The Kid’s Kid(’s) Bed: Generic or Possessive? A Mandarin Insight

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Abstract
The recursive computational mechanism generates an infinite range of expressions. However, little is known about how different concepts interact with each other within recursive structures. The current study investigated how Mandarin-speaking children dealt with possessives and generics in recursive structures. The picture-matching task showed that Mandarin-speaking children 4 to 6 had a bias for generics in ambiguous possessive constructions in Mandarin, where the genitive marker was covert (e.g., Yuehan de baobao chuang John's kid bed, where baobao chuang kid bed has both a generic interpretation and a referential interpretation). It was found that that Mandarin-speaking children below 6 had a non-recursive interpretation of the possessive John’s kid(’s) bed, and instead understand kid(’s) bed to refer generically to a type of bed. This finding suggests that semantics does not parallel syntax in the acquisition of indirect recursion, in line with the prediction of the generic-as-default hypothesis which claims that generics are the default mode of representation of ambiguous statements when the statement can be either generic or non-generic. The delayed recursive possessive interpretation suggests that the full determiner phrase is acquired later than a noun phrase modification, which is universal in all languages. We also discuss the role of the overt functional category in the acquisition of indirect recursion.

1. Introduction
An intriguing enquiry in acquisition literature is the question of how children ultimately reach the final state of grammar, but language-specific parameters and language experience complicate theoretical accounts. Empirical studies seek to establish an acquisition theory by answering the following questions: how the efficient grammar growth happens, whether developmental stages can be predicted, how different levels of linguistic representations (syntax, semantic, phonology, and pragmatics) interface, and the extent to which the universality of language can be explained (Roeper, 2021). In light of these questions, studies on the acquisition of recursive structures have emerged, since recursion is the core property of human language (Hauser et al., 2002). So far, recursive possessives have been investigated across languages (e.g., Limbach & Adone, 2010; Pérez-Leroux et al., 2012; Li et al., 2020; Akiko & Terue, 2018). One striking finding is that young children have conjunctive readings of recursive structures, suggesting that conjunction is the default grammar in the syntactic representation thereof, as articulated in many works (e.g., see in Roeper, 2011; Roeper & Oseki, 2018). In other words, the syntactic and semantic representations do not develop in parallel with the mapping between them (Muskens, 2001). Another finding is that the acquisition age of recursive structures across languages differs, which is explained by parametrical factors such as the overtness of morphosyntactic markers (Di Sciullo, 2015; Sevcenco et al., 2017) and by language-general factors such as the interface of different levels of linguistic representations (Kennedy, 2008; Roeper & Diego, 2020, in preparation; Yang et al., 2021). Unlike possessives, generics are used to express the mapping of form-referent qualities that are relatively essential, enduring, and timeless (Lyons, 1977). Although both possessives and generics are conceptual underpinnings, their linguistic expressions are language specific—for example, English has generic possessives and recursive referential possessives, whereas German has neither. Currently, little evidence is available regarding the interaction between possession and genericity in child grammar growth, let alone cross-linguistically. The current study provides a cross-linguistic comparison of the developmental trajectory of recursive possessives where generics are embedded.

This work is interested in the ambiguous, non-prepositional possessives that are common in English (e.g., kid’s
bike) where the possessive marker is overt, and in Mandarin (e.g., baobao che kid bike) where the possessive marker is covert. This linguistic difference helps attest the semantic-syntax interface and the language-specific parameters (i.e., the option of the covert and overt functional category) in the acquisition of indirect recursion. We find that children below 6-years prefer a generic reading when comprehending strings of interdependent and combined referential (or “regular”) possessives (RPs) and generic possessives (GPs) (e.g., Bill’s kid’s bike, where kid’s bike is a type-denoting RP), either in Mandarin or English. This work indicates that generics are the default mode of representation in indirect recursive structures that are ambiguous between generic and referential possessive readings.

2. Linguistic Forms of Possessives and Generics in English and Mandarin

Possessives and generics are used to organize knowledge of the world and guide inferences. Possessive structures provide an interpretation of specificity, while generics do not refer to particular entities but denote concepts of categorization. In light of the difference in semantic and conceptual representations of generics and referential possessives, a number of works seek to examine the mental organization and the developmental trajectory of these two cognitive modes. The following section discusses the cross-linguistic difference between possessives and generics.

2.1 Possessives in English and Mandarin

The possession relation between two entities can be expressed in two subtypes of possessives: prepositional (e.g., the wheel of the car) and non-prepositional (e.g., the car’s wheel) (Merx, 2016). Both prepositional and non-prepositional possessives are available in English, but only non-prepositional possessives are used in Mandarin. In non-prepositional possessives, the sequence organization follows the form of NP1 POS NP2, where NP1 is possessor, and NP2 is possessum, and POS is the possessive marker. The current study concentrates on non-prepositional possessives in Mandarin and English.

In English, a possessive marker’s is obligatory to express non-prepositional possession in the linear order of NP1’s NP2 (e.g., a kid’s bike). By comparison, the non-prepositional possessive can be expressed in different forms (e.g., 1a-1c) in Mandarin, where the possessive marker in (1a) and (1b) can be replaced by the combination of a demonstrative (DEM) and a classifier (CL). The current study only concentrates on the form of (1a) and the possessive marker de. In Mandarin possessives, de is not a necessary word or morpheme to encode possessives, since it can be omitted in externalization in some circumstances. The omission of the possessive marker de leads to an ambiguity between a type-denoting interpretation and regular possessive interpretation (e.g., baobao chuang kid bed can refer to a specific bed or a kind of bed, namely one made for kids). However, possessives without the overt marker de (e.g., in the form of NP1 NP2) bear resemblance to compounds in terms of word formation. Thus, it is necessary and important to distinguish possessives with de omission from compounds in Mandarin.

(1a) John de/ na-ge shu
John POS/DEM-CL book
John has a book.

(1b) John de/ na-ge
John POS/DEM
John has a book.

Consider the constraints of de omission in possessives. In cases where NP1 is a pronominal (e.g., wo (de) jiaxiang my hometown), and where NP1 and NP2 are temporal-related (e.g., zuotian shangwu last evening) or locative-related (e.g., Beijing Gugong the Forbidden City of Beijing), the possessive marker can be omitted (Li, 2005). The economical principle also licenses omission when the possessive appears more than once in a text (Lu, 2003). Omission is always licensed in proper names which are considered compounds (e.g., yuyan yanjiu suo the institution of language research) (Li, 2005). In contrast, in cases of prototype possessives where the omission of the possessive marker leads to a radical change of semantics and syntax (e.g., when NP2 denotes positions, titles etc.), omission is not licensed. Interestingly, the unchangeable relation between pronominal NP1 and NP2 (e.g., wo (de) fuqin my father) permits the optional use of the possessive marker (Cui, 1992).

Regarding the resemblance of the compound to the possessive with an omitted marker, multiple diagnostics have been proposed in the literature to distinguish them. One is that the functor de cannot be inserted between the components in a compound (Chao, 1968; Zhu, 1982). Another diagnostic is inseparability, i.e., a compound as a whole can be modified but the preceding component cannot be modified separately (Lieber & Pavol, 2009). This approach accords with the substitution test, according to which the post component in compounds cannot be substituted by the pronoun ‘one’ (Bauer, 1998). For instance, in English ‘kid bed’ is not equivalent to ‘kid one’, but one can say ‘this kid’s bed’ and ‘kid one’ referring to the generic possessive, and in Mandarin ‘baobao chuang’ kid bed is not equivalent to ‘baobao yi’ kid one. Along the same vein, it is fair to say that 2(a) has either
a generic reading (i.e., a dorm that is good and used by students) or a regular possessive reading like 2 (b) (i.e., a dorm that is used by good student(s)).

2(a). hao de xuesheng sushe
good de student dorm
good student dorm
2(b). hao de xuesheng de sushe
good de student de dorm
good student’s dorm

2.2 Generics in English and Mandarin

In English, generics can be expressed with multiple forms, including definite singulars (e.g., the bird is a warm-blooded animal), bare plurals (e.g., dinosaurs are extinct), and indefinite singulars (e.g., a cat has nice lives) (Lyons, 1977). A strand of studies claim that English has a variety of morphosyntactic, semantic, and pragmatic cues according to which the distinction between generics and non-generics can be drawn. More specifically, four types of morphosyntactic cues are well discussed, including determiners, number, tense, and aspect (see the review in Gelman & Tardif, 1998). In contrast, Mandarin shows substantial typological differences in terms of the way generics are specified. Noun phrases in Mandarin depend more on the pragmatic and discourse situation than on a grammatical marking of definiteness, tense, aspect, or number to gain generic interpretations. For example, the meaning-form mapping is hard to identify in cases where bare forms refer to both indefinite and generic statements and definite statements that encode them (Dahl, 1975). This linguistic difference brings out a longstanding enquiry of how children acquire generics in the absence of dedicated words or morphemes that encode them (Cheng & Sybesma, 1999). This linguistic difference brings out a longstanding enquiry of how children acquire generics in the absence of dedicated words or morphemes that encode them (Dahl, 1975). This enquiry poses the further question of whether linguistic differences in generic expression impact the interface of language and cognition, i.e., whether children with different generic representations show a universal pattern when acquiring complex structures that involve generics.

A classic approach to the interplay of language and cognition is the Generics-as-Default Hypothesis (henceforth, GaD) (Leslie, 2007, 2008), according to which generics are a default, primitive, and innate mode of representation in knowledge organization. This hypothesis makes predictions about child language acquisition and inductive inference, mentioned in Lazaridou-Chatzigoga et al. (2015).

Prediction 1. Age/Ease of Acquisition: children are expected to produce and comprehend generics with greater ease than quantifiers, and at earlier ages.

Prediction 2. Generic Over-generalization Effect: “non-generic generalizations would, from time to time, inappropriately exhibit some characteristics of generics, especially if the information-processing demands were made great enough” (Leslie, 2008).

For decades, the GaD hypothesis has been examined in the acquisition research field. It is well substantiated that children show less difficulty with generic interpretation than quantification in Mandarin (Tardif et al., 2012; Gelman et al., 2019) and in English (e.g., Hollander et al., 2002; Jönsson & Hampton, 2006; Leslie & Gelman, 2012; Gelman et al., 2015). Striking evidence comes from the home sign system of deaf children who use a similar number of generics compared with hearing children (Goldin-Meadow et al., 2005). Tardif et al. (2012) first compared the interpretation of generic noun phrase in Mandarin children and adults. They found Mandarin children aged 5 can distinguish generics from quantificational generalizations encoded by all or some. With reference to the earlier sensitivity of English-speaking children to generics around 3 years, they attributed this inconsistency of developmental trajectories to the grammatical marking difference. More importantly, cross-linguistic comparisons are needed to sharpen the status of generics. Indeed, Gelman and Tardif (1998) were the only and first to examine the use of generics in child language in English and Mandarin. By analyzing child-directed speech from caregivers interacting with their children aged 19–23 months, they found that languages showed a vast difference in the distribution of generics and non-generics, and that the generic advantage was more apparent for animal domain than artifacts, and that the frequency of non-generics showed no cross-linguistic difference. These results bring a pivot comparison to two contrasting views: the conceptual universal view, which holds that the use of generics depends on the conceptual system rather than language-specific forms of expression, and the linguistics relativity view, which holds that the tendency to produce generics should be influenced by means of linguistic expression. Further, the accessible ease of generics is also demonstrated by online processing (e.g., Prasada et al., 2008; Leslie et al., 2011; Meyer et al., 2011),
which is predicted in Leslie (2008)—quantified generalizations require the “conceptual system to override or inhibit its default operation”.

3. The Current Research Interests

The current study seeks to investigate the ambiguous non-prepositional possessive like men’s clothing. According to Munn’s (1999) analysis, men’s clothing can refer to clothing which is designed for men (called “generic possessive”, shown in 3a) or clothing which belongs to a particular individual (called “regular/referential possessive”, shown in 3b), in line with claims in other works (Strauss, 2004; Willemse, 2007). Recent literature claims that a mass-type meaning underlies the lexical semantics of property concept lexemes across all languages (Menon & Pancheva, 2014; Hanink et al., 2019), in line with the GaD hypothesis.

Hollebrandse and Rooper (2014) proposed that Will’s in Will’s bike is treated as an NP and then the whole phrase is interpreted as a generic. This proposal is in line with previous studies that children tend to omit the generic marker’s at the two-word stage. The contrast is shown in 4(a) and 4(b). The hypothesis is that generic possessives function as noun modifiers. Whatever the case, the different interpretation lies in how the possessive marker is analyzed.

Moving on to the analysis of recursive possessives. According to Munn (1999), for non-recursive possessives shown in 5(a), 3(a) and a PossP are combined to form a DP, whereas for recursive possessives, the lowest projected DP in 3(b) is substituted by a PossP, shown in 5(b). When men’s clothing is interpreted as an RP, Bloomingdale’s men’s clothing is considered a recursive possessive with two RPs (i.e., 5b); when men’s clothing is interpreted as a GP, Bloomingdale’s men’s clothing involves the non-recursive embedding of regular and GP structures (i.e., 5a).

Hollebrandse and Rooper (2014) agree with the claim that generics are the default mode of human language. They further propose that, to form recursive possessives, children must substitute DPs for NPs first and then project PossPs. Therefore, the acquisition path can be predicted in 6 (a, b, c). Specifically, first the genitive part is treated as a noun modifier; second, projected PossPs are substituted for NPs; finally, the NP inside of the possessive phrase is projected as a DP. This step-by-step analysis finally derives an RP. That is to say, generic interpretation is an intermediate stage in children’s acquisition of recursive possessives. The acquisition path of recursive possessives follows a step-by-step stage, namely, one-level possessive (e.g., 3a/3b)→possessives which combine the GP and RP (e.g., 4a)→two-level recursive RPs (e.g., 4b) (the “arrow” indicates the timeline). This path suggests that the transition from two-level recursive possessives to recursive three-level possessives poses a challenge in acquisition, since two-level possessives may not entail recursion. Without insight into generic possessives, this result would seem counterintuitive, as once the recursive mechanism is instantiated in a
two-level construction, it should “come for free” in three-plus-possessive constructions. But, given the influence of generics, it is fair to say that once children acquire three-level recursive possessives, they ought then to have multiple-level recursive possessives since they have passed the intermediate stage.

The current study examines the interpretation of two-level and three-level possessives with generic and regular sub-structures in Mandarin, with reference to an ongoing study by Poisson and Bing (in preparation 2021), in order to provide a cross-linguistic insight. In two-level possessives shown in (7a.) and three-level possessives shown in (7b.), the lowest possessive marker in Mandarin is less overt than in English, leading to an ambiguity of generic and non-generic possession in two-level possessives, but no ambiguity in three-level possessives according to our experimental design. We seek to examine the extent to which the developmental trajectories of recursive possessives in Mandarin and English differ due to the option of the morphosyntactic cue. By doing so, we are interested in the following issues.

7(a). Xiaoming de baobao chuang
   John POS kid bed(s)
   John’s kid’s bed(s)
7(b). Xiaoming de baobao de baobao chuang
   John POS kid POS kid beds(s)
   John’s kid’s kid’s bed(s)

First, we seek to figure out whether the option of an overt possessive marker can make a difference to the acquisition of indirect recursion. The morphosyntactic cue of non-prepositional possessives is overt in English, while it is optional in Mandarin (Note 1). Recently, Di Sculillo (2015) has claimed that overt functional categories facilitate the acquisition of recursion, since covert functional categories challenge minimal search when labeling recursive nodes without lexical presentation in surface structure. The facilitation was attested by the earlier acquisition of recursive relative clauses than recursive locative prepositional phrases in English, since recursive relative clauses have morphosyntactic cues (Sevcenko et al., 2017). This result calls for more cross-linguistic evidence.

Secondly, our interest lies in whether the default mode of generics can be independent of the dedicated morpheme that encodes generics. Both natural linguistic data (e.g., corpus-based study, Gelman et al., 2008; Gelman, 2004; Li et al., 2020) and experimental approaches (Hollandan et al., 2002; Gelman & Raman, 2003; Gelman et al., 2008; Graham et al., 2011; Graham et al., 2016) demonstrate that pre-school English-speaking children show sensitivity to generics and non-generics around 2–3 years. Children at the very early stages of grammar usually produce structures like Mommy’s or Mommy milk to express possession relations. Only after 2-years-old, children can produce the complete structure Mommy’s milk (Tomasetto, 1998). Similarly, Mandarin-speaking children can produce the complete possessive phrase NP1 POS NP2 in the second year (Zhou & Liang, 2007). A striking finding in Mandarin was reported in Shi et al. (2018), who found that Mandarin-Speaking children at 3 use NP1 NP2 to express possession relations, and that children can comprehend and produce possessive structures with de at 4 years. These conflicting findings make it necessary to investigate the optional use of the grammatical marker in form-referent mapping across languages.

Third, we would like to find out whether generics have the same status during the development of recursive possessives across languages. Up to date, many works have shown that children acquire recursive possessives at around 4–6 (two-level recursive possessives (e.g., Jane’s father’s bike): Limbach and Adone (2010); Gilblin et al. (2018); Shi and Zhou et al. (2019); three-level recursive possessives (e.g., Midori’s father’s bear’s balloon: Terunuma et al., 2017). In fact, these studies mainly consist in recursive structures with overt morphosyntactic markers, and they do not examine the interplay of the generic and regular possessive. We seek to test the default generic analysis in recursive structures across languages, in order to figure out the semantic-syntax interface in
the acquisition of indirect recursion (or the language-cognition interplay in a broader sense).

4. Methods

This work sought to provide first experimental evidence on the acquisition path of the ambiguous non-prepositional possessives with generics in English and in Mandarin Chinese. According to Zhou and Liang (2007), kinship relation and whole-part relation with respect to the human body are acquired earlier than other possessive relations, so we manipulated the possession relation type by only investigating human-object relation. We asked whether generic semantics is the default mode in the acquisition of non-prepositional recursive possessives in Mandarin and English, and whether the acquisition age of recursive possessives differs due to the option of morphosyntactic markers, and whether generics are intermediate in the acquisition of recursive structures across languages. Empirically, we predict first that young children tend to interpret more GPs than adults, second that children’s acquisition of two-level recursive possessives follows three steps, and third that the acquisition of three-level recursive possessives will trigger the efficient computation of multiple-level recursive possessives.

4.1 Participants

We recruited one-hundred and three Chinese-speaking children aged four to ten who grew up in Gansu Province (located in Northwestern China). Twenty-two Mandarin-speaking college students served as controls and they had no exposure to linguistic training for the current research interest. All participants were not told the objective of the research. Children were split into 6 groups: 4 years (N=18, M=4.05, SD=0.25), 5 years (N=15, M=5.04, SD=0.28), 6 years (N=15, M=6.08, SD=0.20), 7 years (N=18, M=7.04, SD=0.26), 8 years (N=19, M=8.05, SD=0.25), 9 years (N=18, M=9.05, SD=0.19). None of participants had hearing or visual impairment and all were typically developing. Children were chosen by the examiners at random to engage in the task, in order to minimize the effect of the teacher-student relationship.

4.2 Materials

The experiment in this study consisted of three tests for critical items and three fillers. Initially, ten Mandarin-speaking adults were recruited to write down 30 Chinese noun phrases that had both generic and possessive readings, as well as a noun phrase that only had a generic reading. And then another ten postgraduates majoring in Chinese linguistics were asked to rate the ambiguity of these phrases using a six-point scale (from 1(non-ambiguous) to 6 (most ambiguous)). Due to the possible influence of prosody, all test items follow syllable structure of 2+1, and control 2+2. Finally, three ambiguous items (i.e., kid’s beds/cars/shoes) were chosen as critical items. Two-level and three-level possessives were critical items, and they were ambiguous and non-ambiguous (see in Table 1). Specifically, two-level ambiguous possessives (e.g., Bill’s kid’s bed) had [RP[R]] and [RP GP] readings; two-level, non-ambiguous possessives (e.g., Bill’s grownup’s bed) were only interpretable as [RP GP]; three-level possessives (e.g., Bill’s kid’s kid’s bed) were interpretable as the embedding of non-ambiguous two-level recursive regular possessives and a generic possessive possessum, namely, [RP [RP GP]].

Two types of non-ambiguous strings served as controls, one interpreted as [RP GP] and differing in the right-edged two NPs (i.e., bucket lid/ pencil box/car wheel), and the other interpreted as [RP [RP GP]] and differing in the right-edged two NPs (i.e., bucket lid/pencil box/car wheel).

The non-ambiguous embedding of [RP GP]

Xiaoming  de  shuitong  gai
John       POS  bucket  lid

John’s  bucket  lid

The non-ambiguous embedding of [RP [RP GP]]

Xiaoming  de  jiejie  de  shuitong  gai
John       POS  sister  POS  bucket  lid

John’s  sister’s  bucket  lid

4.3 Procedures

A picture-structure matching task was designed. Participants were engaged in a “Helping John and Bill” game introduced in Mandarin. Participants were tasked with 4 practice trials before the experiment began, and they were tested individually. We’ll now use the critical item kid bed to illustrate the whole procedure for each critical test. The experiment was conducted in Mandarin.
The experiment began with the introduction of 4 characters including John (in yellow), his kid (in yellow), and Bill (in blue) and his kid (in blue) (see in Figure 1a), all of whom owned two kinds of beds: a kid-type bed, smaller with guardrails, and a grownup-type bed, without guardrails (see in Figure 1b). Participants were asked to circle xiaoming de baobao John’s kid and xiaoliang de baobao Bill’s kid. Then two characters (John and Bill) and four beds were presented (see in Figure 1c), and participants were asked to comprehend the strings (4-1a) and (4-1c) and circle the referents. Finally, we presented four characters and all the beds together, and asked participants to circle the referents indicated (4-1a, b, c, d).

4-1a. xiaoming/xiaoliang de baobao chuang
   John’s/Bill’s POS kid bed
   John’s/Bill’s kid’s bed

4-1b. xiaoming/xiaoliang de daren chuang
   John/Bill POS grownup bed
   John’s/Bill’s grownup’s bed

4-1c. xiaoming/xiaoliang de baobao de baobao chuang
   John/Bill POS kid POS kid bed
   John’s/Bill’s kid’s kid’s bed

4-1d. xiaoming/xiaoliang de baobao de daren chuang
   John/Bill POS kid POS grownup bed
   John’s/Bill’s kid’s grownup’s bed

In order to make sure that the decision-making of participants was not blind guess, a truth-value-based judgment task was designed. After all constructions were tested in the picture matching task, participants needed to judge whether the experimenter pointed to the correct referent expressed in Q1–Q4. If participants’ answers were not in line with the decision-making in the matching task, participants needed to be re-examined with the corresponding stings.

Q1 [Pointing to John’s kid’s kid’s bed] Is this John’s kid’s bed?
Q2 [Pointing to John’s kid’s grownup’s bed] Is this John’s grownup’s bed?
Q3 [Pointing to John’s kid’s bed] Is this John’s kid’s kid’s bed?
Q4 [Pointing to John’s grownup’s bed] Is this John’s kid’s grownup’s bed?

Table 1. Constructions tested in each critical item

| critical items | two-level ambiguous possessives | two-level non-ambiguous possessives | three-level non-ambiguous possessives |
|---------------|---------------------------------|------------------------------------|---------------------------------------|
| baobao        | xiaoming/xiaoliang de baobao chuang | xiaoming/xiaoliang de daren chuang | xiaoming/xiaoliang de baobao de baobao/daren chuang |
| chuang        | John/Bill POS kid bed            | John/Bill POS grownup bed          | John/Bill POS kid POS kid/grownup bed |
| kid bed       | John’s/Bill’s kid’s bed          | John’s/Bill’s grownup’s bed         | John’s/Bill’s kid’s kid’s/grownup’s bed |
| baobao xie    | xiaoming/xiaoliang de baobao xie | xiaoming/xiaoliang de daren xie    | xiaoming/xiaoliang de baobao de baobao/daren xie |
| kid shoes     | John/Bill POS kid shoes          | John/Bill POS grownup shoes        | John/Bill POS kid POS kid/grownup shoes |
| baobao che    | xiaoming/xiaoliang de baobao che | xiaoming/xiaoliang de daren che    | xiaoming/xiaoliang de baobao de baobao/daren che |
| kid bike      | John/Bill POS kid bike           | John/Bill POS grownup bike         | John/Bill POS kid POS kid/grownup bike |
| kid bike      | John’s/Bill’s kid’s bike         | John’s/Bill’s grownup’s bike       | John’s/Bill’s kid’s kid’s/grownup’s bike |
4.4 Coding

We only coded critical items. This study focused on the interpretation of ambiguous structures like Kid’s bed in children’s acquisition of possessives. The target and non-target interpretations of the four constructions are listed in Table 2. For the ambiguous two-level construction John’s Kid’s X, three kinds of target interpretations were coded differently. For other constructions, target interpretations were differentiated from non-target interpretations.
Table 2. The target and non-target interpretations in this study

| Constructions          | Target interpretations | Non-target ones |
|------------------------|------------------------|-----------------|
| John’s kid’s X         | RPs                    | others          |
|                        | GP                     |                 |
|                        | GPs + RPs              |                 |
| John’s grownup’s X     | RPs                    | others          |
| John’s kid’s X         | RPs                    | others          |
| John’s kid’s grownup’s X| RPs                   | others          |

5. Results

We only analyzed the critical items. Taking the three ambiguous constructions into consideration (kid bed/shoes/bike), the ANOVA analysis did not show significant difference (p=0.804>0.05), indicating that the three critical items were indeed tokens of the same type. Similarly, the results also indicated that the unambiguous RPs (i.e., grownup’s bed/cars/shoes) can be treated as the tokens of the same type (p=0.407>0.05). The descriptive data showed the percentage of various answers in different items produced by children and adults. Regarding the ambiguous two-level constructions, as predicted children preferred [RP GP] readings rather than recursive regular possessives (see in Figure 3). The distribution of interpretations across different age groups showed that children produced more GPs as they grew older (see in Figure 4). As for non-ambiguous two-level and three-level constructions, the distribution of different answers indicated that over eighty percent of children across ages understood these constructions as embedding of two-level recursive RP(s) and GP (see in Figure 5).

Figure 3. The percentage of different types of answers in the ambiguous items across age groups

Figure 4. The distribution of answers in the ambiguous item by children across ages and adults
Considering the two-level ambiguous constructions (i.e., *kid’s bed*), the Chi-square test found that age significantly influenced children’s acquisition of possessives (*p*=0.00<0.05). Taking the unambiguous constructions into consideration, there were three factors: level (2-level vs. three-level), keyword (kid vs. grownup) and age (6 groups). The ANOVA analysis showed that there was not a main effect of level (*p*=0.6502>0.05). There was, however, significant difference with regard to different keywords (*p*=0.0255<0.05). We also found the main effect of age (*p*=0.00<0.05).

We also compared the comprehension of children and adults. With regard to two- and three-level non-ambiguous constructions with the keyword “grownup”, we found that children as young as 4-years-old could reach adult-like comprehension. The binomial probability of having 4 or more by chance was significant (*p*<0.05), and the red dots indicated that these participants had 4 or more answers coded as accurate (for each construction, there are 6 items). With regard to three-level unambiguous constructions with the keyword “kid”, we found that children could not achieve adult-like performance until they were older than 6-years-old. The binomial probability of having 7 or more by chance was significant (*p*<0.05), and the red dots indicated that these participants had 7 or more answers 1 (For this construction, there are 12 items).

**Figure 5.** The percentage of different types of answers in unambiguous items by children and adults

**Figure 6.** The distribution of answers in two- and three-level unambiguous constructions with keyword “grownup”
Figure 7. The distribution of answers in three-level unambiguous constructions with keyword “kid”

6. Discussion

By incorporating Poisson and Bing’s study on the same issue and using the same materials in English, the current study provides a cross-linguistic insight into the acquisition picture of indirect recursive structures where non-recursive interpretation is also involved. The results showed that children aged 4 to 6 tended to understand recursive possessives as generic noun phrases embedded within possessives. These results support our prediction that different conceptual underpinnings (i.e., generic and possessive inference) interact with each other.

Our results are in accordance with the prediction of the generic-as-default hypothesis which characterizes the asymmetry of generics and non-generics in representation. This work further demonstrates that generics are the default mode of representation, which is mentioned in the comparison of quantifiers and generics in inductive inference in Mandarin (Tardif et al., 2012; Gelman et al., 2019) and in English (e.g., Hollander et al., 2002; Leslie & Gelman, 2012; Gelman et al., 2015). The strong bias for generic semantics in recursive possessives, when they are available, is in favor of the cognition developmental trajectories illuminated in previous works (e.g., Menon & Pancheva, 2014; Hanink & Koontz-Garbo, 2020). This result suggests that the generic possessive is a pivotal stage before children finally attain the adult-like representation of recursive possessives, and lends support to the acquisition difficulty of indirect recursion.

The acquisition age of recursive possessives is in line with many results in previous studies. Limbach and Adone (2010) found that English-speaking children generally acquired recursive possessives (e.g., Jane’s father’s bike) by the age of 5–6. Terunuma et al. (2017) also found that Japanese-speaking children produced three-level recursive possessives (e.g., Midori’s father’s bear’s balloon) by the age of 4 or 5. Gilblin et al. (2018) showed that 4-year-old Mandarin-speaking children produced two-level possessives (haidao de qingwa de binggan the pirates’ frog’s biscuit), and this finding was further confirmed in Shi et al. (2019). By incorporating the generic representation, the acquisition path of recursive possessives starts with the one-level possessive and is followed by the combination of generics and regular possessives, until finally recursive possessives are formed. In other words, the interface of semantics and syntax is also one of determinants of the acquisition of indirect recursion, and generics serve as an intermediate stage in the development of recursion. Poisson and Bing (2021 in preparation) used the same paradigm as the current study to examine generics and possessives in the development of recursive possessives In English. They found that children young enough to misinterpret recursive possessives demonstrated comprehension of ambiguous two-level constructions (e.g., John’s kid bed) and even three-level constructions containing generic possessums (e.g., John’s kid’s kid’ bed). More specifically, the comprehension accuracy of children aged 4 to 6 was below eighty-percent, but 94.38% children of age 7 and older demonstrated accurate comprehension. Additionally, nearly seventy percent of younger children (i.e., ≤6 years) had generic, non-recursive readings for ambiguous two-level possessives, but only thirty percent of children (i.e., ≥7 years) read them non-recursively. Thus, the intermediate status of generic is supported by cross-linguistic evidence.

This work indicates that the option of overtness in terms of the morphosyntactic marker does not necessarily cause acquisition delay in recursive possessives. As the result shows, the ambiguous possessives have a drastic reduction of generic interpretation and a substantial increase of recursive possessive interpretation in Mandarin and in English at the age of six. Compared with English generics, which heavily rely on morphosyntactic cues to distinguish generics from non-generics, generics in Mandarin make less overt use of dedicated words or morphemes. We agree with the claim that the branching of recursion is one of the constraints of the acquisition of indirect recursion (Hollebrandse & Roeper, 2014). Specifically, although English and Chinese are
typologically different in many aspects, non-prepositional recursive possessives in both languages are left-branching. Thus, we argue that the same branching of recursion may nullify the disparity caused by typology, and that the acquisition difference would be caused by different morphosyntactic cues. In the syntactic representational level, the functional head is indispensable for indirect recursion, but the externalization in the sensory-motor system can be driven by the economical principle in the mapping of syntax and semantics. In other words, the functional head is an operator in syntactic representation, and the option of its overtness is determined in externalization. This account is in line with the Minimize Externalization principle in sensory-motor system (Di Sciullo, 2015), as well as the Pronounce the Minimum (Chomsky, 2013).

7. Conclusion and Further Research

To conclude, we first argue that the mapping of semantics and syntax is asymmetrical when conceptual underpinnings compete. In addition, although the morphosyntactic marker is indispensable in recursive computation, the option of overtness or covertness in externalization is subjected to The Economical Principle in the interface of the sensory-motor system and the intentional-conceptual system.

This research in essence asks a fundamental question: whether the acquisition challenge of indirect recursion is caused by syntactic computation, or by conceptual atoms. Our offline acquisition data sheds light on the comprehension of ambiguous structures, but online techniques, such as event-related potentials (ERPs) that feature a higher temporal and spatial resolution, can provide immediate index in language processing and comprehension. One more factor that should be taken into account is prosodic cues such as stress and duration, which influence the interpretation of ambiguous structures. As a consequence, the effect of prosody on acquiring recursion should be examined across languages in order to frame a universal account for the acquisition path of indirect recursion.

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**Notes**

Note 1. The structure building differs when it expresses different semantics. According to Luo (2013), the possessive marker *de* is optional in kinship relation; the marker *de* is omitted in inanimate part–whole relation; the marker *de* is obligatory in other possessive relations.

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