The Role of Qualia Structure in Mandarin Children Acquiring Noun-modifying Constructions

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Abstract

This paper investigates the types and the developmental trajectory of noun modifying constructions (NMCs), in the form of [Modifier + *de* + (Noun)], attested in Mandarin-speaking children's speech from a semantic perspective based on the generative lexicon framework (Pustejovsky, 1995). Based on 1034 NMCs (including those traditionally defined as relative clauses (RCs)) produced by 135 children aged 3 to 6 from a cross-sectional naturalistic speech corpus "Zhou2" in CHILDES, we analyzed the relation between the modifier and the head noun according to the 4 major roles of qualia structure: formal, constitutive, telic and agentive.

Results suggest that (i) NMCs expressing the formal facet of the head noun's meaning are most frequently produced and acquired earliest, followed by those expressing the constitutive quale, and then those expressing the telic or the agentive quale; (ii) RC-type NMCs emerge either alongside the other non-RC type NMCs *at the same time*, or emerge *later* than the other non-RC type NMCs for the constitutive quale; and (iii) the majority of NMCs expressing the agentive and telic quales are those that fall within the traditional domain of RCs (called RC-type NMCs here), while the majority of NMCs expressing the formal and the constitutive quales are non-RC type NMCs.

These findings are consistent with: (i) the semantic nature and complexity of the four qualia relations: formal and constitutive aspects of an object (called natural type concepts in Pustejovsky 2001, 2006) are more basic attributes, while telic and agentive (called artificial type concepts in Pustejovsky 2001, 2006) are derived and often eventive (hence conceptually more complex); and (ii) the properties of their adult input: NMCs expressing the formal quale are also most frequently encountered in the adult input; followed by the constitutive quale, and then the agentive and telic quales.

The findings are also consistent with the idea that in Asian languages such as Japanese, Korean and Chinese, RCs develop from attributive constructions specifying a semantic feature of the head noun in acquisition (Diessel 2007, c.f. also Comrie 1996, 1998, 2002).

This study is probably the first of using the generative lexicon framework in the field of child language acquisition.

1 Introduction

1.1 Noun Modifying Constructions (NMCs) in Asian Languages from Semantic and Pragmatic Perspectives (Comrie 1996, 1998, 2002; Matsumoto 1997, 2007)

In typology, relative clauses (RCs) in certain Asian languages such as Japanese, Korean and Chinese have recently taken on new theoretical significance. In these Asian languages, RCs can be considered a subset of NMCs involving

no syntactic operation such as gap-filling or movement (Comrie 1996, 1998, 2002). Rather, it could involve simply attaching a modifying clause to the head noun based on semantic-pragmatic relations.

Chinese has a productive NMC in which a noun is modified by a clause without there being a grammatical relation between the clause and the head noun. For example, in the Mandarin examples (1) and (2) the head nouns 'shoes' and 'sound' are not strictly arguments of the verbs 'go (to school)' and 'play', but are associated with the modifying clauses semantically and pragmatically.

(1) 上学　　的 鞋子
　　　shangxue de xiezi
　　　go to school DE shoes
　　　'The shoes for going to school'

(2) 我 弹　钢琴　的 声音
　　　wo tan gangqin de shengyin
　　　I　play piano DE sound
　　　'The sound from me playing the piano'

It proves difficult, if not impossible, to separate NMCs such as (1) and (2) from those 'conventional' RCs such as (3) and (4) below (Comrie 1996, 1998, 2002).

(3) 我 买 的 鞋子
　　　wo mai de xiezi
　　　 I buy DE shoes
　　　'The shoes that I bought'

(4) 我 听到　的 声音
　　　wo tingdao de shengyin
　　　 I　hear　DE noise
　　　'The sound that I heard'

Under this alternative view, Chinese and some other Asian languages such as Japanese and Korean do not have a syntactic RC distinct from other NMCs such as (1) and (2). Rather, these languages have a general NMC for attaching modifying clauses to head nouns based on semantic-pragmatic relations

between the two constituents, and this construction has a range of interpretations which can be characterized as relative clause interpretations, or complement clause interpretations, or some kind of modifying clause interpretations (see also Huang 2008). As such, Chinese RCs can be analyzed as a subset of NMCs in which a modifying clause is attached to the head noun based on semantic-pragmatic relations.

If this is so, Chinese NMCs call for an approach that recognizes the role of semantics and pragmatics in accounting for the processing and acquisition of these constructions. For instance, Matsumoto (1997, 2007) developed a framework to account for NMCs in Japanese, building on ideas in existing works on frame semantics (e.g., Fillmore 1977, 1982; Fillmore & Atkins 1992). Under this frame semantic analysis of NMCs in Japanese, the construal of NMCs is described in terms of 'the relation between the concept denoted by one of the constituents of the construction (i.e. the modifying clause or the head noun) and the frame evoked by the other' (Matsumoto 1997: 166). In addition, how a specific interpretation of the construction is determined depends on the construer's world-views regarding contextual information and cultural knowledge (Matsumoto 1997: 166-167; 2007: 132). Future research could apply similar framework to consider the acquisition and processing of Chinese RCs and other NMCs from a semantic-pragmatic approach (c.f. Matsumoto 1997, 2007 on Japanese).

1.2 Semantic Relations between the Modifier and the Head Noun: Qualia Structure (Pustejovsky, 1995)

As an initial attempt to study the acquisition of NMCs in child Mandarin from a semantic perspective, we first focus on characterizing the semantic relations between the modifier

and the head noun of NMCs in young children's speech across age.

Generative Lexicon (GL) Theory (Pustejovsky, 1995) has become one of the most influential theories in semantics and qualia structure is a central framework in the GL theory. The GL Theory provides us with an explanatory model for capturing the qualia modification relations in the semantic composition within a compound (Lenci et al., 2000). Similarly, Chinese NMCs are composed of a modifier and a head noun. It can be deduced that qualia modification relations also exist between the modifiers and the heads of Chinese NMCs. We therefore attempt to use qualia structure relations as a framework to analyze the semantic relations between the modifier and the head noun NMCs in this paper.

Qualia structure specifies four essential aspects of a lexical item's meaning (Pustejovsky (1995), see also Lenci et al., (2000) for further elaborations):

1) The Formal role can distinguish the object within a larger domain. Orientation, magnitude, shape, dimensionality, color, and position are its role values. For example: beautiful dancer, white paper.

2) The Constitutive role is the relation between an object and its constituents or parts. The role values include material, weight, parts and component elements. For example: glass door, heavy stone.

3) The Agentive role describes the factors involved in the origin of an object, such as creator, artifact, natural kind, and causal chain. For example: bullet hole, lemon juice.

4) The Telic role is about the purpose and function of an object. For example: hunting rifle, race car.

2 Data Analyses

2.1 The Zhou2 Corpus in the Child Language Data Exchange System (CHILDES)

The naturalistic data used in this study came from one released naturalistic child Mandarin corpus called "Zhou2" deposited at the CHILDES archive (MacWhinney, 2000) (downloadable at: http://childes.psy.cmu.edu/data/EastAsian/Chinese/). The corpus "Zhou2" was created by Zhou Jing (Eastern China Normal University) in 2007. This cross-sectional corpus consists of transcripts of naturalistic adult-to-child interactions from 140 mother-child pairs in Nanjing, China. The children, with equal numbers of girls and boys, belong to 7 age groups (see Table 2) and there are about 20 children in each age group.

2.2 NMCs Expressing Different Qualia Relations in Children's Speech

There are 1034 utterances containing NMCs, in the form of [Modifier + *de* + (Noun)] where the Head Noun can be (un)expressed, attested in the children's spontaneous speech. These NMCs include those that fall *within* the traditional domain of RCs (called RC-type NMCs here), and those that do *not* fall within the traditional domain of RCs (called non-RC NMCs here; these constructions are "gapless" because there is no grammatical relation between the head noun and the modifier, and hence there cannot be a gap co-referential with the head). In addition, the modifiers in these NMCs include both clausal and non-clausal.

We analyzed the relation between the modifier and the head noun according to the four major roles of qualia structure: formal, constitutive, telic and agentive.

Table 1 below gives examples of each type attested in the corpus.

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Table 1: Examples of Each Type of NMC Attested in the Corpus

NMC type	Qualia	Examples
Non-RC	Formal	大大 的 眼睛 (Age[1]: 3;00) dada de yanjing big DE eye 'Big eyes'
		尖尖 的 嘴 (Age: 5;06) jianjian de zui pointed DE mouth 'A pointed mouth'
	Constitutive	兔子 的 脚 (Age : 3;00) tuzi de jiao Rabbit DE foot 'The rabbit's foot'
		玻璃 的 （杯子）(Age: 6;00) boli de (beizi) glass DE (cup) 'A glass cup (a cup made of glass)'
	Agentive	宝宝 的 声音 (Age: 3;06) baobao de shengyin baby DE noise 'Baby's noise (The noise made by the baby)'
		吃 跳跳糖 的 声音 (Age: 5;06) chi tiaotiaotang de shengyin eat Leaping Sweets DE noise 'The noise made from eating the Leaping Sweets'
	Telic	好玩 的 东西 (Age: 3;06) Haowan de dongxi good-play DE thing 'The thing that is fun for playing'
		你 的 电话 (Age: 6;00) ni de dianhua you DE phone call 'Your phone call (a phone call to find you)'
RC	Formal	跟 这个 一样 的 （颜色） (Age: 3;00) gen zhege yiyang de (yanse) as this CL same DE (color) 'The color that is same as this'
		像 玩具 的 （东西） (Age: 6;00) xiang wanju de (dongxi) like toy DE (thing) 'The thing that looks like a toy'
	Constitutive	剩下来 的 香蕉 (Age: 4;00) shengxialai de xiangjiao left-over DE banana 'The banana that is left over'
		剩下 的 一只 皮皮鼠 (Age: 6;00) shengxia de yizhi pipishu left-over DE one CL Hooded Rat 'One Hooded Rat that is left over'
	Agentive	我 搭 的 这个 球 (Age: 3;06) wo da de zhege qiu I build DE this CL ball 'This ball that I built'

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[1] Age: 3;00 means 3 years and 0 month old; Age: 5;06 means 5 years and 6 months old

		我 做　的 楼梯　　　(Age: 6;00) wo zuo de louti I　make DE stairs 'The stairs that I made'
	Telic	我 看 过　　的 书　　　(Age: 4;00) wo kan guo de shu I　read ASP DE book 'The book that I have read'
		我 最 喜欢　的 玩具　　(Age: 6;00) wo zui xihuan de wanju I　most like　DE toy 'The toy that I like playing most'

Table 2 presents an overview of the distribution of NMCs (both non-RC type NMCs and RC-type NMCs) expressing the four major qualia roles across the seven age groups of children. In addition, we also singled out the RC-type NMCs and examined the distribution of their types expressing the four major qualia roles in children's naturalistic speech across age. See Table 3.

Table 2. The Distribution of NMCs Expressing the Four Major Qualia Roles in Children's Naturalistic Speech Across Age

Age	3;00 (20)[2]		3;06 (21)		4;00 (16)		4;06 (19)		5;00 (22)		5;06 (16)		6;00 (21)	
Qualia	Token	%	Token	%	Token	%	Token	%	Token	%	Token	%	Token	%
Formal	88	68.8	109	75.2	88	56.8	74	61.7	93	52.2	70	50.0	93	55.4
Constitutive	26	20.3	22	15.2	43	27.7	30	25.0	51	28.7	39	27.9	45	26.8
Agentive	11	8.6	4	2.8	5	3.2	5	4.2	15	8.4	24	17.1	17	10.1
Telic	3	2.3	10	6.9	19	12.3	11	9.2	19	10.7	7	5.0	13	7.7

Table 3. The Distribution of RC-type NMCs Expressing the Four Major Qualia Roles in Children's Naturalistic Speech Across Age

Age	3;00 (20)		3;06 (21)		4;00 (16)		4;06 (19)		5;00 (22)		5;06 (16)		6;00 (21)	
Qualia	Token	%	Token	%	Token	%	Token	%	Token	%	Token	%	Token	%
Formal	4	23.5	5	31.3	6	20.0	6	30.0	7	17.1	7	20.6	3	11.1
Constitutive	0	0.0	0	0.0	1	3.3	0	0.0	0	0.0	0	0.0	3	11.1
Agentive	10	58.8	3	18.7	4	16.7	3	15.0	15	36.6	21	61.8	10	37.0
Telic	3	17.7	8	50.0	18	60.0	11	55.0	19	46.3	6	17.6	11	40.8

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[2] The number in parentheses indicates the number of children who have produced at least 1 NMC in that age group.

Results in Table 2 show that:
- across all the 7 age groups, NMCs expressing the formal quale are most frequently attested, accounting for more than two-third of the NMCs produced at ages 3;00 and 3;06 and at least half of the NMCs produced for the remaining 5 age groups
- NMCs expressing the constitutive quale rank consistently second for all age groups, accounting for about a quarter of the NMCs produced from age 4 to 6
- NMCs expressing the telic or agentive quale are relatively less frequently attested

Upon further examination of the data for each individual child, the developmental pattern revealed appears to be consistent with the above analyses that are based on token frequency of use of NMCs:
- By age 3;00 and consistently thereafter, more than 80% of the children in their respective age group have at least 1 NMC expressing the formal quale attested in their speech sample
- By age 3;06 and consistently thereafter, more than 50% of the children in their respective age group have at least 1 NMC expressing the constitutive quale attested in their speech sample
- By age 5;00 and consistently thereafter, more than 40% of the children in their respective age group have at least 1 NMC expressing the agentive quale attested in their speech sample
- By age 3;06 and consistently thereafter, around 40% of the children in their respective age group have at least 1 NMC expressing the telic quale attested in their speech sample

Taken together all the above facts, the findings suggest that NMCs expressing the formal quale are acquired earliest; followed by constitutive; and then telic or agentive.

Results in Table 3 show that in general, RC-type NMCs constitute only 17.8 % (184 out of 1034 NMCs) of all the NMCs attested in children's speech. RC-type NMCs emerge either *alongside* the other non-RC type NMCs at the same time, or emerge *later* than the other non-RC type NMCs for the constitutive quale.

In addition, taking the results in Tables 2 and 3 together, the majority of NMCs expressing the agentive and telic quales are RC-type NMCs; while the majority of NMCs expressing the formal and the constitutive quales are non-RC type NMCs.

3 Discussion

How do we account for the developmental patterns observed? We consider (i) the semantic nature and complexity of the four qualia relations; (ii) adult input properties; and (iii) structural complexity.

3.1 The Semantic Nature and Complexity of the Four Qualia Relations

The developmental findings are consistent with the semantic nature and complexity of the four qualia relations: formal and constitutive aspects of an object (called natural type concepts in Pustejovsky 2001, 2006) are more basic attributes, while telic and agentive (called artificial type concepts in Pustejovsky 2001, 2006) are derived and often eventive (hence conceptually more complex).

3.2 Adult Input Properties

The developmental findings appear to be also consistent with the properties of their adult input. We did a parallel analysis of the 3053 NMCs attested in the mother-to-child speech in the Zhou2 corpus. See Table 4. The adult input findings indicate that NMCs expressing the formal quale are also most frequently

Table 4. The Distribution of NMCs Expressing the Four Major Qualia Roles in Children's Adult Input (mother-to-child's naturalistic speech) Across Age

Age	3;00 (20)[1]		3;06 (21)		4;00 (16)		4;06 (19)		5;00 (22)		5;06 (16)		6;00 (21)	
Qualia	Token	%	Token	%	Token	%	Token	%	Token	%	Token	%	Token	%
Formal	307	57.2	294	56.0	256	54.1	223	51.6	218	53.0	133	55.0	190	45.9
Constitutive	148	27.6	142	27.0	118	24.9	107	24.8	101	24.6	65	26.9	119	28.7
Agentive	40	7.4	56	10.7	53	11.2	64	14.8	61	14.8	28	11.6	64	15.5
Telic	42	7.8	33	6.3	46	9.7	38	8.8	31	7.5	16	6.6	41	9.9

encountered in the adult input; followed by the constitutive quale, and then the agentive and telic quales.

3.3 Structural Complexity

The idea to consider here is that since the Telic and Agentive quales always involve some event, which is in turn expressed by a full clause, telic and agentive NMCs are structurally more complex than the formal and constitutive ones, and therefore acquired later. However, in Mandarin, telic and agentive NMCs can also be non-clausal (hence not necessarily always structurally more complex; e.g. "Baby's noise (The noise made by the baby)") and examples of these are also attested in the children's speech at an early age, although few. In addition, some NMCs expressing the formal quale with a clausal (hence structurally more complex) modifier are also noticed in the children's speech at an early age, albeit not frequently attested in the current corpus (see examples of the RC type-NMCs in Table 1).

On the other hand, to clarify, we are not claiming that structural complexity has no or only an insignificant role to play here. We need to design experimental tasks such as elicited production and imitation tasks (as future research) to systematically elicit the 4 types of NMCs (formal, constitutive, agentive and telic) within each type of which varying in structural complexity (involving both clausal and non-clausal modifiers, for instance) to fully consider and evaluate the role of structural complexity.

4 Concluding Remarks

Traditionally, RCs have often been studied from a structural perspective and with little emphasis on the relationship between RCs and other types of NMCs in the language. More recently, however, linguists such as Comrie (1996, 1998, 2002) and Matsumoto (1997, 2007) proposed that, in certain Asian languages, RCs should be analyzed as a subset of NMCs based on semantic-pragmatic relations between the head noun and its modifier.

As an initial attempt to study the acquisition of NMCs in child Mandarin from a semantic perspective, we first focus on characterizing the semantic relations between the modifier and the head noun based on the generative lexicon framework (Pustejovsky, 1995).

This attempt is probably the first of using the generative lexicon framework in the field of child language acquisition. The new data and the observed developmental patterns may serve as a basis or reference for inspiring more experimental work and more wide-ranging cross-linguistic work examining the acquisition of NMCs from a semantic approach. Such cross-linguistic findings may reveal some robust descriptive generalizations about the acquisition of NMCs from a semantic perspective.

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