COMPREHENSION AND PRODUCTION OF RELATIVE CLAUSES IN CANTONESE CHILDREN WITH AND WITHOUT DEVELOPMENTAL LANGUAGE DISORDER (DLD)

LAI, JANE MAN-YU

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Comprehension and Production of Relative Clauses in Cantonese Children with and without Developmental Language Disorder (DLD)

LAI, Jane Man-yu

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Abstract

This thesis studies the comprehension and production of relative clauses (RCs) in Cantonese-speaking children with and without Developmental Language Disorder (DLD). It consists of three studies that examine Cantonese RCs incorporating typological distinct properties of the language and reports empirical findings that bear on the theoretical dichotomy of domain-specific versus domain-general accounts in both typical and atypical language development.

Study one presented two novel corpus studies that considered the typological characteristics of Cantonese as an attributive clause language and examined the acquisition of prototypical RCs and their related noun-modifying clause constructions (NMCCs) in a broader conceptual context. It investigated the developmental trajectory and characteristics of NMCCs, including both conventional RC-type NMCCs and gapless NMCCs, in 78 monolingual Cantonese-speaking children's naturalistic speech aged 1;7 – 5;6. Results posed challenges to structurally-oriented accounts that consider structural constraints as the primary determinants affecting acquisition outcomes, but rather, findings were discussed in light of constructivist perspectives (eg. Lieven & Tomasello, 2008) that focus on form-function pairings and conceptualize constructions in an interrelated network.

Study two reported the first experimental study that investigated RC comprehension offline and online in Cantonese-speaking children with and without Developmental Language Disorder (DLD). Following a similar design in Frizelle and Fletcher (2014), this study compared children with DLD (n=22) with their age-matched typically-developing peers (AM-TD, n=23) aged between 6;6 - 9;7 and language-matched, younger TD children (YTD, n=21) aged between 4;7 – 7;6. This second study used a referent selection eye-tracking task to test the predictions from domain-specific versus domain-general accounts of Cantonese RCs and DLD children, with regards to three dimensions: (i) two RC types (SRCs vs ORCs); (ii) relativization strategies (CL vs *ge3*) and (iii) DLD vs TD peers. The developmental pattern cannot be adequately accounted for by domain-specific structural perspectives that conceptualize the nature of processing demands in terms of structural constraints (eg. structural distance (Hawkins, 1999, 2004) or structural intervention (Friedmann, Belletti & Rizzi, 2009)); but are well-predicted by domain-general emergentist-constructivist approaches (eg. O'Grady, 2010, 2011, 2021) that allow multiple factors to jointly determine acquisition outcomes.

Study three extended the investigation to a wider range of relativized positions and presented the first empirical study that examined RC production in Cantonese-speaking

children with and without DLD. To evaluate the applicability of the noun phrase accessibility hierarchy perspective (NPAH, Keenan & Comrie, 1977) versus domain-general emergentist-constructivist approaches on Cantonese RCs, this study assessed the same three groups of children from study two and used a sentence repetition task to test (i) the relative difficulty between RC types; (ii) the relative difficulty within an RC type; and (iii) the relative difficulty between relativization strategies. The specific pattern of results is not consistent with the predictions based on NPAH, but maps well onto a multifactorial, domain-general account of acquisition that identifies a core role for language-specific properties and learner's experience.

These new findings contribute novel naturalistic and experimental data on the developmental patterns of RCs in Cantonese-speaking children with and without DLD. The pattern of results exhibited across the three studies consistently challenge the domain-specific structurally-oriented perspective to RC acquisition, and are best predicted and accounted for by domain-general emergentist-constructivist approaches that are multifactorial and give primacy to the interaction of multiple factors such as learner's experience, language-specific properties in form-function mappings and relationships between constructions, cognition as well as processing.

(549 words)

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List of Abbreviations

A	Agent
ADV	Adverb
ASP	Aspect
C, CP	Complementizer, Complementizer phrase
CL	Classifier
EXCL	Exclamation
OCOMP	Object of comparison
GEN	Genitive
GENO	Genitive object
GENS	Genitive subject
IO	Indirect object
IP	Inflectional phrase
N, NP	Noun, Noun phrase
O	Object
OBL	Oblique
OBLHelp	Subtype of oblique relative clause
OBLWith	Subtype of oblique relative clause
P	Patient
PART	Particle
PL	Plural
PRF	Perfective aspect marker
PROG	Progressive aspect marker
PST	Past
RC	Relative clause
S	Subject
SFP	Sentence final particle
V, VP	Verb, Verb phrase
XP	Predicate phrase

Chapter One
Introduction

1.1 Introduction

The acquisition of relative clauses (RCs) has received considerable attention in the past four decades because of its theoretical significance to syntactic development and relevance to testing the various perspectives of factors affecting acquisition and/or processing (e.g. Gibson, 1998, 2000; MacDonald, 1999; Kidd, 2011). In well-studied languages like English and other European languages, it is widely accepted that subject RCs (SRCs) like (1) are typically acquired earlier and cause fewer problems to process than object RCs (ORCs) as in (2) when cues such as animacy contrast are neutralized (e.g. Diessel & Tomasello, 2000, 2005 in English and German; Brandt, Kidd, Lieven & Tomasello, 2009 in German; Friedman, Belletti & Rizzi, 2009 in Hebrew).

(1) English SRC:

[$_{\text{Head noun}}$ The elephant$_i$] that [$_{\text{RC}}$ ___$_i$ caught the giraffe].

(2) English ORC:

[$_{\text{Head noun}}$ The elephant$_i$] that [$_{\text{RC}}$ the giraffe caught __$_i$].

Such asymmetry in RC processing is not only observed in typically-developing (TD) children, but also children with Developmental Language Disorder (DLD) who demonstrated robust difficulty with ORCs in frequently-studied languages (e.g. Adani et al., 2014, Frizelle & Fletcher, 2014 in English; Stavrakaki, Tasioudi & Guasti, 2015 in Greek; Friedmann & Novogrodsky, 2004, Friedmann, Yachini & Szterman, 2014 in Hebrew; Contemori & Garraffa, 2012 in Italian; De Lopez et al., 2014in Danish; Rakhlin et al., 2016 in Russian).

Several proposals for this general subject preference exist, with which the most relevant proposals to the current dissertation are first outlined here and will be further elaborated in section 1.2. For instance, the typological generalization Noun Phrase Accessibility Hierarchy (NPAH, Keenan & Comrie, 1977) are often cited and mapped onto the RC developmental phenomena to describe the ease of relativizing different syntactic positions in acquisition. On the other hand, structurally-oriented accounts assume domain-specific, innate knowledge of

language represented in hierarchical syntactic structures and consider syntactic complexity as indexed by the hierarchical distance (Hawkins,1999, 2004; Lin & Bever, 2006) or structural intervention (Friedmann et al., 2009) between the head noun and the gap. For those who consider incremental processing, the filler-gap distance is viewed in a linear left-to-right parsing of the surface form (Gibson, 1998, 2000). Moreover, from an emergentist perspective (O'Grady, 2011) that assumes a domain-general, efficiency-driven learning mechanism, the linear processing distance factor has been incorporated, together with general subject prominence effects and other experience-based factors to account for the phenomena observed in English and other European languages where SRCs are favored over ORCs. In addition, usage-based or constructivist approaches focus on relationships between constructions in a language and attribute the source of asymmetry in acquisition/ processing to factors such as similarity to simpler known constructions and distributional frequency (Diessel & Tomasello, 2005; Kidd, Brandt, Lieven & Tomasello, 2007; Fitz, Chang & Christiansen, 2011).

In recent years however, when investigation is extended to typologically diverse languages, a less consistent pattern of developmental trajectory has been reported. TD children learning East Asian languages with prenominal RCs like Japanese (Ozeki & Shirai, 2007), Mandarin (Chen & Shirai, 2015) and Cantonese (Chan et al., 2011; Yip & Matthews, 2007a, 2007b) by contrast show lack of a robust SRC advantage. As research on SLI/ DLD in the context of East Asian languages has received more attention, two recently-published studies documented that Japanese- and Korean- speaking children with SLI did not find ORCs more difficult than SRCs, even though they performed significantly worse than their TD peers in general (Sasaki et al., 2020 in Japanese; Yoo & Yim, 2021 in Korean). This is unlike the findings reported in English and other European languages in the DLD literature. As such, these discrepant findings give rise to the question of the applicability of NPAH to East Asian languages in general and to what extent the diverse theoretical perspectives can adequately account for the developmental phenomena across typologically diverse languages. Furthermore, studying the acquisition/ processing of relative clauses in DLD children can bear on existing accounts of DLD and their nature of difficulties with syntactic processing.

This thesis examines the comprehension and production of relative clauses in Cantonese-speaking children with and without DLD. As will be illustrated in the coming sections, Cantonese is an important language in debates regarding the acquisition of RCs given their distinctly rare word order in having prenominal RCs and SVO main clauses. Section 1.2 begins with an overview of Cantonese RCs and discusses the theoretical perspectives that have been commonly cited and considered in the RC literature, as well as their relevance to and

predictions for Cantonese. Section 1.3 introduces the current theoretical accounts of DLD and illustrates how Cantonese RCs bear on these theories in terms of their particular hypotheses on RC performance in Cantonese-speaking children with DLD. Section 1.4 briefly describes the three studies of this thesis.

1.2 Cantonese RCs and theoretical perspectives on RC processing

Like English, Cantonese is a SVO language but unlike it in having postnominal RCs, Cantonese RCs are prenominal where the RC is placed before the head noun. This combination of head-final RCs within a SVO language is cross-linguistically rare (Dryer, 2013). Consider the Cantonese SRC (3) and ORC (4) examples[1] below and their English equivalents.

(3) Cantonese SRC

[$_{RC}$ __$_i$ 摸兔仔]嗰隻 / 嘅 [$_{head\ noun}$ 貓仔 $_i$]

mo2 tou3 zai2 go2 zek3 / ge3 maau1 zai2

stroke rabbit that CL/ ge3 cat

'the cat that strokes the rabbit'

(4) Cantonese ORC

[$_{RC}$ 貓仔摸 __$_i$]嗰隻 / 嘅 [$_{head\ noun}$ 兔仔 $_i$]

maau1 zai2 mo2 go2 zek3 / ge3 tou3 zai2

cat stroke that CL/ ge3 rabbit

'the rabbit that the cat strokes'

As included in (3) and (4), there are two relativization strategies in the formation of Cantonese RCs, namely the classifier (CL) and the particle *ge3*. It is also possible to construct a RC in Cantonese by a combination of CL and *ge3*, referred to as the 'hybrid' form by Matthews & Yip (2001) which are described to be relatively rare and attested in strictly formal contexts. As such, the current thesis restricts the empirical investigation to focus on the two relativization strategies (CL versus *ge3*) only. The two strategies are said to belong to different functional

[1] The underscore '__' indicates where the gap is supposed to be in analyses that assume a syntactic gap position from which the NP was extracted to generate a relative clause. On the other hand, this thesis also recognizes and adopts an alternative analysis of Cantonese RCs as a subtype of noun-modifying clause constructions without the need of a syntactic filler-gap dependency. However, it is beyond the scope of this thesis to verify between these two theoretical analyses of Cantonese RCs.

registers, with CL RCs commonly found in colloquial speech, whereas *ge3* RCs are used in more formal registers such as news reporting and literacy texts (Chan et al., 2011; Matthews & Yip, 2001). It is worth mentioning that the same strategies are used for other noun-modifiers in the language. Typologically, RCs in certain Asian languages including Cantonese have been argued to be fundamentally different from RCs in English and some European languages (Comrie, 1996; 1998; Matsumoto, 1997). In the same vein, there are proposals that considered Cantonese RCs as a subset of general attributive clauses or noun-modifying clause constructions (NMCCs) that are constructed based on semantic-pragmatic relations (Matthews & Yip, 2016; 2017), which will be discussed in greater details in Study One (i.e. the next chapter). Thus, Cantonese presents a good opportunity to examine whether cross-linguistic differences would result in variations in acquisition and how these would bear on the current theories as well as the acquisition factors specific to the language. Yet to date, existing studies consider only the developmental trajectory of prototypical RCs. There has been so far no developmental study attempted to systematically examine the acquisition of both RCs and other NMCCs in Cantonese. Study One of this thesis is designed to fill this research gap (see Chapter Two).

Empirically, published acquisition studies on Cantonese RCs are still relatively few and findings from these studies regarding the relative ease of SRCs vs ORCs are mixed. Using an act-out task and an elicited imitation task, Lau (2006, 2016) studied the comprehension and production of Cantonese RCs in Cantonese-speaking children aged between 4;0 and 6;1 (Lau, 2006); 3;0 to 5;11 (comprehension study in Lau, 2016) and 4;0 to 5;10 (production study in Lau, 2016), where a subject over object RC advantage was consistently reported across both tasks. However, the design of these experimental tasks in Lau's studies suffer from the lack of a supportive, felicitous discourse context for the use of relative clause (see Correa, 1995 for more details). By contrast, having created a supportive felicitous discourse context for the use of RCs and controlled for animacy cues, Chan et al. (2007) tested the production of different types of classifier RCs in Cantonese-speaking four-year-old children in a sentence repetition task, where they reported in a conference presentation that no subject advantage was observed and children's performance on ORCs were even numerically better than SRCs. Based on longitudinal data of three bilingual Cantonese children's naturalistic speech, Yip and Matthews (2007a) reported an early emergence of ORCs either before or simultaneously with SRCs in children's Cantonese. A non-significant ORC advantage in monolingual Cantonese children was also observed in Kidd, Chan and Chiu (2015). Furthermore, asymmetry in Cantonese-speaking four-year-old children's comprehension of RCs constructed with classifier and *ge3*

was reported (Chan et al., 2018), in which a significant ORC advantage was found in the CL RCs but SRC advantage in *ge3* RCs. These findings challenge theoretical perspectives that uniformly predict a subject or object advantage because they fail to account for the differences in subject/object processing asymmetry attested in different types of SRCs and ORCs within a single language like Cantonese. The authors explained this set of findings with relation to language-specific properties and the distributional frequency of constructions in children's linguistic experience. These mixed findings in the literature suggest that acquisition or processing outcomes are affected by multiple factors which may or may not pull in the same direction to favor and disfavor subject or object RC acquisition/processing. Moreover, these mixed findings in the literature challenge theoretical perspectives that consider structural constraints as the primary determinant in acquisition which would predict a uniform subject over object RC advantage for Cantonese RCs. Studies two and three (see Chapter Three and Four) of this thesis will further address these theoretical perspectives by examining comprehension and production of RCs in Cantonese-speaking children with and without DLD. The following sections first introduce the theoretical perspectives central to the discussion of RC acquisition, as well as their relevance to Cantonese RCs.

1.2.1 Typological perspective: Noun Phrase Accessibility Hierarchy (NPAH, Keenan & Comrie, 1977)

Based on observations from 49 languages, Keenan & Comrie (1977)'s noun phrase accessibility hierarchy (NPAH) is a typological generalization describing the relative accessibility of a noun phrase (NP) at various syntactic positions to relativization across languages:

(5) Noun Phrase Accessibility Hierarchy
Subject > Direct Object > Indirect Object > Oblique > Genitive > Object of Comparison

According to the NPAH, if a language allows relativization on a given position, then it should allow relativization on all other positions to its left in the hierarchy. Subsequent works extend the notion of accessibility to ease of processing/ acquisition, most notably Keenan & Hawkins (1987) who demonstrated the ease/ difficulty in processing RCs reflecting the order of NPAH through a repetition task: the higher position an NP is on the hierarchy, the easier it is to repeat the sentence with the NP relativized. Later, Hawkins (2004) formulated metrics to quantify the

processing difficulty based on the depth/ embeddedness of the relativized position on the hierarchical sentence structure, which could also be considered as structurally-based (see Chan et al., 2011). The processing demands underlying NPAH, whether or not they are structural in nature, may be relevant to language acquisition; and if so, there should be parallels between developmental phenomena and the ranking on NPAH.

While the primacy of subject RCs is reported in languages with postnominal RCs such as English (e.g. Keenan & Hawkins, 1987; Diessel & Tomasello, 2000), German (e.g. Brandt, Diessel & Tomasello, 2008; Diessel & Tomasello, 2005) and Hebrew (eg. Friedmann et al., 2009), not all findings follow the rankings in NPAH for other relativized positions. For instance, Diessel & Tomasello (2005) tested the production of a wide range of RCs in four-year-old English- and German- speaking children and found that the relative ease of production between patient (P), indirect object (IO) and oblique (OBL) varies in the two languages (i.e. P, IO and OBL RCs (except P vs OBL) were not significantly different from each other in English; P was much better than IO and OBL RCs in German, and the difference between IO and OBL RCs, although not significant, was much larger than in English). A similar ranking of difficulty has also been reported in English-speaking children with DLD (Frizelle & Fletcher, 2014), despite their generally lower level of RC performance than their TD peers. In particular, both Diessel & Tomasello (2005) and Frizelle & Fletcher (2014) distinguished intransitive SRCs (S) and transitive SRCs (i.e. Agent (A) RCs) in their studies, where differential performance within the subject position was observed which could not be accounted for by NPAH: both English and German-speaking children performed better at S than A RCs. The authors explained their findings from a multifactorial approach, that other processing factors such as semantic and conceptual simplicity, relationship between RC and simple sentences, and distributional frequency could influence acquisition outcomes. These processing factors will be further discussed in the next section 1.2.2.

By contrast, findings from East Asian languages are mixed. Having also prenominal RCs like Cantonese, naturalistic production data from Japanese (Ozeki & Shirai, 2007) reported a lack of subject advantage in TD children and that ORCs emerged earlier or simultaneously with SRCs and Oblique RCs in comparable frequencies, posing challenges to the NPAH cross-linguistic predictions. However, the latest published study by Sasaki and her colleagues (2021) on the comprehension of Japanese RCs using a picture pointing task found a subject over object advantage in TD children. RC acquisition studies in Chinese are also mixed in this regard, with some reporting a subject over object RC advantage (e.g. Hsu, Hermon & Zukowski, 2009 in Mandarin-speaking TD children; Lau, 2016 in Cantonese-

speaking TD children's RC comprehension but no preference for either SRC or ORC in production), whilst others reported a lack of subject over object advantage or even an object advantage (see Chan et al., 2011 for a review of Chinese RCs; Chen & Shirai, 2015 in Mandarin-speaking TD children's naturalistic speech; Chan et al., 2007 in Cantonese-speaking TD children's elicited imitation and Chan et al., 2021 in elicited production; and Yip & Matthews, 2007a, 2007b in bilingual Cantonese-speaking TD children's naturalistic speech). Moreover, recent investigations in the DLD literature also featured typologically diverse languages. Focusing on the comparisons between subject and object RCs, data from Japanese- and Korean- speaking children with SLI/ DLD demonstrated a lack of ORC difficulty, unlike findings in the English and European DLD population. For instance, Sasaki et al. (2020) reported no preference for either SRC or ORC among Japanese-speaking children with SLI when comprehending RCs that modify the noun of the main clause, and even an object advantage when comprehending RCs that modify an isolated noun phrase. In Korean-speaking children with SLI, Yoo and Yim (2021) also found no preference for either SRC or ORC in children's online and offline comprehension of Korean RCs. However, given both the theoretical and clinical significance, to date there has been no published first language acquisition study that systematically investigates the offline and online comprehension of SRCs versus ORCs in the Chinese DLD literature. Study two will address this issue (see Chapter Three). There is also no known study that tests a broad range of relativized positions beyond SRCs and ORCs in Cantonese-speaking children with and without DLD. As such, the applicability of NPAH effects in East Asian languages such as Cantonese deserves further investigation and the source of asymmetry or difficulty with certain types of RCs need to be evaluated against current proposals of processing demands or factors affecting acquisition. Study three of this thesis will address this research gap (see Chapter Four).

1.2.2 Domain-specific versus domain-general accounts of language acquisition

Theories of language acquisition put forward proposals that differ in the nature of the mechanisms that enable language learning, and the processing factors that influence both typical and atypical language acquisition. The field's dichotomy lies in the assumption of a domain-specific module committed solely to language learning, or a domain-general, non-linguistic mechanism that serves all kinds of learning including language acquisition. Domain-specific approaches are also pertinent to Chomsky's Universal Grammar (UG) that posit children come to the task of language learning with an innate set of grammatical principles and

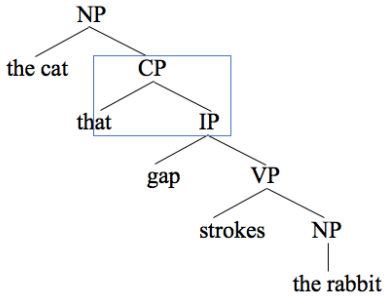
constraints to process and generate linguistic representations that are assumed to be hierarchical in nature. As such, structural factors are regarded as primary determinants (i.e. other information considered peripheral) in syntactic development. On the other hand, domain-general accounts are multi-factorial and give primacy to factors such as learner's experience, meaning and function, cognition as well as processing. The following sections discuss factors within both perspectives that are relevant to the study of RCs and their predictions for Cantonese.

1.2.2.1 Domain-specific perspective: Structural-oriented account

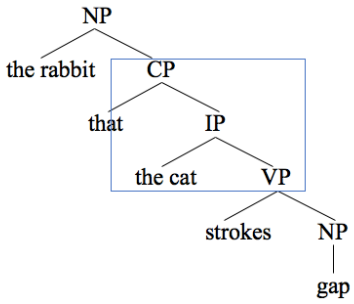
Within domain-specific approaches, formal/ structural account is among the prominent perspectives in the study of RCs which assumes hierarchical structure of sentences and conceptualizes processing ease or difficulty in relation to the hierarchical representations. Whilst several proposals exist within the structural account, the core idea is that more computational effort (hence more difficult to process/ acquire) is required to access constituents that are more deeply embedded in hierarchical structure. Despite the variations in metrics to compute the depth/ embeddedness of a gap, accounts that consider structural effects consistently predict a subject RC advantage in RC acquisition literature on commonly-studied European languages like English, because subject is supposed to be less embedded than object in syntactic structure in these languages. Resolving filler-gap dependency is central to the discussion of the source of RC difficulty. Frazier's (1987) active-filler hypothesis proposes that SRC interpretation is readily applied to all RC structures because there is a tendency for parsers to actively posit a gap as soon as a potential filler is encountered; and within the formal framework, subject gaps appear sooner than other positions in the hierarchical structure.

Subsequent work has considered the intervening elements between the filler and gap in accounting for difficulty with RCs. There are two prominent proposals in this regard. One way to measure the intervening elements is to consider the structural distance between the filler and gap, as represented by the depth of the gap in terms of intervening syntactic nodes in a hierarchical structure (Hawkins, 1999, 2004; O'Grady, 1997). Both the English and Cantonese paired examples (6a-b) and (7a-b) below demonstrate that the gap in ORCs is more deeply embedded and thus has a longer structural distance between the filler and gap than that in SRC. Therefore, from a structural perspective, SRCs are predicted to be easier to process than ORCs in both English and Cantonese.

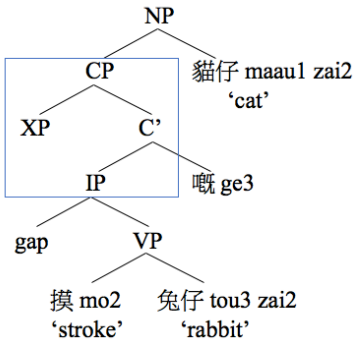
(6) a. English SRC



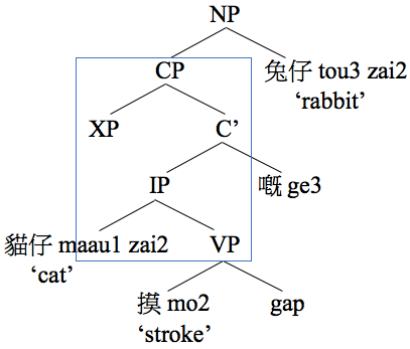
b. English ORC



(7) a. Cantonese SRC

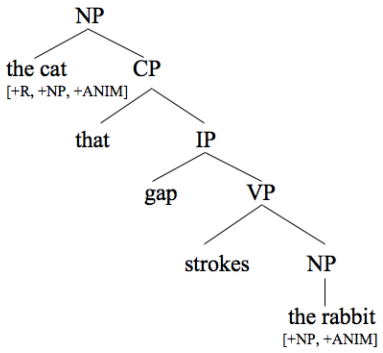


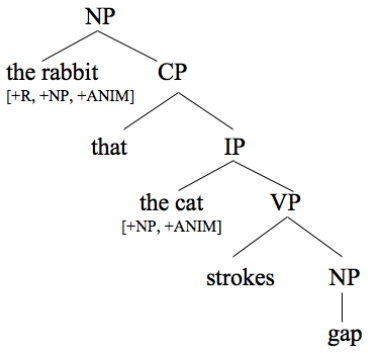
b. Cantonese ORC



Alternatively, structural intervention effect has been suggested to be the source of subject-object asymmetry (Friedmann et al., 2009). It was developed with reference to the notion of Relativized Minimality (RM, Rizzi, 1990, 2004): local relation between an extracted element and its trace is blocked when there is a structural intervening element; and therefore, RM is violated which causes the dependency to be harder to resolve (Friedmann et al., 2009). In the context of RCs, a qualified structural intervener shares some featural specifications with the relative head noun. For instance, in English ORCs as in example (6b) repeated below as (8b), the dependency between the head ("the rabbit") and the gap has to cross over the RC-internal subject ("the cat") which shares a subset of features with the head noun (e.g. both are animate lexical NPs). As such, the RC-internal subject becomes a structural intervener, violating RM and placing local constraints on dependencies, which results in processing difficulties. By contrast, no structural intervener occurs between the head and the gap in English SRCs as in example (6a) repeated below as (8a), hence easier to process/ acquire. The same is observed in Cantonese RCs (see examples (3) and (4) repeated below as (9a) and (9b) with featural specifications indicated on the relative head and RC-internal subject/ object).

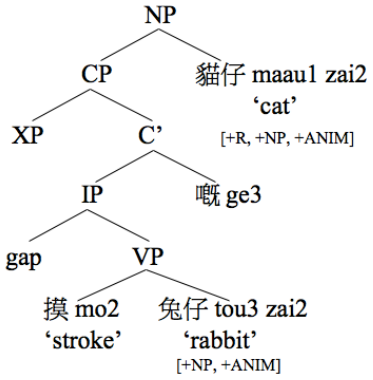
(8) a. English SRC b. English ORC

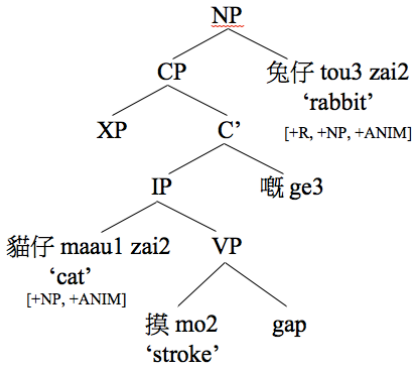




[R = relative; NP = noun phrase; ANIM = animacy]

(9) a. Cantonese SRC b. Cantonese ORC





[R = relative; NP = noun phrase; ANIM = animacy]

To summarize, structural accounts emphasizing the depth of embedding of the gap and the intervening structural elements in hierarchical representations predict a uniform subject RC advantage in processing/ acquisition in both English and Cantonese: like English, Cantonese SRCs have shorter structural distance between the filler and gap in structural representations and have no structural intervener between the head and the gap; whereas Cantonese ORCs are more deeply embedded and had a longer structural distance between the filler and gap, in which their local relation is blocked by a structural intervener (i.e. the RC-internal subject).

1.2.2.2 Domain-general perspective: Linear distance-based processing

Alternatively, in linear distanced-based approach, processing cost is calculated as the linear distance (i.e. the number of intervening elements) between the head and the gap on the surface form. The assumption is that the parser has to retain information in working memory to resolve filler-gap dependency, thus the longer linear distance the greater burden on working memory. This view is compatible with domain-general approaches that consider also cognition and processing, alongside other factors, in affecting acquisition outcomes. Domain-general

emergentist account such as O'Grady (2010; 2011; 2021) explains linguistic development by reference to the operation of a linear, efficiency-driven cognitive mechanism that seeks to minimize the burden on working memory and interacts with other external factors from experience to shape processing routines. In his account of relative clauses, O'Grady (2011) highlighted the linear distance factor, together with subject prominence effects (which will be discussed in the next section 1.2.2.3), as two particularly relevant factors in RC processing and acquisition.

Among the various metrics proposed to determine the linear distance, Gibson (1998, 2000)'s 'Dependency Locality Theory (DLT)' has been regarded as a representative proposal, to which O'Grady (2011) also subscribes in his formulation of the distance factor: "*the difficulty of processing a relative clause increases with the length of the filler-gap dependency (calculated in terms of intervening new discourse referents)* (p.22)". While the existence of hierarchical syntactic representations is assumed in Gibson's DLT, the domain-general emergentist account does not make such an assumption but rather views the effects of intervening elements as simply postponing the resolution of filler-gap dependency, which increases working memory burden. Following the metrics in DLT, linear distance is measured by the number of new discourse referents denoted by noun phrases and verbs, because the integration and storage of such new information are additionally taxing on working memory. For instance, in the English examples (10a-b) below, ORC has a longer linear distance than SRC in terms of intervening discourse referents (i.e. two discourse referents denoted by RC-internal subject NP and verb). Hence, like the domain-specific structural-oriented account, linear distance factor would also favor the processing of SRCs over ORCs in English and predict English ORCs to be more challenging than SRCs.

(10) a. English SRC

$[_{\text{head noun}}$ the cat$_i]$ $[_{\text{RC}}$ that $\_\__i$ strokes the rabbit]

0

b. English ORC

$[_{\text{head noun}}$ the rabbit$_i]$ $[_{\text{RC}}$ that the cat strokes $\_\__i]$

1 2

On the other hand, because of the prenominal RC configuration in Cantonese, linear distance becomes shorter in ORCs where there is no intervening discourse referent between

the head noun and the gap, as shown in the paired Cantonese examples (11a-b) below. Unlike structural perspectives that predict a subject advantage in both English and Cantonese, accounts that are based on linear distance make different predictions according to the RC head directionality. Thus, Cantonese RCs allow one to tease apart the effects of structural versus linear factors, that are confounded in English RCs: structural factors favor the processing of Cantonese SRCs; whereas linear distance confers an ORC advantage. Study two (i.e. Chapter Three) and three (i.e. Chapter Four) of this thesis consider both structural and linear factors, alongside other processing factors and test the predictions from domain-specific versus domain-general approaches in Cantonese RC comprehension and production.

(11) a. Cantonese SRC: 'the cat that strokes the rabbit'

[RC__i 摸兔仔]	嗰隻 / 嘅	[head noun 貓仔 i]
mo2 tou3 zai2	go2 zek3 / ge3	maau1 zai2
stroke rabbit	that CL/ ge3	cat
1	2	

b. Cantonese ORC: 'the rabbit that the cat strokes'

[RC 貓仔摸 __i]	嗰隻 / 嘅	[head noun 兔仔 i]
maau1 zai2 mo2	go2 zek3 / ge3	tou3 zai2
cat stroke	that CL/ ge3	rabbit
	0	

1.2.2.3 Domain-general emergentist perspective: Subject prominence

The prominence of subject is regarded as another factor that is of special relevance to RCs in domain-general emergentist account (i.e. O'Grady, 2011) of RC processing and acquisition. The idea of subject prominence builds on classical notions of topicality (Kuno, 1976; Givon, 1984), perspective (MacWhinney, 1977, 2005), givenness and thematic prominence (Bornkessel-Scheslewski & Scheslewski, 2009). A RC is functionally about the referent of the head noun and there is a general facilitating effect from subject prominence in the construal of such an 'aboutness' relationship: given that the subject position is reserved for clausal topics (Lambrecht, 1994) and the head noun is the RC topic, therefore SRCs are more salient and accessible in the discourse as they match the expectations of topichood (Kuno, 1976; Givon, 1984; Mak, Vonk & Schriefers, 2006; O'Grady, 2011; Lin, 2018).

The general subject prominence factor is thus formulated in O'Grady (2011)'s proposal as: "the ease with which the processor establishes an aboutness relationship with a nominal is proportional to the prominence of that nominal's referent within the RC. (A referent functioning as subject within the RC is most prominent, a referent functioning as direct object is next most prominent and so on.)" (p.21). As such, this factor would predict a general subject RC advantage in Cantonese and across languages. On the other hand, it is not incompatible with or disallows a view that multiple factors can jointly affect acquisition. Recall that the emergentist approach is in its essence multifactorial, giving primacy to a range of relevant factors (which are not inherently grammatical) that interact over the course of development; and contrasts with domain-specific, purely structural accounts which consider structural factors as primary determinants (i.e. other information regarded peripheral to grammar). Consequently, general subject prominence and the other relevant factor to RC acquisition, linear distance, as highlighted by O'Grady (2011) would pull in opposite directions to favor and disfavor the processing of SRCs in Cantonese depending on the strength of these factors. Studies two and three (see Chapters Three and Four) will address this issue and take into account of other experienced-based, language-specific factors that are relevant to RC acquisition within the domain-general perspectives, and test their predictions against hypotheses from purely domain-specific, structural approaches that are adopted in the study of RCs.

1.2.2.4 Domain-general constructivist perspective: Relationships with simpler known constructions and distributional frequency

Another prominent approach within the domain-general emergentist framework is the usage-based/ constructivist approach (e.g. Lieven & Tomasello, 2008; Tomasello, 2003) which focuses on the functional aspect of language and regards grammatical constructions as form-function pairings constructed on the basis of distributional properties of the learner's experience. Conceptualizing grammar in terms of an interconnected network of constructions, constructivists consider language-specific properties and emphasize relationships between constructions in acquisition, allowing differential predictions of the relative ease/ difficulty in processing/ acquiring RCs according to the language specific characteristics of the target language which would impact on the distributional frequencies of the target and its related constructions in a learner's experience.

Relationships with simpler known constructions

On this theoretical perspective, the acquisition of complex constructions such as RCs could be influenced by simpler, related constructions that are overlapping in form and/ or function. The idea follows from the 'construction conspiracy hypothesis' (Abbot-Smith & Brehens, 2006), which proposes that the acquisition of new, complex constructions could be supported by prior acquisition of simpler, related constructions with overlapping form and/ or function. The hypothesis is formulated upon the authors' corpus analyses of a German-speaking boy's acquisition of passives, which demonstrated that the acquisition of the *sein*-passive was facilitated by simpler, early-acquired *sein* copula construction (as a source construction), while this was not observed for the *werden*-passive. In relation to RCs, Fitz et al. (2011)'s connectionist model demonstrated that the subject over object RC advantage in English could be supported by the more frequently experienced SRC substructure of "THAT VERB" than the ORC substructure of "THAT ARTICLE NOUN" in the input.

The potential influence of simpler, related constructions on the acquisition of RCs is also related to the canonical word order hypothesis proposed in the earlier days in the seminal work by Bever (1970). Canonicity effects are observed in acquisition, where young children tend to adhere to the canonical word order of the language and apply schemas of canonical sentences to interpret other structures (Bever, 1970; Slobin & Bever, 1982; MacWhinney, Bates & Kliegl, 1984). The canonical word order hypothesis suggests that the difficulty or ease of processing any syntactic structure is influenced by its similarity to the word order of canonical simple sentences, which are frequently occurring in the language. In English RCs, the canonical NVN/ SVO word order has been argued to facilitate children's interpretation of SRCs but not ORCs (Bever, 1970), as illustrated by the examples (12a-b) below. Because the NVN schema occurs a lot more frequently than the NNV schema (as in English ORCs), SRCs are predicted to be easier to process than ORCs that deviate from the canonical word order schema in English.

(12) a. English SRC

N V N

[$_{\text{head noun}}$ the cat$_i$] that [$_{\text{RC}}$ __$_i$ strokes the rabbit]

b. English ORC

N N V

[$_{\text{head noun}}$ the rabbit$_i$] that [the cat strokes __$_i$]

More recent studies have also argued for a facilitating effect of similarity with simple constructions, beyond only word order in the acquisition of RCs. Most notably, Diessel and Tomasello (2005), as a modification of the canonical word order hypothesis, suggested that it is the frequent occurrence of agent being expressed by the sentence-initial NP in the target language, rather than a fully developed word order schema that accounts for the SRC over ORC advantage in English- and German-speaking children's RC production. Another piece of evidence comes from their error patterns, when children made frequent errors in converting ORCs into SRCs misassigning the thematic roles in ORCs by regarding the first NP encountered as the agent. Considering also their earlier work on naturalistic speech of four English-speaking children (Diessel & Tomasello, 2000) where early RCs are mostly presentational and resemble simple clauses (i.e. reflecting clause expansion) in the language, the authors argued that multiple factors jointly determine the developmental trajectory of RCs, including the distributional frequency of RCs and their relationship to other simpler constructions, given the idea of an interrelated network of constructions and that children acquire new syntactic structures by relating them to constructions they already know (Diessel & Tomasello, 2000, 2005).

Turning to the study of Chinese RCs, Chen and Shirai (2015) proposed a similar account as Diessel and Tomasello (2005) for the naturalistic Mandarin RC developmental data. A predominance of isolated NPs modified by ORCs was reported in Mandarin-speaking children's early speech, which were structurally simpler than ORCs with a main clause and also similar to simple SVO transitive sentence structure. Working from a multifactorial, constructivist approach, the authors argued that ORCs, instead of SRCs, could be supported by similarity to simple SVO sentence structure and the input, where children could bootstrap from their knowledge of the frequently experienced, simpler SVO sentences to learn ORCs in Mandarin. In the case of Cantonese, Chan et al. (2011) has also discussed that relativizing the object position in Cantonese (which is also a SVO language like Mandarin and English) preserves the SVO/ NVN word order configuration and thus shares similarity with simple SVO transitives. See examples (13a-b) below.

(13) a. Cantonese SRC

V N		N
[$_{RC}$ __$_i$ 摸兔仔]	嗰隻 / 嘅	[$_{head\ noun}$ 貓仔 $_i$]
mo2 tou3 zai2	go2 zek3 / ge3	maau1 zai2
stroke rabbit	that CL/ ge3	cat

‘the cat that strokes the rabbit’

b. Cantonese ORC

N V N

[RC 貓仔摸 __i] 嗰隻 / 嘅 [head noun 兔仔 i]

maau1 zai2 mo2 go2 zek3 / ge3 tou3 zai2

cat stroke that CL/ ge3 rabbit

‘the rabbit that the cat strokes’

Note that ORCs constructed with a classifier (CL) even shares surface identity with simple SVO transitive constructions in the language. There is also empirical evidence from Chan et al. (2018) reporting variations in subject/ object asymmetry between the two relativization strategies in Cantonese four-year-old children’s RC comprehension: an ORC over SRC advantage in the CL condition but SRC over ORC advantage in the *ge3* condition. Thus, given the formal and functional overlaps (i.e. in the agent-patient semantic configuration) between ORCs and simple SVO transitives, a general facilitating effect for ORCs is predicted and support from simple SVO transitives could be even stronger for CL ORCs in Cantonese.

Distributional frequency

Moreover, the emergentist-constructivist approach to language acquisition identifies a core role for language-specific properties that affect form-function mappings in a language such as the relationships between constructions, which in turn would affect the distributional frequencies in the learner’s experience. Domain-general accounts of language acquisition are frequency sensitive, where input-based frequency effects play an explicit theoretical role (Ambridge et al., 2015). The basic idea of frequency effects is that the more frequent a structure is in a learner’s experience, the stronger its representation and more accessible it is to process (hence easier) because it meets the parser’s expectation of the upcoming elements (O’Grady, 2010, 2011, 2021; Hale, 2001; Levy, 2008).

Within the emergentist-constructivist framework of an interrelated network of constructions, input frequency is indexed by not only the target construction but also its related constructions at different levels of granularity including the level of general structural frequency (Vasishth et al., 2013). For instance, frequency effects can exist in different types and levels, ranging from concrete lexical strings like the target structures or sequences that are

like the target structure to abstract cues such as word order properties and animacy configurations (Ambridge et al., 2015). Taking English RCs as an example, the developmental phenomenon of early RCs (predominantly SRCs) occurring in presentational copular constructions has been observed to be related to their distributional properties in children's ambient language (Diessel & Tomasello, 2000). On a more abstract level, Fitz et al. (2011) demonstrated in their connectionist model that the frequency of substructure of "THAT VERB" over "THAT ARTICLE NOUN", rather than the frequency of the constructions, support the processing of SRCs in English. Moreover, animacy contrast can also be interpreted in terms of frequency effects. When the animacy configurations are manipulated to reflect naturalistic occurrence (i.e. a particular pattern of animacy contrasts such as SRCs mostly occurring with animate head nouns and ORCs often occurring with inanimate head nouns) in experiments, the subject/ object asymmetry in processing RCs is neutralized (Kidd et al., 2007; Brandt et al., 2009 in English and German).

Findings from the study of Chinese RCs have also lent further support to the role of input frequency in acquisition. Mandarin corpus studies such as Chen and Shirai (2015) and Liu (2015) found that ORCs were more frequently attested than SRCs in both children's speech and also adult's child-directed speech, arguing for the distributional properties of input influencing the developmental trajectory of RCs. However, no corpus study has been attempted in Cantonese that examines the development of RCs and related structures in children's naturalistic speech and adults' child-directed speech. Study one of this thesis (i.e. Chapter two) therefore aims to address this gap by documenting the learning trajectory of conventional RCs and other related noun-modifying clause constructions in child Cantonese naturalistic speech; and discusses the developmental phenomenon in relation to input properties.

In Cantonese RCs, because ORCs resemble simple SVO transitive constructions, the acquisition of ORCs (rather than SRCs) could be further supported by the higher structural frequencies of SVO constructions in children's linguistic experience. Moreover, frequency effects could make predictions about the two relativization strategies. Recall that CL and *ge3* belong to different functional registers as introduced in section 1.2 and CL RCs are therefore more frequently experienced than *ge3* RCs for younger children. As such, a general CL over *ge3* advantage would be predicted by frequency effects. In the DLD literature, it has been reported cross-linguistically that DLD children are dependent on canonical word order and demonstrate greater input dependence in their syntactic development (Leonard & Kueser, 2019; Riches, Faragher & Conti-Ramsden, 2006; Skipp, Windfuhr & Conti-Ramdsden, 2002). Hence,

children with DLD might be hypothesized to not exhibit a difficulty with ORCs in Cantonese considering the potential support from experience-based factors.

However, it should be noted that some studies on typically-developing (TD) children have also reported competition effects between similar constructions resulting in a slowed processing/ acquisition of the target structure (e.g. Rowland et al., 2014; Kidd, Chan & Chiu, 2015; Chan et al., 2017). In particular, Kidd et al. (2015) and Chan et al. (2017) both found a large number of head errors in TD bilingual and trilingual children's comprehension of Cantonese and Mandarin ORCs. They argued that these errors arise from the competition between canonical NVN/ SVO construction and the prenominal NVN/ SVO object RCs in Chinese. Similarity between constructions, therefore, could lead to facilitation and/or competition in acquisition/processing. Moreover, given the multifactorial account of language acquisition in emergentist-constructivist approaches, it is possible that the relationships between different types of RCs (including different relativized positions and RC strategies) and other simple known constructions and their distributional frequencies in the input, would interact with other relevant factors in domain-general accounts such as the general subject prominence and linear distance effects introduced in previous sections to jointly impact on RC acquisition outcomes in Cantonese-speaking children with and without DLD. Studies two and three (i.e. Chapter Three and Four) will address this issue.

1.3 Cantonese RCs in the context of DLD

Studying the processing/ acquisition of Cantonese RCs in the DLD population is of particular theoretical significance, as it allows us to compare and test certain accounts of DLD. Traditionally, theoretical explanations are polarized between structurally-oriented perspective that regard their language difficulties to arise from deficits in domain-specific grammatical knowledge, and domain-general cognitive processing-based approach that proposes a non-linguistic deficit in their processing capacity due to memory and other cognitive limitations. Prominent among the structurally-oriented perspective are 'the Representational Deficit for Dependent Relationship Theory (RDDR)' (van der Lely, 1998) and the more recent 'Computational Grammatical Complexity account (CGC)' (van der Lely, 2005), in which a core deficit in grammatical knowledge was proposed, affecting all syntactic dependencies derived by movement. Specifically, as defined by van der Lely (2005) on developmental patterns in DLD children, 'a core deficit will be significantly below age-matched peers' performance and often below other language abilities: for example, grammatically-impaired

children perform significantly worse on tasks that tap aspects of morpho-syntax than younger children matched on vocabulary, or on general measures of grammar (p.54)'. Hence, under the domain-specific account, children with DLD are predicted to exhibit a specific difficulty with RCs, that is more than a general delayed language development. As such, they are expected to perform not only worse than their age-matched typically-developing peers but also the younger, language-matched typically-developing children.

By contrast, domain-general accounts such as the limited processing capacity account (Montgomery & Evans, 2009) explain the grammatical impairments in DLD as a more general nonlinguistic deficit in phonological or working memory that in turn impacts on complex sentence processing. More recently, other cognitive linguistic approaches also suggest a weaker statistical learning skills in children with DLD (Plante, Gomez and Gerken, 2002; Hsu, Tomblin, & Christiansen, 2008; Hsu & Bishop, 2010) which could affect their processing and uptake of linguistic input. For instance, there are published studies reporting that DLD children performed worse than their TD peers in generalizing across exemplars, showing greater input dependence and lack of productivity in their language learning (Riches et al., 2006; Skipp et al., 2002 on English verb and noun schema use; Stokes & Fletcher, 2000; Fletcher et al., 2005 on Cantonese aspect marker; see Hsu & Bishop (2010) for a summary of more cross-linguistic evidence). From the domain-general capacity limitation and statistical learning perspectives, DLD children are predicted to have a global language delay (Paradis, Crago & Genesee, 2006), performing worse than their age-matched peers but resembling the younger, language-matched children.

Cantonese RCs present an opportunity to test these diverging predictions of DLD. While both domain-specific CGC hypothesis and domain-general capacity and statistical learning perspectives do not make explicit predictions about the subject/object asymmetries but a general weaker performance in RCs for DLD children, domain-general accounts could make further predictions that DLD children are worse than their typically-developing peers in generalizing across exemplars and are more susceptible than their TD peers to experience-based frequency effects and factors that burden working memory. The language-specific properties of Cantonese RCs provide an opportunity to examine whether children with DLD would also find ORCs more challenging to process, as reported robustly in the crosslinguistic DLD literature (eg. Adani et al., 2014, Frizelle & Fletcher, 2014 in English; Stavrakaki, Tasioudi & Guasti, 2015 in Greek; Friedmann & Novogrodsky, 2004, Friedmann, Yachini & Szterman, 2014 in Hebrew; Contemori & Garraffa, 2012 in Italian; De Lopez et al., 2014 in Danish; Natalia et al., 2016 in Russian). Recall that Cantonese ORCs, rather than SRCs, are

shorter in linear distance, similar to simple SVO transitives and therefore higher in structural frequency in the input. Considering their limitations in working memory and statistical learning, domain-general approaches would predict children with DLD to be more prone to linear processing demands and dependent on the distributional properties of the input; hence a lack of ORC disadvantage in Cantonese-speaking children with DLD. Study two (see Chapter Three) therefore examines the comprehension of SRCs versus ORCs in Cantonese-speaking children with and without DLD and compares the predictions from domain-specific versus domain-general accounts of DLD children. Furthermore, extending to other relativized positions in Cantonese RCs, restricted competence between exemplars of the same position is hypothesized by domain-general cognitive approaches to be more prominent in children with DLD if the exemplars vary in processing demands or degree of similarity to frequently experienced simpler constructions as in the case of subject, oblique and genitive RCs in Cantonese. Study three (see Chapter Four) discusses this in more details and investigates RC production of a range of relativized position in Cantonese-speaking children with and without DLD. Both studies two and three compare findings with not only their age-matched peers but also a group of language-matched, younger children to evaluate the two current accounts of DLD.

1.4 This Thesis

Difficulty with RCs has been robustly documented in children with DLD cross-linguistically. Cantonese RCs present unique typological properties that are theoretically important in debates regarding the acquisition and processing of RCs, as well as the diverse perspectives of the source of difficulty in DLD. Yet, to date, there has been no published research on the syntactic competence of RCs in Cantonese-speaking children with DLD. Existing studies in Cantonese have focused on studying subject vs object RCs in typically-developing children and many of them contrasted theoretical perspectives that predict either a subject or object advantage. There is a lack of theoretical emphasis on the language-specific properties of Cantonese RCs that consider multiple factors in acquisition such as the relationship between constructions and input properties and investigates how these factors interact and impact on acquisition outcomes. Moreover, concerning their relationship with other constructions in the language, Cantonese RCs have been argued to be a subset of general noun-modifying clause constructions (NMCCs) or attributive clause constructions that attach a modifying clause to the head noun based on semantic-pragmatic relations (Matthews & Yip, 2016; 2017), following Comrie's (1996, 1998, 2002) typological analysis of RCs for East Asian languages. Existing studies however have

considered the acquisition of Chinese RCs largely in isolation from other related constructions like NMCCs in the language (Chan et al., 2011); and there has so far been no published study on the developmental trajectories and characteristics of Cantonese RCs in the naturalistic speech of monolingual Cantonese-speaking children. To address these research gaps in the literature, this thesis consists of three studies on the acquisition and processing of RCs in Cantonese-speaking children with and without DLD. Novelties of the three studies are highlighted as below:

i) Study one presents the first two corpus studies of monolingual Cantonese child naturalistic speech that examine the learning trajectory of conventional RC-type NMCCs and other noun-modifying clause constructions (NMCCs), considering the relationship between RCs and other related constructions as well as the typological analysis of Cantonese RCs as general NMCCs. The developmental characteristics and distributional properties of Cantonese RC-type NMCCs and other NMCCs in early child speech are reported (see Chapter Two).

ii) Study two is the first experimental study that examines the offline and online comprehension of SRC vs ORC in Cantonese-speaking children with and without DLD. It tests the predictions from domain-specific versus domain-general accounts of Cantonese RCs and DLD children, in relation to three dimensions. The study compares (i) the processing of SRCs versus ORCs to examine their relative difficulty; (ii) the processing of the two relativization strategies to examine their relative difficulty between CL and ge3 RCs in comprehension; (iii) DLD children with their age-matched, typically-developing (AM-TD) peers and also a group of younger, language-matched (YTD) children to test the predictions from domain-specific CGC account versus domain-general approaches based on capacity limitation and statistical learning abilities.

iii) Study three is the first experimental study that assesses production of a wide range of RCs in Cantonese-speaking children with and without DLD. Including not only the commonly investigated subject versus object RCs, the study evaluates the applicability of NPAH-oriented perspective versus domain-general approaches on Cantonese RCs by testing their diverging predictions in relation to three dimensions. The study extends investigation to (i) a broad range of relativized positions to

examine the relative difficulty between RC types; (ii) two subtypes of exemplars within certain RC types to examine relative difficulty within an RC type; and (iii) two relativisation strategies to examine relative difficulty of production between CL and *ge3* RCs. Moreover, the study ascertains whether RC production is vulnerable in children with DLD by comparing them with a group of age-matched TD peers and a group of younger, language matched TD children, following similar design in Frizelle and Fletcher (2014).

Chapter Two

Beyond relative clauses: The development of noun-modifying clause constructions in Cantonese

2.1 Introduction

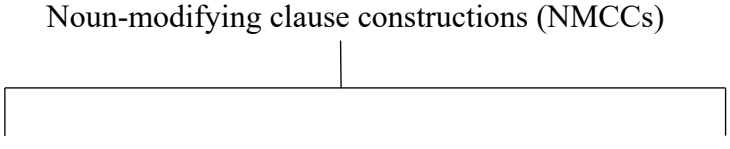
The acquisition of relative clauses (RCs) has attracted much attention and been well-investigated in English and European languages for decades. More recent studies have turned to looking at typologically diverse languages which demonstrate unique acquisition patterns highlighting language-specific effects (see e.g. Kidd, 2011). Unlike previous acquisition studies that focus mainly on comparing subject versus object RCs, the present study takes on an alternative typological perspective by considering RCs and their relationship with other noun-modifying clause constructions (NMCCs) in the language. Specifically, not only the prototypical RCs but also other NMCCs were examined in children's naturalistic speech. In addition, this chapter discusses the findings in light of constructivist perspectives of child language acquisition.

In typology, RCs in certain Asian languages such as Japanese, Mandarin and Cantonese have taken on new theoretical significance. RCs in these languages can be considered a subset of general NMCCs or attributive clause constructions involving no syntactic operation such as gap-filling or movement (see e.g. Comrie 1996, 1998, 2002 for East Asian Languages; Matsumoto, 1997 and Matsumoto et al., 2017 for Japanese, and Matthews & Yip 2016, 2017 for Cantonese and Mandarin). Notably, the so-called RCs in these Asian languages have been argued to suffer from descriptive techniques proven useful in English and some European languages but may not be universally applicable. Since these languages allow zero anaphora and lack relative pronouns, these so-called RCs are hard to tease apart from other noun modifying constructions, both in terms of form and function, unlike the cases of English and other European languages. Rather, RCs in these Asian languages do not necessarily constitute a syntactic relation between the head noun and the modifying clause, but can be conceived as having an associative relationship in a semantic-pragmatic sense. As such, Comrie (1996, 1998, 2002) and others proposed a unified account in these attributive languages: that all NMCCs (regardless of whether a filler-gap syntactic dependency is conceivable or not) can be construed as based on semantic-pragmatic motivations, including the interpretation of RCs or more precisely, the conventional RC-type NMCCs.

Parallelly in acquisition, Chen & Shirai (2015) hypothesized that cross-linguistic differences in learning trajectories could result from whether a language is a "RC language" or an "attributive clause language" in Comrie's terms. The authors proposed a multifactorial usage-based learning account where multiple factors coalesce (or compete) to determine the acquisition outcomes of RCs (or NMCCs) in "attributive clause languages" like Mandarin Chinese, including factors such as input frequency and similarity to canonical clauses, rather than the commonly cited Noun Phrase Accessibility Hierarchy or other purely structural factors in the RC acquisition literature. Closely related to Mandarin and also an "attributive clause" language, Cantonese provides an interesting case for addressing these perspectives. Although this alternative analysis of Chinese RCs as NMCCs is recognized in a number of acquisition works (e.g. Yip & Matthews, 2007a, 2007b; Chan, Matthews & Yip, 2011; Chen & Shirai, 2015), the existing studies have considered the acquisition of Chinese RCs largely in isolation from the other NMCCs in the language (Chan et al., 2011). Intending to fill this gap, this chapter reports on two corpus studies of Cantonese child naturalistic speech that examine the learning trajectory of conventional RC-type NMCCs and other NMCCs.

2.2 Cantonese RCs in a broader context of Noun Modifying Clause Constructions (NMCCs)

Cantonese has a cross-linguistically rare combination of head-final RCs within a SVO language (Dryer, 2013). Moreover, noun modifiers are also consistently prenominal (i.e. head-final) in Cantonese. Like other noun-modifiers in the language, Cantonese RCs share the same prenominal position with no explicit marking specific for RC, yet constructed through the same noun-modifying strategies of classifier (CL) and the linking particle *ge3* (Matthews & Yip, 2016, 2017). As such, it is not obvious whether Cantonese RCs are distinct from other attributive or noun-modifying clause constructions (NMCCs) in the language. Given that there are NMCCs in which no syntactic relationship is conceivable between the head noun and the modifying clause, it gives rise to the alternative analysis of Cantonese RCs as a subtype of general NMCCs where the modifying clause relates to the head noun in an eventive or semantic-pragmatic sense (Matthews & Yip, 2017). The following diagram illustrates the classification of NMCCs:



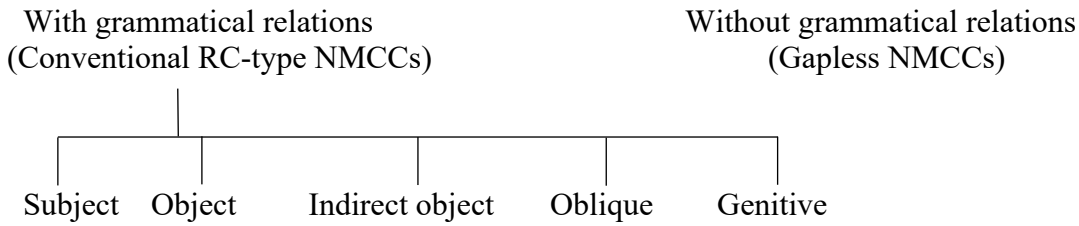


Figure 2.1. Classification of Noun-modifying Clause Constructions (c.f. Matthews & Yip, 2016:256)

As shown in Figure 2.1, Cantonese RCs as a subset of NMCCs are classified into two distinct types based on whether there is a grammatical relationship between the head noun and the modifying clause. Conventional RC-type NMCCs refer to those in which the head noun plays a grammatical role in the modifying/ relative clause as in (1) and (2) resulting in a subject RC (SRC) and an object RC (ORC) respectively. A slash is used to indicate the grammatical options of using CL or *ge3* to construct a NMCC, as introduced earlier in Chapter 1.2. If there is no conceivable grammatical role for the head noun in the modifying clause, this type of NMCC is considered "gapless" (Cheng & Sybesma, 2006; Zhang, 2008). Gapless NMCCs relate to the head nouns in an "aboutness" or semantic-pragmatic sense (Matthews & Yip, 2017; Chan et al., 2011) as illustrated in (3) and (4). Unlike conventional RC-type NMCCs, translation into RC constructions in English is not available for gapless NMCCs; rather, they can only be translated into English prepositional gerunds (c.f. Zhang, 2008 for more syntactic tests to differentiate gapless NMCCs and conventional RC-type NMCCs). It is also worth noting that the head nouns of NMCCs are not always expressed and headless NMCCs are grammatical and common in Chinese naturalistic discourse (Matthews & Yip, 2016), thus the head nouns in the examples below are bracketed to indicate their optionality.

Conventional RC-type NMCCs:

(1) Subject-RC (SRC): [$_{RC}$ __$_i$ 踢緊斑馬] [$_{head\ noun}$ 嗰隻/ 嘅 (長頸鹿 $_i$)]
tek3 gan2 baan1 maa5 go2 zek3 / ge3 (coeng4 geng2 luk6)
kick-PROG zebra that CL/ ge3 (giraffe)
'(the giraffe) that is kicking the zebra'

(2) Object-RC (ORC): [$_{RC}$ 斑馬踢緊 __$_i$] [$_{head\ noun}$ 嗰隻/ 嘅 (長頸鹿 $_i$)]
baan1 maa5 tek3 gan2 go2 zek3 / ge3 (coeng4 geng2 luk6)
zebra kick-PROG that CL/ ge3 (giraffe)

‘(the giraffe) that the zebra is kicking’

Gapless NMCCs:

(3) [你 返學 [head noun 嗰對(鞋)]] (adapted from Matthews & Yip, 2017)

nei5 faan2 hok6 go2 deoi3 haai4

You go school that-CL shoe

‘(The pair of shoes) for your going to school.’

(4) [食飯 [head noun 嗰個 (碗)]] (adapted from Matthews & Yip, 2017)

sik6 faan6 go2 go3 wun2

Eat rice that-CL bowl

‘(The bowl) for eating rice.’

An additional unique feature of Cantonese is that classifier (CL) ORCs are identical in surface form to SVO main clause as illustrated in the following paired examples where the same surface form can be interpreted either as an ORC that modifies an isolated noun phrase as in (5) or a SVO simple transitive main clause as in (6), depending on the context:

Classifier ORC (CL ORC):

(5) [RC 貓 捉住 __i] [head noun 嗰隻 (老鼠)i]

maau1 zuk1 zyu6 go2 zek3 lou5 syu2

Cat catch PRF that-CL mouse

‘(The mouse) that the cat has caught’

SVO transitive main clause:

(6) 貓 捉住 嗰隻 (老鼠)

maau1 zuk1 zyu6 go2 zek3 lou5 syu2

Cat catch PRF that-CL mouse

‘The cat has caught that mouse’

2.3 Child Language Studies in Chinese

Given their typologically rare word order properties, Chinese conventional RC-type NMCCs (called RCs by others in the literature) present an interesting case for testing various theoretical predictions in the acquisition and processing of conventional RC-type NMCCs.

Experimental studies using methods of eye-tracking and elicited imitation (or production) have focused on testing certain theoretical perspectives (e.g. structural versus linear factors, and experience based accounts) regarding the relative ease or complexity in processing SRCs versus ORCs (e.g. Chan et al. (2011) for a review on earlier Cantonese and Mandarin studies; see more recently Chan et al. (2021), Chan, Yang, Chang & Kidd (2018) for Cantonese; and Hu et al. (2016); Tsoi, Yang, Chan & Kidd (2019); Yang, Chan, Chang & Kidd (2020) for Mandarin). Whilst also focusing on teasing apart theoretical predictions of a subject or object advantage for Chinese RCs, other experimental RC acquisition studies extended the investigation to the bilingual as well as trilingual Chinese children and documented cross-linguistic influence in the multi-lingual context of RC acquisition (e.g. see Kidd, Chan & Chiu (2015) for bilingual Cantonese-English children; Chan, Chen, Matthews & Yip (2017) for trilingual Cantonese-Mandarin-English children; and Tsoi et al. (2019) for bilingual Mandarin-English children).

On the other hand, naturalistic data from corpus studies have also attempted in documenting the developmental trajectory of conventional RC-type NMCCs in early speech of Mandarin-speaking children (Chen & Shirai, 2015) and bilingual Cantonese-English children (Yip & Matthews, 2007a, 2007b). Common to both studies' findings is the fact that ORCs, rather than SRCs, emerged earlier in child Mandarin and Cantonese, which might be explained by experience-based properties such as input frequency and word order overlap between SVO main clause and ORCs (Chen & Shirai, 2015); as well as unique language-specific features which give rise to the possibility of an internally-headed analysis for the classifier type of ORCs in Cantonese (Yip & Matthews, 2007a, 2007b).

However, these existing studies have focused only on the acquisition patterns of conventional RC-type NMCCs, largely in isolation from the other NMCCs in the language. To date, a developmental study that systematically examines the acquisition of conventional RC-type NMCCs and other gapless NMCCs has never been attempted.

2.4 Current Study

This chapter presents the first two corpus studies that aim to document the learning trajectory of NMCCs, including both conventional RC-type NMCCs and gapless NMCCs, in Cantonese-speaking children. As an attempt to capture comprehensively the developmental trajectory of Cantonese NMCCs, the study focuses on investigating their order of emergence, distributional frequency of usage and developmental characteristics, documenting the types of

NMCCs children use in their early speech. Two corpus studies were conducted, examining a longitudinal dataset of 8 Cantonese-speaking children in *Longitudinal Study* (2.4.1) and a cross-sectional dataset for a larger sample size of 70 Cantonese-speaking children in *Follow-up Cross-sectional Study* (2.4.2) to substantiate the current chapter's findings. These two monolingual Cantonese corpora are available on CHILDES database (childes.talkbank.org), namely CanCorp (Lee & Wong, 1998) and HKU-70 (Fletcher et al., 2000). The two corpora combined produced a total of 241 transcripts from 78 Cantonese-speaking children (39M; 39F) aged between 1;07 to 5;6.

2.4.1 Longitudinal Study

2.4.1.1 Data

This longitudinal dataset of 8 monolingual Cantonese Children (4M; 4F) from CanCorp was collected at naturalistic setting where the conversation between each child and the interviewer was spontaneous. Children were interviewed at approximately biweekly or 1-month intervals, with the beginning of observation between age 1;07 and 1;11 for 4 children; and between 2;02 and 2;08 for the remaining 4 children. Observation ended between 2;07 and 3;08. These produced a total of 171 transcripts.

2.4.1.2 Data coding and analysis

The present data were coded and verified by two native speakers of Hong Kong Cantonese who are professionally trained in linguistics and language research. Using the Computerized Language Analysis (CLAN) program (MacWhinney, 2000), all NMCCs, including both conventional RC-type and gapless NMCCs, marked by a classifier (CL) or the relative marker *ge3* were extracted. Because these linguistic markers in Cantonese are multi-functional, the extracted data by CLAN was manually disambiguated and coded accordingly. As classifier ORCs share surface identity with SVO transitive main clauses in Cantonese, the discourse functions associated with the extracted structure were examined to ascertain whether it is referential (hence a NMCC) or declarative (i.e. a SVO): ten utterances before and after which the extracted structure appeared were considered for this purpose. Upon identification of NMCCs, they were first classified into the relativization strategies used (i.e. CL or *ge3*) accordingly. The coding then diverged after categorizing the NMCCs into their subtypes (i.e. conventional RC-type NMCC or gapless NMCC). The head nouns of all NMCCs were coded for their conceivable grammatical role in the main clause and their information status

(restrictive or non-restrictive) in the discourse context. Moreover, there are coding criteria specific to the subtypes with respect to their distinct characteristics. Following the usual practice in coding prototypical RCs in the literature (Diessel & Tomasello, 2000, Ming & Chen, 2010; Chen & Shirai., 2015), the conventional RC-type NMCCs were further coded according to their structural features: (a) the grammatical role of the head noun in the modifying clause; (b) the animacy of the modifying clause-internal NP; and (c) the animacy of the head noun. As with gapless NMCCs, they were classified based on their functions following Matthews & Yip (2016, 2017). Among the gapless NMCCs attested in child naturalistic speech, they were categorized into three basic semantic functions: temporal, locative, associative. Examples of each subtype are included in Table 2.1 below.

There is one methodological remark that warrants elaborations. While all the NMCCs analysed in the current study contain clausal-level modifiers with a predicate expressed in the modifying clauses, there are occasions when the NMCC might also be conceived as involving an additional abstract null verb. Cases as such are evident in the present dataset but the choice of missing verb is ambiguous and unverifiable especially in child language. With an alternative analysis of gapless NMCCs available (Matthews & Yip, 2017), it is not necessary and in fact undesirable to assign a 'missing' verb as an empty category because it can lead to inflation of a particular NMCC type. As such, the last resort principle was followed: when there can be a conceivable grammatical relation between the NMCC and the head noun, it is coded as a conventional RC-type NMCC; otherwise, it is assigned to the gapless NMCC category where no grammatical relation can be conceived between the modifying clause and the head noun.

Table 2.1. *Extracted Examples of Each Type of Gapless NMCCs*

Type of Gapless NMCC	Extracted Examples (PART: particle, PL: plural)	
1) Temporal	CHI: [食嘢 [$_{\text{head noun}}$嗰 時]] 用 嘅 .	(HKU70_3;6;22)
	sik6 je5 go2 si4 jung6 ge3	
	Eat things that time use PART	
	'It is used at the time of eating.'	
	CHI: 啱啱[沖涼 [$_{\text{head noun}}$嗰時]]瞓.	(HKU70_4;5;27)
	ngaam1 ngaam1 cung1 loeng4 go2 si4 fan3	
	Just now shower that time sleep	

	‘(I) fall asleep just now at the time of showering.’	
2) Locative	CHI: [晾衫衫[head noun 嗰度]]呀.	(CanCorp_LTF_2;6;1)
	long6 saam1 saam1 go2 dou6 aa3	
	Dry clothes that place PART	
	‘That place for drying clothes.’	
	CHI: [睇 戲 [head noun 嗰度]] 呢.	(HKU70_3;1;5)
	tai2 hei3 go2 dou6 ne1	
	Watch movie that place PART	
	‘That place for movie viewing.’	
3) Associative	CHI: [瞓覺 [head noun 嗰隻(版圖書)]]	(CanCorp_MHZ_2;4;7)
	fan3 gaau3 go2 zek3 (baan2 tou4 syu1)	
	Sleep that-CL (CL picture book)	
	‘That (page of a picture book) about sleeping.’	
	CHI: 嗰啲[沖涼嘅[head noun 嘢]] !	(HKU70_5;1;18)
	go2 di1 cung1 loeng4 ge3 je5 !	
	That-PL shower ge things	
	‘Those are things for showering !’	

2.4.1.3 Results

The present set of data analyses focused on the developmental properties of Cantonese NMCCs based on their subtypes and emergence order attested in child speech. The characteristics of the conventional RC-type and gapless NMCCs produced by Cantonese-speaking children were further examined. In this longitudinal dataset, the analyses focused on examining the order of emergence and type measures of the early NMCCs produced by children before age 3. This age range was set based on previous corpus studies that conventional RC-type NMCCs should be attested before age 3 in Chinese-speaking children’s naturalistic speech (Yip & Matthews, 2007a, 2007b on bilingual Cantonese children; Chen & Shirai, 2015 on monolingual Mandarin children). Among these eight Cantonese children, either

conventional RC-type NMCCs or gapless NMCCs were attested except for child HHC and WBH, likely due to sampling constraints. Both types of NMCCs were attested in four children (CCC, CGK, LTF, MHZ). Across all these four children, gapless NMCCs were attested about the same time (within around only a one-month range, as in CCC, CGK and MHZ) or even slightly earlier (as in LTF) than conventional RC-type NMCCs as seen in Table 2.2. In terms of type measures, gapless NMCCs were also attested in comparable frequency as conventional RC-type NMCCs among these four children as shown in Table 2.3. Within gapless NMCCs, it was observed that children's first attested gapless NMCCs before age 3 were almost always gapless associative NMCCs (3 out of 4 children).

Table 2.2. *Age of first emergence of conventional RC-type NMCCs and gapless NMCCs in eight Cantonese-speaking children before age 3*

	CCC	CGK	HHC	LLY	LTF	MHZ	CKT	WBH
NMCC type								
Conventional								
RC-type NMCC								
Subject	2;8;0	------	------	------	------	2;3;9	------	------
Object	------	2;4;30	------	2;8;10	2;7;20	------	2;2;5	------
Gapless NMCC								
Temporal	------	------	------	------	------	------	------	------
Locative	------	------	------	------	2;6;1	------	------	------
Associative	2;9;7	2;4;30	------	------	------	2;4;7	------	------

Table 2.3. *Type measures of conventional RC-type NMCCs and gapless NMCCs in eight Cantonese speaking children before age 3*

	CCC	CGK	HHC	LLY	LTF	MHZ	CKT	WBH
NMCC type								
Conventional								
RC-type NMCC								
Subject	2	------	------	------	------	2	------	------
Object	------	2	------	1	1	------	1	------
Gapless NMCC								
Temporal	------	------	------	------	------	------	------	------

Locative	------	------	------	------	1	------	------	------
Associative	2	1	------	------	------	2	------	------

The developmental trajectory within the conventional RC-type NMCCs was further examined. Among the 6 children having conventional RC-type NMCCs attested in their speech samples, only ORCs but no SRCs were attested in the samples of most children (4 out of 6). There were exceptions observed from the other two children (CCC and MHZ), with only SRCs (but no ORCs) attested before age 3. There were in total only four SRCs attested in these two children, with some interesting functional characteristics that will be discussed in the later section. Since none of the children has both SRC and ORC attested in their speech samples, there could be two possibilities. One possibility is that ORCs were in fact acquired earlier than SRCs in most of these children. A second possibility would be that the other type (SRC/ ORC) was somehow not sampled.[2]

Thus in this longitudinal study, it was observed that gapless NMCCs were attested alongside conventional RC-type NMCCs before age 3, around the same time as or even slightly earlier than the first attested RC in these speech samples. There is also evidence for gapless NMCCs being produced at a comparable frequency to conventional RC-type NMCCs, where these early gapless NMCCs were mostly of the associative subtype. However, given the limited occurrence of NMCCs in this dataset, it could be informative to examine an additional cross-sectional Cantonese corpus that showcases a larger sample size with more age groups, so as to substantiate and extend the current findings for children before and after age 3.

2.4.2 Follow-up Cross-sectional Study

2.4.2.1 Data

The cross-sectional data was obtained from the HKU-70 corpus, also featuring naturalistic speech of Cantonese-speaking children but with a larger sample size of 70 children (35M; 35F) and age ranging from 2;5 to 5;6 (10 children per half-year age group). Each child was interviewed once with conversations organized around their familiar daily routines, producing a total of 70 transcripts.

[2] One reason why conventional RC-type NMCCs are rarely found in such corpora involves their restrictive function. Yip & Matthews (2007b: 164) note that children use restrictive relatives to identify objects on the basis of shared knowledge. They share such knowledge with their parents and caregivers but to a lesser extent with the research assistants making the recordings. In their data, (18) is an example where knowledge of the referent is shared between the child and the research assistant.

2.4.2.2 Results

Findings from this cross-sectional dataset are largely consistent with the longitudinal study. Similarly, gapless NMCCs were attested around the same age as or even earlier than conventional RC-type NMCCs. As shown in Table 2.4, before age 3, gapless NMCCs were used as early as 2;5;27, before conventional RC-type NMCCs which were first attested at 2;11;19. Similarly, gapless NMCCs were also attested more frequently than conventional RC-type NMCCs as shown in Table 2.5. The early emergence of gapless NMCCs in early Cantonese naturalistic speech has not yet been systematically reported in the previous literature, and relates to the typological uniqueness of Chinese noun modifying constructions, a point which will be further discussed in the next section. The only conventional RC-type NMCC attested before age 3 was an ORC (not SRC), which corroborates our findings from the longitudinal study that ORC seems to emerge earlier than SRC in most Cantonese-speaking young children.

Note that relative to the longitudinal corpus, this cross-sectional corpus used a more structured context to elicit child speech with the aid of a standard set of toy props and conversational topics, and it was observed that gapless NMCCs were more productively attested in this follow-up cross-sectional study. All three subtypes of gapless NMCCs were attested before age 3, consistent with the early emergence of gapless NMCCs reported in the longitudinal study. At age 3 and beyond, the frequency of attested gapless NMCCs (30 type measures) was higher than that of conventional RC-type NMCCs (11 type measures) except for the four-year-olds where there were comparable type measures of both kinds. At age 5, the data saw a noticeable increase of using a lot more gapless NMCCs in these children's speech. Comparing subtypes, temporal gapless NMCCs were more frequently produced than associative gapless NMCCs at the older ages after 3. In terms of conventional RC-type NMCCs, this cross-sectional study shows that ORCs were attested earlier than SRCs although they were used in comparable frequency in general.

Table 2.4. *Earliest age at which conventional RC-type NMCCs and gapless NMCCs were attested in four age groups*

NMCC type	2;5-2;11	3;0-3;11	4;0-4;11	5;0-5;11

Conventional				
RC-type NMCC				
Subject	------	3;1;5	4;5;23	5;0;5
Object	2;11;19	3;1;5	4;4;16	5;0;10
Gapless NMCC				
Temporal	2;5;27	3;1;5	4;5;27	5;0;5
Locative	2;11;28	3;1;5	------	------
Associative	2;11;29	3;1;5	4;2;0	5;0;10

Table 2.5. *Type measures of conventional RC-type NMCCs and gapless NMCCs attested in four age groups*

NMCC type	2;5-2;11	3;0-3;11	4;0-4;11	5;0-5;11
Conventional				
RC-type NMCC				
Subject	------	2	1	2
Object	1	1	3	2
Gapless NMCC				
Temporal	1	6	3	10
Locative	1	2	------	------
Associative	1	1	2	6

In the next two sections, this chapter reports some structural and functional characteristics associated with early gapless and conventional RC-type NMCCs, highlighting both the cross-linguistically consistent and language-specific phenomena. Since the developmental phenomenon is highly similar across the two studies, findings from the two corpus studies are merged and presented below.

Developmental characteristics of gapless NMCCs

Gapless NMCCs differ from conventional RC-type NMCCs in that they can only denote a semantic-pragmatic relationship, but not a syntactic relationship, between the head noun and the modifying clause (Matthews & Yip, 2017; Chan et al., 2011). In early child speech, gapless NMCCs are restricted in function, with the majority belonging to the

associative subtype before age 3. More productive use of temporal and other functions were attested after age 3. All attested gapless NMCCs were also restrictive in their discourse function: they comment on the head noun to restrict the referent from its set. Young children tend to use gapless NMCCs to describe an associative relationship like functions or physical characteristics of a generic noun such as "this" or "that" or a common object, accounting for why head nouns are always inanimate. The prevalence of generic head nouns such as "this" and "that" also suggests young children's tendency to use gapless NMCCs to refer to an entity when they lack the precise vocabulary to refer to the referent.

Structurally, it was found that some early gapless NMCCs appeared as isolated NPs and were simple in terms of proposition as in (7) – (8). Chen & Shirai (2015) also reported the same phenomenon for early Mandarin RCs modifying largely isolated NPs, alongside some head nouns of the early RCs being at the object position in the main clause which was also observed in our dataset such as (9) – (10).

Gapless NMCCs as isolated NPs:

(7) CHI: [出 街 [head noun 嗰 啲 (門)]] (CanCorp_CCC_2;9;7)
ceot1 gaai1 go2 di1 (mun4)
Go-out that-PL door
'(The doors) for going out.'

(8) CHI: [沖 涼 [head noun 嗰 度]]. (HKU_CHI_3;5;23)
cung1 loeng4 go2 dou6
Shower that place
'That place for showering.'

Head nouns of Gapless NMCCs as an object of the main clause:

(9) CHI: 爹爹 攞咗 [去番 工 [head noun 啲錢]]. (CanCorp_CGK_2;4;30)
de1 de1 lo2 zo2 heoi3 faan1 gung1 di1 cin2
Dad take PST go work PL money
'Dad took those money for his going to work.'

(10) CHI: 去 [沖 涼 [head noun 嗰 度]]. (HKU_CHI_2;11;28)
heoi3 cung1 loeng4 go2 dou6

Go shower that place

'Go to that place for showering.'

In addition, there are some head nouns occupying the adjunct position as in (11) – (12) or serving the topic role in the main clause construction as in (13) – (14). Occurrence of gapless RCs in topic-comment construction reflects the typological property of Chinese being a topic prominent language.

Head nouns of Gapless NMCCs as an adjunct of the main clause:

(11) CHI: [你 屋企 瞓覺 [head noun 嗰 陣]] , (HKU_CHI_2;5;27)

nei5 nguk1 kei5 fan3 gok3 go2 zan6 ,

You Home Sleep that time

你 有 冇 呢 啲 架 ?

nei5 jau5 mou5 ne1 di1 gaa3 ?

You have not-have this PL PART

'At the time of your sleeping at home, do you have these?'

(12) CHI: [食 嘢 [head noun 嗰 陣]] 要 jaap3 片片 架 . (HKU_CHI_5;0;5)

sik6 je5 go2 zan6 jiu3 jaap3 pin3 pin3 gaa3

Eat things that time need wear diapers PART

'At the time of eating food, (the baby) needs to wear diapers.'

Head nouns of Gapless NMCCs as a topic of the main clause:

(13) CHI: [綁 繩 [head noun 嗰 隻 (鞋)]] 去 街 aa3. (CanCorp_CCC_2;10;13)

bong2 sing4 go2 zek3 (haai4) heoi3 gaai1 &aa3

Tie thread that CL (shoe) go street PART

'That (shoe) with shoelaces to tie, (I) go out with (it).'

(14) CHI: [睇 醫生 [head noun 嗰 頁]] 要 ! (CanCorp_MHZ_2;4;21)

tai2 ji1 saang1 go2 jip6 jiu3

See doctor that page want

'That page (of the picture book) about going to the doctor, (I) want!'

Developmental characteristics of conventional RC-type NMCCs

There was a lack of subject primacy in early Cantonese conventional RC-type NMCCs. Rather, ORCs were attested earlier than SRCs. All early attested ORCs were classifier RCs except for LTF who produced a RC marked by both the *ge3* particle and a classifier. Interestingly, the few SRCs attested before age 3 (see 15-18) were all unlike the SRC experimental stimuli in RC studies that typically involve an action verb, a prototypical agent-patient relation, and an animate head noun. Moreover, whilst exemplars such as (16) to (18) are potential candidates for being analyzed as SRCs in terms of having a conceivable syntactic relationship between the head noun and the modifying clause; functionally they overlap with gapless associative NMCCs semantically and pragmatically in terms of describing the functions associated with the head nouns. Thus (16) – (18) could theoretically be SRCs ('the brushes that brush teeth'; 'that (camera) that takes photos'; 'those (recorders) that record') but are more plausibly interpreted as associative NMCCs ('the brushes for brushing one's teeth'; 'that (camera) for taking photos)'; 'those (recorders) for recording'). This point will be further elaborated in the discussion section. Prototypical SRCs involving an action verb and an animate agent (head noun) acting on an inanimate patient (RC-internal NP) were attested later only after age 3.

Early SRCs attested before 3 (PL: plural):

(15) CHI: 打 [$_{RC}$ __$_{i}$ 搭飛機] [$_{head\ noun}$ 嗰隻 (公仔)$_{i}$] (CanCorp_MHZ_2;4;7)
daa2 daap3 fei1 gei1 go2 zek3 (gung1 zai2)
Hit take flight that-CL (toy)
'Hit that (toy) that takes the flight'

(16) CHI: [$_{RC}$__$_{i}$ 刷 牙] [$_{head\ noun}$ 嗰啲 (牙刷)$_{i}$] 啦 . (CanCorp_MHZ_2;3;9)
caat3 ngaa4 go2 di1 (ngaa4 caat3) laa1
Brush teeth that PL (toothbrush) PART
'Those (toothbrushes) that brush teeth.'

(17) CHI: 有 [$_{RC}$__$_{i}$ 映 相] [$_{head\ noun}$ 嗰 (相機)$_{i}$] lo1. (CanCorp_CCC_2;8;0)
jau5 jing2 soeng1 go2 (soeng1 gei1) lo1
Have take photo that (camera) PART
'(I) have that (camera) that takes photos.'

(18) CHI: 睇 [RC__i 錄] [嗰 啲 (錄音機) i] 呢. (CanCorp_CCC_2;10;13)

tai2 luk6 go2 di1 (luk6 jam1 gei1) ne1

Watch record that PL (recorder) PART

'Watch those (recorders) that record'

This study also observed that the attested conventional RC-type NMCCs aligned with the cross-linguistic findings that early conventional RC-type NMCCs are restricted in function and form (Diessel & Tomasello, 2000 in English; Brandt et al., 2008, 2009 in German). For instance, all ORCs attested modified only inanimate head nouns, being acted upon by an animate subject as in (19 -20); whereas SRCs occurred with both animate (or personified head nouns) such as (21-22) and inanimate head nouns as in (23-24). In addition, as mentioned, the early SRCs attested before age 3 were also restricted functionally, overlapping with gapless associative NMCCs. In the discourse context, quite a number of early conventional RC-type NMCCs were used to simply add attribution to the head noun without restricting the referent from its set. Looking across ages, there seemed to be a developmental pattern from some non-restrictive use of conventional RC-type NMCCs before age 3; to mostly functioning to restrict a reference after age 3. Structurally, many early conventional RC-type NMCCs attested before age 3 modified simple isolated NPs, expressing only a single proposition (6 out of 10; see Chen & Shirai, 2015; Diessel & Tomasello, 2000; Brandt et al., 2008 for similar phenomena in early Mandarin, English and German respectively). See (16, 19) for example.

(*11/11 instances*) ORCs occurring with inanimate head nouns:

(19) CHI: [RC 姐姐揸 住__i] [head noun 嗰 啲 錢 i] . (CanCorp_LLY_2;8;10)

ze2 ze2 caa4 zyu6 go2 di1 cin2.

Sister hold ASP that-CL money

'Those money sister is holding.'

(20) CHI: [RC 佢玩緊__i] [head noun 啲玩具 i] 囉 ! (HKU_70_5;6;15)

keoi5 waan2 gan2 di1 waan2 geoi6 lo1!

(S)he play PROG PL toy PART

'The toys that (s)he is playing! '

(4*/9 instances*) SRCs referring to animate/ impersonated head nouns:

(21, repeated from (15))

CHI: 打[RC __i 搭飛機] [head noun 嗰隻(公仔)i] (CanCorp_MHZ_2;4;7)

daa2 daap3 fei1 gei1 go2 zek3 (gung1 zai2)

Hit catch airplane that-CL (toy)

'Hit that toy that catches the airplane.'

(22) CHI: [RC __i 煮嘢食] 嘅 [head noun 人 i] 囉. (HKU_70_4;5;23)

zyu2 je5 sik6 ge3 jan4 lo1

Cook things eat ge3 person PART

'The person who cooks food'

(*5/9 instances*) SRCs referring to inanimate head nouns:

(23, repeated from (18))

CHI: 睇 [RC __i 錄] [head noun 嗰啲(錄音機) i] 呢. (CanCorp_CCC_2;8;0)

tai2 luk6 go2 di1 (luk6 jam1 gei1) ne1

Watch record that PL (recorder) PART

'Watch those (recorders) that record'

(24) CHI: [RC __i 有好多蚊] [head noun 嗰 個 山 i]. (HKU_70_5;5;12)

jau5 hou2 do1 man1 go2 go3 saan1

Have many mosquitos that-CL mountain

'The mountain that has many mosquitoes (on it)'

2.4.3 Discussion

This chapter reported the first two corpus studies that documented the developmental trajectory and characteristics of NMCCs, including the conventional RC-type NMCCs and gapless NMCCs, in monolingual Cantonese-speaking children's naturalistic speech. A primacy of gapless NMCCs was observed in children as young as two-year-olds, where they were attested simultaneously with or earlier than conventional RC-type NMCCs in the two corpora examined. Moreover, gapless NMCCs were produced more frequently or at comparable frequency to conventional RC-type NMCCs in the early speech of these children. Although instances of early gapless NMCCs have been reported previously (e.g. Yip & Matthews, 2007a,

2007b), this is the first time production of gapless NMCCs versus conventional RC-type NMCCs has been systematically examined and documented in a corpus study of Chinese-speaking children's naturalistic speech.

These findings indicated that children's mastery of conventional RC-type NMCCs does not necessarily have to precede the acquisition of gapless NMCCs (Matthews & Yip, 2017). The early emergence of gapless NMCCs might be attributable to input properties. The same procedures were performed to extract all the NMCCs attested in adult child-directed speech in both corpora as supplementary analyses. In the longitudinal dataset, it was found that gapless NMCCs were attested around the same time as or even earlier than conventional RC-type NMCCs in the adult child-directed speech of 6 out of the 8 children (see Table A1 in Appendix A). In their linguistic experience, most children also heard conventional RC-type NMCCs used in a broader context of also some comparable amount of gapless NMCCs (see Table A2 in Appendix A). The potential effect of input properties is even more evident in the cross-sectional corpus. The earliest age at which gapless NMCCs were attested in the adult child-directed speech was 2;5.11 (see Table A3 in Appendix A) and gapless NMCCs were also used consistently more often than conventional RC-type NMCCs across the four age groups (see Table A4 in Appendix A). The cross-sectional corpus findings therefore suggested that gapless NMCCs are consistently more frequent in both input and output of Cantonese-speaking children's linguistic development.

Another interesting finding is that the earliest potential SRCs attested (e.g. (16) – (18)) do not resemble the SRC experimental test items that typically involve an action verb, a prototypical agent-patient relation, and an animate head noun as illustrated in (1) – (2) above; but overlapped functionally with some gapless associative NMCCs describing an associative/aboutness relationship between the head noun and the modifying clause that were attested earlier. This observation leads one to consider whether these earliest SRC exemplars and the functionally-similar gapless NMCC exemplars are qualitatively distinct belonging to two constructional categories where the conventional RC-type NMCC exemplars were syntactically governed but the gapless NMCC exemplars were semantic-pragmatically governed, OR whether they were constructed under the same unified mechanism that is motivated semantically and pragmatically. Here it is relevant to incorporate the typological insights in light of Comrie's (1996, 1998, 2002) unified framework of NMCCs when he proposed rethinking the typology of RCs. He and others such as Matsumoto et al. (1997, 2007) and Matthews & Yip (2016, 2017) argued that conventional RCs can also be categorized on the basis of semantic-pragmatic relationships in attributive clause languages such as Cantonese,

Mandarin, Japanese and other Asian languages: that all NMCCs (regardless of whether a filler-gap syntactic dependency can be conceived or not) can be construed as based on semantic-pragmatic motivations, including the interpretation of conventional RC-type NMCCs. The corpus findings of the functional overlaps between the earliest potential SRC exemplars and some gapless NMCC exemplars attested earlier[3], together with this typological perspective, provide a theoretically motivated and empirically supported hypothesis that the gapless NMCCs and the early conventional RC-type NMCCs might be constructed under a single unified mechanism.

Moreover, from a constructivist perspective to language acquisition, there is a possibility that some gapless NMCC exemplars could be the source construction of some early SRC exemplars. It is theoretically interesting to note that some early gapless NMCCs attested in our dataset can be easily extended into a SRC. Consider the gapless NMCCs (25a) and (26a) attested, which could be extended to become SRC tokens as illustrated in (25b) and (26b) respectively, if one simply adds a predicate 'have' or 'can' at the beginning of the modifying clause. In fact, the operation "ADD ON" has been documented to be frequently attested in early child language development in usage-based linguistics (Lieven, Salomo & Tomasello, 2009; Dabrowska & Lieven, 2005; Lieven, Behrens, Speares & Tomasello, 2003).

(25a) Gapless NMCC exemplar:

CHI: **[**綁繩 [$_{\text{head noun}}$ 嗰隻 (鞋)]] 去街 呀. (CanCorp_CCC_2;10;13)

bong2 sing4 go2 zek3 (haai4) heoi3 gaai1 aa3

Tie rope that CL (shoes) go street PART

'The shoes with shoelaces to tie are for going out.

(25b) SRC with *jau5* 'have':

[$_{\text{RC}}$ __$_i$ *有* 綁繩] [$_{\text{head noun}}$ 嗰隻 (鞋)$_i$] 去街 呀.

[3] In addition to the earliest SRC exemplars (16)-(18), the SRC exemplar (24) attested later at age 5 overlaps functionally with gapless NMCCs of the locative type ('the mountain such that/where there are lots of mosquitoes'). Such kind of functional overlap with gapless NMCCs was not observed in early ORC exemplars such as (19)-(20). Here methodologically we followed the last resort principle as stated in the section on *Data coding and analysis*, and therefore for consistency coded those exemplars as SRCs (rather than gapless NMCCs), because there could be a conceivable grammatical relationship between the head noun and the modifying clause. To the extent that the syntactic status of these exemplars may be subject to diverse views, an important implication is that if these overlapping exemplars were not counted as SRCs by others, then the observed ORC over SRC preference in early naturalistic speech could be even more prominent.

jau5 bong2 sing4 go2 zek3 (haai4) heoi3 gaai1 aa3
Have Tie rope that CL (shoes) go street PART
'The shoes that have shoelaces to tie are for going out.'

(26a) Gapless NMCC exemplar:
CHI: [吹 波波 [$_{\text{head noun}}$ 嗰啲 (鹼液)]] (HKU_CHI_2;11;29)
ceoi1 bo1 bo1 go2 di1 (gaan2 jik6)
blow bubbles those liquid soap
'Those (liquid soap) for blowing bubbles.'

(26b) SRC with 'can':
[$_{\text{RC}}$__$_{i}$ *可以* 吹波 波] [$_{\text{head noun}}$ 嗰 啲(鹼液)$_{i}$].
ho2 ji5 ceoi1 bo1 bo1 go2 di1 (gaan2 jik6)
can blow bubbles those liquid soap
'Those (liquid soap) that can blow bubbles.'

However, the longitudinal dataset from CanCorp, as well as another longitudinal bilingual Cantonese child language corpus, are not dense enough in terms of sampling for one to test this hypothesis. Pending availability of dense corpora, future works could attempt tracing back the operations undertaken by children to form new NMCC utterances upon their previous utterances or schemas, as in Lieven, Salomo & Tomasello (2009), Dabrowska & Lieven (2005) and Lieven, Behrens, Speares & Tomasello (2003).

Regarding conventional RC-type NMCCs, the current findings showed a lack of subject RC preference in early Cantonese naturalistic speech. Both cross-sectional and longitudinal data pointed to the tendency for ORCs to emerge first, although type measures of SRCs and ORCs were comparable. This developmental pattern is unlike English (Diessel & Tomasello, 2000) and German (Brandt et al., 2008), but is consistent with corpus findings of early naturalistic speech in bilingual Cantonese-speaking children (Yip & Matthews, 2007a, 2007b) and in Mandarin-speaking children (Chen & Shirai, 2015). Another relevant finding to note is that input properties also show a similar pattern: ORCs were attested around the same time or even earlier in adult child-directed speech (see Tables A1 and A3 in Appendix A) and ORCs were used more often than or in comparable frequency with SRCs in adult child-directed speech (see Tables A2 and A4 in Appendix A), highlighting the potential influence of input.

Moreover, this developmental phenomenon poses challenges to structurally-oriented accounts specified in structural intervention as primary determinants affecting acquisition outcomes (Friedmann, Belletti & Rizzi, 2009). Specifically, the structurally-oriented approaches would predict a subject over object preference in Chinese because subject RCs lack structural intervention in the Relativized Minimality framework (Hu et al., 2016; Rizzi, 1990; Friedmann et al., 2009; see also Chan et al., 2011 and Chan, Chen, Matthews & Yip, 2017 for more detailed elaborations). Moreover, this study also documented that children showed a selective preference of CL ORCs in their early speech, where all but one ORC exemplars attested were of the classifier type. An additional typologically unique feature of Cantonese is that its CL ORCs share surface identity with simpler, frequent, and earlier acquired SVO transitives in the language. As such, CL ORCs in particular, could be facilitated by high structural frequencies of S-V-CL-O in children's linguistic experience, which has been documented by Chan, Yang, Chang & Kidd (2018) when they reported their corpus analyses of Cantonese adult input properties. Moreover, from a constructivist perspective, children could make use of simple SVO transitive (as a source construction) to bootstrap onto object classifier RCs in production. Taken together observations on the earliest SRCs and ORCs attested in these Cantonese-speaking children's language samples, this study noticed strikingly consistent patterns that these earliest conventional RC-type NMCCs share structural and functional overlaps with simpler constructions: the earliest SRCs overlapping with some gapless NMCCs attested earlier, and the early CL ORCs overlapping with the simpler SVO transitives acquired earlier. These observations suggest that children construct new NMCC expressions by relating to the simpler constructions experienced earlier as source constructions. This idea aligns with the construction conspiracy hypothesis by Abbot-Smith & Behrens (2006) which proposed that the acquisition of complex constructions can be supported by prior acquisition of simpler and overlapping constructions in child language. In addition, this idea also supports Diessel (2007)'s cross-linguistic observations that East Asian relatives, although structurally different from RCs in English and other European languages, follow a consistent learning trajectory, building from simple to complex constructions in which "early RCs tend to share important properties with simple sentences".

Moreover, the current findings provide additional evidence from a major Chinese language in further support of the cross-linguistic patterns described in the developmental literature. Specifically, the NMCC usage patterns in Cantonese-speaking children's early speech appeared to be restricted in function and form. Within conventional RC-type NMCCs, the early SRCs attested before 3 were restricted functionally, overlapping with gapless

associative NMCCs. Whilst the SRCs attested occurred with both animate and inanimate head nouns, all ORCs attested were with inanimate head nouns. These findings align with cross-linguistic observations that early prototypical RCs are restricted in their semantic functions (Kidd et al., 2007 in English & German; Diessel & Tomasello, 2000 in English; Brandt et al., 2008, 2009 in German; Kirjavainen et al., 2017 in Finnish). Diessel (2007) also explained this phenomenon in terms of the associations between form and semantic features that influence acquisition. It is likely that children are developing sensitivity to these form-function pairings where an animate NP is expected to function as subject whilst an inanimate NP is less expected to function as a subject. Turning to gapless NMCCs, the earliest gapless NMCCs before age 3 were mostly associative, with children extending the construction to more productive use of the temporal function after age 3. A closer inspection of gapless NMCCs attested in adult child-directed speech, as supplementary analyses, pointed to a similar usage pattern in both corpora, highlighting children's sensitivity to their input properties. In the longitudinal data, adults also used more gapless associative and temporal NMCCs. Both functions of gapless NMCCs were consistently attested in child-directed speech for most of the children (see Table A2 in Appendix A). In the cross-sectional data, temporal NMCCs were used even relatively most frequently throughout the adult child-directed speech of the four age groups (see Table A4 in Appendix A), which are congruent with the child findings in our follow-up study featuring the same cross-sectional corpus that has noted children progressing to a more productive use of temporal NMCCs after age 3 (see Table 2.5).

2.4.4 Conclusion

To conclude, these two corpus studies in this chapter have generated a number of findings that are theoretically interesting: gapless NMCCs emerge simultaneously with or earlier than conventional RC-type NMCCs, object-RCs emerge earlier than subject-RCs, the earliest conventional RC-type NMCCs overlap with frequently attested gapless NMCCs or SVO transitives attested earlier, and early NMCCs (gapless and conventional RC-type) are restricted in form and function. With the typological insight that Cantonese has naturally-occurring gapless NMCCs that are difficult to separate from prototypical RCs (Comrie, 1996, 1998, 2002; Matthews & Yip, 2016, 2017), it is relevant and important to take into account these gapless NMCCs and simpler SVO transitives as related constructions in the study of acquisition of Chinese NMCCs, where these frequent and simpler constructions might affect the acquisition of NMCCs in light of the constructivist perspective. This typological

perspective prompts us to consider whether formal structural complexity is necessary or may even be problematic in accounting for the developmental phenomenon attested. Rather, the findings are better accounted for by emergentist and constructivist approaches to language acquisition (Lieven & Tomasello, 2008) that consider how language-specific features impact form-function overlaps between constructions, which affect the structural frequencies of target and related constructions in a learner's experience that in turn influences developmental preferences during the course of learning.

Chapter Three

Relative Clause Comprehension in Cantonese-Speaking Children with and without Developmental Language Disorder

3.1 Introduction

Developmental Language Disorder (DLD) is an impairment that affects primarily linguistic abilities and language development in children, independent of any obvious accompanying conditions such as hearing loss, emotional and behavioral problems, intellectual disability and neurological problems. DLD is estimated to affect 7-11% of the population in English-speaking countries (Norbury et al., 2016; Tomblin et al., 1997), but does not affect all aspects of language equally. Notably, across the past two decades it has been observed that children with DLD have difficulties understanding and producing complex sentences. One specific structure commonly assessed is the relative clause (RC), on which children with DLD robustly perform below their typically-developing (TD) peers, a finding that has been observed across many different languages, including English (eg. Adani et al., 2014; Hestvik, Schwartz & Tornyova, 2010; Frizelle & Fletcher, 2014), Danish (eg. De Lopez, Sundahl & Chondrogianni, 2014), Greek (eg. Stavarkaki, 2001; Stravrakaki, Tsaioudi & Guasti, 2015), Italian (eg. Contemori & Garraffa, 2012), Hebrew (Friedmann & Novogrodsky, 2004, 2007; Novogrodsky & Friedmann, 2006), and Russian (eg. Rakhlin et al., 2016).

RC studies in DLD have focused on the asymmetry of subject RCs (SRCs) and object RCs (ORCs) extensively reported in TD children and adults. Majority of this literature involves English and other European languages, and their results consistently indicated that DLD children performed significantly poorer than their TD peers and showed greater difficulty with ORCs than SRCs (e.g. Adani et al., 2014, Frizelle & Fletcher, 2014 in English; Stavrakaki, Tasioudi & Guasti, 2015 in Greek; Friedmann & Novogrodsky, 2004, Friedmann, Yachini & Szterman, 2014 in Hebrew; Contemori & Garraffa, 2012 in Italian; De Lopez et al., 2014 in Danish; Rakhlin et al., 2016 in Russian).

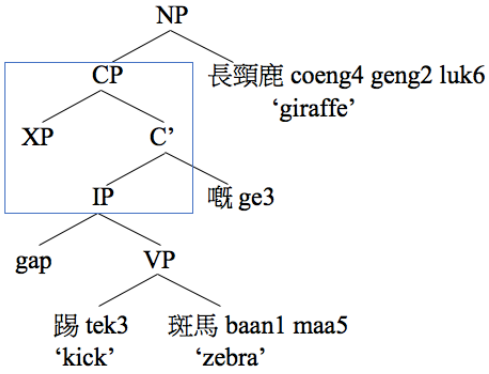
More recently, the investigations have been extended to featuring East Asian languages in the RC DLD literature, including one study on Japanese (Sasaki et al., 2020) and another on Korean (Yoo & Yim, 2021). Like the earlier literature, these two studies also documented that Japanese- and Korean- speaking children with DLD performed significantly worse than their TD peers in general. However, they also reported that Japanese- and Korean- speaking children

with DLD did not find ORCs more difficult than SRCs, unlike what has been documented in English and other European languages. Specifically, Sasaki et al. (2020) tested children on their comprehension of RCs, through a picture pointing task, and reported that unlike the TD children showing a consistent subject over object advantage, Japanese-speaking children with DLD by contrast showed a lack of subject over object advantage. Similarly, Yoo and Yim (2021) did not find ORCs more difficult than SRCs in the performances of both online and offline comprehension tasks in Korean-speaking children with and without DLD, using a self-paced reading task and a picture selection task respectively. The lack of ORC difficulty in Korean and Japanese DLD children could be attributable to certain linear properties favoring ORCs when they are prenominal. For instance, Sasaki et al. (2020) attributed the lack of subject over object advantage in Japanese to ORCs (rather than SRCs) resembling the canonical S-O-V word order in the language, and the shorter linear distance between the filler and gap in ORCs relative to SRCs. The authors reasoned that since children with DLD are more constrained by their phonological and working memory limitations, they may be more sensitive to linear-based effects, which would favor ORCs rather than SRCs. Moreover, the authors pointed out an additional impact arising from phonological and working memory limitations in DLD could be that child with SLI are less sensitive to the less salient morphological cues, which are particularly important for a language like Japanese that relies on case marking for role assignment.

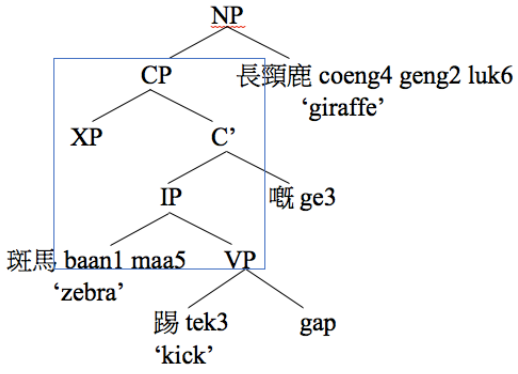
Cantonese, another East Asian language with prenominal RCs similar to Japanese and Korean, provides an additional opportunity to examine whether DLD children would also find ORCs more difficult than SRCs. Studying the comprehension of RCs in Cantonese-speaking children with and without DLD is of theoretical significance, as it bears on the long-standing debate of domain-specific versus domain-general theories in language acquisition and their opposing accounts of DLD. The core thesis of domain-specific approaches assumes a mechanism devoted solely for language learning and is pertinent to Chomsky's Universal Grammar, positing that children come to the task of language learning with some specialized knowledge (i.e. an innate set of grammatical rules and constraints) to construct linguistic representations that are hierarchical in nature. While numerous proposals exist within domain-specific accounts, formal/ structural approach is among the prominent perspectives in the study of RCs where processing ease or difficulty is associated with the embeddedness of a constituent in hierarchical structure, as measured by structural distance between the filler and gap (Hawkins, 1999, 2004) or structural intervention of an element that intervenes between the filler and gap (Friedmann et al., 2009). The structural representations of Cantonese SRCs and

ORCs are presented in examples (1a-b). In Cantonese, the gap is more deeply embedded with an ORC than with its SRC counterpart. Structurally, the dependency between the filler and gap in ORC is also intervened by the RC-internal subject; whereas no intervening constituent occurs in the dependency in SRC. Therefore, domain-specific structural approaches would predict a SRC over ORC advantage in Cantonese for both adult and children, due to the reduction/ absence of structural constraints in terms of shorter structural filler-gap distance and lack of structural intervention (Hu et al., 2016).

(1) a. Cantonese SRC



b. Cantonese ORC



Accounting for the source of difficulties in children with DLD, structurally-oriented perspective regards the grammatical impairments in DLD as deficits in domain-specific grammatical knowledge. The Representational Deficit for Dependent Relationship Theory (RDDR)" (van der Lely, 1998) and later "the Computational Grammatical Complexity account (CGC)" (van der Lely, 2005) proposed a core deficit in the computation system that affects all syntactic dependencies derived by movement, including conventional RCs that have been conceptualized as involving syntactic movements in this formal syntactic account. According to van der Lely (2005), 'a core deficit will be significantly below age-matched peers' performance and often below other language abilities: for example, grammatically-impaired children perform significantly worse on tasks that tap aspects of morpho-syntax than younger children matched on vocabulary, or on general measures of grammar' (p.54). As such, the domain-specific CGC hypothesis would predict children with DLD to have a specific difficulty with RCs (i.e. more than a general language delay), performing not only worse than their age-matched peers but also the younger, language-matched group.

By contrast, domain-general accounts of language acquisition posit that broad cognitive mechanisms which serve all kinds of learning, not dedicated to language learning alone, allow one to acquire language; and proposals arising from this line of approach give primacy to

factors such as learner's experience, meaning and function, cognition as well as processing. Within the domain-general framework, the emergentist approach to syntax has been another prominent view in the study of RCs. For instance, O'Grady (2010; 2011; 2021) explains syntactic development by reference to the operation of a linear, efficiency-driven cognitive mechanism that aims to minimize the burden on working memory, which interacts with external factors arising from experience to shape processing routines. This follows that input-based frequency effects are expected in acquisition, because the more frequently a word or a pattern is heard or used, the stronger and more accessible the corresponding processing becomes. For RC acquisition in particular, O'Grady (2011) suggested two other factors, namely general subject prominence and distance effects, in addition to input frequency, that interact to contribute to processing cost, which in turn defines a scale of difficulty that predicts the course of development for RCs.

A key issue with RC processing/ acquisition is to resolve argument dependencies. The relevance of general subject prominence comes from the idea that an 'aboutness' relationship exists between the relative clause and the head noun (Kuno, 1976). Since subject is the most salient in processing (see the notion of topicality by Kuno (1976) and Mak et al. (2006); and the notion of foregrounding by MacWhinney (2005)), the prominence factor states that it is easier for the processor to compute an aboutness relation when the referent of the head noun is more prominent, especially so if it functions as a subject within the relative clause (O'Grady, 2011). This factor therefore would favor a general subject over object RC advantage across languages including Cantonese. The second factor relates to the distance of the filler-gap dependency because resolving such a dependency impacts on processing cost. From a linear processing perspective, O'Grady (2011) put forward the distance factor which associates the difficulty of RC with the length of the filler-gap dependency, measured in terms of intervening new discourse referents adapting the metrics by Gibson (1998). In the case of Cantonese RCs, SRCs are favored by general subject prominence whereas ORCs enjoy a shorter linear filler-gap distance advantage as demonstrated in the paired examples (2) and (3).

(2) Subject-RC (SRC): [$_{RC}$ _$_i$ 踢斑馬] 嗰 隻/ 嘅 [$_{head\ noun}$ 長頸鹿 $_i$]

tek3 baan1 maa5 go2 zek3 / ge3 coeng4 geng2 luk6

kick zebra that CL/ ge3 giraffe

'the giraffe that kicks the zebra'

(3) Object-RC (ORC): [$_{RC}$ 斑馬踢 $_{i}$] 嗰 隻/ 嘅 [$_{head\ noun}$ 長頸鹿 $_{i}$]

baan1 maa5 tek3 go2 zek3 / ge3 coeng4 geng2 luk6

zebra kick that CL/ ge3 giraffe

'the giraffe that the zebra kicks'

Moreover, from an emergentist constructivist perspective, an additional factor that would influence the acquisition and processing of RCs would be support from similar known constructions. The idea is related to the 'construction conspiracy hypothesis' (Abbot-Smith & Brehens, 2006), which proposes that the acquisition of new, complex constructions could be supported by prior acquisition of simpler, related constructions with overlapping form and/ or functions. This hypothesis is also related to the canonical word order hypothesis proposed in the earlier days dated back to Bever (1970), which proposed that processing of a syntactic construction would be facilitated if it follows the canonical word order of simpler main clauses in the language. Specifically, Slobin & Bever (1982: 231) hypothesized that "children extract schemas of canonical sentences and use such schemas to guide comprehension of syntactic structures." (see also MacWhinney, Bates & Kliegl, 1984). Furthermore, in considering experience-based effects, input frequency is indexed by not only the target construction but also its related constructions at the level of general structural frequency (Vasishth et al., 2013) within the emergentist-constructivist framework of a 'network of constructions' (Lieven & Tomasello, 2008). In the case of Cantonese RCs, it is ORCs, instead of SRCs, that resemble simple SVO transitive constructions in the language; hence support from simpler known constructions and high frequency of SVO structures in children's experience further support the processing/ acquisition of ORCs. Within the domain-general emergentist account, these relevant factors pull in opposite directions in Cantonese with prominence favoring SRCs whereas distance, input frequency and support from simpler known constructions confer an ORC advantage. Depending on which factor is stronger, domain-general approaches would predict at least a lack of SRC advantage (if not an ORC advantage) or only a weak SRC advantage (if any) from the interaction of these processing/ acquisition factors.

Furthermore, specific prediction about the two relativization strategies (CL vs *ge3*) in Cantonese could be formed under the domain-general framework, with which a learner's experience is among the primacy factors in language development and hence input-based effects are expected. Cantonese RCs can be constructed with a classifier (CL) as in (4) or *ge3* as in (5).

(4) Classifier RCs (CL RCs):

[RC 妹妹　著__i] [head noun 嗰條　裙 i]

mui6 mui6　zoek3　go2 tiu4　kwan4

Sister　　wear　that CL　dress

'The dress that sister wears'

(5) *ge3* RCs:

[RC 妹妹　著__i] 嘅 [head noun　裙 i]

mui6 mui6　zoek3　ge3　kwan4

Sister　　wear　ge3　dress

'The dress that sister wears'

These two relativization strategies are said to belong to different functional registers, in which CL RCs are used more often in colloquial speech; while *ge3* RCs are spoken in the formal register such as news reporting and literacy texts (Chan et al., 2011; Matthews & Yip, 2001). In terms of language input, CL RCs are therefore more frequently experienced in adult child-directed speech for younger children, while *ge3* RCs only become more frequently encountered when children grow older and have more experience with formal register of speech and literacy texts. As such, domain-general accounts would predict a general CL over *ge3* advantage in Cantonese RC comprehension, owing to the prevalent frequency effects. On the other hand, it is also possible that *ge3* RCs are at advantage in some (older) children as the functional informativeness associated with the relative marker *ge3* could potentially aid comprehension, signaling a RC construction. If so, the functional informativeness of *ge3* may compete with frequency effects that favor CL RCs. Depending on the relative strength of these competing constraints, domain-general accounts would allow prediction of a CL over *ge3* advantage or a *ge*3 over CL advantage. In contrast, domain-specific structurally-oriented perspectives make no explicit predictions regarding frequency effects and functional informativeness in processing/acquisition, as frequency information and functional informativeness are considered peripheral to core grammar.

On atypical language development exhibited by children with DLD, domain-general accounts regard the deficits to be in basic cognitive processes that support learning in broad, whether or not the task is linguistic. For instance, the limited processing capacity accounts

(Montgomery & Evans, 2009) suggest children with DLD have more general nonlinguistic deficits such as phonological or working memory limitations that result in reduced processing speed and impact on complex sentence processing which is taxing for working memory. Other cognitive linguistic approaches also suggest a weaker statistical learning abilities in DLD children (Plante, Gomez & Gerken, 2002; Hsu, Tomblin & Christiansen, 2008; Hsu & Bishop, 2010) which could affect their uptake of linguistic input and account for their difficulties in language development. On this account, the domain-general capacity limitation and statistical learning perspectives would predict a global delay (Paradis, Crago & Genesee, 2006), not a specific difficulty with RCs, in DLD children's language development: children with DLD are expected to perform worse than their age-matched peers; but resemble the younger, language-matched group.

3.2 Current Study

With the theoretical considerations above, this chapter presents the first empirical study examining comprehension of RCs in Cantonese-speaking children with and without DLD. We compared children with DLD with reference to their age-matched TD children (AM-TD) and language-matched (and therefore younger) TD children (YTD; c.f. Frizelle & Fletcher, 2014). Specifically, this second study examined their comprehension of two relativisation strategies CL versus GE RCs, and two RC types (SRCs versus ORCs). This investigation would allow one to test predictions of domain-specific versus domain-general accounts. Table 3.1 summarizes and contrasts the major predictions from the domain-specific versus domain-general accounts.

Table 3.1. *Predictions of domain-specific v.s. domain-general accounts for the acquisition and processing of Cantonese RCs*

	Domain-specific	**Domain-general**
SRC vs ORC	a uniform SRC over ORC advantage in Cantonese	a lack of SRC advantage (if not an ORC advantage) or only a weak SRC advantage (if any)
CL vs *ge3*	No explicit prediction (as frequency is peripheral to core grammar)	a CL over *ge3* advantage OR a *ge3* over CL advantage, depending on the relative strength of the competing constraints (frequency effect favors

		CL RCs, but functional informativeness favors *ge3* RCs)
DLD vs TD peers	a specific difficulty with RCs in DLD (i.e. more than a general language delay): DLD < AM-TD; DLD <YTD	a global language delay in DLD (i.e. not a specific difficulty with RCs): DLD <AM-TD; DLD = YTD

DLD: Developmental Language Disorder; AM-TD: age-matched typically developing peers; YTD: younger language-matched typically developing peers

3.2.1 Method

3.2.1.1 Participants

Sixty-eight predominantly monolingual Cantonese-speaking children were recruited from schools in Hong Kong to participate in this study. All participants were assessed by speech therapists, passed hearing screening, and completed the standardized norm-referenced language tests to confirm their clinical status (Hong Kong Cantonese Oral Language Assessment Scale (HKCOLAS, T'sou et al., 2006) for school-aged children; or the Cantonese version of the Reynell Developmental Language Scales (RDLS-R and RDLS-E; Hong Kong Society for Child Health and Development, 1987) for preschool children). They were attending local mainstream primary schools or kindergartens using Cantonese as the medium of instruction, receiving the same regular education despite their language status. Twenty-three children were identified as DLD based on the following considerations recommended by Bishop et al. (2017) in the diagnosis of DLD: (i) these children showed lack of competence even in the best language (as evidenced by scoring at 1.25 SD below age means in two or more out of six subtests of the norm-referenced Hong Kong Cantonese Oral Language Assessment Scale (HKCOLAS; T'sou et al., 2006) in their L1 Cantonese); (ii) their language difficulties had negative functional impact affecting daily social interactions or educational progress based on parental and/or school expressed concerns; (iii) there were poor prognostic features such as difficulties affecting multiple areas of language functioning including receptive language and language learning difficulties persisting till aged 5 or above; and (iv) there was absence of associated biomedical conditions such as absence of hearing disability, intellectual disability or ASD. Each DLD child was individually matched to a typically-developing child according to age (+ or – 4 months) and grade, and as such both DLDs (N=22) and AM-TDs (N=23) were aged between 6;6 – 9;7. One child with DLD was excluded because his data were un-codable due to technical issues during data collection. In addition, we included a group of younger and language-matched typically-developing children (N=21; aged between 4;7 and 7;6), with each

child being about two years younger than a corresponding DLD child (Frizelle & Fletcher, 2014). One YTD participant was excluded because she did not attend all the experimental sessions.

The younger group of typically developing children[4] (YTD; HKCOLAS: *M*=196.94, *SD*=62.11; Receptive Grammar: *M*=39.56, *SD*=9.32) were considered language matched to the DLD group (HKCOLAS: *M*=180.85, *SD*=48.92; Receptive Grammar: *M*=35.60, *SD*=6.85), based on the facts that these two groups did not differ in their overall language scores in general, $t(34) = -0.87$, $p = .390$ and their subtest scores on receptive grammar in particular in HKCOLAS, $t(34) = -1.47$, $p=.151$.

3.2.1.2 Materials and Tasks

Language Assessments

Children's clinical language status was informed by their performance in HKCOLAS (T'sou et al., 2006), a standardized norm-referenced language test that consists of six subtests: Test of Hong Kong Cantonese Grammar, Textual Comprehension Test, Word Definition Test, Lexical-Semantic Relations Test, Narrative Test and Expressive Nominal Vocabulary Test. Five participants from the YTD group were assessed by another standardized norm-referenced language assessment, the Cantonese version of Reynell Developmental Language Scales (RDLS-R and RDLS-E; Hong Kong Society for Child Health and Development, 1987) that assessed verbal comprehension and expression, instead of HKCOLAS as they had not reached the minimum age of conducting HKCOLAS (i.e. 5 years old) at the time of testing.

Relative Clause Comprehension Task

Sixteen experimental sentences, the same items as Chan et al. (2018), were incorporated for this eye-tracking comprehension task: eight CL and eight *ge3* relative clause constructions, with four subject-extracted and four object-extracted in each condition. Each sentence contained common animal names (bear, cow, dog, elephant, giraffe, horse, lion, monkey, panda, pig, tiger, zebra) and transitive action verbs (bite, bump, chase, feed, kick, lick, push, tickle,

[4] Five YTD and two DLD participants were excluded from this *t*-test analysis because of the following reasons: (i) these 5 YTD children were below age 5 at the time of testing and were administered the Cantonese version of Reynell Developmental Language Scales instead of HKCOLAS which is intended for children aged 5 to 12 (and therefore while we could confirm their TD status, their HKCOLAS scores were not available for direct comparisons with other children); (ii) these 2 DLD children did not meet the inclusionary criteria for our data analyses (see section 3.2.2 for details) and therefore were subsequently excluded.

wipe) that are familiar to children. A native speaker of Cantonese pre-recorded these sentence stimulis. Relativization strategy (i.e. CL versus *ge3*) and Extraction type (subject versus object) were tested as within-participants variables. See Appendix B for a complete list of sentence stimuli.

3.2.1.3 Experimental Procedure

The present study used the referent selection task in Chan et al. (2018), which was adapted from Brandt, Kidd, Lieven and Tomasello's (2009). In this task, children were asked to pick up the correct toy referent upon watching the experimenter act out the relevant scenes and hearing the sentence stimuli. In each trial, four animals (i.e. target, distractor, related character, irrelevant character) are placed on the four corners of a table that has a hole cut at the center, allowing a central video camera to protrude from below and record children's eye movements. Another camera was placed overhead, to record the entire experiment for cross-checking the offline accuracy data. There were two experimenters, one responsible for monitoring the camera to ensure children's eye movements were recorded and for playing the prerecorded experimental items from a laptop; while the other experimenter was in charge of placing the toy referents at their pre-specified locations on the table and acting out the background scenes within an experimental trial. To ascertain that children knew the names of the animal figures, the task began with the experimenter asking the child to name each toy on the table. In the rare cases when children provided a label that was different to our experimental stimuli, the experimenter corrected the child.

Previous studies have indicated a need to present a felicitous discourse context in RC processing studies (Correa, 1995; Hamburger & Crain, 1982). Following Chan et al. (2018), we fulfilled this condition by creating two background scenes prior to playing the target sentence that contained a RC: one target scene as in (a) and one distractor scene as in (b). The animal toys were returned to their prespecified positions after each sentence was played and acted out by the experimenter. Before the target test sentence was played, an attention getter "Now look at the smiley face" was inserted as in (c) to divert the child's eye gaze to the center, instead of looking to toy referents mentioned in the background scenes. The target test sentence was then played to the child, as in (d). This ensures that the tracked eye gaze was reflective of the child's processing of the test sentence. A complete trial is included below, i.e. (a) to (d). There were four scripts, each containing a total of sixteen trials, but with a different random ordering of stimuli. The assignment of scripts was counterbalanced across children, with each

child assigned to one of the four scripts. Across trials within a script, the order of presenting the background scenes was also counterbalanced: half presenting the target scene first, distractor scene the second; and half presenting the distractor scene first, target scene the second. The location of the toys was also pseudo-randomized across trials within a script, constrained by the requirement that the target head referent and the distractor being placed horizontally or diagonally from the child's perspective, but never appearing on the same vertical plane where one was behind the other. The experiment was so designed to facilitate an accurate eye-movement coding offline (Snedeker & Trueswell, 2004): with the target and distractor organized in such manner, children would need to make saccades or head movements; and in turn, disambiguated eye movements to ensure more precise coding. Children's final choice of toy referent provided the offline measure of accuracy data of their RC comprehension. The entire experiment lasted approximately 20 minutes for each child, with two practice trials included in the beginning to familiarize children with the instructions and the task expectation to pick up the toy according to the child's interpretation of the RC sentence in this task.

(a) 睇吓！呢隻老虎踢緊呢隻馬仔喎

tai2 haak3! ne1 zek3 lou5fu2 tek3-gan2 ne1 zek3 maa5zai2 wo3
look PRT this CL panda kick-PROG this CL lion SFP
'Look! This tiger is kicking the horse.'

(b) 咦！另外一隻老虎就舐緊呢隻馬仔

ji2 ! ling6 ngoi6 jat1 zek3 lou5fu2 zau6 lem2-gan2 ne1 zek3 maa5zai2
EXCL another one CL tiger ADV lick-PROG this CL horse
'The other tiger is licking this horse.'

(c) 而家，睇下個哈哈笑公仔呀

ji4 gaa1，tai2haa5 go3 haa1haa1siu3 gung1zai2 aa1
now look at CL smiley figure SFP
'Now look at the smiley face.'

(d) 你可唔可以拎起#頭先舐馬仔嘅老虎呀？

nei5 ho2-m4-ho2ji5 ling1hei2 #tau4 sin1 lem2 maa5zai2 ge3 lou5fu2 aa3 ？

you can-not-can pick up #just now lick horse ge3 tiger SFP

'Can you pick up #the tiger that just licked the horse?'

(#: pause)

(a) The presentation of the animal toy figures, with the hidden digital camera to record children's eye movements in the visual world eye-tracking task.

(b) Experimenter acting out the background scenes (e.g. 'This tiger is kicking the horse. The other tiger is licking this horse'), before playing the pre-recorded test sentence ('Can you pick up the tiger that just licked the horse?').

Figure 3.1. Experimental set-up

3.2.1.4 Offline accuracy scoring and online eye-movement coding

Regarding offline accuracy data, children's final choice of toy referent (i.e. the toy that was picked up) was coded. A binary score of "0" was assigned for any incorrect response (i.e. toys other than the target referent) and "1" for a correct response. The scorings of 15% of the data were double-checked by a trained student helper and the agreement was 100%.

The camera placed under the table focused on the top-half part of children's faces, allowing coding of their eye movements frame-by-frame to the four locations on the table using the visual editing program Sound Forge ©. This program displays the visual recording of the child's face, with an audio track at the bottom, enabling researchers to select the critical time points of the target test sentence and code children's eye movements frame by frame. Each frame was 40ms. Coding began at the onset of the first syllable of the RC, until 2400ms post RC-onset at 40ms intervals following the procedures reported in Chan et al. (2018). At each time frame, look to the target was coded as '1'; otherwise it was coded as '0'. Two experienced

coders each coded about half of the dataset and their coding were further evaluated by another experienced coder. Interrater reliabilities were high (coder A: 93.7%; coder B: 94.3%).

3.2.2 Results

Since this study is interested in examining children's online sentence processing when they correctly interpreted an RC, children whose accuracy was too low for an accurate analysis of their eye movements were excluded. The inclusion criterion was set to an overall 50% comprehension accuracy within each relativization strategy, following Chan et al. (2018). As such, four out of sixty-six children were further excluded for CL RCs; whereas eight out of sixty-six children were further excluded for *ge3* RCs. The final sample consisted of sixty-two children (19 DLDs (6;7;17 – 9;4;26, *M*=7;7;22, *SD*=0;8;14); 23 AM-TDs (6;5;26 - 9;6;23; *M*=7;6;12, *SD*=0;9;6) ; 20 YTDs (4;7;14 – 7;6;4, *M*=5;7;3, *SD*=0;9;6) for the CL condition and fifty-eight children (19 DLDs (6;7;17 – 9;4;26, *M*=7;7;15, *SD*=0;8;20); 23 AM-TDs (6;5;26 – 9;6;23, *M*=7;6;12, *SD*=0;9;6); 16 YTDs (4;7;24 – 7;6;4, *M*=5;7;3, *SD*=0;8;18)) for the *ge3* condition.

The first set of analyses targeted children's offline accuracy data by group (DLD, AM-TD, YTD), by relativization strategy (CL versus *ge3*) and by extraction (subject versus object). Figure 3.2 presents children's offline comprehension accuracy to CL and *ge3* types of subject and object RCs by the three groups of children (DLD versus AM-TD versus YTD).

As shown in Figure 3.2, all three groups of children performed better on CL RCs than *ge3* RCs. Within CL RCs, both DLD and YTD children scored higher on subject than object RCs whilst AM-TD group scored high on both object and subject RCs. For *ge3* RCs, all three groups of children did better on subject than object RCs. Children's offline comprehension accuracy (correct = 1) was predicted by Generalized Linear Mixed Effects Models (GLMM; Jaeger, 2008) using the lme4 package for Linear Mixed Effects (Bates & Maechler, 2010) in R (version 4.0.5; R Core Development Team, 2021. Relativization strategy (CL versus *ge3*; mean-centered), extraction (subject versus object; mean-centered), language groups (YTD versus DLD; DLD versus AM-TD; sliding contrast difference coding) and their interaction were entered as fixed effects. Random effects for participants and items were included (Barr, Levy, Scheepers & Tily, 2013).

Results from the mixed effects model, as presented in Table 3.2, indicated significant main effects of extraction, relativization strategy, and language group DLD versus AM-TD but there was no significant main effect of language group YTD versus DLD nor interactions

between these fixed effects. The main effects of extraction and relativization strategy indicated a significant subject over object and CL over *ge3* advantage overall, for all children regardless of their language groups. As predicted, DLD's RC performance was significantly worse than their AM-TD peers across all conditions. On the other hand, the comparison between DLD and YTD children indicated no significant group difference. A further scrutiny of the error responses allowed us to better understand why a significant subject over object RC advantage arose here. The error analyses revealed a frequent error type that was attested particularly prominently in DLD and YTD (not AM-TD) children when they comprehended ORCs (not SRCs): children made head noun assignment errors choosing the RC-internal subject erroneously as the noun. The significant difference between SRCs versus ORCs therefore arose due to ORCs being mis-parsed rather than children preferring SRCs. We will discuss this point further in the discussion section.

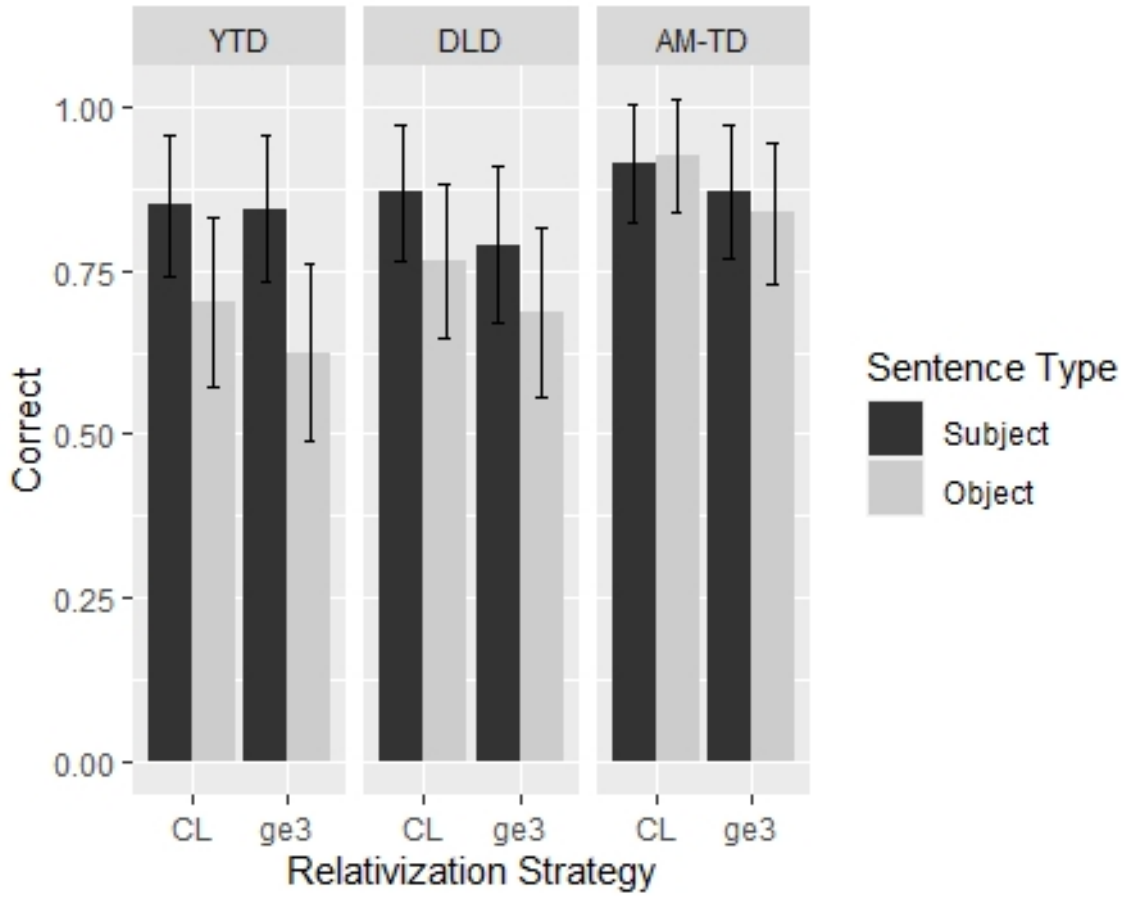


Figure 3.2. Offline comprehension accuracy for CL and *ge3* types of subject and object RCs

Table 3.2. *GLMM Analysis Summary for Fixed Effects Predicting RC Offline Accuracy*

Fixed Effect	***B***	***SE***	***z***	***P***

(Intercept)	1.61	0.13	12.29	<0.001***
Extraction (Subject)	0.61	0.21	2.87	<0.01**
Relativization Strategy (CL)	0.48	0.21	2.25	<0.05*
Language Group (YTD vs DLD)	0.12	0.27	0.43	0.66
Language Group (DLD vs AM-TD)	0.86	0.28	3.04	<0.01**
Extraction (Subject) : Relativization Strategy (CL)	-0.18	0.42	-0.44	0.66
Extraction (Subject) : Language Group (YTD vs DLD)	-0.42	0.42	-1.01	0.31
Extraction (Subject) : Language Group (DLD vs AM-TD)	-0.61	0.45	-1.35	0.18
Relativization Strategy (CL) : Language Group (YTD vs DLD)	0.28	0.43	0.66	0.51
Relativization Strategy (CL) : Language Group (DLD vs AM-TD)	0.16	0.45	0.35	0.73
Extraction (Subject) : Relativization Strategy (CL) : Language Group (YTD vs DLD)	0.48	0.84	0.57	0.57
Extraction (Subject) : Relativization Strategy (CL) : Language Group (DLD vs AM-TD)	-0.59	0.90	-0.65	0.51

Online Processing

Children's online looking patterns reflect more information about their underlying processing differences or challenges. Since we were interested in examining children's online processing of sentences that were correctly interpreted, only the correct trials were analyzed. Figure 3.3 shows the average proportions of looks to the target across participants and items for CL and *ge3* types of subject and object RCs in DLD, AM-TD, and YTD groups. To capture their processing differences over time, the time variable is divided into two regions from the RC onset to 2400ms (i.e. the first half from 0-1200ms and the latter from 1200-2400ms). Since Cantonese RCs are head-final, and the disambiguation point (head noun) started around 900ms (onset) to 1500 ms (offset) after the RC onset, these two regions represent two distinct temporal phases: the first half mostly features processing before the head noun while the second half mostly features processing after the head noun.

Children's online looking to the target toy was predicted by Generalized Linear Mixed Effects Models (GLMM; Jaeger, 2008) using the lme4 package for Linear Mixed Effects (Bates

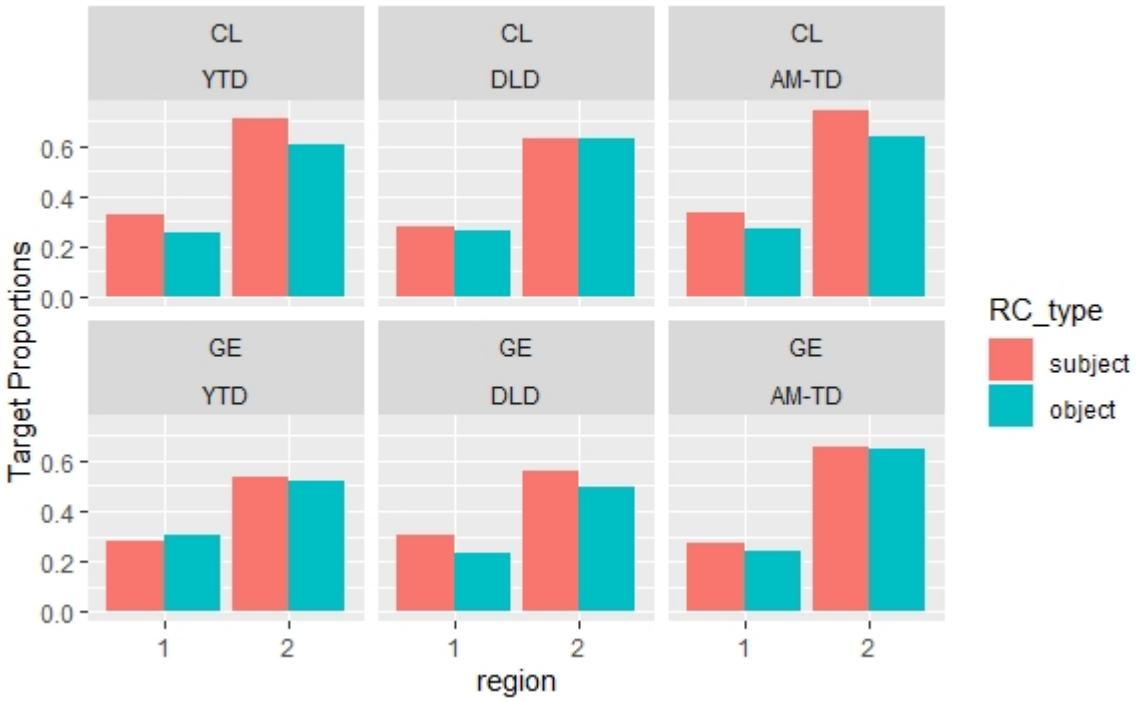
& Maechler, 2010) in R (version 4.0.5; R Core Development Team, 2021). Relativization strategy (CL versus *ge3*; mean-centered), extraction (subject versus object; mean-centered), time region (1st cluster versus 2nd cluster) and language group (YTD versus DLD; DLD versus AM-TD; sliding contrast difference coding) and their interactions were entered as fixed effects. Random effects for participants and random effects of items with the random slope of language group (YTD versus DLD; DLD versus AM-TD) were included (Barr, Levy, Scheepers & Tily, 2013). As presented in Table 3.3, results from the mixed effects model showed a significant main effect of relativization strategy where the proportions of target looks were higher in CL than *ge3* RCs, a significant effect of time region where the proportions of target looks were higher in the latter half of the time region (i.e. 2nd cluster: 1200-2400ms) demonstrating children's knowledge of RCs, and no significant main effect of extraction nor language group. There was also a number of significant interactions registered as follows. There was a significant two-way interaction between relativization strategy and time region indicating that the increase of target looks across time was not uniform across relativization strategy in all children. The interpretation of this interaction was assisted by Figure 3.4 showing that children exhibited more target looks in the CL RCs condition than the *ge3* RCs condition, upon hearing the head noun (i.e. at the second phase).

There were two sets of significant interactions involving DLD and AM-TD. Specifically, there was a two-way significant interaction between time region and language group (DLD vs AM-TD) indicating that the increase in target looks across time was not uniform across these two language groups. The interpretation of this interaction was assisted by Figure 3.3 showing that DLD children differed from the AM-TD in exhibiting lower overall looks to the target in all conditions. Moreover, there was a significant three-way interaction between relativization strategy, time region and language group (DLD vs AM-TD) indicating that the increase of target looks across time in CL vs *ge3* was not uniform between these two language groups. The interpretation of this interaction was assisted by Figure 3.5 showing that while the increase of target looks across time was not distinctly different between CL and *ge3* in the AM-TD children, there was a clear distinction between strategies in DLD where they showed relatively quicker convergence on the target in CL than *ge3* RCs.

Furthermore, there were two sets of significant interactions involving DLD and YTD. Specifically, there was a significant three-way interaction between extraction, time region and language group (DLD vs YTD) indicating that the increase of target looks across time in SRC vs ORC was not uniform between these two language groups. The interpretation of this interaction was assisted by Figure 3.6 showing that while YTD showed more overall looks to

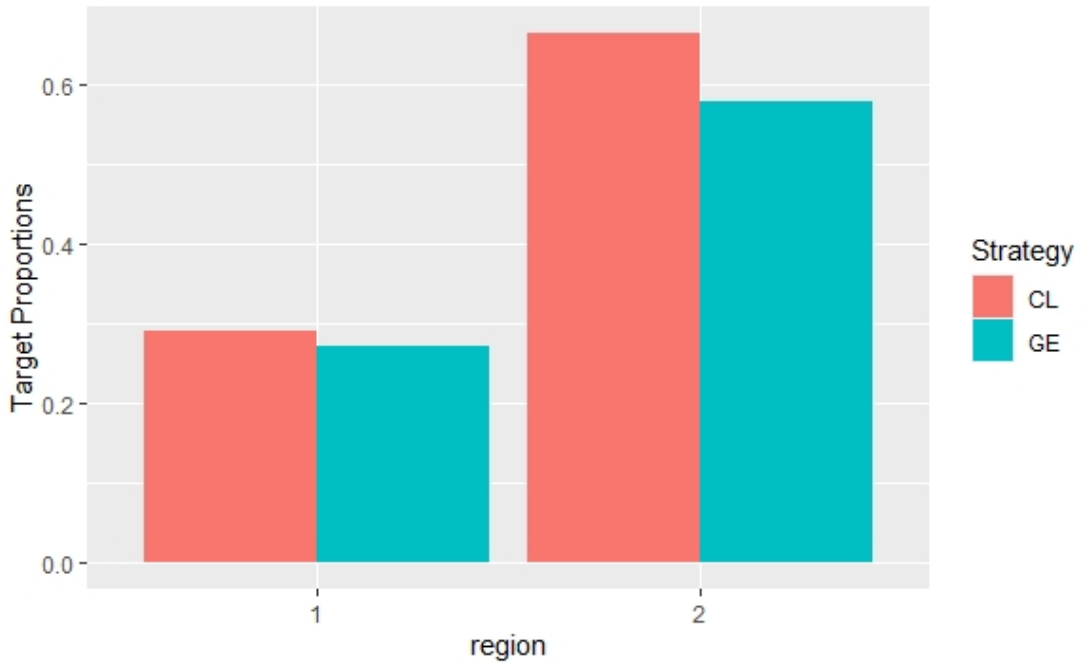
the target when comprehending SRCs relative to ORCs, DLD children showed little difference between SRCs and ORCs in terms of increase of target looks over time or even a slight increase in target looks when comprehending ORCs relative to SRCs, indicating a lack of ORC disadvantage.

In addition, there was a significant three-way interaction between extraction, relativization strategy and language group (DLD vs YTD) indicating that the proportions of target looks in SRC vs ORC and whether there was any distinction between CL and *ge3* was not uniform between these two groups. Looking at Figure 3.3, the DLD children appeared to show generally higher proportions of target looks to SRCs than ORCs in the *ge3* condition but not the CL condition; contrasting with the YTD group who appeared to show generally higher proportions of target looks to SRCs than ORCs only the CL condition but not the *ge3* condition.



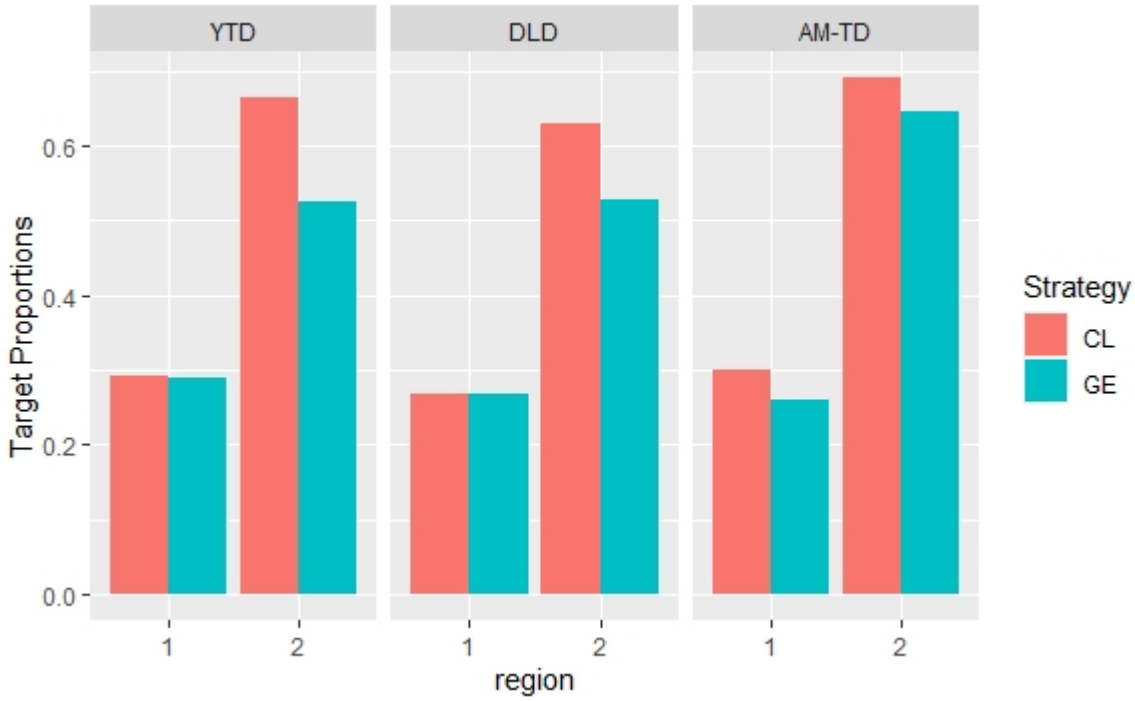
region: (1) 0 - 1200ms; (2) 1200 - 2400ms

Figure 3.3. Average target proportions of looks for CL and *ge3* types of subject and object RCs in DLD, AM-TD, and YTD groups



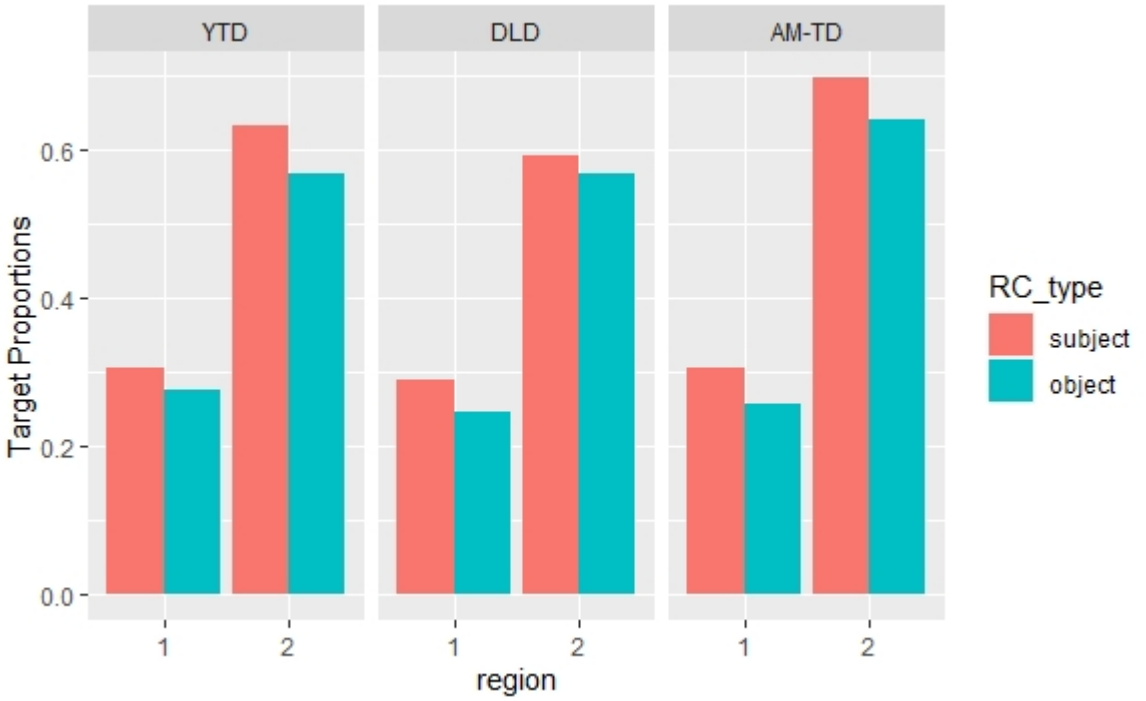
region: (1) 0 - 1200ms; (2) 1200 - 2400ms

Figure 3.4. Average target proportions of looks for CL and *ge3* RCs in all children



region: (1) 0 - 1200ms; (2) 1200 - 2400ms

Figure 3.5. Average target proportions of looks for CL and *ge3* RCs in DLD, AM-TD, and YTD groups



region: (1) 0 - 1200ms; (2) 1200 - 2400ms

Figure 3.6. Average target proportions of looks for SRCs and ORCs in DLD, AM-TD, and YTD groups

Table 3.3. *GLMM Analysis Summary for Fixed Effects Predicting Proportions of Looks to the Target in Online RC Processing*

Fixed Effect	***β***	***SE***	***z***	***P***
(Intercept)	-0.26	0.10	-2.62	<0.01**
Extraction (Subject)	0.21	0.13	1.67	0.09
Relativization Strategy (CL)	0.25	0.13	1.98	<0.05*
Time Region (1st Cluster)	-1.56	0.02	-71.22	<0.001***
Language Group (YTD vs DLD)	-0.08	0.21	-0.37	0.71
Language Group (DLD vs AM-TD)	0.23	0.21	1.13	0.26
Extraction (Subject) : Relativization Strategy (CL)	0.21	0.26	0.81	0.42
Extraction (Subject) : Time Region (1st Cluster)	-0.03	0.04	-0.67	0.51
Relativization Strategy (CL) : Time Region (1st Cluster)	-0.37	0.04	-8.66	<0.001***

Extraction (Subject) : Language Group (YTD vs DLD)	-0.03	0.20	-0.13	0.90
Extraction (Subject) : Language Group (DLD vs AM-TD)	0.14	0.20	0.70	0.48
Relativization Strategy (CL) : Language Group (YTD vs DLD)	-0.16	0.20	-0.79	0.43
Relativization Strategy (CL) : Language Group (DLD vs AM-TD)	0.01	0.20	0.04	0.97
Time Region (1st Cluster) : Language Group (YTD vs DLD)	-0.05	0.06	-0.91	0.37
Time Region (1st Cluster) : Language Group (DLD vs AM-TD)	-0.37	0.05	-7.19	<0.001***
Extraction (Subject) : Relativization Strategy (CL) : Time Region (1st Cluster)	-0.13	0.09	-1.52	0.13
Extraction (Subject) : Relativization Strategy (CL) : Language Group (YTD vs DLD)	-0.85	0.40	-2.13	<0.05*
Extraction (Subject) : Relativization Strategy (CL) : Language Group (DLD vs AM-TD)	0.50	0.40	1.27	0.20
Extraction (Subject) : Time Region (1st Cluster) : Language Group (YTD vs DLD)	0.33	0.11	2.99	<0.01**
Extraction (Subject) : Time Region (1st Cluster) : Language Group (DLD vs AM-TD)	-0.14	0.10	-1.41	0.16
Relativization Strategy (CL) : Time Region (1stCluster) : Language Group (YTD vs DLD)	0.22	0.11	1.95	0.051
Relativization Strategy (CL) : Time Region (1stCluster) : Language Group (DLD vs AM-TD)	0.40	0.10	3.93	<0.001***
Extraction (Subject) : Relativization Strategy (CL) : Time Region (1stCluster) : Language Group (YTD vs DLD)	-0.13	0.22	-0.61	0.55
Extraction (Subject) : Relativization Strategy (CL) : Time Region (1stCluster) : Language Group (DLD vs AM-TD)	-0.24	0.20	-1.19	0.24

3.3 Discussion

This chapter reported on the first experimental study examining the offline and online comprehension of RCs in Cantonese-speaking children with and without DLD- an empirical first not only in the Chinese DLD literature but also the East Asian languages DLD literature. Examining Cantonese RCs in the DLD context presents a unique opportunity to test and compare domain-specific versus domain-general accounts of typical and atypical language development. Recall the three sets of predictions we are testing concerning SRCs vs ORCs, CL vs GE RCs, and DLD vs TD children. First, domain-specific structural approaches would favor SRC over ORC in Cantonese because of the reduction/ absence of structural constraints in SRCs; whereas domain-general emergentist perspective would predict a lack of SRC advantage (if not an ORC advantage) or only a weak SRC advantage (if any) from the interaction of processing factors that pull in opposite direction in Cantonese. Second, domain-specific structurally-oriented approach makes no explicit predictions regarding relativization strategies, but domain-general approaches allow prediction of both a CL over *ge3* advantage OR a *ge3* over CL advantage in Cantonese RC comprehension as frequency effects favoring CL RCs compete with functional informativeness favoring *ge3* RCs. Third, the domain-specific CGC hypothesis (van der Lely, 2005) expects DLD children to have a specific difficulty with RCs and perform not only worse than their AM-TD peers, but also the language-matched YTD group in RC competence; but domain-general approaches based on capacity limitation (Montgomery & Evans, 2009) and statistical learning deficits (Plante et al., 2002; Hsu et al., 2008; Hsu & Bishop, 2010) would predict a global delay, not a specific difficulty with RCs, in DLD children whose performance should be worse than AM-TD but could resemble the language-matched YTD group. This current set of findings is discussed in light of these opposing predictions.

SRCs vs ORCs

The current study did not observe a robust SRC over ORC advantage: while offline accuracy saw a significant main effect of extraction that all children performed better in SRCs than ORCs, such an advantage disappeared in online looking patterns where no significant main effect of extraction was detected. Before moving onto discussing the online results, the apparent subject over object advantage in the offline findings is first commented, where error analyses on children's responses could be revealing. The error analyses indicated frequent head noun assignment errors of choosing the RC-internal subject erroneously as the head noun in ORC

comprehension (but not in SRCs), and this phenomenon was frequently attested particularly in DLD and YTD groups (AM-TD children were equally good at SRCs and ORCs, on the other hand). These frequent head noun errors in comprehending ORCs have also been reported in other RC comprehension studies on Chinese-speaking children (e.g. Kidd et al., 2015; Chan et al., 2017; Tsoi et al., 2019), suggesting the influence of an SVO transitive competing interpretation, given the structural and functional overlaps between Chinese ORCs and SVO transitive constructions. As such, this surface phenomenon of SRC advantage in the offline data arose due to comprehension of ORCs being affected by competing SVO interpretation affecting DLD and the younger YTD children who were more prone to be garden-pathed, rather than SRCs being preferred.

However, when children were not garden-pathed, online analyses indicated no significant main effect of extraction across groups nor any interaction between group and extraction. This means that the proportions of target looks in SRC vs ORC were uniform in all three groups of children. Considering both offline and online findings, this lack of a robust subject advantage (or object disadvantage) cannot be readily explained by domain-specific structurally-oriented approach specified in structural intervention (Friedmann et al., 2009) or structural distance (Hawkins, 1999, 2004) which predicts a subject over object advantage for Cantonese RC processing and acquisition. Rather, these findings are consistent with ideas from the domain-general accounts, which predict that the effect of general subject prominence could be weakened by the opposing effects of shorter linear distance of filler-gap dependency, high SVO structural frequencies in children's experience, and support from simpler known constructions (SVO transitive constructions) that are associated with ORCs in Cantonese.

Moreover, when we specifically consider the DLD children, the findings collectively do not indicate that they had a deficit specific to ORCs relative to the other two TD groups. First, recall that the significant main effect of extraction indicating SRC over ORC advantage in the offline measures was not specific to any language group. Second, the significant interaction between extraction, time region and group (YTD vs DLD) in the online results revealed a lack of ORC disadvantage in Cantonese DLD when children were not garden-pathed: unlike their YTD peers who showed more overall looks to the target toy when comprehending SRCs relative to ORCs, DLD children showed little difference between the two extraction types and even a slight increase in target looks when comprehending ORCs (see Figure 3.6). This pattern is unlike results from English and other European languages (e.g. Adani et al., 2014; Frizelle & Fletcher, 2014 in English; Jensen De Lopez et al., 2014 in Danish; Friedmann & Novogrodsky, 2004 in Hebrew; Stavrakaki et al., 2015 in Greek) reporting that while there

was a general SRC over ORC advantage for both DLD and TD children, where the DLD children in these languages found ORCs particularly challenging relative to the TDs. Taking the offline and online results together, this study presents novel findings from a typologically distinct language, Cantonese, that do not identify ORCs causing more difficulties (as compared with the other two TD groups) to Cantonese DLD children.

Recall also that the lack of a robust ORC disadvantage in DLD children is similarly reported in Japanese- and Korean-speaking children with DLD (Yoo & Yim, 2021; Sasaki et al., 2020). These typological parallels observed could also be attributed to the effects of competing processing factors in these languages: In Japanese and Korean, ORCs, rather than SRCs, resemble simple transitive SOV constructions in these languages, as a result of placing the RC before the head noun like Cantonese. As such, the effect of support from simpler known constructions that favor ORCs would pull in opposite direction from general subject prominence. The scenario would be very different in postnominal RC languages like English and other European languages, where factors such as subject prominence, distance, support from simpler known constructions, and structural frequencies in the input would all coalesce to create a strong bias favouring SRCs over ORCs. Moreover, the contrast between the lack of robust ORC disadvantage in Cantonese, Korean and Japanese DLD and the robust SRC advantage in English and other European languages concurs with Leonard & Kueser (2019)'s cross-linguistic observation that DLD children find syntactic structures easier to acquire if they resemble simpler known constructions with the same canonical word order. In the former languages, it is the ORCs that resemble canonical word order; while in the latter languages, it is the SRCs that resemble canonical word order.

CL vs GE

As anticipated by the domain-general perspectives where either direction of preference (CL over *ge3* OR *ge3* over CL) is possible, subject to the relative strength of the factors prominent in comprehension, both offline accuracy and online findings registered significant main effects of relativization strategy, indicating a strong CL over *ge3* advantage in terms of both accuracy and proportions of target looks for all children. Online analyses also captured a significant interaction between relativization strategy and time region, showing that all children exhibited more target looks in the CL RCs condition than the *ge3* RCs condition, upon hearing the head noun (i.e. at the second phase). This suggests that children converged to the target looks in the CL RCs condition faster than the *ge3* RCs condition. Such a robust CL over *ge3* advantage in relativization strategies cannot be readily explained by the domain-specific structurally-

oriented approach, but instead, better accounted for by domain-general approaches that consider the varying degrees of strength in the interaction of factors: in this case, frequency effects favouring CL RCs override the competing effect of functional informativeness supporting *ge3* RCs, at least in the modality of comprehension.

Moreover, online findings found a significant three-way interaction between relativization strategy, time region and group (DLD vs. AM-TD), indicating that the AM-TD children processed both strategies equally well where their looking pattern was not distinctly different between CL and *ge3* RCs but the DLD children showed a clear distinction between strategies where the proportions of target looks were overall higher in CL than *ge3* RCs, suggesting that DLD children converged quicker on the target in CL than *ge3* RCs. This specific pattern of findings could also be interpreted in light of domain-general perspectives. Under constructivist perspectives, CL and *ge3* RCs can be conceived as connected in a "network of constructions" given their formal and functional similarities. While all children in this study benefited from the higher structural frequency of CL RCs in the input and comprehended CL RCs with more ease than *ge3* RCs, comprehension of *ge3* RCs could potentially be supported by one's ability to generalize across exemplars and recognize *ge3* as a functional informative relative marker and the constructional relationships between CL and *ge3* RCs. If so, DLD children who have been hypothesized as having weaker statistical learning skills (Plante et al., 2002; Hsu et al., 2008; Hsu & Bishop, 2010) would be at a disadvantage in terms of being less able to generalize their knowledge from CL to facilitate *ge3* RC comprehension, resulting in slower online processing of *ge3* RCs than CL RCs as suggested in the present study. The domain-specific structurally-oriented approach, by contrast, cannot readily explain this three-way interaction.

DLD vs TD children

Consistent with the robust cross-linguistic evidence in the DLD literature, Cantonese DLD children performed significantly worse than their AM-TD peers, scoring lower in offline RC comprehension. Moreover, online findings registered a two-way significant interaction between time region and group (DLD vs AM-TD), indicating that the increase in target looks over time was smaller in DLD relative to AM-TD in general. This result therefore suggested that these DLD children displayed a slower processing speed than age-matched TD in general, a phenomenon that has also been well-documented in the literature (Kail, 1994; Miller et al., 2006; Leonard et al., 2007). The finding of slower processing speed is again compatible with how the domain-general limited capacity processing accounts of DLD (Montgomery & Evans,

2009) conceptualize the nature of difficulty in DLD: children with DLD having limited processing capacity could find it more challenging to process complex sentences like RCs that are cognitively taxing, resulting in slower processing speed during comprehension.

Importantly, the current results also indicated that DLD children were not worse than YTD children in offline accuracy, and there is no evidence from the online results that DLD children were worse than YTD in online processing. This pattern of findings therefore suggests that these DLD children did not show a specific difficulty with RC comprehension relative to their language-matched YTD peers. Hence, unlike the hypothesis from the domain-specific CGC account (van der Lely, 2005) that DLD children would have selective difficulty with RCs and perform even worse than their language-matched YTD peers, these findings are instead consistent with the domain-general perspectives predicting a global delay (rather than a specific difficulty) in DLD, where DLD children could resemble their language-matched YTD peers in RC comprehension.

3.4 Conclusion

To conclude, the present study is the first to examine offline and online comprehension of RCs in not only the Chinese but also the East Asian languages DLD literature. Empirically, the findings demonstrated that RC comprehension is indeed vulnerable in Cantonese-speaking DLD children relative to their age-matched TD peers. Theoretically, three dimensions were examined, namely SRCs vs ORCs, CL vs GE RCs, and DLD vs TD children, where domain-specific and domain-general theories would make diverging predictions. The current findings pose challenges to the domain-specific structural approaches specified in structural intervention (Friedmann et al., 2009) or structural distance (Hawkins, 1999, 2004), in combination with CGC account (van der Lely, 2005), and are better explained by domain-general emergentist and constructivist perspectives of both typical (O'Grady, 2011; Lieven & Tomasello, 2008; Abbot-Smith & Brehens, 2006) and atypical language development (i.e. Montgomery and Evan (2009)'s domain-general limited capacity processing account of DLD).

Chapter Four

Production of Relative Clauses in Cantonese-Speaking Children with and without Developmental Language Disorder

4.1 Introduction

Difficulty with relative clauses (RCs) in children with Developmental Language Disorder has been robustly documented cross-linguistically in the literature. Most studies are skewed so far on English and European languages which attest postnominal RCs, focusing on subject- (SRC) and object-RC (ORC). These published works consistently point towards an ORC disadvantage in children with DLD (e.g. Adani et al., 2014, Frizelle & Fletcher, 2014 in English; Stavrakaki, Tasioudi & Guasti, 2015 in Greek; Friedmann & Novogrodsky, 2004, Friedmann, Yachini & Szterman, 2014 in Hebrew; Contemori & Garraffa, 2012 in Italian; De Lopez et al., 2014 in Danish; Rakhlin et al., 2016 in Russian). However, RC acquisition studies that extend investigation beyond SRCs and ORCs are still relatively scarce on children with and without DLD in the literature. When there is first language acquisition research that examines a broader range of relativized positions, it is often linked to the classical typological generalization, NPAH (Noun Phrase Accessibility Hierarchy, Keenan & Comrie, 1977; see Diessel & Tomasello, 2000, 2005 for studies on child English and German).

The NPAH is a putative, descriptive linguistic universal that concerns the relative accessibility of a noun phrase at various syntactic positions to relativization cross-linguistically: if a language allows relativization on a given position, then it should allow relativization on all other positions to its left in the hierarchy. See (1) below.

(1) Noun Phrase Accessibility Hierarchy (> indicates "higher than"):
Subject > Direct Object > Indirect Object > Oblique > Genitive > Object of Comparison

While the NPAH is intended to be descriptive (i.e. not subscribing to any particular theoretical account), subsequent works extend the notion of accessibility to order or ease of acquisition, most notably Keenan & Hawkins (1987) who demonstrated the ease/ difficulty in processing RCs to reflect the ranking of NPAH through a repetition task: the higher position an NP is on the hierarchy, the easier it is to be relativized in production. Hawkins (2004) later formulated

metrics based on the hierarchical sentence structure to quantify the processing demands, which could also be taken as structurally-based (see Chan, Matthews & Yip, 2011), that potentially underlie NPAH.

If these underlying factors, whether they are structural or purely processing in nature, that govern the NPAH are applicable to language acquisition, there should be parallels between this typological generalization and the differential ease of acquisition of relativized positions on the hierarchy. As such, mapping NPAH ranking onto acquisition would predict a higher position on the hierarchy being easier to process/ acquire than a lower position, but not contrariwise. In the course of development, the phenomenon of a relatively higher position co-occurring with a relatively lower position is still considered consistent with NPAH (Hawkins, 2007). However, it would not predict a lower position being easier than a higher position, nor would it predict a higher position being significantly more difficult than a lower position. Since subject is positioned higher than all other grammatical relations on NPAH, this approach would predict a universal SRC advantage for all languages. Moreover, it does not make explicit predictions about differential competence between exemplars of the same position, a phenomenon that was observed in Diessel and Tomasello (2005) where intransitive subject RCs were found to be easier to process than transitive subject (agent) RCs. Furthermore, this perspective motivated by the NPAH also does not explicitly predict or account for the nature of difficulty in children with DLD.

The NPAH-driven perspective contrasts with a domain-general account of language acquisition, that considers learner's experience, meaning-function and cognition/ processing as primary factors influencing both typical and atypical language development. Prominent within the domain-general framework on syntactic development, which are also relevant to RCs, include the emergentist account and usage-based/ constructivist perspectives that are compatible with one another. An emergentist view of syntax unifies with the theory of sentence processing and makes reference to a "linear, efficiency-driven processor" that operates to reduce working memory burden and interacts with experience-based factors to determine processing routines (O'Grady, 2010; 2011; 2021), giving primacy to the interaction between experience-based effects and processing demands. Compatible with emergentism, usage-based/ constructivist perspectives focus on the functional aspect of language and regards syntax as an inventory of form-function pairings constructed on the basis of distributional properties of the language (e.g. Tomasello, 2003). Constructivists conceptualize syntax in terms of an interrelated network of constructions where children acquire new syntactic structures by relating them to constructions they already know. This gives emphasis to input frequency and

relationships between constructions within a language, as evident also in Diessel and Tomasello (2005)'s discussion of their findings of a SRC over ORC advantage where effects of canonicity and similarity to simple sentences (i.e. the frequent occurrence of agent being expressed by the sentence-initial NP in the target language) facilitate the acquisition of SRCs in English and German-speaking children.

Unlike hypotheses derived from NPAH, domain-general approaches could make opposing predictions given these collective acquisition factors considered salient under this alternative framework. For instance, it can predict a grammatical relation of lower rank on the hierarchy, if supported by experience based- frequency effects, to be easier than a higher position. Conversely, it is also possible for a higher-ranked position to cause significantly more difficulties than a lower position, if it is hindered by other factors that increase its processing demands. Within the domain-general perspective, learner's differential competence between exemplars of the same position is also expected, especially when the exemplars vary in their processing demands or similarity to frequently-experienced, early-acquired simpler constructions. Such effects are expected to be even more prominent in children with DLD who have been suggested within domain-general approaches to have more general nonlinguistic deficits, such as working memory limitations (Montgomery & Evans, 2009) and weaker statistical learning abilities (Plante, Gomez and Gerken, 2002; Hsu, Tomblin, & Christiansen, 2008; Hsu & Bishop, 2010) which could impact on their processing and affect their uptake of the input.

In Cantonese, the language-specific properties in the formation of RCs make the language particularly interesting both typologically and theoretically (Matthews & Yip, 2001), allowing us to test these alternative theoretical perspectives with diverging predictions. Cantonese, being a SVO language, is unusual to place the RC before the head noun (i.e. prenominal RCs), where such combination is cross-linguistically rare (Dryer, 2005). As such, Cantonese ORCs, instead of SRCs, share surface similarity with canonical SVO sentences and also presents a shorter linear filler-gap distance than SRCs, as illustrated in the examples (2) and (3) below. While NPAH-motivated approaches would not predict a ORC over SRC advantage because subject is at the higher position than object on the hierarchy, it is possible for domain-general perspectives to predict a ORC over SRC advantage, because the acquisition of ORCs can be facilitated by higher input structural frequencies as they resemble frequently-experienced and early acquired SVO transitive constructions, and a shorter linear distance between the filler and the gap.

(2) Subject (Agent)-RC:

V O S

[RC __i 踢緊斑馬] 嗰 隻/ 嘅 [head noun 長頸鹿 i]

tek3 gan2 baan1 maa5 go2 zek3 / ge3 coeng4 geng2 luk6

kick-PROG zebra that CL/ ge3 giraffe

'the giraffe that is kicking the zebra'

(3) Object-RC (ORC):

S V O

[RC 斑馬踢緊 __i] 嗰 隻/ 嘅 [head noun 長頸鹿 i]

baan1 maa5 tek3 gan2 go2 zek3 / ge3 coeng4 geng2 luk6

zebra kick-PROG that CL/ ge3 giraffe

'the giraffe that the zebra is kicking'

Extending to other relativized positions, accounts based on NPAH would predict lower positions to pose more difficulties such that IO should be more difficult than DO, OBL would be worse than IO and so on. However, Cantonese presents some interesting language-specific properties that would prompt domain-general approaches to make opposing predictions. In Cantonese, OBL-RCs share structural and functional similarities with the highly productive serial verb constructions in the language, as shown in (4) and (5) below.

(4) Oblique (OBL) RC:

N prep[5] N V N

[RC 媽媽 同佢 i 洗手] 嗰個/嘅 [head noun 妹妹 i]

Maa4 maa1 tung4 keoi5 sai2 sau2 go2 go3 /ge3 mui4 mui2

mum for 3.SG. wash hands that CL/ ge3 little sister

'the little sister that mum washed hands for'

(5) Serial Verb Construction:

N V N V N

媽媽幫佢洗手

[5] Some linguists would consider prepositions in Chinese as coverbs because they display some verbal properties (e.g. Li & Thompson, 1981; Francis & Matthews, 2006; Matthews & Yip, 2011).

Maa4 maa1 bong1 keoi5 sai2 sau2
mum help 3.SG. wash hands
'mum helps her wash hands'

It is also reported that serial verb constructions are attested in Chinese children's naturalistic speech at a very young age at 2 (Fung, 2011). Thus, within a domain-general framework, the acquisition of OBL-RCs can be supported by experienced based- frequency effects arising from their resemblance with frequently experienced, early acquired serial verb constructions; and therefore, OBL-RCs are predicted to be rather easy in Cantonese. On the other hand, IO-RCs which is ranked below DO but above OBL on the NPAH hierarchy are predicted by domain-general approaches to cause significantly more difficulties than a supposedly lower-ranked position in Cantonese. IO-RCs in Cantonese are hindered by potential pronoun resolution issues that increase its processing demands, because the RC together with the head noun overlaps structurally and functionally with prepositional dative main clauses and as such the pronoun can be co-indexed with more than one possible referent (as shown in (6) below) which could be taxing working memory capacity for its resolution in young children.

(6) Indirect Object (IO) RC:

Interpretation 1: [$_{RC}$ 男仔送花畀佢 $_{i}$]嗰個/嘅[$_{head\ noun}$ 女仔 $_{i}$]
naam4 zai2 sung3 faa1 bei2 keoi5 go2 go3 /ge3 neoi5 zai2
boy give flowers to 3.SG. that CL/ ge3 girl
'the girl that the boy gave flowers to'

Interpretation 2: 男仔 $_{k}$ 送花畀佢 $_{k}$ 嗰個/嘅女仔
'the boy gave flowers to his girl'

Interpretation 3: 男仔 $_{k}$ 送花畀佢 $_{j}$ 嗰個/嘅女仔
'the boy gave flowers to someone else's girl'

While the NPAH-motivated perspective does not make explicit predictions on differential competence between exemplars of the same position, there is empirical evidence reporting indeed that children's performance on SRCs are not uniform across the subject intransitive RCs and subject transitive (agent) RCs. Findings from English-speaking and

German-speaking typically-developing children have reported processing ease with subject intransitive RCs (Diessel & Tomasello, 2005), with the same results replicated in English-speaking children with DLD (Frizelle & Fletcher, 2014). Diessel and Tomasello (2005) explained their findings in light of the nature of difficulty between the two types: S-RCs caused fewer problems than A-RCs because S-RCs are conceptually less complex with a single referent characterized by the RC, denoting a simpler situation; whereas A-RCs contain additional referents because they denote a transitive activity (Goodluck & Tavakolian, 1982). As general semantic/ conceptual complexity should be applicable cross-linguistically, it is predicted by domain-general accounts that Cantonese should pattern similarly with other languages in this comparison, in which S-RCs should be significantly easier than A-RCs.

Unlike NPAH-driven approaches that do not account for DLD, domain-general perspectives expect children with DLD to exhibit restricted competence among exemplars of the same position, considering their limitations in working memory and statistical learning skills that could affect processing and uptake of linguistic input. They are therefore predicted to be more susceptible to experienced-based effects and processing demands; and worse than their TD peers in generalizing across exemplars (eg. Stokes & Fletcher, 2000; Fletcher et al., 2005 on Cantonese aspect marker; Riches, Faragher & Conti-Ramsden, 2006 on English verb schema use; see Hsu & Bishop (2010) for a summary of more cross-linguistic evidence). Cantonese RCs present a valuable opportunity to test these hypotheses, given the variations within certain relativized positions. For instance, within OBL-RCs, the subtype OBLHelp RCs as in (7a) denote even closer semantic overlaps with the serial verb constructions (resembling "X help Y Verb Object") in Cantonese; while the other subtype OBLWith RCs as in (7b) denotes companionship as in "X with Y Verb Object". Although both subtypes use the same preposition and are structurally similar to serial verb constructions, OBLHelp RCs receive further support from being even semantically closer to the simple, frequently occurring serial verb main clause constructions; and therefore predicted to be easier to parse than OBLWith RCs, especially for children with DLD who are expected to be less competent in generalizing across exemplars.

(7a) OBLHelp RC:

[$_{RC}$ 婆婆同佢 $_{i}$ 刷牙]嗰個/嘅[$_{head\ noun}$ 弟弟 $_{i}$]

po4 po2 tung4 keoi5 caat3 ngaa4 go2 go3 /ge3 dai4 dai2

grandma for 3.SG. brush teeth that CL/ ge3 little brother

‘the little brother that grandma (helped) brushed his teeth for’

(7b) OBLWith RC:

[RC 哥哥同佢 i 搭巴士]嗰個/嘅[head noun 女仔 i]

go4 go1 tung4 keoi5 daap3 baa1 si6 go2 go3 /ge3 neoi5 zai2

brother with 3.SG. take bus that CL/ ge3 girl

‘the girl that the brother takes bus with’

Moreover, Cantonese GEN-RCs also provide a unique opportunity to test for effects of linear distance in affecting processing demands and particularly DLD children’s competence with exemplars of the same position, as suggested by domain-general accounts. Other things being equal where both subtypes within the classic complex GEN-RCs are low in input frequency and are structurally similar to SVO construction, GENS and GENO differ in linear distance between the resumptive pronoun *keoi5* and the head noun as shown in (8a) and (8b) respectively below. Given the shorter linear distance in GENO, it is predicted that GENO would be easier to parse than GENS in general and significantly the case for DLD children because the longer linear distance in GENS would tax further their limited working memory capacity, resulting in differential performance between the two subtypes of GEN-RCs.

(8a) GENS RC:

[RC 佢 i 隻狗仔追兔仔]嗰個/嘅[head noun 姨姨 i]

keoi5 zek3 gau2 zai2 zeoi1 tou3 zai2 go2 go3 /ge3 ji1 ji1

3.SG. CL dog chase rabbit that CL/ ge3 aunt

‘the aunt whose dog chased the rabbit’

(8b) GENO RC:

[RC 妹妹錫佢 i 隻貓仔]嗰個/嘅[head noun 伯伯 i]

mui4 mui2 sek3 keoi5 zek3 maau1 zai2 go2 go3 /ge3 baak3 baak3

little sister kiss 3.SG. CL cat that CL/ ge3 grandpa

‘the grandpa whom the little sister kissed his cat’

In addition, given the importance of experience-based factors in the domain-general approach, further predictions on production preferences relating to the two relativization

strategies in Cantonese could be formed. As illustrated in previous examples, Cantonese RCs are constructed with a classifier (CL) or the particle *ge3*. The two RC strategies are regarded as grammatical options associated with different functional registers: CL RCs belong to the colloquial register; while *ge3* RCs belong to formal settings such as news reporting and literacy texts (Chan et al., 2011; Matthews & Yip, 2001). Thus, CL RCs are more frequently encountered in younger children's language experience and as such, frequency effects would favor CL RCs. However, it is also possible that the particle *ge3* is more preferred by some (older) children who have more experience with formal registers and recognize *ge3* as a functionally informative relative marker to signal the listener of a RC construction for clarity of communication. Hence depending on the relative strength of these competing constraints in production (i.e. frequency effects in favor of CL RCs while functional informativeness favor *ge3* RCs), domain-general predictions would allow predictions of a CL over *ge3* advantage or a *ge3* over CL advantage. By contrast, the NPAH-oriented perspectives make no explicit prediction regarding experience-based or form-function effects in acquisition.

Thus far, majority of the acquisition data that lent support to NPAH-based hypotheses comes from English and European languages, the applicability of NPAH in accounting for acquisition phenomena is debatable when East Asian languages are taken into consideration. In typology terms, Cantonese among other East Asian languages like Japanese and Korean have been argued to be qualitatively different from syntactic operations such as gap filling or movement that are traditionally adopted for European RCs; to the extent that some analyses regard RCs in these East Asian languages as attributive clauses or noun-modifying clause constructions (Comrie, 1996, 1998; Matsumoto, 1997). Given their typological differences, others have questioned to what extent NPAH-based perspectives are of the same explanatory adequacy to these attributive clause languages. For instance, the special issue on RC acquisition and NPAH from the journal *Studies in Second Language Acquisition* has sampled evidence from Japanese monolingual children and Cantonese bilingual children that the NPAH cannot adequately account for the acquisition trajectory reported, where SRCs are not attested earlier than ORCs (Ozeki & Shirai, 2007 in Japanese; Yip & Matthews, 2007b in Cantonese). Despite its conceptual interest, to date there has been no published experimental studies examining a wide range of RC positions in the L1 Chinese acquisition and East Asian literature on children with TD versus DLD. Furthermore, there has been only a few published studies on identifying the linguistic features of Cantonese-speaking children with DLD such as passives and wh-questions (Leonard et al., 2006; Wong et al., 2004); thus the syntactic competence of RCs in Cantonese DLD children remains an issue that deserves more research attention.

4.2 Current Study

This chapter is the first to examine RC production in Cantonese-speaking children with and without DLD. To test the diverging predictions from NPAH-driven and domain-general perspectives as summarized in Table 4.1, this study included (i) a broad range of relativized positions to examine the relative difficulty between RC types; (ii) two subtypes of exemplars within certain RC types to examine relative difficulty within an RC type; and (iii) two relativisation strategies to examine relative difficulty of production between CL and GE RCs. Moreover, the present study included a group of age-matched (AM-TD) and younger, language-matched (YTD) typically-developing children to ascertain whether RCs are particularly vulnerable in Cantonese DLD children (see Frizelle & Fletcher for a similar study design on L1 English).

Table 4.1. *Developmental Predictions derived from NPAH versus domain-general perspectives for the acquisition of Cantonese RCs*

	NPAH-based perspective	Domain-general perspective
Difficulty between RC types	A higher position easier than a lower position, OR A lower position not more difficult than a higher position, BUT NOT a lower position easier than a higher position or a higher position more difficult than a lower position [NPAH: S > DO > IO > OBL > GEN > OCOMP]	A lower position easier than a higher position, if supported by experience-based frequency effects; OR A higher position more difficult than a lower position, if hindered by other factors that tax its processing
Difficulty within a RC type	Difficulty level is uniform between exemplars of the same RC type.	Differential and restricted competence between exemplars of an RC type (given their variations in processing demands), and this phenomenon being more prominent in DLD than TD children

	No explicit predictions	CL may be easier than *ge3* or *ge3* may be easier than CL in production, depending on the relative strength of the competing constraints (frequency effects favor CL RCs but functional informativeness favors GE RCs)
Difficulty between RC strategies		

4.2.1 Method

4.2.1.1 Participants

A total of sixty-six predominantly Cantonese-speaking children participated in this study. They were recruited from local mainstream primary schools or kindergartens that use Cantonese as medium of instruction in Hong Kong. Having assessed by speech therapists, all participants passed hearing screening and their clinical status was confirmed by administering the standardized norm-referenced language tests, i.e. Hong Kong Cantonese Oral Language Assessment Scale (HKCOLAS, T'sou et al., 2006) for school-aged children; or the Cantonese version of the Reynell Developmental Language Scales (RDLS-R and RDLS-E; Hong Kong Society for Child Health and Development, 1987) for preschool children.

Twenty-three children have been identified as DLD based on Bishop et al. (2017)'s recommendations in the diagnosis of DLD: (i) lack of competence even in the best language (as indicated by scoring 1.25 SD below age means in at least two or more subtests in HKCOLAS); (ii) reported negative socio-emotional impact by parents or schools; (iii) existence of poor prognostic features that persist till the age of 5 or above; and (iv) absence of other biomedical conditions such as hearing disability, intellectual disability or ASD. One child with DLD was excluded due to un-codable data arising from technical issues during data collection. As such there were 22 DLDs and 23 AM-TDs aged between 6;6 – 9;7, individually matched according to age (+ or -4 months) and grade. Similar to Frizelle & Fletcher (2014), we also recruited a group of younger and language-matched typically-developing children (YTD) aged between 4;7-7;6. One YTD child was excluded because she did not attend all the experiments. Hence, there were 21 language-matched YTD children, with each of them being about two years younger than a corresponding DLD child.

These YTD children were considered language matched to the DLD group because of their comparable language competence in terms of their overall HKCOLAS language scores

(YTD: *M*=196.94, *SD*=62.11; DLD: *M*=170.18, *SD*=58.01) , *t*(36) = -1.36, *p* = .767 and their subtest scores on grammar (YTD: *M*=51.81, *SD*=11.44; DLD: *M*=42.32, *SD*=10.49), *t*(36) = -2.65, *p* = .655 and in particular expressive grammar (YTD: *M*=12.25, *SD*=3.00; DLD: *M*=7.77, *SD*=4.51), *t*(36) = -3.45, *p* = .071, as well as their subtest scores on story retelling (YTD: *M*=74.25, *SD*=23.57; DLD: *M*=58.91, *SD*=21.13), *t*(36) = -2.11, *p* = .856 and especially on complex sentences (YTD: *M*=14.69, *SD*=7.10; DLD: *M*=12.05, *SD*=7.45), *t*(36) = -1.10, *p* = .308.

4.2.1.2 Experimental Procedures

The present study adopted the sentence repetition task designed by Diessel & Tomasello (2005) in their investigation of RC production by English- and German-speaking children. Unlike studies that use elicited production tasks where children's responses with target structures are not warranted, a sentence repetition restricts to a certain degree children's production, allowing the testing of a broad range of RCs. In clinical setting, sentence repetition tasks are also widely used as measure of language abilities and to identify children with DLD. At the beginning of our experimental task, children were introduced to a 'parrot-game', in which they were instructed to repeat exactly what they heard after the beep sound. Each test sentence was pre-recorded and presented using a powerpoint slideshow, accompanied by a picture depicting the referents and event expressed by the RC. Children were to complete two practice trials before the task moved on to the test sentences, so that they understood the task requirements. A total of two sessions were required to complete this task, and each session lasted for about 10-15minutes to ensure their attention was focused on the task.

4.2.*1.3* *Materials*

A total of 64 test sentences and 16 fillers were designed for this study and divided into two sessions, each containing 40 items with an additional 2 practice trials at the beginning of the task. Following Diessel and Tomasello (2005), this study extended investigation to a wide array of relativized positions including subject (S- RCs with an intransitive verb), agent (A, RCs with a transitive verb), patient/ object (P), indirect object (IO), oblique (OBL, including the subtypes of OBL-Help and OBL-With) and genitive (GEN, including the subtypes of GEN-S and GEN-O). These various types of RCs were further manipulated into the classifier (CL) and *ge3* condition, given previous finding of asymmetry in processing of the two relativization strategies in Cantonese (Chan et al., 2018). There are four trials in each condition, as shown in

the Table 4.2 below. Fillers were main clause constructions such as SVO transitive clauses, serial verb constructions and topic-comment structures and were inserted between test sentences. All sentences were controlled for length (12-14 syllables long) and all RC test sentences were controlled for animacy (all animate nouns). See Appendix C1 and C2 for a complete list of sentence stimuli.

Table 4.2. *Number of Test Items in Each Condition*

Relativized Positions	**Relativized Strategies**	
	Classifier (CL) RCs	***ge3* RCs**
Subject (S) (Intransitive verb in RC)	4	4
Agent (A) (Transitive verb in RC)	4	4
Patient (P)	4	4
Indirect Object (IO)	4	4
Oblique (OBL)	8 (4 OBL-Help; 4 OBL-With)	8 (4 OBL-Help; 4 OBL-With)
Genitive (GEN)	8 (4 GEN-S; 4 GEN-O)	8 (4 GEN-S; 4 GEN-O)

4.2.1.4 Scoring

A score of 1 was given to an essentially correct repetition, where some minor changes that did not alter the meaning and structure of the test sentence were disregarded: for example, changes in demonstratives (e.g. 'this' to 'that'), classifiers, aspect markers, adverbials (or the lack of, e.g. '*tau4sin1*' just now to '*aam1aam1*' just now), or minor changes of RC-internal noun phrases or the head nouns to semantically similar NPs (e.g. '*mui4mui2*' little sister to '*neoi5zai2*' little girl). A response of the target structure (i.e. RC and the head noun) without the carrier phrase '*this is*…' was also accepted. However, no change of relativization strategy or target structure was allowed.

On the other hand, a score of 0 was assigned to any incorrect repetition that arose from significant changes to the meaning and structure of the test sentence. No mark was given to any ungrammatical sentences, no response or incomplete utterances nor changes in relativization strategy, thematic roles of the NPs (e.g. '*This is the horse that kicked the cow*' to '*This is the cow that kicked the horse*') or responses with the target RC changed to other RC types (e.g. '*This is the cat that the duck is kissing*' to '*This is the cat that is kissed by the duck*').

4.2.2 Results

The study sample consisted of sixty-six children, 22 DLDs (6;7;17 – 9;4;26, *M*=7;6;28, *SD*=0;8;7) ; 23 AM-TDs (6;5;26 - 9;6;23; *M*=7;6;12, *SD*=0;9;6) ; 21 YTDs (4;7;14 – 7;6;4, *M*=5;6;27, *SD*=0;9;1). Figure 4.1 reports children's production accuracy for each RC type (S, A, P, IO, OBLHelp, OBLWith, GENS, GENO) by language group (YTD, DLD, AM-TD) and by relativization strategy (CL versus *ge3*). Overall accuracy pattern shows DLD children performed worse than their age-matched TD peers, as well as the younger, language-matched TD (YTD) group in all RC types.

Children's production accuracy (correct = 1) was predicted by Generalized Linear Mixed Effects Models (GLMM; Jaeger, 2008) using the lme4 package for Linear Mixed Effects (Bates & Maechler, 2010) in R (version 4.0.5; R Core Development Team, 2021. RC type/ Condition (S, A, P, IO, OBLHelp, OBLWith, GENS, GENO; mean-centered), relativization strategy (CL versus *ge3*; mean-centered), language group (YTD versus DLD; DLD versus AM-TD; sliding contrast difference coding) and their interaction were entered as fixed effects. Random effects for participants was included (Barr, Levy, Scheepers & Tily, 2013). Table 4.3 reports the summary of GLMM analysis.

Results from the mixed effects model indicated significant main effects of RC type where accuracy varied across the different types of RC, relativization strategy suggesting a significant *ge3* over CL advantage and language group YTD versus DLD and DLD versus AM-TD indicating that DLD's RC production was worse than both YTD and AM-TD. There were also significant two-way interactions between RC type and language group YTD versus DLD and DLD versus AM-TD, suggesting that the ranking of difficulty of RCs was not uniform across the three groups. As a post-hoc analysis, emmeans pairwise comparisons were run for a GLMM model refitted with Condition (8 levels: S, A, P, IO, OBLHelp, OBLWith, GENS, GENO), language group (YTD versus DLD; DLD versus AM-TD; sliding contrast difference coding) and their interaction as fixed effects; and participants as random effects. Figure 4.2 reports the accuracy of each RC type by language group; and Table 4.4 presents the results of contrasts between each RC type in each language group.

This study reports further findings from post-hoc emmeans pairwise comparisons between each RC type based on the following dimensions: difficulty between RC types, and restricted and differential competence within a RC type in DLD.

Difficulty between RC types

The findings indicated no robust object (P-RCs) disadvantage in DLD nor in their younger, language matched TD peers. The non-significant comparison between A- and P-RCs in both groups indicated that DLD and YTD children produced A- and P-RCs with equal ease. A significant A > P advantage was observed only in the older, age-matched TD children. Moreover, across all three groups of children, OBL-RCs were fairly easy for children to produce in that the accuracy of both subtypes (ie. OBLHelp and OBLWith) was not significantly different from A-RCs and P-RCs. Unlike the developmental pattern of RCs in English and other European languages, IO-RCs were rather difficult to parse in Cantonese that they were as challenging as GEN-RCs for children to repeat, as indicated by the lack of significant difference between IO-RCs and the classically complex GEN-RCs (both GENS and GENO) in all children (except for the single instance of IO-RCs being significant better than GENS observed in DLD only which will be discussed further). Basically, IO- and GEN- RCs were the two RC types that had the lowest accuracies among all RC types across the three groups of children.

Restricted and differential competence within a RC type in DLD

Unlike their TD peers whose performance was uniform across the two types of subject RCs, DLD children uniquely showed a significant difference in processing S- and A-RCs. Thus, even within subject RCs, DLD children found it easier to produce the subject intransitive RCs (S-RCs) than subject transitive RCs (A-RCs), likely because S-RCs are conceptually less complex. Within OBL-RCs, there was also differential performance between the two subtypes in children with DLD. Although there was no significant difference within the two subtypes of OBL-RCs (OBLHelp vs OBLWith) in all three groups of children, DLD children, like the other two TD groups, also found OBLHelp significantly easier than IO-RCs to repeat; but when OBL-RCs were changed to another subtype (OBLWith), their performance with OBL-RCs dropped resulting in no significant difference between OBLWith and IO-RCs, whereas the other two TD groups (AM-TD and YTD) consistently found OBL(subtypes Help and With alike) significantly easier than IO-RCs to repeat. Hence, DLD children demonstrated a more restricted competence than their TD peers with OBL-RCs. Similarly with the more complex GEN-RCs, DLD children's performance was not uniform across the subtypes GENS and GENO, even though no significant statistical difference was detected between the two subtypes (GENS vs GENO, possibly due to low accuracies). Like the other two TD groups, DLD children found GENO as difficult to repeat as IO-RCs resulting in no significant difference

between GENO and IO-RCs; but when GEN-RCs were switched to another subtype (GENS), DLD children's performance with GEN-RCs notably declined resulting in GENS being significantly worse than IO-RCs while both AM-TD and YTD still found GEN-RCs (subtypes GENS and GENO alike) equally difficult as IO-RCs to repeat. As such, DLD children were unlike their TD peers to show slight disadvantage with GENS than GENO.

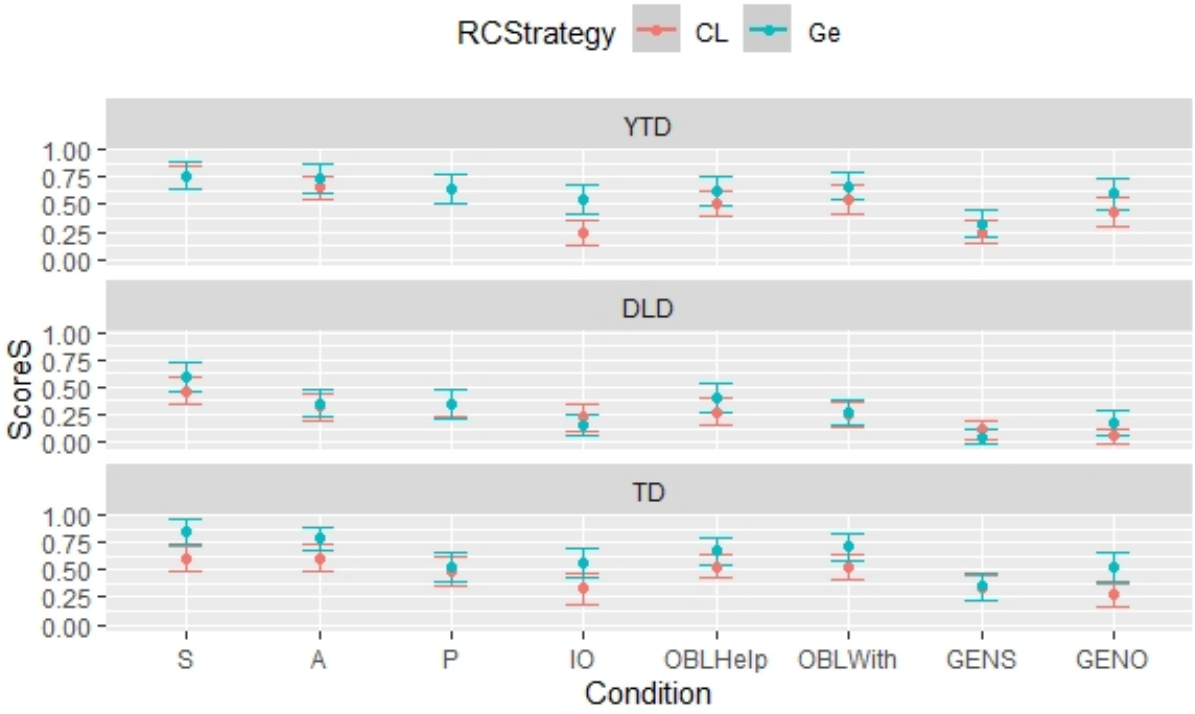


Figure 4.1. Children's Production Accuracy for Each RC type by Relativization Strategy and Language Group

Table 4.3. *GLMM Analysis Summary for Fixed Effects Predicting RC Production Accuracy*

Fixed Effect	***β***	***SE***	***z***	***P***
(Intercept)	-0.30	0.14	-2.22	<0.05*
RC Type / Condition	-0.27	0.02	-15.63	<0.001***
Relativization Strategy (CL)	-0.61	0.16	-3.77	<0.001***
Language Group (YTD vs DLD)	-1.60	0.34	-4.76	<0.001***
Language Group (DLD vs AM-TD)	1.50	0.33	4.55	<0.001***
RC Type/ Condition : Relativization Strategy (CL)	-0.05	0.03	-1.49	0.14
RC Type/ Condition : Language Group (YTD vs DLD)	-0.09	0.04	-2.06	<0.05*

RC Type/ Condition : Language Group (DLD vs AM-TD)	0.09	0.04	2.10	<0.05*
Relativization Strategy (CL) : Language Group (YTD vs DLD)	0.17	0.40	0.42	0.67
Relativization Strategy (CL) : Language Group (DLD vs AM-TD)	-0.52	0.40	-1.30	0.19
RC Type/ Condition : Relativization Strategy (CL) : Language Group (YTD vs DLD)	0.08	0.09	0.99	0.32
RC Type/ Condition : Relativization Strategy (CL) : Language Group (DLD vs AM-TD)	0.01	0.08	0.08	0.94

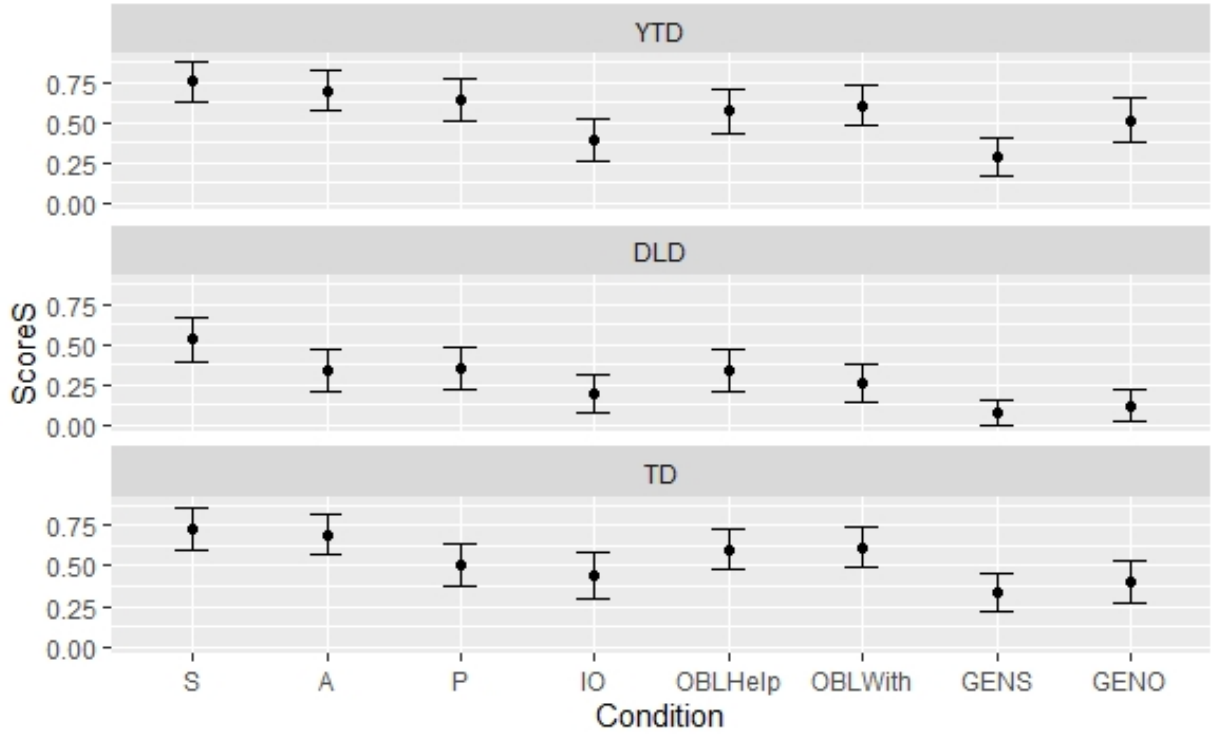


Figure 4.2. Children's Production Accuracy for Each RC type by Language Group

Table 4.4. *Contrasts between Each RC type in Each Language Group*

	YTD				DLD				AM-TD			
	β	***SE***	***z***	***P***	***β***	***SE***	***z***	***P***	***β***	***SE***	***z***	***P***
S - A	0.36	0.27	1.33	n.s.	0.96	0.24	3.99	p <.01 (S > A)	0.19	0.25	0.76	n.s.
S - P	0.65	0.26	2.46	n.s.	0.90	0.24	3.76	p <.01 (S > P)	1.18	0.25	4.82	p < .0001 (S > P)
S - IO	1.89	0.26	7.18	p < .0001 (S > IO)	1.83	0.27	6.91	p < .0001 (S > IO)	1.51	0.25	6.10	p < .0001 (S > IO)
S - OBLHelp	1.01	0.26	3.89	p < .01 (S > OBLHelp)	0.96	0.24	3.99	p <.01 (S > OBLHelp)	0.69	0.25	2.80	n.s.
S - OBLWith	0.83	0.26	3.18	p <.05 (S > OBLWith)	1.38	0.25	5.52	p <.0001 (S > OBLWith)	0.64	0.25	2.57	n.s.
S - GENS	2.46	0.27	9.01	P < .0001 (S > GENS)	2.96	0.34	8.80	p <.0001 (S > GENS)	2.04	0.25	8.06	p < .0001 (S > GENS)
S - GENO	1.30	0.26	5.02	p <.0001 (S > GENO)	2.47	0.30	8.29	p <.0001 (S > GENO)	1.70	0.25	6.83	p <.0001 (S > GENO)
A - P	0.29	0.25	1.15	n.s.	-0.06	0.25	-0.25	n.s.	0.99	0.24	4.10	p <.01 (A > P)
A - IO	1.54	0.25	6.04	p <.0001 (A > IO)	0.87	0.27	3.25	P <.05 (A > IO)	1.32	0.24	5.42	p <.0001 (A > IO)

A - OBLHelp	0.66	0.25	2.61	n.s.	-0.00	0.25	0.00	n.s.	0.50	0.24	2.06	n.s.
A - OBLWith	0.48	0.25	1.88	n.s.	0.42	0.25	1.65	n.s.	0.44	0.24	1.82	n.s.
A - GENS	2.11	0.26	7.98	p <.0001 (A > GENS)	2.00	0.34	5.92	p <.0001 (A > GENS)	1.85	0.25	7.43	p <.0001 (A > GENS)
A - GENO	0.95	0.25	3.78	P <.01 (A > GENO)	1.51	0.30	5.03	p <.0001 (A > GENO)	1.51	0.24	6.17	p <.0001 (A > GENO)
P - IO	1.24	0.25	5.00	p <.0001 (P > IO)	0.93	0.27	3.48	p <.05 (P > IO)	0.32	0.23	1.40	n.s.
P - OBLHelp	0.36	0.25	1.48	n.s.	0.06	0.25	0.25	n.s.	-0.49	0.23	-2.10	n.s.
P - OBLWith	0.19	0.25	0.75	n.s.	0.48	0.25	1.89	n.s.	-0.55	0.24	-2.34	n.s.
(Continued)			**YTD**				**DLD**				**AM-TD**	
	β	***SE***	***z***	***P***	***β***	***SE***	***z***	***P***	***β***	***SE***	***z***	***P***
P - GENS	1.82	0.26	7.02	p <.0001 (P > GENS)	2.06	0.34	6.11	p <.0001 (P > GENS)	0.86	0.24	3.61	p <.01 (P > GENS)
P - GENO	0.66	0.25	2.67	n.s.	1.57	0.30	5.24	p <.0001 (P > GENO)	0.52	0.23	2.21	n.s.
IO - OBLHelp	-0.88	0.25	-3.60	p <.01 (IO < OBLHelp)	-0.87	0.27	-3.25	p <.05 (IO < OBLHelp)	-0.82	0.24	-3.47	p <.05 (IO < OBLHelp)
IO - OBLWith	-1.06	0.25	-4.30	p <.001 (IO < OBLWith)	-0.45	0.28	-1.65	n.s.	-0.87	0.24	-3.70	p <.01 (IO < OBLWith)
IO - GENS	0.58	0.25	2.26	n.s.	1.13	0.35	3.20	p <.05	0.53	0.24	2.24	n.s.

								(IO > GENS)				
IO - GENO	-0.59	0.24	-2.41	n.s.	0.64	0.32	2.02	n.s.	0.19	0.23	0.82	n.s.
OBLHelp - OBLWith	-0.18	0.24	-0.74	n.s.	0.42	0.25	1.65	n.s.	-0.06	0.24	-0.24	n.s.
OBLHelp - GENS	1.45	0.26	5.71	p <.0001 (OBLHelp > GENS)	2.00	0.34	5.92	p <.0001 (OBLHelp > GENS)	1.35	0.24	5.60	p <.0001 (OBLHelp > GENS)
OBLHelp - GENO	0.29	0.24	1.21	n.s.	1.51	0.30	5.03	p <.0001 (OBLHelp > GENO)	1.01	0.24	4.26	p <.001 (OBLHelp > GENO)
OBLWith - GENS	1.63	0.26	6.37	p <.0001 (OBLWith > GENS)	1.58	0.34	4.61	p =.0001 (OBLWith > GENS)	1.40	0.24	5.81	p <.0001 (OBLWith > GENS)
OBLWith - GENO	0.47	0.24	1.94	n.s.	1.09	0.31	3.57	p <.01 (OBLWith > GENO)	1.06	0.24	4.48	p <.001 (OBLWith > GENO)
GENS - GENO	-1.16	0.25	-4.59	p = .0001 (GENS < GENO)	-0.49	0.38	-1.30	n.s.	-0.34	0.24	-1.43	n.s.

4.3 Discussion

This chapter reported on the first RC production study that examined a wide range of RC types in Cantonese-speaking children with and without DLD - an empirical first not only in the Chinese literature but also in the East Asian languages literature. Cantonese RCs present a unique opportunity to test the diverging developmental predictions of NPAH-motivated approach and domain-general perspectives. Production of the two relativization strategies (CL and *ge3*) in Cantonese RCs were also compared, considering the reported variations between the two strategies in comprehension (Chan et al., 2018). The study's findings are discussed in light of NPAH-driven perspectives and domain-general accounts in acquisition and their predictions of DLD. Specifically, we tested three dimensions: 1) difficulty between RC types, 2) difficulty within a RC type, and 3) difficulty between RC strategies.

Before proceeding to discuss each of these three dimensions, the findings regarding DLD versus their TD peers are first discussed. Comparing to their age-matched TD peers, DLD children performed significantly worse resulting in lower accuracy in their production of RCs. This aligns with the robust cross-linguistic evidence of DLD's difficulty with RCs in the literature (e.g. Adani et al., 2014, Hestvik, Schwartz & Tornyova, 2010, Frizelle & Fletcher, 2014 in English; De Lopez, Sundahl & Chondrogianni, 2014 in Danish; Stavarkaki, 2001, Stravrakaki, Tsaioudi & Guasti, 2015 in Greek; Contemori & Garraffa, 2012 in Italian; Friedmann & Novogrodsky, 2004, 2007, Novogrodsky & Friedmann, 2006 in Hebrew; and Rakhlin et al., 2016 in Russian). Results also indicated that Cantonese DLD children's RC performance in production was also significantly worse than the YTD group, consistent with Frizelle & Fletcher's (2014) finding on English-speaking children with DLD. To tease apart whether these DLD children exhibited specific difficulty with RCs (van der Lely, 2005) or had more difficulties with production of sentences in general, we further examined children's production of the filler items which are non-RC and non-movement related candidate structures. We found that these DLD children (M=8.23, SD=4.78) were also significantly worse than their AM-TD peers (M=14.83, SD=1.34), $t(43) = -6.37$, $p < .001$ and their language-matched YTD peers (M=13.76, SD=2.70), $t(41) = -4.64$, $p < .001$ in repeating the non-RC constructions. Overall, our study findings are consistent with domain-general accounts of DLD in terms of weaker cognitive abilities (e.g. Montgomery & Evans, 2009; Hsu et al., 2008, 2010) that result in a global language delay in DLD (Paradis, Crago & Genesee, 2006); and contribute to the DLD literature that not only RC production, but production of other non-movement related constructions are vulnerable in Cantonese-speaking children with DLD.

Difficulty between RC types

Regarding relative difficulty between RC types, domain-general accounts would predict a possibility, that is non-viable within NPAH, for lower positions being easier than a higher position due to facilitating experience-based effects or for a higher position to cause significantly more difficulties than a lower position if it is hindered by factors that tax processing. Results from the current study are consistent with the domain-general predictions: unlike the order/ ease of acquisition of different relativized positions reflected on the NPAH generalization, Cantonese RCs demonstrate a reverse ranking of difficulty in which OBL-RCs (both OBLHelp and OBLWith) were as predicted to be relatively easy for both TD and DLD children to produce given the facilitating effect from frequently experienced and early acquired serial verb constructions in the language, to the extent that their OBL-RCs performance was not significantly different from A-RCs and P-RCs; whereas IO-RCs, having potential pronoun resolution issues that could increase processing demands and burden working memory, were confirmed in the present study to be among the difficult RC types in Cantonese, not significantly different from the classically complex Gen-RCs (both GENS and GENO) for all children to repeat (except for IO-RCs being significant better than GENS observed in DLD only, which will be discussed in details). This pattern of findings is similar to the status of OBL-RCs not causing significantly more difficulties than P-RCs; but stands in contrast with the insignificant difference between OBL and IO-RCs as reported in Diessel & Tomasello (2005)'s study on English and German-speaking children, Frizelle and Fletcher (2014) on English-speaking children with and without DLD, and Kirjavainen et al. (2017) on Finnish-speaking children. The authors of these studies also explain their findings from a domain-general constructivist view, identifying a core role for language-specific properties (i.e. similarity with other simple constructions and word order) that would affect distributional frequencies in the learner's experience, and other processing factors such as memory capacity and general semantic/ conceptual complexity.

Moreover, another language-specific finding relates to the lack of a robust object (P-RCs) disadvantage in Cantonese. Both DLD and their younger, language matched TD peers produced A- and P-RCs with equal ease; whereas a significant A > P-RCs advantage was observed only in the older, age-matched TD children. While it is not incompatible with NPAH-based hypotheses for a lower position being of similar ease with a higher position (Hawkins, 2007), this finding does not support the universal subject RC advantage (irrespective of exemplars of the same subject position, ie. S-RC and A-RC) as assumed in NPAH. The lack

of a robust P-RCs disadvantage in Cantonese is also unlike the developmental trajectory of RCs in English and other European languages that invariably reported a robust subject over object RC advantage in acquisition studies when factors such as animacy contrast and the discourse status of the NP are controlled (e.g. Diessel & Tomasello, 2005 in English and German; Friedmann, Belletti & Rizzi, 2009 in Hebrew; Contemori & Belletti, 2014 in Italian), and also unlike the broad consensus of a difficulty with P-ORCs as feature of DLD in the literature (e.g. Adani et al., 2014, Frizelle & Fletcher, 2014 in English; Stavrakaki, Tasioudi & Guasti, 2015 in Greek; Friedmann & Novogrodsky, 2004, Friedmann, Yachini & Szterman, 2014 in Hebrew; Contemori & Garraffa, 2012 in Italian; De Lopez et al., 2014 in Danish; Rakhlin et al., 2016 in Russian). On the contrary, this result is again predicted by domain-general accounts for Cantonese RCs: P-RCs were hypothesized to not cause more difficulty than A-RCs, because P-RCs present shorter linear filler-gap distance and resemble frequently occurring, early acquired SVO transitive constructions; thus the acquisition of P-RCs, rather than A-RCs, can be supported by the higher input frequencies in learner's experience, simpler known constructions and a shorter linear distance between filler and gap.[6]

Difficulty within an RC type

Besides, the domain-general accounts make further predictions about learner's differential competence between exemplars of the same position, especially when the exemplars vary in their processing demands or degree of similarity to frequently-experienced, early-acquired simpler constructions. Positing the nature of difficulty in children with DLD as deficits in cognitive abilities, these effects are expected to be even more prominent among children with DLD within the domain-general framework. As confirmed by this study, restricted competence with exemplars of the same position was observed particularly in the DLD group. For instance, in the subject position, Cantonese DLD children performed significantly better in the production of S-RCs than A-RCs, contrasting with their TD peers who performed uniformly across the two subtypes. This is consistent with Frizelle and Fletcher

[6] The significant A over P-RCs advantage in the older AM-TD children (6;6-9;7) is likely due to a shift in subject/ object RC preferences during the course of development. Similar to the current finding of an A = P-RCs in the younger TD children (4;7-7;6), another study of ours (Chan et al., 2021) tested RC production in an even younger group of Cantonese-speaking TD children (3;1-3;11) and observed a clear P over A-RCs advantage in their production. Under the emergentist account, it is possible that the effects of multiple factors vary in strength across the course of development at different ages, considering the growth or changes in children's cognition and processing constraints. For instance, when working memory capacity is more constrained, structural input frequency and linear based factors may have a stronger effect at younger ages; whereas the effect of general subject prominence could be prominent at older ages, when working memory capacity in older children and adults is less constrained. Future research could examine this further ideally using a longitudinal design.

(2014)'s findings in English-speaking children with DLD and aligns with the domain-general predictions of DLD. Cross-linguistically, the subject intransitive S-RCs are both structurally and semantically less complex with only a single referent modified by the RC; whereas A-RCs denote a transitive activity containing additional referents (Goodluck & Tavakolian, 1982). As such, our results demonstrate that DLD children are more prone to effects of general semantic/conceptual complexity than their age-matched TD peers even though their input experience is similar and also than the younger, language-matched group, highlighting this observed phenomenon as a unique characteristic of children with DLD.

Relative to their TD peers, DLD children also showed a more restricted competence when producing RCs of other relativized positions. Recall that the present study includes the two subtypes within OBL-RCs (i.e. OBLHelp vs OBLWith) because their semantic differences can potentially impact on processing/ acquisition ease, following the domain-general view that considers form-function pairings and the facilitating effects from simpler construction in language learning. Indeed, the degree of similarity to simpler, related constructions seem to play a prominent role in DLD children's production of complex structures. Although no significant difference within OBL-RCs was detected, the DLD group's differential competence with the two subtypes of OBL-RCs was registered in the comparisons with IO-RCs. Unlike their TD peers who performed consistently across the two subtypes (i.e. finding OBL-RCs (subtypes Help and With alike) significantly easier than IO-RCs), DLD children's accuracy in repeating OBL-RCs declined notably in subtype OBLWith resulting in a lack of significant difference between OBLWith and IO-RCs. Subtype OBLWith was as predicted by domain-general accounts to be slightly disadvantaged, because it does not receive as much support as OBLHelp from the simple, frequently occurring serial verb main clause constructions. Our finding is also in line with domain-general predictions of DLD children being even more susceptible to such effects arising from the degree of similarity with simpler, related constructions. While TD children's stable performance of OBL-RCs (OBLHelp and OBLWith alike) in our study reflect their abilities to generalize across exemplars and identify the relationship between the subtypes, DLD's restricted performance with the two subtypes of OBL-RCs is consistent with the literature's observation that DLD children are worse than their TD peers in generalizing across exemplars (e.g. Stokes & Fletcher, 2000; Fletcher et al., 2005 on Cantonese aspect marker; Riches, Faragher & Conti-Ramsden, 2006 on English verb schema use; see Hsu & Bishop (2010) for a summary of more cross-linguistic evidence) considering their reported limitations in statistical learning skills that could impact on their pattern-finding abilities to generalize across exemplars in the linguistic input.

Moreover, this study observed differential competence between exemplars within genitive RCs that is particularly evident among the DLD children in our study. Recall that within the classic complex GEN-RCs, the current study tested for the linear distance effects potentially underlying the processing of subtypes GENS and GENO as they present a clean case, unlike A- and P-RCs, with equally low input frequency and a SVO configuration. DLD children, like the other two TD groups, produced GENO at comparable accuracies as IO-RCs as suggested by the insignificant difference between GENO and IO-RCs; but when the condition was changed to the other subtype (GENS), their GEN-RCs performance dropped resulting in GENS being significantly worse than IO-RCs; while both AM-TD and YTD repeated GEN-RCs (GENS and GENO alike) at similar accuracy as IO-RCs by contrast. As such, our result is consistent with domain-general perspectives hypothesizing reduced cognitive abilities such as working memory limitations, making DLD children more prone to linear distance effects than their TD peers in producing GEN-RCs, showing disadvantage with GENS when they were taxed further with a longer linear distance between the resumptive pronoun and head noun.

Difficulty between RC strategies

Finally turning to relativization strategies, the present study found an overall significant *ge3* over CL advantage in all children, which could be accountable by domain-general perspectives. Recall that the two strategies have functional differences, in which CL RCs are more often used in colloquial speech, contrasting with *ge3* RCs that are more common in formal registers such as news reporting and literacy texts (Chan et al., 2011; Matthews & Yip, 2001). While input frequency would favor CL RCs as they are more frequently encountered than *ge3* RCs in younger children's language environment; in production, it is also possible that *ge3* RCs are more preferred given their functional informativeness (i.e. to clearly mark a RC status) by older children who have more experience with formal registers.

Children's preference for using *ge3* over CL RCs in our production task could therefore be an indicator of their development of recognizing *ge3* as an informative relative marker, that serves as a morphosyntactic cue to signal the structure of a RC to the hearer in speech planning. A relevant remark for clarification is that it is not the case that these children did not have knowledge of CL RCs. Our error analyses revealed that a good percentage of the errors (over 50% in both TD groups and about 43% in the DLD group) made in the CL condition was related to only the change of RC strategies: all three groups of children tended to respond using *ge3* or a hybrid of both CL + *ge3* or *ge3* + CL when asked to repeat CL RCs, resulting in a

score of '0' following our current scoring scheme. This pattern of finding suggests children's growing knowledge of the constructional relationship between CL-RCs and *ge3* RCs from a constructivist perspective and that the functional informativeness of *ge3* could override frequency effects in production.

4.4 Conclusion

This chapter is novel in both Chinese and East Asian RC literature to extend investigation to a broad range of relativized positions, in addition to the commonly studied subject versus object RCs. It is also the first to document RC production of Cantonese DLD children and confirmed that RC production is indeed vulnerable in these children, as the DLD group was not only worse than their age-matched TD peers but also the language-matched YTD children. The same pattern was observed for the non-RC, non-movement related constructions, suggesting that these DLD children had difficulties with production of sentences in general. Theoretically, the study tested the diverging developmental predictions derived from NPAH-based perspective versus domain-general perspective in three dimensions (i.e. difficulty between RC types, difficulty within a RC type, and difficulty between RC strategies). Findings from this study do not align with the predictions based on NPAH, and instead are better explained by domain-general perspectives.

Chapter Five
Summary and Discussion

5.1 Introduction

This thesis examines the acquisition of RCs in Cantonese-speaking children with and without DLD and reports empirical findings from a typologically distinct language, Cantonese, that could bear on the polarized, long-standing debate of domain-specific versus domain-general theories in typical and atypical language development. Recall that the main contention underpinning the dichotomy is the assumption of a specific module dedicated to language learning or a more general, non-linguistic mechanism that serves all kinds of learning, not committed to language acquisition alone. While the domain-specific account considers processing ease/ difficulty of RCs in terms of structural distance (Hawkins, 1999, 2004) or structural intervention (Friedmann et al., 2009) between the filler and gap, the domain-general accounts such as the emergentist approach (e.g. O'Grady, 2010; 2011; 2021) and the usage-based/ constructivist perspectives (e.g. Tomasello, 2003) gives primacy to the interaction of factors such as learner's experience, meaning and function (i.e. relationship between constructions and general subject prominence), cognition as well as processing (i.e. linear distance effects that tax working memory).

Study one considers the relationship of RCs with other noun-modifying clause constructions (NMCCs) in Cantonese and examines the developmental trajectory of conventional RC-type NMCCs and gapless NMCCs in Cantonese child naturalistic speech. Study two investigates the comprehension of RCs, specifically SRCs versus ORCs and the two relativization strategies (CL versus *ge3*) in Cantonese-speaking children with and without DLD; and tests the predictions of domain-specific versus domain-general accounts on Cantonese RCs and DLD children. Extending to a wider array of relativized positions, study three examines the production of RCs in Cantonese-speaking children with and without DLD; and evaluates the applicability of the NPAH-oriented perspective versus domain-general approaches on Cantonese RCs. Their opposing predictions in studies two and three are recapitulated as follows in Table 5.1 and 5.2 respectively:

Table 5.1. *Predictions of Cantonese RCs from Domain-specific v.s. Domain-general Accounts*

	Domain-specific	Domain-general
SRC vs ORC	a uniform SRC over ORC advantage in Cantonese	a lack of SRC advantage (if not an ORC advantage) or only a weak SRC advantage (if any)
CL vs ge3	No explicit prediction (as frequency is peripheral to core grammar)	a CL over *ge3* advantage OR a *ge3* over CL advantage, depending on the relative strength of the competing constraints (frequency effect favors CL RCs, but functional informativeness favors *ge3* RCs)
DLD vs TD peers	a specific difficulty with RCs in DLD (i.e. more than a general language delay): DLD < AM-TD; DLD <YTD	a global language delay in DLD (i.e. not a specific difficulty with RCs): DLD <AM-TD; DLD = YTD

Table 5.2. *Predictions of Cantonese RCs from NPAH-oriented v.s. Domain-general Accounts*

	NPAH-based perspective	Domain-general perspective
Difficulty between RC types	A higher position easier than a lower position, OR A lower position not more difficult than a higher position, BUT NOT a lower position easier than a higher position or a higher position more difficult than a lower position [NPAH: S > DO > IO > OBL > GEN > OCOMP]	A lower position easier than a higher position, if supported by experience-based frequency effects; OR A higher position more difficult than a lower position, if hindered by other factors that tax its processing
Difficulty within a RC type	Difficulty level is uniform between exemplars of the same RC type.	Differential and restricted competence between exemplars of an RC type (given their variations in processing demands), and this phenomenon being more prominent in DLD than TD children

Difficulty between RC strategies	No explicit predictions	CL may be easier than ge3 or ge3 may be easier than CL in production, depending on the relative strength of the competing constraints (frequency effects favor CL RCs, but functional informativeness favors GE RCs)

5.2 Summary of major findings

This section reviews the major findings of the three studies on the acquisition and processing of relative clauses in Cantonese-speaking children with and without DLD.

Study one

The chapter report two corpus studies that investigate the developmental trajectory and characteristics of NMCCs, including both conventional RC-type NMCCs and gapless NMCCs, in 78 monolingual Cantonese-speaking children's naturalistic speech aged 1;7 – 5;6. This goes beyond the typical acquisition study of RCs alone, and considers language-specific properties in Cantonese where the relationship between prototypical RCs and other NMCCs are less explored. The NMCCs examined include not only conventional RC-type NMCCs where a filler-gap dependency can be conceived, but also gapless NMCCs where no filler-gap dependency can be conceived, a typological characteristic unique to Cantonese and some Asian languages. Results showed that (i) gapless NMCCs emerged simultaneously or even earlier than conventional RC-type NMCCs; (ii) object-RCs (ORCs) were attested earlier than subject-RCs (SRCs); (iii) almost all early ORCs were of the classifier type, which shares surface identity with simple SVO transitives; (iv) the earliest subject-RCs deviate from those SRCs typically used as experimental stimuli but overlap structurally and functionally with the gapless NMCCs attested earlier. These findings challenge domain-specific structurally-oriented approaches that conceptualize structural constraints in hierarchical syntactic representations as the primary factor driving acquisition, but are better accounted for by domain-general emergentist-constructivist perspectives that identify a core role for language-specific features and the relationship between constructions, which impact on the distributional regularities of form-function pairings and input properties in children's experience as well as support from

known constructions that are crucial factors jointly influencing developmental trajectories under this theoretical framework.

Study two

The second study presents the first experimental study that examines the comprehension of RCs offline and online in Cantonese-speaking children with and without DLD in the East Asian languages DLD literature; and compares the domain-specific versus domain-general accounts of typical and atypical language development. Our investigation focuses on three dimensions, namely SRC versus ORCs, CL versus *ge3* RCs and DLD versus TD children, where domain-specific and domain-general theories would make diverging predictions. Sixty-eight predominantly monolingual Cantonese-speaking children were recruited with data from sixty-four children included in the final sample for data analyses. The study used the referent selection task in Chan et al. (2018), which was adapted from Brandt, Kidd, Lieven and Tomasello's (2009). Considering both offline accuracy and online looking patterns, the study's findings collectively indicate a lack of robust SRC over ORC advantage in all children, and a lack of ORC disadvantage (as compared with the other two TD groups) in Cantonese DLD children, which is a novel finding from a typologically distinct language (i.e. Cantonese) to the DLD literature on RC studies. These findings pose challenges to domain-specific structural accounts which would predict a uniform SRC over ORC advantage and consider other information such as experience-based effects as peripheral to the core grammar; rather, the results are consistent with predictions by domain-general theories that take into account the strength of multiple factors relevant to RC processing including prominence, distance, input frequency and support from simpler known constructions that work together to predict a lack of SRC advantage (if not an ORC advantage) or only a weak SRC advantage (if any). As also accounted for by domain-general accounts regarding the two relativization strategies, both online and offline results show a strong CL over *ge3* advantage, revealing frequency to have a more prominent effect than functional informativeness (at least) in comprehension. Moreover, consistent with cross-linguistic evidence, Cantonese DLD children performed worse than their age-matched TD children in offline RC comprehension and processed RCs significantly slower than AM-TD in online processing. On the other hand, our results indicated that DLD children resembled YTD children in their RC performance; and there is no evidence from the online analyses that suggests DLD were worse than YTD in online processing either. This pattern of findings again concurs with the domain-general limited processing accounts of a global delay

in DLD (Montgomery & Evans, 2009), rather than a specific difficulty of movement structures like RCs in DLD (van der Lely, 2005).

Study three

The third study is the first to examine the production of RCs by Cantonese-speaking children with and without DLD. It is the first comprehensive study in both Chinese and East Asian RC literature to extend investigation to a wide range of relativized positions, including not only the commonly investigated subject versus object RCs. This allows one to test the opposing predictions from the arguably domain-specific, structurally-oriented NPAH-driven (considering Hawkins (2004)'s metrics based on hierarchical structure; see Chan et al., 2001 for more details) and domain-general perspectives. The study tested the production of S-, A-, P-, IO-, OBL-Help, OBL-With, GENS- and GENO-RCs. Given the reported variations between the two relativization strategies in comprehension (Chan et al., 2018), production of CL and *ge3* RCs were also compared. Results confirmed that RC production is indeed vulnerable in Cantonese-speaking children with DLD, who performed significantly worse than their TD peers. The same pattern was observed for the filler items which are non-RC, non-movement related constructions, suggesting that these DLD children had difficulties with production of sentences in general. Unlike the hierarchy of difficulty specified in the NPAH, Cantonese RCs demonstrate a reverse ranking: all children found it rather easy to produce OBL-RCs, not significantly different from the higher positioned A- and P-RCs; whereas IO-RCs were among the difficult RC types in Cantonese, not significantly different from the classically complex GEN-RCs. Moreover, there is a lack of a robust P-RCs disadvantage in Cantonese where both the DLD and YTD group produced A- and P-RCs with equal ease. A significant A > P-RCs advantage was found only in the older AM-TD children. Thus, our finding does not support the universal subject RC advantage as assumed by the NPAH-oriented accounts. While the NPAH would not predict differential competence across exemplars of the same relativized position, Cantonese DLD children demonstrated restricted competence in subject RCs (intransitive S- better than transitive A-RCs); OBL-RCs (OBLHelp better than OBLWith-RCs) and GEN-RCs (GENO better than GENS). Although NPAH would not make explicit predictions regarding the two relativization strategies in Cantonese, there was a significant *ge3* over CL preference in all children's RC production. These findings are better predicted and readily accounted for by domain-general emergentist and constructivist approaches that consider experience-based effects, processing demands and the degree of formal and functional similarities to simpler, known constructions. Unlike NPAH-oriented

approaches that do not make predictions about DLD, domain-general perspectives expect these factors to be even more prominent in children with DLD which would result in restricted competence with exemplars of the same position (as evident in this study), considering their limitations in working memory and statistical learning skills that could affect processing and uptake of linguistic input.

5.3 Significance of this thesis

The current studies contribute new knowledge to the study of RCs in both typical and atypical language development from a typologically distinct language Cantonese; and enrich the field's polarized debate of domain-specific versus domain-general approaches to language acquisition and developmental language disorder with new empirical evidence. The studies bear on testing the diverging predictions of these relevant theories and their accounts of the nature of difficulties posed for children with DLD. The following section discusses the novelties of each study first, before integrating the findings from the three studies to highlight the theoretical significance of this thesis.

5.3.1 Empirical Novelties

Study one presents novel corpus data on the developmental trajectory of conventional RC-type NMCCs and other noun-modifying clause constructions from Cantonese child naturalistic speech. In typology, RCs in certain Asian languages including Cantonese have been analyzed as a subset of general NMCCs or attributive clause constructions that are fundamentally different from syntactic operations such as gap-filling or movement adopted for RCs in European languages (Comrie, 1996, 1998, 2002 for East Asian languages; Matsumoto, 1997 and Matsumoto et al., 2017 for Japanese; Matthews & Yip, 2016, 2017 for Cantonese and Mandarin). However, previous studies have focused only on the acquisition pattern of RCs, largely in isolation from other NMCCs in the language (eg. Chen & Shirai, 2015 in Mandarin; Yip & Matthews, 2007a, 2007b in bilingual Cantonese-English children). Working from a domain-general constructivist perspective, the first study considers the typological characteristics of Cantonese as an "attributive clause" language and the relationship of conventional RC-type NMCCs with other related, 'gapless' NMCCs in the language. The study therefore fills the gap in the literature by providing systematic naturalistic data on the learning trajectory of not only prototypical RCs but also other NMCCs in Cantonese.

Study two reports new systematic developmental data on offline and online comprehension of two RC types (SRC vs ORCs) and relativization strategies (CL vs *ge3*) in Cantonese-speaking children with and without DLD. So far there has been no published research on the syntactic competence of RCs in Cantonese children with DLD, despite studies on other complex structures such as passives and wh-questions in Cantonese DLD (Fletcher et al., 2008; Leonard et al., 2006; Wong et al., 2004). Empirically, the second study examined three dimensions, namely SRCs vs ORCs, CL vs *ge3* RCs, and DLD vs TD children where DLD children were compared to their age-matched TD children (AM-TD) and language-matched (and therefore younger) TD children (YTD; c.f. Frizelle & Fletcher, 2014). These new data from study two allow us to not only (i) ascertain whether RC processing is particularly vulnerable in Cantonese children with DLD; but theoretically, (ii) test domain-specific versus domain-general accounts of both typical and atypical language development; and (iii) to address the nature of difficulties experienced by the DLD group when processing RCs.

Study three brings in novel comprehensive data on RC production by Cantonese-speaking children with and without DLD. Unlike previous studies that focused only on the asymmetry between SRCs and ORCs (Lau, 2006) or RCs constructed by the classifier (CL RCs) only (Chan, Lau, Lieven & Tomasello, 2007), study 3 investigates a broad range of relativized positions and includes variations between exemplars of the same position as well as the two relativization strategies in Cantonese to examine not only the relative difficulty between RC types but also difficulty within a RC type and between RC strategies. Similar to Frizelle and Fletcher (2014), DLD children were compared to two groups of TDs, the age-matched TDs and the language-matched younger TDs. These new developmental findings from study three allow us (i) to determine whether RC production is vulnerable in Cantonese children with DLD; and more interestingly, (ii) to evaluate the applicability of NPAH-oriented perspective versus domain-general approaches on Cantonese RCs by testing their diverging predictions relating to the three dimensions examined (i.e. difficulty between RC types, within a RC type and between RC strategies).

5.3.2 Theoretical Significance

Integrating the major findings from the three studies, this thesis is theoretically significant in a number of ways. First, the thesis incorporates the typological perspective that Cantonese is an attributive clause language, stresses the conceptual relationships between conventional RCs

and other noun-modifying clausal constructions (NMCCs), and examines the acquisition of conventional RC-type NMCCs and their related gapless NMCCs in a broader conceptual context. Second, the new findings bear on the field's long-standing debate of domain-specific versus domain-general theories of language acquisition and developmental language disorder. Third, the new findings also address the applicability of NPAH perspectives in a Chinese and East Asian language context. This section summarizes and discusses the theoretical significance in the contexts of the following major empirical dimensions examined.

RCs and their relationships with other Noun Modifying Clausal Constructions (NMCCs)

Study one reported an early primacy of gapless NMCCs that were attested earlier or simultaneously with conventional RC-type NMCCs in both longitudinal and cross-sectional corpora of the Cantonese-speaking children's naturalistic speech. In particular, the earliest SRCs were observed to overlap functionally with some gapless NMCCs attested earlier, which describe an associative relationship between the head noun the modifying clause.

These findings, together with the typological proposal of Cantonese being an attributive clause language, lead one to consider a possible developmental relationship between RC-type NMCCs and gapless NMCCs in Cantonese. While a grammatical relation can be conceived between the head noun and the modifying clause in conventional-RC type NMCCs, other NMCCs are constructed based on semantic-pragmatic relations (Matthews & Yip, 2016, 2017) where there is no conceivable grammatical role for the head noun (hence also called 'gapless', Cheng & Sybesma, 2006; Zhang, 2008). From a domain-general constructivist perspective, this has implications on representational issues of RCs and NMCCs if the gapless NMCCs are indeed the source construction for at least the acquisition of some RCs (i.e. the early SRCs). Study one noted that the earliest SRCs deviate from those SRCs typically used as experimental stimuli denoting a prototypical agent-patient relation. Rather, they overlapped functionally with gapless NMCCs which relate to the head nouns in an 'aboutness' or semantic-pragmatic sense. This observation motivates a logical consideration of representational issues, whether these earliest SRC exemplars and functionally-similar gapless NMCC exemplars were qualitatively distinct: that the conventional RC-type NMCCs were syntactically-governed while the gapless NMCCs were semantic-pragmatically governed; or alternatively, they were constructed under the same, uniform acquisition mechanism that is driven by language functions (i.e. semantics and pragmatics). Taken into account typological perspectives, RCs in attributive clause languages including Cantonese have been suggested for a reconceptualization as a subset of general NMCCs under a unified framework Comrie (1996, 1998, 2002) and

others such as Matsumoto et al. (1997, 2007) and Matthews and Yip (2016, 2017) proposed, arguing that the RC construal and production mechanism in these attributive clause languages like Cantonese, Mandarin and Japanese are fundamentally different from the traditional analysis of European RCs assuming syntactic operations such as gap-filling or movement. Specifically, all NMCCs (regardless of whether a filler-gap syntactic dependency can be conceived or not) can be construed as based on semantic-pragmatic motivations, including the interpretation of conventional RC-type NMCCs. The corpus findings in study one regarding the functional overlaps between the earliest SRCs and gapless NMCCs attested earlier provide a well-motivated hypothesis that the early so-called RCs in Cantonese might be constructed under the same unified mechanism as NMCCs. If this is the case, the relative ease of acquiring different types of Cantonese RCs may not be primarily based on structural factors that are advocated by domain-specific accounts; and developmentally, the acquisition of Cantonese RCs may also be supported by prior acquisition of NMCCs as a source construction.

Difficulty between RC types

A lack of robust subject versus object RC advantage

Robust across the three studies, there was a lack of a strong subject over object RC advantage in both naturalistic speech data and in experimental evidence of Cantonese-speaking children's comprehension and production of RCs despite the apparent variations in findingsbetween studies. Study one reported that ORCs were attested earlier than SRCs in both cross-sectional and longitudinal data of early Cantonese naturalistic speech, although the early ORCs attested were restricted in form (constructed with a classifier in almost all children except one instance) and function (modifying solely inanimate head nouns). As such this ORC over SRC advantage observed in study one should not be regarded as a complete mastery of adult-like competence; and there is need to call for experimental studies that manipulate the contexts to examine children's RC performance. In experimental settings when equal opportunities were given for children to comprehend or produce SRCs versus ORCs and when animacy cues were controlled, study two showed only a weak subject advantage in offline comprehension accuracy because frequent head noun assignment errors in interpreting ORCs (but not in SRCs) were attested. When children were not garden pathed and accurately interpreted the RCs, such an advantage disappeared in online looking patterns (i.e. the proportions of target looks in SRC vs ORC were uniform in all children). On the other hand, study three also indicated no significant difference in both DLD and their younger, language-matched TD peer's production accuracy of A- versus

P-RCs, whereas a significant subject over object RCs advantage was observed only in the older, age-matched TD children.

This set of findings consistently point towards a lack of a robust subject advantage (or object disadvantage) which cannot be readily explained by domain-specific structurally-oriented approaches that favor the processing of SRCs due to the reduction/ absence of structural constraints in terms of shorter structural filler-gap distance or lack of structural intervention (Hu et al., 2016). The current findings also do not support the general subject RC advantage (irrespective of exemplars of the same subject position, i.e. S-RC and A-RC) as assumed in NPAH. Rather, these results are best accounted for by domain-general emergentist (e.g. O'Grady, 2011) and constructivist (e.g. Lieven & Tomasello, 2008; Abbot-Smith & Brehens, 2006) prediction of a lack of SRC advantage (if not an ORC advantage) or only a weak SRC advantage (if any) from the interaction of multiple factors in RC acquisition/ processing: the effect of general subject prominence could be weakened by the opposing effects of shorter linear filler-gap distance, higher structural frequencies in children's experience, and support from simpler known constructions (i.e. SVO transitive constructions) that are associated with ORCs in Cantonese. The variations in findings between comprehension (i.e. Study two) and production (i.e. Study One and Study Three) also provide empirical support for Chan et al. (2021)'s hypothesis of the surface similarity between ORCs and SVO transitives having a facilitation effect in formulating ORCs in production; but could cause misinterpretation in comprehension because of structural ambiguity and competition between constructions. Moreover, under the emergentist view, the shift in subject/ object RC preferences across ages observed in Study 3 is possible since effects of multiple factors could vary in strength over the course of development, considering the growth or changes in children's cognition and processing constraints.

A reverse ranking of difficulty

Extending to the relative difficulty between other RC types, our experimental production study (study three) found that Cantonese RCs demonstrate a ranking of difficulty that is reverse from the NPAH ranking for certain relativized positions: OBL-RCs, which are positioned lower than IO-RCs, were found to be relatively easy for both TD and DLD children to produce; whereas IO-RCs, which are higher-ranked, were found to cause greater difficulties and were among the difficult RC types in Cantonese. This goes against the predictions by NPAH-oriented accounts in which a lower position should not be easier than a high position nor should a higher position be significantly more difficult than a lower position. On the contrary, such a developmental

pattern is possible and readily explainable under domain-general accounts if a lower position is facilitated by experience-based effects such as similarity to simpler known constructions; or if a higher position is hindered by other factors that tax its processing.

In accounting for the attested difficulty between RC types, the current findings bear on factors that would affect the ease/difficulty of a construction. The current developmental profiles suggest that the nature of language acquisition is sensitive to relationships between constructions when the processor is processing and acquiring the mappings and overlaps between forms and functions. Recall that Cantonese ORCs resemble simple SVO transitive constructions and overlap also semantically at the agent-patient configuration; and OBL-RCs are also similar in surface form, and possibly also in function, with the frequently experienced and early acquired serial verb constructions in Cantonese. The current findings of a lack of ORC disadvantage across the three studies and a fairly easy production of OBL-RCs in study three are consistent with the domain-general emergentist-constructivist perspective that language is acquired in a network of constructions related through specific links, in which both the acquisition of ORCs and OBL-RCs in Cantonese could receive further support from formal and functional similarity to known structures and the higher structural frequency of these related constructions in the learner's experience. Naturalistic evidence from study one also found strikingly consistent patterns with cross-linguistic observations (Diessel, 2007) that the earliest RCs share formal and functional overlaps with simpler constructions: the earliest SRCs overlapping with some early gapless NMCCs attested; and the early ORCs share surface identity with the simpler SVO transitives, where all but one ORC exemplars attested were of the classifier (CL) type. Taken together our observations from the three studies, these findings suggest that children construct new RC expressions by relating to simpler constructions experienced earlier as source constructions, providing further evidence for the 'construction conspiracy hypothesis' (Abbot-Smith & Behrens, 2006) and domain-general emergentist-constructivist perspectives of a functionally-driven learning of language, where language-specific experience of form-function mappings affect acquisition outcomes.

Moreover, the developmental profiles attested also suggest that the nature of acquisition is constraint-based, and the processor would find structures that are more taxing to working memory more challenging to process and acquire, given children's limitations in working memory capacity. The current findings provide empirical support for a domain-general, linear efficiency-driven learning mechanism which involves multiple factors that can vary in strength over the course of development and jointly determine acquisition outcomes (eg. O'Grady, 2010; 2011; 2021). Young children are more prone to linear processing demands and experience-

based effects as the robust findings of a lack of SRC over ORC advantage across the three studies in the current thesis suggested: although Cantonese SRCs are favored by general subject prominence, effects from the shorter linear distance in ORCs and the higher structural frequency in the input arising from their resemblance to simple SVO constructions could be stronger for young children. On the other hand, competition and structural disambiguation arising from similar structures would tax children's executive function, leading to increased processing demands and hinder processing and acquisition of the target structure as observed in the finding of IO-RCs being one of the most difficult RC types in Cantonese: because IO-RCs share structural and functional similarity with prepositional dative main clauses, the pronoun in the IO-RC can be co-indexed with more than one possible referent which could tax executive function in young children.

Within a RC type

Specifically in study three, exemplars of the same relativized position were examined for the effects of their varying processing demands on Cantonese children's RC production. Differential competence between exemplars of the same position was observed particularly in the DLD group, where Cantonese DLD children performed significantly better in the production of intransitive S-RCs than transitive A-RCs; OBLHelp than OBLWith RCs; and GENO better than GENS RCs.

This set of findings highlight effects that appear to be even more prominent among children with DLD and shed light on the nature of language acquisition, lending support to the domain-general view of deficits in cognitive abilities in these children. Effects of general semantic/ conceptual complexity are especially important to DLD children's language learning, as suggested by their significantly better performance at the semantically and conceptually less complex S-RCs with only a single referent modified by the RC, contrasting with A-RCs that contain two referents denoting a transitive event. The same developmental phenomenon is also observed in English-speaking TD children (Diessel & Tomasello, 2005) and DLD children (Frizelle & Fletcher, 2014). Moreover, the degree of similarity with simpler known construction also plays a crucial role in acquisition, as indicated by DLD children's differential performance between the two subtypes of OBL-RCs. Although both OBL-RCs subtypes are similar in form with serial verb constructions, OBLHelp rather than OBLWith RCs are semantically closer to the simple, productive serial verb main clause constructions in Cantonese. This sheds light on the nature of syntactic acquisition as a construction network connected through their overlaps in form and function. For instance, competence with OBL-

RCs would require children to generalize across exemplars and identify the relationship between the subtypes. A plausible explanation of DLD's restricted competence here could be their reported limitations in statistical learning skills (Plante et al., 2002; Hsu et al., 2008; Hsu & Bishop, 2010) that impact on their pattern finding skills and their uptake of the input. Further, the observation of a significant GENO over GENS advantage in children with DLD highlights their sensitivity to linear distance demands and provides supporting evidence for the hypothesis of limitations in working memory in DLD children and the nature of the language learning mechanism as a linear, efficiency-driven and constrained processing mechanism.

RC Strategies (CL vs ge3)

Based on the important status of learner's experience and input-based effects within the domain-general framework, further predictions were made about the two relativization strategies (CL vs *ge3*) in Cantonese. Recall that frequency effects would favor the processing of CL RCs because they are more often used in colloquial speech and therefore frequently encountered by young children; whereas *ge3* RCs belong to the formal register and only become more frequently experienced when children grow older and have more experience with formal register through schooling and literacy texts. While input frequency would favor CL RCs, the functional informativeness of the RC marker *ge3* would favor *ge3* RCs, and the strength of these factors may vary between comprehension and production, which could lead to variations in processing preferences between comprehension and production.

The comprehension offline and online findings from study two registered a strong CL over *ge3* advantage in all Cantonese-speaking children. By contrast, the production findings from study three found a significant *ge3* over CL advantage in the same group of children. A further scrutiny of their error patterns in the CL RCs condition revealed that these children preferred to produce a RC using *ge3* or a hybrid of both CL and *ge3*. As such, our current scoring scheme rendered a score of '0', even though these children were able to recognize and repeat a RC in the CL condition. Furthermore, it was learnt from study one that majority of the early conventional RCs and gapless NMCCs attested in the naturalistic speech of very young children aged between 1;7-5;6 were of the CL type. Note that our other two experimental studies involve children who are older (DLD and AMTD children aged between 6;6-9;7 and YTD children aged between 4;7-7;6). These results together provide supportive evidence that the acquisition mechanism is frequency-sensitive, aligning with domain-general perspectives where frequency effects facilitate the early acquisition of CL RCs, but factors vary in strength and the functional informativeness of *ge3* could override frequency effects in production

among the older children who have more experience with formal register and recognize the function of *ge3* as an informative relative marker.

This idea is compatible with the constructivist view of grammar as a network of constructions (Lieven & Tomasello, 2008), where CL and *ge3* RCs can be conceived as connected at some point during the course of development, given their overlaps in form and function. The learning of *ge3* RCs could potentially be supported by one's ability (as they grow older and have more experience) to generalize across exemplars and recognize the constructional relationships between the two strategies, as evidenced in the competing effects of frequency and functional informativeness observed in the older children's production of RCs. The domain-specific structurally-oriented approach, by contrast, cannot readily explain this developmental pattern.

Furthermore, the three studies also repeatedly show differences in acquisition outcomes between the modalities of comprehension and production, in terms of developmental preferences of SRCs vs ORCs; and CL RCs vs *ge3* RCs. These findings allude to the consideration that multiple factors could vary in their strength of effects between comprehension and production, giving rise to one effect overriding another in ways that could differ between comprehension and production (as also recognized in the works of Chan et al., 2021).

DLD vs TD

Study two and study three of this thesis extend investigation to the clinical group of Cantonese children with DLD, which bears on domain-specific versus domain-general accounts of atypical language development. Both studies consistently found that children with DLD performed worse than their age-matched TD peers in both RC comprehension and production. This result is in line with cross-linguistic DLD literature on RC acquisition (e.g. Adani et al., 2014, Hestvik, Schwartz & Tornyova, 2010, Frizelle & Fletcher, 2014 in English; De Lopez, Sundahl & Chondrogianni, 2014 in Danish; Stavarkaki, 2001, Stravrakaki, Tsaioudi & Guasti, 2015 in Greek; Contemori & Garraffa, 2012 in Italian; Friedmann & Novogrodsky, 2004, 2007, Novogrodsky & Friedmann, 2006 in Hebrew; and Rakhlin et al., 2016 in Russian). Specifically, in online comprehension, there is suggestive evidence from the significantly lower overall target looks observed in DLD children (as compared to their AM-TD peers) suggesting that DLD children displayed a slower processing speed than their AM-TD peers in general, a phenomenon that has also been well-documented in the literature (Kail, 1994; Miller et al., 2006; Leonard et al., 2007). Such a finding is compatible with the domain-general limited

capacity processing accounts of DLD (Montgomery & Evans, 2009) which propose general nonlinguistic deficits such as phonological or working memory limitations in DLD children, resulting in reduced processing speed and affect their complex sentence processing which burdens their working memory.

The only discrepancy between studies two and three lies in the performance between DLD and the language matched, younger TD group. Both studies included a YTD group in the study design to examine whether children with DLD have a specific difficulty with movement-derived structures like RCs (i.e. more than a general language delay) as proposed by domain-specific "Computational Grammatical Complexity account (CGC)" (van der Lely, 2005); or a global language delay (Paradis, Crago & Genesee, 2006) where DLD children could resemble their YTD peers, as predicted by domain-general capacity limitation and statistical learning perspectives. Consistent with domain-general predictions, study two indicated that DLD children were not worse than YTD children in both offline and online comprehension of RCs. However, DLD children were found to perform significantly worse than the YTD group in RC production (i.e. study three). At face value, this could be taken as a result against domain-general accounts, but it could also be that DLD children have more difficulties with the task of repetition as compared with comprehension in general. However, the follow-up analyses, having examined these children's production of the filler items which are non-RC and non-movement related candidate structures, indicated that these children with DLD were also significantly worse than their TD counterparts in repeating the non-movement related candidate structures in general. Taken together, the findings from study three are therefore best explained by domain-general approaches, which indicated that these children with DLD had difficulty in producing sentences in general, rather than exhibiting difficulty specific to movement related constructions like RCs. In addition, these DLD children were as predicted to display restricted competence between exemplars of the same RC type (i.e. S vs A; OBLHelp vs OBLWith; GENS vs GENO). These are compatible once again with domain-general capacity limitations and statistical learning accounts, that children with DLD (as compared with TD children) are more prone to factors affecting processing demands and are more likely to exhibit differential competence within a RC type.

5.4 Implications for future work

Results from the three studies in this thesis all consistently point towards a domain-general account of acquisition. There are also some further methodological and conceptual remarks

that the author would like to make, which could lead to some suggestions for future research. First, it must be acknowledged that the study one contains a relatively small sample size, considering the absence of NMCCs in two of the children from the longitudinal study and the few type measures of NMCCs attested in both the longitudinal and cross-sectional corpora. Despite having analysed the only two monolingual Cantonese child corpora at CHILDES, there are consistent developmental patterns observed across children as reported in study one through systematic investigations. Future research could increase the database and extend investigation to Mandarin Chinese given their parallel NMCC structure constructed with the particle DE or used together with a classifier (DE+CL, Yang et al., 2020). It will be of theoretical interest to also extend analysis to other non-clausal noun-modifying constructions such as adjectives and nominal attributives in Chinese, in light of their formal and functional overlaps with clausal-level NMCCs that could affect structural frequencies in learner's experience and jointly contribute to acquisition outcomes. Consider the referential function associated with NMCCs, the production of NMCCs in child language studies would require a supportive, felicitous context where knowledge of the referent is shared between the child and the researcher (Correa, 1995; Yip & Matthews, 2007b). To address the sampling constraints in child spontaneous speech data, future research could consider adopting experimental production paradigms to intentionally elicit the range of target structures as a follow-up.

Second, while the current thesis has considered language-specific properties that would affect experience-based factors and form-function pairings, the role of cognitive factors, despite its important status within the emergentist-constructivist framework, in predicting children's complex sentence performance can be further examined in greater depth in future research. Individual differences in cognitive abilities such as working memory and statistical learning skills have been a recent line of research in the context of RC acquisition. Given the reported limitations in working memory capacities (Montgomery & Evans, 2009) and statistical learning skills (Evans, Saffran & Robe-Torres, 2009; Plante, Gomez and Gerken, 2002; Hsu, Tomblin, & Christiansen, 2008; Hsu & Bishop, 2010), future research could investigate whether and how individual differences in cognitive abilities predict children's competence with RCs in Cantonese. The following discusses in turn possible research in particular to working memory and statistical learning abilities.

Working Memory

The role of working memory has been studied in relation to processing of complex sentences including RCs in both typical and atypical language development (e.g. Frizelle and Fletcher, 2015; Boyle, Lindell & Kidd, 2013; Riches et al., 2010; Montgomery & Evans, 2009; Montgomery, Magimairaj & O'Malley, 2008; Booth, MacWhinney & Haraskai, 2000) and in adults (e.g. Just & Carpenter, 1992; King & Just, 1991). Working memory is a domain-general system that temporarily holds and manipulates information in cognitive processing (Baddeley, 2003; Baddeley & Hitch, 1974). In particular, Montgomery and his colleagues found a significant correlation between working memory and complex sentences that involved nonlocal syntactic dependencies in comprehension by typically-developing school-age children (Montgomery et al., 2008) and by children with DLD (Montgomery & Evans, 2009). Focusing on RCs specifically, Frizelle and Fletcher (2015) reported a significant association between working memory and RCs of a range of relativized positions in a sentence repetition task by English-speaking children with DLD and their younger TD peers, but no relationship was detected in the age-matched TD children likely because their performance was at ceiling.

So far there has been no comparable studies in child Cantonese that address the role of working memory in predicting RC performance in the Chinese developmental literature. The idea has remained speculative as in Hsu (2014)'s discussion about the shift in subject/ object asymmetry during the course of development in Mandarin children and Chan et al. (2021) in Cantonese children: that these age-related discrepancies could be due to the role of working memory capacity effects in acquiring RCs. From a domain-general cognitive perspective, the language-specific characteristics of Cantonese could potentially interact with individual differences in working memory. For instance, the longer filler-gap linear distance in Cantonese SRCs can be more taxing on children's working memory span; whereas the competition between ORCs and simple transitives in the parsing of Cantonese ORCs may draw on children's capacity to update and monitor the contents of working memory (Whitely & Colozzo, 2013) and/or executive functioning skills such as inhibition control to inhibit potential misanalysis of ORCs as simple SVO transitive constructions. Future research could test the predictive power of working memory span and executive functioning abilities in accounting for children's RC performance in Cantonese. Given our findings suggesting a generally slower processing speed observed in DLD children (as compared to their age-matched TD peers), it will also be theoretically interesting to compare their working memory scores with the TD groups and examine whether there are differences and similarities in these cognitive abilities that uniquely predict children's RC performance in each group.

Statistical Learning Abilities

Another prominent cognitive skill in the recent literature of language acquisition is statistical learning skills, which is a domain-general ability to learn patterns and extract regularities in the environment (Saffran, 2003). Such an ability is particularly relevant to language acquisition, if we consider usage-based/ constructivist perspectives of acquisition where children are to identify the statistical regularities in their input (which are referred to as distributional cues in these theories) and abstract over this information to create form-function mappings and generalize across exemplars to build an interconnected network of constructions (Diessel, 2007; Lieven & Tomasello, 2008). As such, a good command of statistical learning skills would facilitate the identification of cues or distributional patterns present in a learner's experience and in turn, the acquisition of the target structures especially those of lower frequency (Kidd & Arciuli, 2016). The relevant role of statistical learning in language acquisition has been demonstrated in research work on the associations between individual differences in statistical learning capacity and children's language performance (e.g. Kidd and Arciuli, 2016; Kidd, 2012; Wells et al., 2009); and limitations in statistical learning abilities are reported in the DLD literature (e.g. Evans et al., 2009; Plante et al., 2002; Hsu et al., 2008; Hsu & Bishop, 2010). While it is not known whether there is a causal relationship between statistical learning and DLD, studies in typically-developing children have identified statistical learning as a direct predictor of children's syntactic performance. For example, Kidd & Arciuli (2016) investigated whether individual differences in statistical learning is a direct predictor to account for English-speaking children's comprehension of syntactic structures, including RCs. It was found that the comprehension accuracy of English passives and ORCs were independently predicted by statistical learning capacity. The authors argued their findings to be suggestive of an associative relationship between individual differences in children's statistical learning abilities and the acquisition of syntax. Despite the theoretical significance, the role of statistical learning has not been fully addressed in Chinese acquisition studies nor DLD literature. This deserves further scrutiny to assess how statistical learning relate to particular sentence structures such as relative clauses in Cantonese. Future research could examine this issue and examine whether differences in statistical learning abilities could account for Cantonese DLD children and their TD peers' performance with RCs.

5.5 Conclusion

This thesis studies the acquisition of RCs in Cantonese-speaking children with and without DLD. It reports comprehensive empirical findings from a typologically distinct language, Cantonese, that are significant to the theoretical dichotomy of domain-specific versus domain-general accounts in both typical and atypical language development. Study one contributes novel naturalistic data on the developmental trajectory of conventional RC-type NMCCs and gapless NMCCs from two corpus studies on Cantonese child naturalistic speech, while study two provides new empirical findings on offline and online RC comprehension addressing the asymmetry between two RC types (SRC vs ORCs) and relativization strategies (CL vs *ge3*) in Cantonese-speaking children with and without DLD; and study three brings in novel developmental data on RC production assessing a wide range of relativized positions by Cantonese-speaking children with and without DLD. The developmental patterns exhibited across the three studies could not be readily explained by domain-specific perspectives and challenge purely structural-oriented account that conceptualize the nature of processing demands in terms of structural constraints such as hierarchical structural filler-gap distance (Hawkins, 1999, 2004) or structural intervention (Friedmann et al., 2009) in the study of RCs. Instead, they are best predicted and accounted for by domain-general accounts such as the emergentist approach (e.g. O'Grady, 2010; 2011; 2021) and the usage-based/ constructivist perspectives (e.g. Tomasello, 2003) that are multifactorial and give primacy to the interaction of factors such as learner's experience, language-specific properties in light of form-function mappings and their overlaps in conceptualizing relationships between constructions and similarity to simpler known constructions, cognition as well as processing.

Appendix A: Supplementary analyses on adult input properties of the two corpora

Table A1. *Age of first attested conventional RC-type NMCCs and gapless NMCCs in the adult child-directed speech of eight Cantonese-speaking children before age 3 in the longitudinal CANCORP corpus*

	CCC	CGK	HHC	LLY	LTF	MHZ	CKT	WBH
NMCC type								
Conventional								
RC-type NMCC								
Subject	2;1;10	2;2;7	2;5;3	2;9;9	2;11;16	1;11;6	1;9;29	------
Object	2;1;10	1;11;1	2;5;13	2;8;10	2;8;2	2;0;16	1;11;27	2;4;15
Gapless NMCC								
Temporal	2;1;10	2;8;8	2;6;10	2;8;22	2;7;20	2;0;3	1;9;29	------
Locative	------	------	------	------	------	------	2;0;16	2;7;14
Associative	2;1;17	2;9;9	------	2;11;1	2;9;7	1;10;10	1;8;21	2;11;6

Table A2. *Type measures of conventional RC-type NMCCs and gapless NMCCss in the adult child-directed speech of eight Cantonese-speaking children before age 3 in the longitudinal CANCORP corpus*

	CCC	CGK	HHC	LLY	LTF	MHZ	CKT	WBH
NMCC type								
Conventional								
RC-type NMCC								
Subject	16	5	8	4	2	6	2	------
Object	36	9	5	5	3	6	3	7
Gapless NMCC								
Temporal	5	2	1	1	6	7	1	------
Locative	------	------	------	------	------	------	1	1
Associative	7	1	------	1	1	4	2	1

Table A3. *Earliest age at which conventional RC-type NMCCs and gapless NMCCss were attested in adult child-directed speech in the four age groups of the cross-sectional HKU70 corpus*

NMCC type	2;5-2;11	3;0-3;11	4;0-4;11	5;0-5;11
Conventional RC-type NMCC				
Subject	------	3;6;6	4;10;2	------
Object	------	3;1;5	4;0;1	5;0;5
Gapless NMCC				
Temporal	2;5;11	3;1;6	4;0;21	5;0;10
Locative	------	3;5;23	------	------
Associative	2;5;11	3;5;23	------	5;0;10

Table A4. *Type measures of conventional RC-type NMCCs and gapless NMCCs attested in adult child-directed speech in the four age groups of the cross-sectional HKU70 corpus*

NMCC type	2;5-2;11	3;0-3;11	4;0-4;11	5;0-5;11
Conventional RC-type NMCC				
Subject	------	1	1	------
Object	------	4	3	4
Gapless NMCC				
Temporal	9	8	8	3
Locative	------	1	------	------
Associative	3	1	------	2

Appendix B: Cantonese RC stimuli - Referent selection task

Can you pick up [relative clause] head noun?

Subject CL RCs

1. 追 獅子 嗰 隻 狗仔
   zeoi1 si1zi2 go2 zek3 gau2zai2
   chase lion that CL dog
   'the dog that chased the lion'

2. 踢 斑馬 嗰 隻 熊人
   tek3 baan1maa5 go2 zek3 hung4jan2
   kick zebra that CL bear
   'the bear that kicked the zebra'

3. 抹 豬仔 嗰 隻 馬騮
   maat3 zyu1zai2 go2 zek3 maa5lau1
   wipe pig that CL monkey
   'the monkey that wiped the pig'

4. zit1 馬騮 嗰 隻 牛牛
   zit1 maa5lau1 go2 zek3 ngau4ngau2
   tickle monkey that CL cow
   'the cow that tickled the monkey'

Object CL RCs

1. 馬仔 推 嗰 隻 狗仔
   maa5zai2 teoi1 go2 zek3 gau2zai2
   horse push that CL dog
   'the dog that the horse pushed'

2. 老虎 咬 嗰 隻 熊人

lau5fu2 ngaau5 go2 zek3 hung4jan2
tiger bite that CL bear
'the bear that the tiger bit'

3. 羊仔 摸 嗰 隻 馬騮
joeng4zai2 mo2 go2 zek3 maa5lau1
sheep touch that CL monkey
'the monkey that the sheep touched'

4. 老虎 餵 嗰 隻 牛牛
lau5fu2 wai3 go2 zek3 ngau4ngau2
tiger feed that CL cow
'the cow that the tiger fed'

Subject *ge3* RCs

1. 舐 斑馬 嘅 獅子
lam2 baan1maa5 ge3 si1zi2
lick zebra ge3 lion
'the lion that licked the zebra'

2. 撞 熊人 嘅 老虎
zong6 hung4jan2 ge3 lou5fu2
bump bear ge3 tiger
'the tiger that bumped the bear'

3. 咬 牛牛 嘅 大象
ngauu5 ngau4ngau2 ge3 daai6zeong6
bite cow ge3 elephant
'the elephant that bit the cow'

4. 推 長頸鹿 嘅 老虎
teoi1 ceong4geng2luk5 ge3 lou5fu2
push giraffe ge3 tiger

‘the tiger that pushed the giraffe’

Object *ge3* RCs

1. 熊貓 舐 嘅 獅子
   hung4maau1 lam2 ge3 si1zi2
   panda lick ge3 lion
   ‘the lion that the panda licked’

2. 大象 追 嘅 老虎
   daai6zoeng6 zeoi1 ge3 lou5fu2
   elephant chase ge3 tiger
   ‘the tiger that the elephant chased’

3. 豬仔 踢 嘅 牛仔
   zyu1zai2 tek3 ge3 ngau4zai2
   pig kick ge3 cow
   ‘the cow that the pig kicked’

4. 大象 撞 嘅 長頸鹿
   daai6zoeng6 zong6 ge3 coeng4geng2luk5
   elephant bump ge3 giraffe
   ‘the giraffe that the elephant bumped’

Appendix C1: Cantonese RC Sentence stimuli - Sentence repetition task

This is [RC] CL/ ge3 head noun. (RC: relative clause; CL: classifier; *ge3*: relative marker)

Subject (S)

CL RCs	*ge3* RCs
1. 飛上屋頂嗰隻雀仔 fei1 soeng5 nguk1 deng2 go2 zek3 zoek3 zai2 fly up roof that CL bird 'the bird that flew up to the roof'	1. 瞓喺草地上面嘅牛仔 fan3 hai2 cou2 dei6 soeng5 min6 ge3 ngau4 zai2 sleep at grass above ge3 cow 'the cow that slept on the grass'
2. 瞓喺樹下底嗰個男仔 fan3 hai2 syu6 haa6 dai2 go2 go3 naam4 zai2 sleep at tree below that CL boy 'the boy that slept under the tree'	2. 坐喺車入面嘅女仔 co5 hai2 ce1 jap6 min6 ge3 neoi5 zai2 sit at car inside ge3 girl 'the girl that sat in the car'
3. 坐喺門口嗰隻貓仔 co5 hai2 mun4 hau2 go2 zek3 maau1 zai2 sit at door that CL cat 'the cat that sat at the door'	3. 飛落草叢嘅蝴蝶 fei1 lok6 cou2 cung4 ge3 wu4 dip6 fly into bush ge butterfly 'the butterfly that flew into the bush'
4. 趴喺地下嗰隻豬仔 paa1 hai2 dei6 haa6 go2 zek3 zyu1 zai2 lie at floor that CL pig 'the pig that lied on the floor'	4. 企喺門外面嘅鴨仔 kei5 hai2 mun4 ngoi6 min6 ge3 ngaap3 zai2 stand at door outside ge3 duck 'the duck that stood at the door'

Agent (A)

CL RCs	*ge3* RCs
1. 捉到牛仔嗰隻獅子 zuk1 dou2 ngau4 zai2 go2 zek3 si1 zi2 catch-ASP cow that CL lion	1. 追到兔仔嘅貓仔 zeoi1 dou2 tou3 zai2 ge3 maau1 zai2 chase-ASP rabbit ge3 cat

‘the lion that caught the cow’	‘the cat that chased the rabbit’
2. 踢親大象嗰隻斑馬 tek3 can1 daai6 zoeng6 go2 zek3 baan1 maa5 kick-ASP elephant that CL zebra ‘the zebra that kicked the elephant’	2. 摸到狗仔嘅豬仔 mo2 dou2 gau2 zai2 ge3 zyu1 zai2 touch-ASP dog ge3 pig ‘the pig that touched the dog’
3. 嚇到雞仔嗰隻老鼠 haak3 dou2 gai1 zai2 go2 zek3 lou5 syu2 scare-ASP rooster that CL mouse ‘the mouse that scared the rooster’	3. 撞到青蛙嘅白兔 zong6 dou2 cing1 waa1 ge3 baak6 tou3 push-ASP frog ge3 rabbit ‘the rabbit that pushed the frog’
4. 撞親哥哥嗰個妹妹 zong6 can1 go4 go1 go2 go3 mui4 mui2 push-ASP brother that CL sister ‘the sister that pushed the brother’	4. 踩到妹妹嘅男仔 caai2 dou2 mui4 mui2 ge3 naam4 zai2 step-ASP sister ge3 boy ‘the boy that stepped on the sister’

Patient (P)

CL RCs	*ge3* RCs
1. 馬騮捉到嗰隻熊貓 maa5 lau1 zuk1 dou2 go2 zek3 hung4 maau1 monkey catch-ASP that CL panda ‘the panda that the monkey caught’	1. 男仔推到嘅女仔 naam4 zai2 teoi1 dou2 ge3 neoi5 zai2 boy push-ASP ge3 girl ‘the girl that the boy pushed’
2. 斑馬咬親嗰隻長頸鹿 baan1 maa5 ngaau5 can1 go2 zek3 coeng4 geng2 luk6 zebra bite-ASP that CL giraffe ‘the giraffe that the zebra bit’	2. 黑熊錫嘅大笨象 hak1 hung4 sek3 ge3 daai6 ban6 zoeng6 Bear kiss ge3 elephant ‘the elephant that the bear kissed’
3. 姐姐嚇親嗰個小朋友 ze4 ze1 haak3 can1 go2 go3 siu2 pang4 jau5 sister scare-ASP that CL child ‘the child that the sister scared’	3. 蝴蝶嚇親嘅蜜蜂 wu4 dip6 haak3 can1 ge3 mat6 fung1 Butterfly scare-ASP ge3 bee ‘the bee that the butterfly scared’

4. 鴨仔追住嗰隻青蛙 ngaap3 zai2 zeoi1 zyu6 go2 zek3 cing1 waa1 duck chase-ASP that CL frog 'the frog that the duck chased'	4. 姨姨踩親嘅叔叔 ji1 ji1 caai2 can1 ge3 suk1 suk1 Aunt step-ASP ge3 uncle 'the uncle that the aunt stepped on'

Indirect Object (IO)

CL RCs	*ge3* RCs
1. 叔叔遞個波畀佢嗰個女仔 suk1 suk1 dai6 go3 bo1 bei2 keoi5 go2 go3 neoi5 zai2 uncle pass CL ball to 3.sg that CL girl 'the girl to whom the uncle passed a ball'	1. 婆婆送粒糖畀佢嘅女仔 po4 po2 sung3 lap1 tong4 bei2 keoi5 ge3 neoi5 zai2 grandma give CL candy to 3.sg ge3 girl 'the girl to whom grandma gave a candy'
2. 姨姨借本書畀佢嗰個叔叔 ji1 ji1 ze3 bun2 syu1 bei2 keoi5 go2 go3 suk1 suk1 aunt lent CL book to 3.sg that CL uncle 'the uncle to whom the aunt lent a book'	2. 男仔送花畀佢嘅姨姨 naam4 zai2 sung3 faa1 bei2 keoi5 ge3 ji1 ji1 boy give flower to 3.sg ge3 aunt 'the aunt to whom the boy gave a flower'
3. 狗仔送蘋果畀佢嗰隻鴨仔 gau2 zai2 sung3 ping4 gwo2 bei2 keoi5 go2 zek3 ngaap3 zai2 dog give apple to 3.sg that CL duck 'the duck to whom the dog gave an apple'	3. 羊仔攞杯奶畀佢嘅牛仔 joeng4 zai2 lo2 bui1 naai5 bei2 keoi5 ge3 ngau4 zai2 sheep pass CL milk to 3.sg ge3 cow 'the cow to whom the sheep passed a cup of flower'
4. 蜜蜂遞支花畀佢嗰隻蝴蝶 mat6 fung1 dai6 zi1 faa1 bei2 keoi5 go2 zek3 wu4 dip6 bee pass CL flower to 3.sg that CL butterfly 'the butterfly to whom the bee passed a flower'	4. 伯伯遞報紙畀佢嘅婆婆 baak3 baak3 dai6 bou3 zi2 bei2 keoi5 ge3 po4 po2 uncle pass newspaper to 3.sg ge3 grandma 'the grandma to whom the uncle passed a newspaper'

Oblique (OBL)

Subtype: OBLHelp

CL RCs	*ge3* RCs
1. 男仔同佢梳頭嗰個女仔 naam4 zai2 tung4 keoi5 so1 tau4 go2 go3 neoi5 zai2 boy for 3.sg comb hair that CL girl 'the girl for whom the boy combed her hair'	1. 姐姐同佢著襪嘅 BB ze4 ze1 tung4 keoi5 zeok3 mat6 ge3 BB sister for 3.sg wear socks ge3 BB 'the baby for whom the sister put on socks'
2. 弟弟同佢抹手嗰個小朋友 dai4 dai2 tung4 keoi5 mat3 sau2 go2 go3 siu2 pang4 jau5 brother for 3.sg wash hands that CL child 'the child for whom the brother washed his hands'	2. 弟弟同佢扎頭髮嘅姨姨 dai4 dai2 tung4 keoi5 zaat3 tau4 faat3 ge3 ji1 ji1 brother for 3.sg tie hair ge3 aunt 'the aunt for whom the brother tied her hair'
3. 姐姐同佢洗面嗰個弟弟 ze4 ze1 tung4 keoi5 sai2 min6 go2 go3 dai4 dai2 sister for 3.sg wash face that CL brother 'the brother for whom the sister washed his face'	3. 哥哥同佢剪頭髮嘅婆婆 go4 go1 tung4 keoi5 zin2 tau4 faat3 ge3 po4 po2 boy for 3.sg cut hair ge3 grandma 'the grandma for whom the brother cut her hair'
4. 鴨仔同佢梳毛嗰隻狗仔 ngaap3 zai2 tung4 keoi5 so1 mou4 go2 zek3 gau2 zai2 duck for 3.sg brush hair that CL dog 'the dog for whom the duck brushed its hair'	4. 羊仔同佢冲涼嘅馬騮 joeng4 zai2 tung4 keoi5 cung1 loeng4 ge3 maa5 lau1 sheep for 3.sg shower ge3 monkey 'the monkey for whom the sheep took a shower'

Subtype: OBLWith

CL RCs	*ge3* RCs
1. 女仔同佢散步嗰個伯伯 neoi5 zai2 tung4 keoi5 saan3 bou6 go2 go3 baak3 baak3	1. 叔叔同佢玩積木嘅女仔 suk1 suk1 tung4 keoi5 waan2 zik1 muk6 ge3 neoi5 zai2

girl with 3.sg walk that CL grandpa 'the grandpa with whom the girl took a walk'	uncle with 3.sg play lego ge3 girl 'the girl with whom the uncle played legos'
2. 海龜同佢砌模型嗰隻兔仔 hoi2 gwai1 tung4 keoi5 cai3 mou4 jing4 go2 zek3 tou3 zai2 sea turtle with 3.sg make model that CL rabbit 'the rabbit with whom the sea turtle made models'	2. 叔叔同佢散步嘅男仔 suk1 suk1 tung4 keoi5 saan3 bou6 ge3 naam4 zai2 uncle with 3.sg walk ge3 boy 'the boy with whom the uncle took a walk'
3. 貓仔同佢睇書嗰隻兔仔 maau1 zai2 tung4 keoi5 tai2 syu1 go2 zek3 tou3 zai2 cat with 3.sg read books that CL rabbit 'the rabbit with whom the cat read books'	3. 馬騮同佢玩砌圖嘅狗仔 maa5 lau4 tung4 keoi5 waan2 cai3 tou4 ge3 gau2 zai2 monkey with 3.sg play puzzle ge3 dog 'the dog with whom the monkey played with puzzles'
4. 媽媽同佢買餸嗰個伯伯 maa4 maa1 tung4 keoi5 maai5 sung3 go2 go3 baak3 baak3 mother with 3.sg buy groceries that CL grandpa 'the grandpa with whom the mother got groceries'	4. 兔仔同佢睇表演嘅羊仔 tou3 zai2 tung4 keoi5 tai2 biu2 jin2 ge3 joeng4 zai2 rabbit with 3.sg watch show ge3 sheep 'the sheep with whom the rabbit watched a show'

Genitive (GEN)

Subtype: GENS

CL RCs	*ge3* RCs
1. 佢隻雀仔追蝴蝶嗰個姨姨 keoi5 zek3 zoek3 zai2 zeoi1 wu4 dip6 go2 go3 ji1 ji1 3.sg CL bird chase butterfly that CL aunt 'the aunt whose bird chased the butterfly'	1. 佢隻狗錫媽媽嘅伯伯 keoi5 zek3 gau2 sek3 maa4 maa1 ge3 baak3 baak3 3.sg CL dog kiss mother ge3 grandpa 'the grandpa whose dog kissed the mother'

2. 佢隻狗嚇親豬仔嗰個叔叔 keoi5 zek3 gau2 haak3 can1 zyu1 zai2 go2 go3 suk1 suk1 3.sg CL dog scare-ASP pig that CL uncle 'the uncle whose dog scared the pig'	2. 佢條蛇咬弟弟嘅婆婆 keoi5 tiu4 se4 ngaau5 dai4 dai2 ge3 po4 po2 3.sg CL snake bite brother ge3 grandma 'the grandma whose snake bit the brother'
3. 佢隻貓踩親兔仔嗰個婆婆 keoi5 zek3 maau1 caai2 can1 tou3 zai2 go2 go3 po4 po2 3.sg CL cat step-ASP rabbit that CL grandma 'the grandma whose cat stepped on the rabbit'	3. 佢隻馬騮追住叔叔嘅妹妹 keoi5 zek3 maa5 lau1 zeoi1 zyu6 suk1 suk1 ge3 mui4 mui2 3.sg CL monkey chase-ASP uncle ge3 sister 'the sister whose monkey chased the uncle'
4. 佢隻龜撞到雞仔嗰個男仔 keoi5 zek3 gwai1 zong6 dou2 gai1 zai2 go2 go3 naam4 zai2 3.sg CL turtle push-ASP rooster that CL boy 'the boy whose turtle pushed the rooster'	4. 佢隻青蛙嚇親姐姐嘅哥哥 keoi5 zek3 cing1 waa1 haak3 can1 ze4 ze1 ge3 go4 go1 3.sg CL frog scare-ASP sister ge3 brother 'the brother whose frog scared the sister'

Subtype: GENO

CL RCs	*ge3* RCs
1. 妹妹望住佢隻貓嗰個伯伯 mui4 mui2 mong6 zyu6 keoi5 zek3 maau1 go2 go3 baak3 baak3 sister stare-ASP 3.sg CL cat that CL grandpa 'the grandpa whom the sister stared at his cat'	1. 叔叔摸佢隻兔仔嘅女仔 suk1 suk1 mo2 keoi5 zek3 tou3 zai2 ge3 neoi5 zai2 Uncle pat 3.sg CL rabbit ge3 girl 'the girl whom the uncle patted her rabbit'
2. 叔叔捉佢隻馬騮嗰個女仔 suk1 suk1 zuk1 keoi5 zek3 maa5 lau1 go2 go3 neoi5 zai2 uncle catch 3.sg CL monkey that CL girl	2. 婆婆餵佢隻貓嘅男仔 po4 po2 wai3 keoi5 zek3 maau1 ge3 naam4 zai2 grandma feed 3.sg CL cat ge3 boy

‘the girl whom the uncle caught her monkey’	‘the boy whom the grandma fed his cat’
3. 伯伯摸佢隻兔仔嗰個弟弟 baak3 baak3 mo2 keoi5 zek3 tou3 zai2 go2 go3 dai4 dai2 grandpa pat 3.sg CL rabbit that CL brother ‘the brother whom the grandpa patted his rabbit’	3. 弟弟錫佢隻狗嘅姨姨 dai4 dai2 sek3 keoi5 zek3 gau2 ge3 ji1 ji1 brother kiss 3.sg CL dog ge3 aunt ‘the aunt whom the brother kissed her dog’
4. 爸爸錫佢隻雀仔嗰個姐姐 baa4 baa1 sek3 keoi5 zek3 zoek3 zai2 go2 go3 ze4 ze1 dad kiss 3.sg CL bird that CL sister ‘the sister whom the father kissed her bird’	4. 姐姐嚇親佢隻鴨仔嘅弟弟 Ze4 ze1 haak3 can1 keoi5 zek3 ngaap3 zai2 ge3 dai4 dai2 Sister scare-ASP 3.sg CL duck ge3 brother ‘the brother whom the sister scared his duck’

Appendix C2 – List of Filler Items – Sentence Repetition Task

1. 熊貓後面跟住隻黑色嘅狗仔。

   hung4 maau1 hau6 min6 gan1 zyu6 zek3 hak1 sik1 ge3 gau2 zai2

   Panda back follow-ASP CL black *ge3* dog

   '(At) the panda's back, there is a black dog following.'

2. 今朝早窗出面一直落住大雨。

   gam1 ciu4 zou2 coeng1 ceot1 min6 jat1 zik6 lok6 zyu6 daai6 jyu5

   Today morning window outside always down-ASP big rain

   'Outside of the window this morning, it has been raining heavily.'

3. 貓仔打爛咗枱上面隻玻璃杯。

   maau1 zai2 daa2 laan6 zo2 toi4 soeng5 min6 zek3 bo1 lei1 bui1

   Cat broke-ASP table top CL glass

   'The cat broke the glass on the table.'

4. 貓仔好開心咁食緊碟上面嗰啲魚。

   maau1 zai2 hou2 hoi1 sam1 gam2 sik6 gan2 dip2 soeng5 min6 go2 di1 jyu4

   Cat very happy ADV eat-ASP dish top that PL fish

   'The cat is happily eating those fish on the dish.'

5. 媽咪送咗一份生日禮物畀妹妹。

   maa1 mi4 sung3 zo2 jat1 fan6 saang1 jat6 lai5 mat6 bei2 mui4 mui2

   Mum give-ASP one CL birthday present give sister

   'Mum gave a birthday present to the sister.'

6. 女仔遞咗枝牛奶畀好肚餓嘅弟弟。

   neoi5 zai2 dai6 zo2 zi1 ngau4 naai5 bei2 hou2 tou5 ngo6 ge3 dai4 dai2

   Girl pass-ASP CL milk give very hungry *ge3* brother

   'The girl passed a bottle of milk to the hungry brother.'

7. 車入面有三個好開心嘅小朋友。

ce1 jap6 min6 jau5 saam1 go3 hou2 hoi1 sam1 ge3 siu2 pang4 jau5

Car inside has three CL very happy *ge3* children

'Inside of the car, there are three very happy children.'

8. 嗰個男仔已經食咗好多麵喇。

go2 go3 naam4 zai2 ji5 ging1 sik6 zo2 hou2 do1 min6 laa1

That CL boy already eat-ASP many noodles SFP

'That boy has already eaten a lot of noodles.'

9. 呢架紅色嘅巴士入面係無人嘅。

ne1 gaa3 hung4 sik1 ge3 baa1 si2 jap6 min6 hai6 mou4 jan4 ge3

This CL red *ge3* bus inside is no one SFP

'Inside of this red bus, there is no one.'

10. 公園裡面見到個伯伯喺度散步。

gung1 jyun4 leoi5 min6 gin3 dou2 go3 baak3 baak3 hai2 dou6 saan3 bou6

Park inside see-ASP CL elderly there walk

'Inside of the park, (I) saw an elderly take a walk.'

11. 嗰個男仔鍾意每朝早去跑步。

go2 go3 naam4 zai2 zung1 ji3 mui5 ciu1 zou2 heoi3 paau2 bou6

That CL boy like every morning go run

'That boy likes going for a run every morning.'

12. 呢個叔叔身型係高高瘦瘦嘅。

ne1 go3 suk1 suk1 san1 jing4 hai6 gou1 gou1 sau3 sau3 ge2

This CL uncle body build is tall slender SFP

'This uncle's body build is tall and slender.'

13. 女仔孭住個綠色書包去返學。

neoi5 zai2 me1 zyu6 go3 luk6 sik1 syu1 baau1 heoi3 faan1 hok6

Girl carry CL green backpack go school

‘The girl carries a green backpack to school.’

14. 今日嘅功課妹妹好快就做完喇。

gam1 jat6 ge3 gung1 fo3 mui4 mui2 hou2 faai3 zau6 zou6 jyun4 laa1

Today ge3 homework sister very quick ADV complete SFP

‘Today’s homework, the sister has already completed them very quickly.’

15. 馬路中間企咗個好精神嘅警察。

maa5 lou6 zung1 gaan1 kei2 zo2 go3 hou2 zing1 san4 ge3 ging2 caat3

Road center stand-ASP CL very spirit ge3 policeman

‘At the center of the road, there is a well-spirited policeman.’

16. 嫲嫲鍾意每個星期日晚去跳舞。

maa4 maa2 zung1 ji3 mui5 go3 sing1 kei4 jat6 maan5 heoi3 tiu3 mou5

Grandma like every CL Sunday night go dance

‘Grandma likes going to dance every Sunday night.’

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