANOVA showed main effect of non-verbal IQs among the three groups ($F(2,85) = 12.879$, $p < .001$). The *post-hoc* tests with Bonferroni corrections indicated that the mean value of non-verbal IQs was significantly different between the TDA and DLD groups ($p < .001$), between the TDA and ALI groups ($p = .001$), while no significant differences were found between the DLD and ALI groups ($p = .459$). As for VCI, the Kruskal-Wallis test showed that there was a significant difference among the three groups ($H(2) = 43.983$, $p < .001$). The *post-hoc* test with Bonferroni corrections indicated a trend for the TDA group to have a higher VCI than the DLD ($p < .001$) and ALI groups ($p < .001$), and there were no significant differences between the DLD and ALI groups ($p = 1$).

4.2 Experiment design

The experiment in this study was adapted, with some changes, from its English version created by van Hout & Harrigan & de Villiers (2010), in which definite NPs were tested in a short context with the presence of two pictures appearing in sequence. The process involves a child viewing a picture and the experimenter providing a description for one of the three referents in the picture.

This action singled out the particular referent as the antecedent, while the other two referents were intentionally not mentioned throughout the process. The first picture then remained present and the second picture occurred, in which all the three referents changed their initial positions or actions. Subsequently, the child was prompted to respond to a question involving a definite NP. As for the question type, we included both *yes-no*[7] and *wh*-questions.

4.3 The question types and syntactic positions feasible for the comprehension experiment

4.3.1 Dem-Cl-NP

As Dem-Cl-NPs in Mandarin can be used both deictically and anaphorically, the Dem-Cl-NP was therefore examined in the pattern where its deictic force is minimized by removing any shared visual common ground between the speaker and hearer (This is explained in more details in Section 4.4). Although definiteness in Mandarin gives rise to subject/object asymmetry, the definite interpretation expressed by Dem-Cl-NPs does not vary with positions. In this case, Dem-Cl-NPs were examined in both subject and object positions, with an aim to examine if children exhibit equal comprehension of Dem-Cl-NPs in different syntactic positions.

4.3.2 Third-person pronoun

Third-person pronouns were examined in the subject position only, since the interpretation of object pronouns involves the Principle B of Binding theory (Chien & Wexler 1990; Perovic & Modyanova & Wexler 2013a, b), which is a topic beyond our focus. Besides, Song (2020) reported that both the DLD and ALI groups, who were also participants in the current study, demonstrated clear difficulties in both understanding and applying Principle B. Supposing the poor performance on object third-person pronouns by children is also observed in the current study, it would be difficult to determine whether this result is due to the deficiencies in the syntactic rules or in the semantic knowledge of definiteness. As a result, we only examined third-person pronouns in the subject position.

4.3.3 Bare NP

As previously mentioned, bare NPs are marked as definite merely in the subject, post-*ba*, and topic positions, while they are neutral for definiteness in the object position. However, there remain some cases where the anaphoric interpretation of bare NPs cannot be attainable in the experimental setting. First, when bare NPs were used in the subject of the *yes-no* question, our

[7] An anonymous reviewer pointed out that coding the accuracy seems only to partially capture the full picture for the *yes-no* question condition, since the participant may simply guess the answers. Using reaction times would better facilitate the examination in addition to response accuracy. We really appreciate their insightful comment.

adult informants said that both “yes” and “no” responses were acceptable to them. This is because the bare NP at this point can either refer to the target referent in the picture that is co-indexed with the indefinite NP in the preceding clause, or it can also refer to the interference referent that fulfills the description of the question sentence but does not correspond to the antecedent. Taking **Figure 5** in Section 4.4 for example, the indefinite NP *yí-gè huāpén* “a flowerpot” in (5a) singles out a referent and acts as the antecedent in discourse; in (5b) although the definite bare NP *huāpén* “the flowerpot” occurs in the subject of the *yes-no* question, it still cannot invariably refer to the antecedent in (5a):

(5) a. Xiǎo nánhái shǒu-lǐ bào-zhē yí-gè huāpén, kàndào-le ma?
little boy hand-in hold-DUR one-Cl flowerpot see-SFP Q
“The little boy is holding a flowerpot. Can you see it?”

b. Xiànzaì, huāpén dǎo-le ma?
now flowerpot fall-down-SFP Q
“Now, has the flowerpot fallen over?”

c. Xiànzaì, huāpén zài nǎ-er?
now flowerpot at where?
“Where is the flowerpot now?”

The same problem also held for post-*ba* and topic bare NPs in *yes-no* questions. One anonymous reviewer pointed out, and we strongly agree, that this is due to the failure of presuppositions in *yes-no* questions, and in this case, the utterances are not computing, so neither *yes* nor *no* can be the answer, which is similar to the situation in Modyanova’s study (2009: 91) on the comprehension of maximality in free-relative clauses. For improvements in future studies, the reviewer suggested that in addition to providing either a *yes* or *no* option, a third choice, like a “silly button” to indicate something that does not make sense, is recommended.

However, if the bare NP is used in the subject of *wh*-question, like in (5c), our informants can always refer to the target flowerpot that has been introduced in (5a). It is interesting why subject bare NPs can exhibit anaphoric interpretations consistently in *wh*-questions, but not in *yes-no* questions. Besides, we also tried to examine bare NPs the way we examined Dem-Cl-NPs, that is, by removing the visual common ground between the speaker and hearer, but our informants claimed that they still accepted both *yes* and *no* options in this experiment pattern. This may occur because definiteness in bare NPs is not inherent but temporarily assigned by word order.

Second, if bare NPs are in the post-*ba* and topic positions of *wh*-questions, even adult speakers tend to mention all the referents that occur in the picture, though the intended antecedent is a single referent. We attribute the case to the fact that definite bare NPs are uniqueness-based definites (Jenks 2018; Dayal & Jiang 2023), and besides, they are also unmarked for number features. Given that plural definite NPs involve inclusiveness (Lyons 1999: 11) or maximality

(Heim 2019), and the number feature of bare NPs in Mandarin is unmarked, when multiple referents with the same property are present, their interpretation shows a bias to include all referents that satisfy the predicate. The adult informants thus exhaustively described the referents that fulfill the description of the question sentence.

Therefore, bare NPs will be examined simply in the subject position of *wh*-questions, whereas the post-*ba* and topic positions only involve Dem-Cl-NPs.

4.3.4 Arrangement

Each condition (position and question type) of the NP type consists of 5 items of the same kind, and each item also serves as fillers for the items of other conditions. Besides, in view of the assumption that children with DLD present difficulties with definite NPs due to memory limitations (Polite et al. 2011), we designed an additional condition to ascertain the assumption, by observing children's performance on Dem-Cl-NPs with increased memory, like the pattern in (8a) to (8c) in Section 4.4, together with children's performance on the visual-spatial working memory test (*Picture Memory and Zoo Locations*) from the WPPSI-IV. As to why the increased memory condition merely involves Dem-Cl-NPs, instead of bare NPs or third-person pronouns, the reason is that only Dem-Cl-NPs can refer to its antecedent not affected by the distance and intervention of other topics (Shen 2005: 121).[8] Considering the reasons mentioned above, the condition of Dem-Cl-NPs with increased memory will be examined in the subject position of *wh*-questions.[9] Moreover, we also included the children's Processing Speed (*Bug search, Cancellation, and Animal Coding*) scores from the WPPSI-IV in an effort to observe whether the cognitive processing capacity can influence children's comprehension of definite expressions.

4.4 Procedures and materials

Children were tested individually with two adult experimenters: one of them (E2) operated a tablet computer to present pictures via Microsoft PowerPoint 2016, while the other (E1) sat across from the child and asked questions that are printed on a manual. During the experiment, E1 and the child were initially situated at opposite ends of a table so as to prevent E1 from seeing the pictures, and the tablet computer was placed vertically between them, with the screen facing towards children. Before the experiment began, E1 told the child that they needed to complete

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[8] Although the distal demonstrative *nà* "that" is preferred for referring to a textually remote referent in Mandarin, there is no clear criterion established as to how far the demonstrative must be from the antecedent and how many intermediate referents and topics are required to cross over if *nà* is used. As there is only one intervening sentence added to each item of the increased memory condition, and adult informants agreed that both the proximal and distal forms are appropriate here, we chose to keep using the proximal *zhè* "this" in the increased memory condition.

[9] Children showed their best performance of comprehending Dem-Cl-NPs in the subject position of *wh*-questions, so we only select this condition to examine the effects of increased working memory load.

a collection of questions on the manual, but they were currently situated in a position that obstructs the visibility of the display. Children were then asked to look at the pictures on the screen and help E1 find the answers. As the first batch of questions that contain Dem-Cl-NPs was finished, E2 found an excuse to leave. E1 then sat next to the participant so that they can look at the screen together, and continued with the second batch of questions aimed for third-person pronouns and bare NPs. The different treatment to Dem-Cl-NPs and to the other two definite expressions is motivated by the following considerations: First, although Dem-Cl-NPs can be used either deictically or anaphorically, the deictic force is far more dominant when the referents can be mutually seen by the speaker and hearer. Therefore, during the experiment, the procedure for examining Dem-Cl-NPs should be controlled so that the speaker and hearer do not see the stimuli at the same time; otherwise, the deictic and anaphoric interpretations of Dem-Cl-NPs can appear simultaneously, leaving hearers unable to identify whether the referent in the immediate situation or in the previous discourse is intended. Second, the bare NP and third-person pronoun are prototypical anaphors, and such anaphors can only acquire occasional deictic use through extensive or symbolic pointing, albeit in a marginal way (Jiang 2016: 485). Therefore, we no longer blocked the visual common ground between the experimenter and the child when we examined bare NPs and third-person pronouns.[10]

Figure 1 presents the sample pictures for subject Dem-Cl-NPs in *yes-no* questions. There are three animate referents of the same type in each picture, and they were all designed to be equally prominent in size and style. The action that each referent is performing differs in the two pictures. As the first picture appeared on the screen, E1 said to children the introductory sentence in (6a), so that "a boy" can be singled out as the antecedent. At the end of each introductory sentence, we added an additional interrogative clause, like *kàndào le ma?* "Can you see (it)?" or *yǒu-méi-yǒu?* "Yes, or no?", for confirming the attention of children. Having received children's affirmative reply that the intended referent was in focus, the second picture appeared. E1 then asked the question in (6b), and waited for children to respond.

(6)	a.	Yǒu	yī-gè	nánhái	zài	dàng-qīuqiān,	kàndào	le
		have	one-Cl	boy	PROG	play-on-the-swing	see	SFP
		ma?					(Wait for affirmation)	
		Q						
		"A boy is playing on the swing. Can you see (him)?"						

[10] One anonymous reviewer indicated that the inconsistency is unfortunate and may have unforeseen repercussions. We admit that this is a disappointing shortcoming in the study, and we chose the inconsistent patterns because we faced a dilemma. In previous comprehension studies, like Maratsos (1976), Modyanova (2009), and van Hout et al. (2010), definite NPs were all examined in a pattern where both the participant and experimenter looked at the stimuli simultaneously. This can be done because definite articles have no deictic force, which is different from the behavior of demonstratives. Therefore, when designing the comprehension experiment for bare NPs and third-person pronouns in Mandarin, we tended to maintain the same style as in the representative studies.

b. Hòulái, zhè-ge nánhái qù tīqíu le ma?
later this-Cl boy go play-football SFP Q
"Later, did the boy go to play football?" (Target: No)

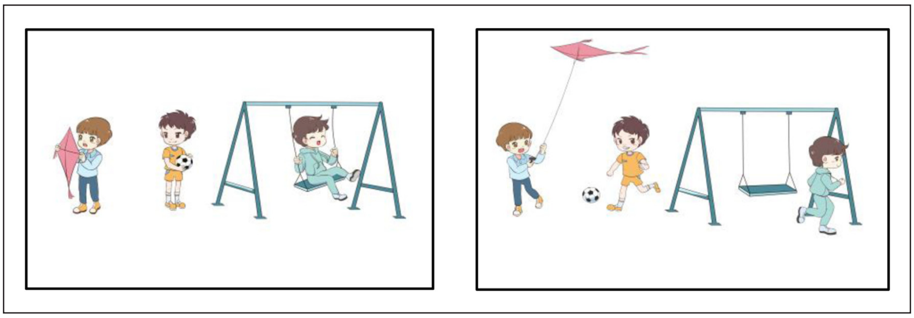

Figure 1: Sample pictures for Dem-Cl-NPs in *yes-no* questions.

Figure 2 shows the sample pictures for subject Dem-Cl-NPs in *wh*-questions. The question sentence contains the *wh*-expression *nǎ-er* "where" or *gàn shénme* "do what", like the cases in (7b) and (8c):[11]

(7) a. Yǒu yī-zhī xiǎoniǎo zhàn zài shù-shàng, kàndào le ma?
have one-Cl little-bird stand at tree-on see SFP Q
"A little bird is standing on the tree. Can you see (it)?"

b. Xiànzài, zhè-zhī xiǎoniǎo zài nǎ-er?
now this-Cl little-bird at where
"Now, where is the little bird?" (Target: on the ground)

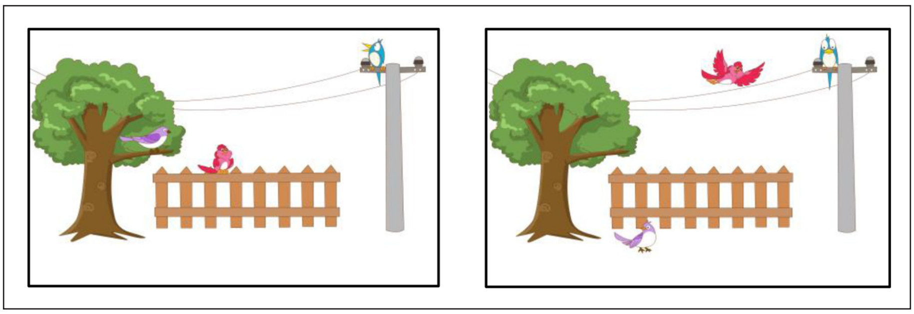

Figure 2: Sample pictures for subject Dem-Cl-NPs in *wh*-questions.

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[11] Mandarin is a *wh*-in-situ language, and *wh*-expressions do not necessarily undergo movement to the sentence-initial position, so that Dem-Cl-NPs can appear either in the subject or object positions of a *wh*-question.

Figure 3 displays the sample pictures for the increased memory condition. The design differs from **Figure 2** by inserting an additional picture that introduces a distinct referent immediately following the first picture. This is done to prevent the referent referred to by the definite NP in the third picture from being adjacent to the antecedent clause, like the sentences in (8a) to (8c):

(8) a. Yǒu yī-zhī xiǎo-hóuzi zài zhāi xiāngjiāo, kàndào le ma?
have one-Cl little-monkey PROG pick banana see SFP Q
"A little monkey is picking bananas. Can you see (it)?"

b. Hòulái, yǒu yī-zhī xiǎogǒu zǒu guòlái le, duì-bú-duì?
later have one-Cl little-dog walk come-over SFP yes-or-no
"Later, a little dog comes over. Yes or no?"

c. Xiànzài, zhè-zhī xiǎo-hóuzi zài gàn shénme?
now this-Cl little-monkey PROG do what
"Now, what is the monkey doing?" (Target: carrying the basket/going home)

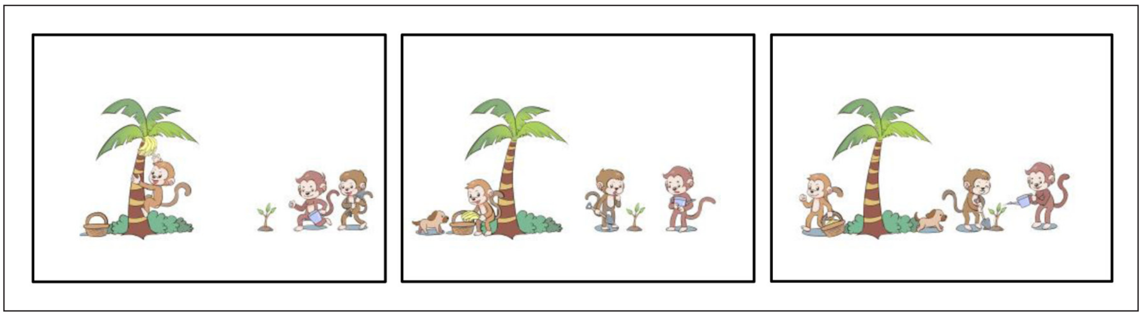

Figure 3: Sample pictures for Dem-Cl-NPs with increased memory.

Figure 4 shows the sample pictures for object Dem-Cl-NPs in *yes-no* questions, and each item consists of three inanimate objects of the same kind, along with one animate character. The question sentences are illustrated in (9):

(9) a. Shù-xià yǒu yī-liàng zìxíngchē, kàndào le ma?
tree-under have one-Cl bicycle see SFP Q
"There is a bicycle under the tree. Can you see (it)?"

b. Hòulái, xiǎo-nánhái qí zhè-liǎng zìxíngchē le ma?
later little-boy ride this-Cl bicycle SFP Q
"Later, did the little boy ride the bicycle?" (Target: No)

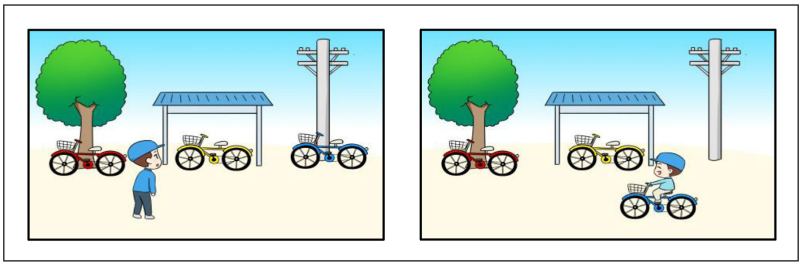

Figure 4: Sample pictures for object Dem-Cl-NPs in *yes-no* questions.

Figure 5 presents the sample pictures for bare NPs. Similarly with **Figure 4**, each picture comprises three inanimate entities and one animate character. The difference lies in that, in the first picture an inanimate object was involved in the activity of the animate character, and was therefore singled out as the antecedent. In the second picture, the previously selected inanimate entity was placed in a different position by the animate character; as for the remaining two inanimate entities, one stays in situ, and one changes its position conspicuously. Since the candidate entities for the reference of the bare NP were all inanimate, the *wh*-question sentences only involve the *wh*-word *nǎ-er* "where".

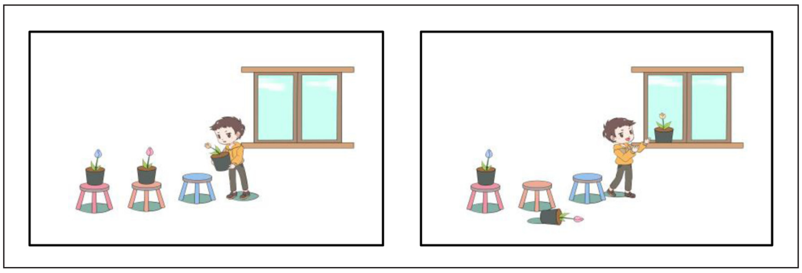

Figure 5: Sample pictures for bare NPs.

Figure 6 shows the sample pictures for third-person pronouns in *yes-no* and *wh*-questions. Each item comprises three different animate characters, and each referent is performing a distinctly different action. The *wh*-expressions in the *wh*-sentences involve *nǎ-ér* "where" and *gàn shénme* "do what".

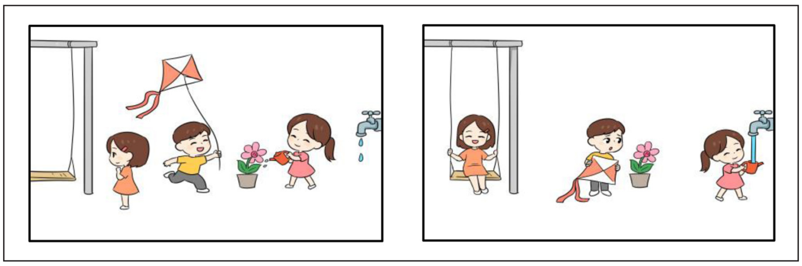

Figure 6: Sample pictures for third-person pronouns.

Sample pictures for testing post-*ba*, topic, and object Dem-Cl-NPs in *wh*-questions are illustrated in **Figure 7**. Each item consists of three inanimate entities of the same type as well as three different animate characters. An inanimate entity was singled out as the antecedent in the first picture, when the second picture appeared, children were required to identify the animate character who disposed the previously mentioned inanimate entity. Therefore, the *wh*-expressions involve only *shuí* “who”.

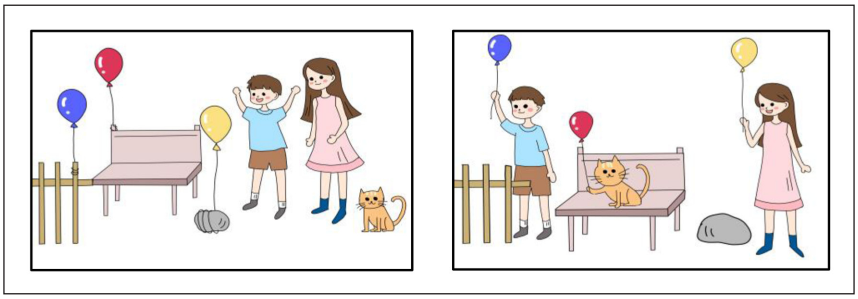

Figure 7: Sample pictures for post-*ba*, topic, and object Dem-Cl-NPs in *wh*-questions.

4.5 Coding and statistics analysis

Each testing condition has 5 question items of the same type, and the answers produced by children were coded either as 0 (incorrect) or 1 (correct), meaning that a participant can receive a maximum score of 5 for each condition. No specific time limit was established for waiting children’s responses. However, if children were clearly unresponsive due to distractions, or failed to follow the directions promptly, they were informed that the question item would be repeated once (starting from the first picture). Children were allowed to self-correct their answer only once for each item, if any, and the score was determined based on their second response.

The data were analyzed using SPSS version 24. Given the data’s non-conformity to the normal distribution, as confirmed by Shapiro-Wilk tests, and its lack of homogeneity of variances, as shown by Levene’s tests, the Kruskal-Wallis test was used for between-group comparisons, the Friedman test or the Wilcoxon signed-rank test for within-group comparisons, and the Spearman’s rank correlation test for assessing the data’s correlations.

4.6 Hypothesis and Prediction

If, as the literature suggests, children with DLD showed impaired performance on production of articles due to cognitive or pragmatic factors, we hypothesize that the DLD group should achieve significantly better performance on the comprehension of definite NPs, ideally on par with TDA children. If the DLD group also struggles with comprehension tasks, we then have reasons to believe that their impairment in using articles may stem from comorbid deficits in syntactic or semantic knowledge of definiteness, not solely by cognitive or pragmatic reasons. Given that the language profiles of DLD and ALI are reported to be substantially comparable, we predict that the DLD group may perform similarly to the ALI group in the majority of the conditions in the experiment.

5 Results

5.1 Dem-Cl-NPs

Table 3 shows the raw scores of Dem-Cl-NPs among the three participant groups. The dependent variables consisted of positions (subject and object positions) and question types (*yes-no* and *wh*-questions), and the independent variables comprise the groups (DLD, ALI, and TDA). No random factors are included. The results revealed strong evidence of differences between the conditions (positions and question types) and the groups: $H(2) = 52.074, p < .001$ for subject Dem-Cl-NPs in *yes-no* questions; $H(2) = 31.786, p < .001$ for subject Dem-Cl-NPs in *wh*-questions; $H(2) = 52.325, p < .001$ for object Dem-Cl-NPs in *yes-no* questions; $H(2) = 46.547, p < .001$ for object Dem-Cl-NPs in *wh*-questions. *Post-hoc* pairwise comparisons with Bonferroni corrections indicated that the TDA group showed significantly better performance than the DLD ($p < .001$) and ALI groups ($p < .001$) in all conditions, while the DLD and ALI groups did not differ from each other across the conditions ($p = 1$ for all).

Group	Subject position		Object position	
	***yes-no* question**	***wh*-question**	***yes-no* question**	***wh*-question**
DLD				
Mean	0.89 (17.8%)	3.14 (62.8%)	0.57 (11.4%)	1.71 (34.2%)
Median	0	3	0	1.50
IQR*	1–0	4–2	1–0	3–1
Range	0–4	0–5	0–5	0–5
ALI				
Mean	1 (20%)	2.97 (59.4%)	0.88 (17.6%)	1.69 (33.8%)
Median	0	3	0	1
IQR	2–0	4–2	1–0	2.75–1
Range	0–5	0–5	0–5	0–5
TDA				
Mean	4.43 (88.6%)	4.61 (92.2%)	4.32 (86.4%)	4.54 (90.8%)
Median	5	5	5	5
IQR	5–4	5–4	5–4	5–4
Range	2–5	3–5	1–5	2–5

Table 3: Raw scores of Dem-Cl-NPs in the DLD, ALI, and TDA groups.
* IQR = Interquartile Range (The spread between the 75^{th} to 25^{th} percentile of data distribution).

To examine within-group comparisons for each condition in the participant groups respectively, we then ran the Friedman test (nonparametric repeated measures ANOVA). The results showed that the accuracy rate of Dem-Cl-NPs was influenced by either positions or question types in the DLD group $\chi^2(3) = 43.130$, $p < .001$, and in the ALI group $\chi^2(3) = 36.961$, $p < .001$, but not in the TDA group $\chi^2(3) = 3.370$, $p = .338$. *Post-hoc* pairwise comparisons with Bonferroni corrections showed that, for the DLD group, there was a significant difference between the *yes-no* question and *wh*-question conditions in both preverbal ($p < .001$) and postverbal Dem-Cl-NPs ($p = .023$); on the other hand, there was no significant difference between preverbal and postverbal Dem-Cl-NPs in the *yes-no* question condition ($p = 1$), nor in the *wh*-question condition ($p = .067$). For children with ALI, differences were also significant for question types in both preverbal ($p < .001$) and postverbal Dem-Cl-NPs ($p = .047$), while no significant differences were found between preverbal and postverbal Dem-Cl-NPs in the *yes-no* question ($p = 1$) and *wh*-questions ($p = .176$) respectively.

Apparently, the condition of *yes-no* question was highly prone to error for children in the DLD and ALI groups, as they produced a large number of affirmative responses, like *duì* "yes", *shì* "yes", or the affirmative clauses as shown in (10a) and (10b) (E: experimenter; C: children):

(10)	a.	E:	Hòulái,	zhè-ge	xiǎo-nánhái	qù	dàng-qīuqīan	le	ma?
			later	this-Cl	little-boy	go	play-on-the-swing	SFP	Q
			"Later, did the little boy go to play on the swing?"						
		C:	Qù-le.						
			go-SFP						
			"He did."						
	b.	E:	Hòulái,	zhè-ge	xiǎo-nánhái	qù	tīqíu	le	ma?
			later	this-Cl	little-boy	go	play-football	SFP	Q
			"Later, did the boy go to play football?"						
		C:	Tā	tī-qíu	le.				
			he	play-football	SFP				
			"He played football."						

Given that the second picture in each item of *yes-no* question conditions contains an interference referent that fulfills the description of the question sentence (and the answer should always be "no"), children who answered "yes" presumably solicited answers by simply looking at the second picture, neglecting the close connection between the Dem-Cl-NP and its antecedent, as well as the contextual connection between the two pictures. It can be summarized that in the *yes-no* question condition, the comprehension of Dem-Cl-NPs in the DLD and ALI groups is driven by the deictic treatment of Dem-Cl-NPs, whereas in the *wh*-question condition, the anaphoric interpretation of Dem-Cl-NPs can be elicited to some extent.

To summarize, there was no significant difference observed between the DLD and ALI groups across the four conditions of Dem-Cl-NPs. The comprehension of Dem-Cl-NPs in the two clinical groups did not vary with positions (though the mean accuracy of subject Dem-Cl-NPs was nearly twice that of object Dem-Cl-NPs in the *wh*-question condition), but with question types.

5.2 Third-person pronouns and bare NPs

Table 4 shows the raw scores of third-person pronouns and bare NPs in the three groups. A Kruskal-Wallis test showed that there was a significant difference for third-person pronouns in the *yes-no* question ($H(2) = 51.293$, $p < .001$) and *wh*-question conditions ($H(2) = 44.254$, $p < .001$). The *post-hoc* comparisons with Bonferroni corrections showed that, in the *yes-no* question condition, significant differences were found between the TDA and DLD groups ($p < .001$), and between the TDA and ALI groups ($p < .001$), while the DLD and ALI groups did not differ from each other ($p = 1$); as for the *wh*-question condition, the differences were significant between the TDA and DLD groups ($p < .001$), between the TDA and ALI groups ($p < .001$), and between the DLD and ALI groups ($p = .021$).

Groups	**Third-person pronoun**		**Bare NP**
	***yes-no* question**	***wh*-question**	***wh*-question**
DLD			
Mean	1.46 (29.2%)	4.21 (84.2%)	4.18 (83.6%)
Median	1	4	4
IQR	2.75–0	5–4	5–4
Range	0–5	2–5	0–5
ALI			
Mean	1.28 (25.6%)	3.09 (61.8%)	3.53 (70.6%)
Median	0.50	3	4
IQR	2–0	4–2	5–3
Range	0–5	1–5	0–5
TDA			
Mean	4.96 (99.2%)	5 (100%)	5 (100%)
Median	5	5	5
IQR	5–5	5–5	5–5
Range	4–5	5–5	5–5

Table 4: Raw scores of third-person pronouns and bare NPs in each participant group.

Upon scrutinizing the raw scores of third-person pronouns in the *wh*-question condition and the experiment pictures (see Data Accessibility), we found that the ALI group displayed considerable fluctuations in accuracy rates across the five items, while the DLD group demonstrated a noticeably higher level of accuracy and stability in their performance. This is shown in **Table 5**:

Picture items	ALI (n = 32) Occurrences (Accuracy)	DLD (n = 28) Occurrences (Accuracy)	TDA (n = 28) Occurrences (Accuracy)
Item_1	25 (78.1%)	26 (92.9%)	28 (100%)
Item_2	16 (50%)	20 (71.4%)	28 (100%)
Item_3	28 (87.5%)	26 (92.9%)	28 (100%)
Item_4	11 (34.4%)	21 (75%)	28 (100%)
Item_5	19 (59.4%)	25 (89.3%)	28 (100%)

Table 5: Frequency of target responses in the five items of the condition of the third-person pronoun in *wh*-questions.

Similar to the situation in Dem-Cl-NPs, the comprehension of third-person pronouns in the two clinical groups was also affected by the question type, as the Wilcoxon signed-rank test revealed a significant difference in the DLD ($Z = -4.312$, $p < .001$) and ALI groups ($Z = -3.990$; $p < .001$), but not in the TDA group ($Z = -1.000$, $p = .317$).

With respect to bare NPs, between-group comparisons continued to be performed by Kruskal-Wallis tests, and results revealed that children's performance on bare NPs differed significantly for groups, $H(2) = 29.411$, $p < .001$. Post-hoc pairwise comparisons with Bonferroni corrections indicated that the scores of bare NPs were significantly different between the TDA and ALI groups ($p < .001$), between the TDA and DLD groups ($p = .001$), but not between the DLD and ALI groups ($p = .402$).

So far, the subject position of *wh*-questions was shown to be able to elicit the best performance of definite expressions in the ALI and DLD groups, which may reflect their ideal level of knowledge about definiteness. Therefore, we used Friedman tests to compare the scores of Dem-Cl-NPs, third-person pronouns, and bare NPs in the subject position of *wh*-questions within each participant group, to investigate whether the three definite expressions are equally developed. The results showed that the ALI group exhibited uniform performance across all definite expressions ($\chi^2(2) = 5.896$, $p = .052$). The TDA group demonstrated a significant difference in overall comparisons ($\chi^2(2) = 16$, $p < .001$), but not in pairwise comparisons ($p = .326$ for Dem-Cl-NPs and third-person pronouns; $p = .326$ for Dem-Cl-NPs and bare NPs; $p = 1$ for bare NPs and third-person pronouns). The DLD group exhibited a significant difference in both overall ($\chi^2(2) = 18.325$, $p < .001$) and pairwise comparisons ($p = .003$ for Dem-Cl-NPs and bare NPs; $p = .012$ for Dem-Cl-NPs and third-person pronouns; $p = 1$ for bare NPs and third-person pronouns).

5.3 The results of Dem-Cl-NPs with increased memory, and of two indicators in WPPSI-IV

Table 6 presents children's performance on Dem-Cl-NPs with increased memory, and the resulting scores of the working memory and processing speed indicators from the WPPSI-IV tests.

Kruskal-Wallis tests showed that there is a significant difference in Dem-Cl-NPs with increased memory, $H(2) = 34.075, p < .001$. Post-hoc comparisons with Bonferroni corrections indicated that there was a significant difference between the TDA and DLD groups ($p < .001$), between the TDA and ALI groups ($p < .001$), but not between the DLD and ALI groups ($p = .705$).

Group	Dem-Cl-NPs with increased memory	Working Memory index in WPPSI-IV	Processing Speed index in WPPSI-IV
DLD			
Mean	2.89 (57.8%)	92.39	96.36
Median	3	92	97
IQR	4–2	97–87	103–91
Range	0–5	79–118	75–109
ALI			
Mean	2.50 (50%)	92.41	91.55
Median	3	90	91
IQR	3–2	96.25–87	100–83
Range	0–5	79–118	73–109
TDA			
Mean	4.46 (89.2%)	100.54	106.43
Median	5	100	107.5
IQR	5–4	107–90	112–100.75
Range	2–5	82–131	86–124

Table 6: Raw scores of Dem-Cl-NPs with increased memory, and standard scores of two indicators from WPPSI-IV.

Moreover, there is a significant group effect in the working memory indicator ($H(2) = 12.345, p = .002$): the TDA group scored significantly higher than the DLD ($p = .013$) and ALI ($p = .004$) groups, while the DLD and the ALI groups did not differ from each other ($p = 1$). Finally, the processing speed index from the WPPSI-IV also demonstrates statistical significance ($H(2) = 28.884, p < .001$) across the participant groups. The TDA group performed significantly better than the DLD ($p = .001$) and ALI groups ($p < .001$), and no significant differences were found between the DLD and ALI groups ($p = .406$).

Additionally, a correlation analysis was made to ascertain the influence of nonverbal working memory and processing speed on the interpretation of definite expressions. This analysis examined the correlations between the index scores of working memory and processing speed obtained from the WPPSI-IV, and the scores of the Dem-Cl-NP, Dem-Cl-NP with increased memory, bare NP, and third-person pronoun in the subject position of *wh*-question condition, respectively. A Spearman's rank-order correlation test did not indicate significant differences within each participant group, and this was evidenced by p-values greater than .05 for all pairwise associations.

5.4 Results of Dem-Cl-NPs in the post-*ba* and topic positions

The scores of Dem-Cl-NPs in the post-*ba* and topic positions are presented in **Table 7**. Kruskal-Wallis tests showed a significant difference in the post-*ba* ($H(2) = 40.240$, $p < .001$) and topic positions ($H(2) = 43.526$, $p < .001$). The *post-hoc* comparisons with Bonferroni corrections indicated that both the ALI and DLD groups were significantly lower than the TDA group in the post-*ba* (ALI-TDA: $p < .001$; DLD-TDA: $p < .001$;) and topic (ALI-TDA: $p < .001$; DLD-TDA: $p < .001$) positions, while they did not differ from each other ($p = 1$) in the two conditions.

Groups	post-*ba* position	topic position
DLD		
Mean	2.07 (41.4%)	1.82 (36.4%)
Median	2	1
IQR	4–0	3–0
Range	0–5	0–5
ALI		
Mean	1.59 (31.8%)	1.47 (29.4%)
Median	1	1
IQR	2.75–0	2.75–0
Range	0–5	0–5
TDA		
Mean	4.64 (92.8%)	4.64 (92.8%)
Median	5	5
IQR	5–5	5–4
Range	1–5	3–5

Table 7: Raw scores of Dem-Cl-NPs in the post-*ba* and topic positions.

Previously in Section 5.1, we found that children in the DLD and ALI groups had a discernible decline in the mean accuracy of object Dem-Cl-NPs in the *wh*-question condition, which contrasts sharply with the mean accuracy of subject Dem-Cl-NPs (see **Table 3**). This decline was caused by a sort of responses indirectly related to definiteness, or what we called "excessive reference errors", due to which children answered *wh*-questions by describing all the referents on the second picture, even if the target referent was a singular one. This problem is also frequently seen in the topic and post-*ba* Dem-Cl-NPs. We put the description and discussion of the error in **Supplementary File_2.**

6 Discussion

6.1 The asymmetric performance on *yes-no* and *wh*-questions by the ALI and DLD groups

We used both *yes-no* and *wh*-questions to examine Dem-Cl-NPs and third-person pronouns, and the question types turned out to have a significant impact on the ALI and DLD groups' understanding of definite expressions. In the *yes-no* questions, both groups displayed a strong tendency to provide affirmative responses, even though the correct answer was always negative. The asymmetry is even more obvious in third-person pronouns, as the DLD group experienced a decrease in mean accuracy from 84.2% (in *wh*-questions) to 29.2% (in *yes-no* questions). Why was the discrepancy thus huge?

The lower performance observed in the *yes-no* questions may be attributed to children's limited recognition of the connection between the pictures. The phenomenon of considering interconnected pictures as isolated ones has been observed in typically developing children. Emslie & Stevenson (1981) reported that, in their picture-based story-telling task, children of 2 years old used indefinite articles 20% of the time for maintaining a given referent. This occurred because the children treated previously mentioned referents as new ones when the referents re-appeared in the subsequent pictures. The same phenomenon was also found in children between the ages of 2; 6 and 5; 6 in De Cat (2011). This type of error has been called *Incoherence Errors*, and it occurs as children show difficulties with identifying the continuity between events/pictures (De Cat 2011: 858), which is considered a cognitive, but not a linguistic limitation (De Cat 2011: 850). Therefore, it follows that the children in the ALI and DLD groups likely responded to *yes-no* questions based solely on their observation of the second picture.

Another question naturally arises: now that children in the ALI and DLD groups had difficulties with the connection between pictures, why did they perform significantly better on *wh*-questions? When children were confronted with *yes-no* questions, their focus at that moment was to determine whether the event described by the question sentence exists or not. Therefore, as long as a referent in the picture fulfils the description of the question sentence, they answered *yes*, without considering the requirement to connect with prior discourse. On the other hand, when the children were dealing with *wh*-questions, their focus shifted from confirming the existence of the event to seeking specific information corresponding to *wh*-words such as who, what, and where. Given that each picture has three referents, it is not feasible to answer the questions solely based on the deictic interpretation of definite expressions. Consequently, the children were compelled to select an appropriate referent. To conclude, we argue that the difficulties with discourse integration and the deictic treatment of definite NPs (Karmiloff-Smith 1979: 72) contributed together to the lower performance on the *yes-no* questions in the ALI and DLD groups. As such type of errors ought to be categorized to the "performance-based error" (Chondrodrianni & Marinis 2015: 26) that did not accurately reflect children's grammatical abilities, the subsequent analysis of children's knowledge of definite expressions will focus solely on their performance in the *wh*-question condition.

6.2 The knowledge of definite expressions in the ALI and DLD groups

We first look at children's morpho-syntactic knowledge regarding definite NPs. Despite neither the ALI nor DLD groups achieving target-like performance on any of the three definite expressions, the referent that a child located to answer the *wh*-questions always stemmed from the pictures provided, and most importantly, the reference of the definite expressions was made to a singular referent by children[12], though there were two interfering referents in each picture simultaneously. At this point, the Dem-Cl-NP, bare NP, and third-person pronoun in the children's language most likely project as a DP, since D relates to the referentiality or deixis of a nominal expression (Willim 2000: 321), and it has a "singularizing"/ "individualizing" function (Cheng & Sybesma 1999). As the [+referential] feature is present, the DP layer is active and visible for interpretation.

According to the DP hypothesis (Abney 1987), the D head is the location that hosts definite determiners. In Mandarin, pronouns base-generate in D since they are definite determiners followed by an elided NP complement (Postal 1970; Elbourne 2001; Huang et al. 2009: 297); bare NPs appear in D to receive definite readings by head movement (Huang et al. 2009: 301); and demonstratives directly base-generate in D (Huang et al. 2009: 296). If the three NP types all project into a DP, the ALI and DLD groups should, in theory, attain a high rate of accuracy evenly across the three definite expressions (as already confirmed by the TDA children in our study). However, the results did not occur in the children with ALI and children with DLD. In the ALI group, the comprehension of bare NPs (70.6%), third-person pronouns (61.8%), and Dem-Cl-NPs (59.4%) did not differ from each other significantly, but none of them achieved target-like (if we

[12] Except for 3 children with ALI (labeled ALI-6, ALI-8, ALI-15) and 1 child with DLD (labeled DLD-5) who made "excessive reference errors" in response to *wh*-questions containing subject definite NPs.

use the 90 percent criteria threshold in Brown (1973)). In the DLD group, children's performance on third-person pronouns (84.2%) and bare NPs (83.6%) was approaching target-like, but they scored significantly lower on Dem-Cl-NPs (62.8%), presenting uneven performance on definite expressions. Therefore, the problem seems to lie more in children's semantic knowledge of definite expressions, than in the morpho-syntactic knowledge of the DP structure.

van Hout & de Ree & de Ree (2008) and van Hout & Harrigan & de Villiers (2010) provide evidence that typically developing children (*Mean* = 4) interpret definite NPs differently than adults. In their experiments, children were shown a picture with a set of identical referents. One referent was explicitly mentioned in the verbal discourse, while the others were not. Children tended to consider all the referents present in the picture as definite, whereas adults accepted the referent that had been previously mentioned as definite. From this perspective, definiteness derived from the immediate situation (the visual context) and that from the verbal discourse was unranked in children's language. Although the same phenomenon was not observed in the TDA group in our study (probably due to the older mean age of our participants), the analysis can still be used to explain the below-average performance of the DLD and ALI groups. When a child (in the two clinical groups) was processing a definite NP, two sources of semantic interpretations of definiteness emerge simultaneously, despite the antecedent already established in the previous discourse: one is the interpretation motivated by uniqueness, which resists having an antecedent (Geist 2021: 22); the other is prompted by familiarity, which necessitates an antecedent (Roberts 2003: 294). The ALI and DLD groups demonstrated a preference for anaphoric interpretations of the three definite expressions (at least 59% of the time), but there were still quite a few occurrences where they relied on the visual context (the immediate situation).

It should be noted that the condition of uniqueness is not met when the children wrongly chose the referent based on the immediate situation. This is because, apart from the referent that had been individualized in the verbal discourse, there were two other referents left unmentioned and therefore remained in the immediate situation. One anonymous reviewer referred us to Wexler (2011: 39, footnote 6),[13] who posited that children have the same lexical entry as adults but have problems computing the uniqueness requirement specified in the presupposition of definite articles, and that uniqueness is a weak/variable property for them. Therefore, children seem to employ a more flexible semantic strategy towards the uniqueness condition than adults, and the definite article can still be used even when there are multiple referents in the relevant situation, not necessarily a unique one. This phenomenon can be frequently seen in the DLD and ALI groups in our study, but not in the TDA group. So far, can we conclude that the non-target-like performance of the DLD and ALI groups on the comprehension of definite expressions is solely

[13] This work was firstly presented at the CUNY Conference on Human Sentence Processing in 2003. We are grateful to the anonymous reviewer for providing us the literature.

due to their insufficient semantic knowledge of definite expressions? That is, they cannot fully identify which particular situations (the immediate situation or previous discourse) definiteness stems from. It may be still inadequate to draw a conclusion if we re-consider the following literature in which no visual context is provided (therefore collapsing the immediate situation).

Children with DLD (5;9–9;8) in Blom & Vasic & Baker (2015) and Chondrogianni & Marinis (2015), and TD children (3;6–5;5) in Schafer & de Villiers (2000) produced definite articles more accurately in bridging conditions (that simply involve uniqueness) than in anaphoric conditions (that necessitate familiarity). Schafer & de Villiers hold a structural point of view, suggesting that the apparent DP in children aged 3;6 to 5;5 is in fact a functional projection *the*P that merely expresses [±unique] feature, and the real DP which involves [±hearer] feature is projected only when children can take listener's point of view into account. This idea exactly aligns with the more recent views on the dichotomy of two levels of definiteness within a DP. Cheng & Heycock & Zamparalli (2017) map the unique and anaphoric distinction onto two syntactic levels, a structurally lower w(eak)DP (predicative/argumental) and a structurally higher s(trong)DP with a pronominal index (argumental). Based on Cheng et al. (2017), Geist (2021) further defines the wDP and sDP into the u(niqueness-based)DP and a(naphoric)DP. Jenks & Konate (2022) propose that in the DP that expresses anaphoric interpretations, an individual-denoting category D or indexP occupies the [Spec, DP] position, whereas in the plain unique DP there is no such an index in the specifier.

Taking all the evidence into accounts, the growth of DP structure in children seems to indicate a bottom-up developmental process from uDP[14] (immediate situation/bridging) to aDP (anaphoric). The DP construction is most likely in place in the DLD and ALI groups, but its inner layers stay in a transitional stage where the semantic components of uniqueness and familiarity intertwine to some extent. Children in the two clinical groups probably already knew the semantic concepts of the two types of definiteness, but from time to time, they cannot block the semantic interference from the structurally lower layer (uDP) when they were processing the semantic property of the structurally higher one (aDP or indexP). The comprehension of definite expressions in the two clinical groups is likely to be impacted by the unstable knowledge of the syntax-semantics interface within the DP.

Since definiteness in Mandarin generates subject-object asymmetry, the syntactic and semantic knowledge regarding definite NPs in the DLD and ALI groups we discussed above is

[14] Although Hawkins (1978: 156) and Lyons (1999: 17) claim that demonstrative descriptions do not involve uniqueness, in this study we adopt Wolter's (2006: 76) uniqueness-based account for the semantics of demonstratives. According to Wolter, the uniqueness of definite descriptions is relativized to a default situation, while the uniqueness of demonstrative descriptions is relativized to a non-default situation. Therefore, we believe that demonstratives can still enter the syntactic representation in the uD position for non-anaphoric interpretations. We thank the anonymous reviewer for providing us the literature.

only applicable to the subject position. In the object, post-*ba*, and topic positions, however, the comprehension of definite NPs seems to be interfered by factors indirectly related to definiteness, which has been discussed in **Supplementary File_2**.

In summary, our findings support the theory proposed by Modyanova (2009: 118), who followed the spirit of Wexler (2011), that the development of determiners in children is predicted by their overall grammatical abilities, rather than solely by pragmatic factors.

6.3 The third-person pronoun as a potential marker to the distinction between ALI and DLD

The difference between the two clinical groups lies in the comprehension of third-person pronouns. Previous studies found that the production of pronouns has always been problematic for individuals with ASD, which is characterized by the avoidance of using pronouns or ambiguous use of pronouns, even in children with ALN (see the literature review in the section "Pronouns and ASD" in Nagano & Zane & Grossman (2021: 1565)). However, the comprehension experiment conducted by Nagano & Zane & Grossman (2021) yields divergent results, showing that children and adolescents with ASD (10 to 17 years old) were capable of comprehending third-person pronouns like the controls, though "they may struggle to apply this knowledge during production" (Nagano et al. 2021: 1574). Note that the individuals with ASD in their study show normal language and IQs, thus having ALN. Besides, the eye-tracking experiment in the same research revealed that the ASD and control groups showed different looking patterns, suggesting that the same interpretation of third-person pronouns in the two groups may be achieved through different processing paths. Nagano et al. (2021: 1575) noted that the processing difference observed in individuals with ASD may lead to their non-target performance in production tasks.

In our study, the children with ALI showed clear difficulties with the comprehension of third-person pronouns. As we have discussed in Section 6.2, the below-average performance on definite expressions in the ALI and DLD groups is due to the fact that the knowledge of syntax-semantics interface inside the DP is not well-developed. On Dem-Cl-NPs and bare NPs, the DLD and ALI groups performed similarly. This can be attributed to the assumption that processing Dem-Cl-NPs is more difficult due to its complex forms and dual functions (the anaphoric and deictic usages), while processing bare NPs is less demanding due to its simpler form. However, the performance by the ALI group no longer conforms to this assumption when it comes to the third-person pronoun. The DLD group continued to present near-target-like performance because third-person pronouns also share a simple form, but the ALI group did not perform any better on third-person pronouns than they did on Dem-Cl-NPs, and the results of Dem-Cl-NPs and third-person pronouns in the ALI group overlap greatly on the following statistical indicators: the interquartile range (4–2) and median (3) of third-person pronouns were completely identical to those of Dem-Cl-NPs, while the mean scores were approximately the same (Dem-Cl-NP: 2.97 (59.4%) vs. third-person pronoun: 3.09 (61.8%)). We argue that there must be an additional factor at work that constrains a better interpretation of third-person pronouns in the ALI group.

According to Nagano et al., the discrepancy in the processing paths between the ASD and the control groups arises from the shortcoming in working memory and attentional allocation abilities within the ASD group. In addition, they found that children with ASD demonstrated significantly facilitated processing in the condition where the "full NPs" (the combination of definite article and common noun) were used to refer to a previously introduced referent, in comparison to the condition where third-person pronouns were used. They noticed that the preference for processing "full NPs" observed in the ASD group coincided with the behavior of the patients with Alzheimer disease who processed narratives faster when "full NPs", instead of pronouns, were used, which is attributed to the working memory defect[15] in the Alzheimer group (Almor 1999).

The analysis in Nagano et al. (2021) provides valuable insights into how the ALI group in our study treated bare NPs and third-person pronouns differently. First, according to Cheng & Sybesma (1999) and Huang et al. (2009: 283), definite bare NPs in Mandarin are equivalent to [*the* + NP] combination in English. Therefore, bare NPs are the counterpart of "full NPs" described in Nagano et al. (2021). As the processing of "full NPs" was more facilitated than the processing of third-person pronouns in the ALI group, the performance on bare NPs therefore derived no significant differences as compared to that of the DLD group. Second, as for third-person pronouns, despite the simplicity of their form, the ALI group scored significantly lower than the DLD group due to the combined factors of (i) the difficulties with the knowledge of syntax-semantics interface inside the DP structure, and (ii) the processing difference (that impacts the interpretation of third-person pronouns); on the other hand, the DLD group was affected simply by the first factor. Therefore, the combined impact of linguistic deficits and processing differences could potentially result in reduced interpretation of third-person pronouns in the ALI group. What is the underlying factor responsible for the processing difference in the ALI group — the deficiencies in working memory, or in attentional allocation abilities, or in both?

First, we believe that working memory cannot be the leading factor. We examined children's non-verbal working memory in the subtest of WPSSI-IV, and the condition of Dem-Cl-NPs with increased memory. The results indicated that there were no significant differences between the two clinical groups in the two tasks. Therefore, it would be less reasonable to conclude that non-verbal working memory only comes into play for children with ALI.

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[15] The retention and retrieval of the referents of third-person pronouns is more taxing than that of "full NPs", since third-person pronouns have no lexical content.

We then considered the potential deficiency in attentional allocation abilities in the ALI group. As presented in **Table 5**, the exceptionally high level of accuracy observed in Items 1 and 3 may be ascribed to the saliency of the target referent, which happens to be the most active or conspicuous referent in the picture. In the Items 2 and 5, the target referent and the interfering referents display equal levels of prominence, therefore leading to decreased accuracy rates. The reason for Item 4 receiving the lowest accuracy rate is due to the interfering referent being the most prominent one. In comparison, the DLD group exhibited noticeably higher levels of accuracy and stability in their performance across the items. It follows then that although the referent introduced by the indefinite NP has been made salient in the discourse, children in the ALI group still tended to reallocate their attention to the referents that are most appealing to them, rather than the one that corresponds to the antecedent. The occurrence of this phenomenon in the third-person pronoun, as opposed to the bare NP, can be attributed to the lack of lexical content in the third-person pronoun, because it is a pure anaphor and its interpretation in verbal discourse is entirely dependent on the antecedent. Therefore, the lack of lexical content in the third-person pronoun renders the ALI group more vulnerable to being distracted by extralinguistic distractions.

In Mandarin, the equivalents of "he", "she", and "it" all share an identical phonological form, and it remains unclear whether this overlap would render the third-person pronoun more difficult to comprehend for Mandarin-speaking children. In this case, it would be interesting to look at children who acquire languages in which the third-person pronoun makes a distinction between gender and animacy. As the attentional allocation ability may be the point where the DLD and ALI groups diverged in their comprehension of third-person pronouns, future research may consider the role of referents' conspicuousness as variables, and an eye-tracking experiment is strongly recommended.

7 Conclusion

This research provides empirical evidence in support of the syntactic and semantic principle-based explanations proposed by Wexler (2011) and Modyanova (2009) for the acquisition of determiners in children. While both the DLD and ALI groups showed similar level of immature syntax-semantics interface knowledge within DPs, their language phenotypes regarding definite expressions are not completely identical, as the ALI group exhibited significantly lower comprehension of third-person pronouns, which can be attributed to the distinct processing characteristics observed in individuals with ASD.

Abbreviations

ASD = autism spectrum disorder; ALI = autism with language impairment; ALN = autism with normal language; BA = marker of the *ba* construction; Cl = classifier; Dem = demonstrative; DLD = developmental language disorder; DUR = durative aspect marker; Num = numeral; TDA = typically developing children matched on age; TDY = typically developing younger children matched on language abilities; PFV = perfective aspect marker; PROG = progressive aspect marker; Q = question marker; SFP = sentence final particle; SLI = specific language impairment.

Data Accessibility Statement

All data, experiment materials, and supplementary files are available at https://osf.io/73uk9/

Ethics and consent

The study was approved by the review board of the Center for Linguistics and Applied Linguistics at Guangdong University of Foreign Studies, China. The parents or guardians of the children had signed the written consent form, granting permission for their children's participation in the research.

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Competing interests

The authors have no competing interests to declare.

Authors' Contributions

The authors contributed equally to this work.

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