The Spontaneous eMERGEnce of Recursion in Child Language

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1. Introduction

The generative approach contends that human language has three fundamental properties: (1) sentences are represented by hierarchical syntactic representations; (2) the hierarchical representations of sentences determine their interpretation; (3) there is no upper bound on the depth of hierarchical structure building. The third property, the uniquely human cognitive ability to create and interpret a discrete infinity of sentences, entails that some recursive procedure underpins human language (Yang *et al.*, 2017). This recursive procedure enables grammars to generate sentences with unbounded length, thus accommodating the long-observed fact that human language makes 'infinite use of finite means'. Researchers working in the generative approach have argued that recursion is a universal property of human languages, as befits a core design feature of the human language faculty (Hauser *et al.*, 2002; Arsenijevic & Hinzen, 2010). Not surprisingly, recursion has come to occupy a central place in contemporary cross-linguistic research, where the universality of recursion has been debated, and in psycholinguistic research, where the availability of recursion in young children's grammars has been debated.

In the study of human cognition, researchers are interested in the particular structure building operations of the mind/brain. Hauser *et al.* (2002) argue that the recursive structure building operation of human language is a combinatorial operation called MERGE. In its simplest terms MERGE is set formation. Given a syntactic object X and another syntactic object Y, MERGE creates a new unordered object {X, Y}. This new object is then assigned a label, forming a hierarchical 'treelet' {X, {X, Y}}. One or both of the constituents in a treelet can be a complex syntactic object that was built previously. Moreover, one of the syntactic objects in a treelet can bear the same label as the treelet itself. In this case, the structured object that results from multiple applications of MERGE is an instance of self-embedding, i.e., recursion. From the perspective of evolutionary biology, it has been proposed that MERGE is the crucial biological innovation responsible for the evolution of human language (Berwick & Chomsky, 2016).

If recursion is the central structure building operation of the human language faculty, an explanatorily adequate theory of language must include an account of how all language learners acquire a recursive grammar (Chomsky, 1965/2014). To meet the criterion of explanatory adequacy, a viable theory of language must impose significant constraints on the initial state of the language faculty. Such constraints are needed in order to guarantee that every normal child converges on a grammar that is equivalent to that of adults in the same linguistic community. A viable account of language learnability, in turn, must meet the criterion of feasibility. The criterion of feasibility requires an account of language learnability to make realistic assumptions about children's processing resources (e.g., working memory) and to explain how, given these resources, children rapidly and effortlessly acquire a recursive grammar in the absence of explicit instruction and in the absence of decisive evidence. To satisfy the criteria of explanatory adequacy and feasibility, the Strong Minimalist Thesis contends that recursion (MERGE) is an innate linguistic property, i.e., part of Universal Grammar. Therefore, c*eteris paribus,* recursion is expected to emerge early in the course of language development even in the absence of evidence in the primary linguistic data (Crain, 1991; Berwick & Chomsky, 2016). Thus, the Strong Minimalist Thesis is consistent with the spontaneous emergence of recursion in child language.

2. Previous Research

This study examined young children's ability to produce and comprehend recursive structures within nominal phrases. Nominal recursion is a useful domain to study recursion because it is a manifestation of a crucial linguistic property within a limited syntactic domain and it is an instance of recursion where a phrasal category immediately dominates another instance of itself:[1]

(1)
a. Mary's house $[_{DP} [_{DP} Mary]$'s $[_{NP}$ house]]
b. Mary's brother's house $[_{DP} [_{DP} [_{DP} Mary]$'s $[_{NP}$ brother]]'s $[_{NP}$ house]]

In the literature, expressions like (1a) are called Level 1 Genitives, and expressions like (1b) are called Level 2 Genitives.

As noted in the introduction, the Strong Minimalist Thesis asserts that recursion (MERGE) is innately specified in Universal Grammar and, therefore, is expected to be available to language learners from the earliest stages of language acquisition. The findings of several previous studies challenge this expectation. These studies have reported that, in contrast to older children and adults, young children experience considerable difficulties producing and comprehending Level

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[1] This analysis follows Abney's (1987) DP hypothesis in which the possessive *'s* genitive marker is the head of the DP and cliticizes onto the phrase in the specifier of the DP.

2 Genitive constructions, such as (1b).[2] Roeper and Snyder (2005) report that young children never spontaneously produce recursive genitives and do not comprehend such phrases when they are produced by adults (see also Roeper, 2007, 2010, 2011). Roeper (2011, citing Gu, 2008) cites the following exchange in the CHILDES corpus as evidence of children's comprehension difficulties:

(2) Mother: huh? what's your.… what's.… what's <u>your</u> cousin
          <u>Arthur's Mummy's</u> name
    Sarah: I don't. …. your cousin?

Children's difficulties comprehending Level 2 Genitives have also been reported in experimental studies. A representative study was conducted by Gentile (2003, cited in Roeper, 2011). On a typical trial in the Gentile study, children were shown the two pictures below:

A: Cookie Monster's sister   B: Cookie Monster and his sister

Figure 1. Picture choice comprehension task

The experimenter then asked children: "Can you show me Cookie Monster's sister's picture?" One third of the child participants exhibited a preference for Picture B.[3] It was suggested by Roeper (2007, 2011) that these children's preference for Picture B indicates that they had assigned a coordinate structure to complex noun phrases like "Cookie Monster's sister's picture", rather than an adult-like recursive structure. Based on this finding, among others, Roeper (2007) argued that young children's grammars initially lack recursion. According to this hypothesis, sentences in children's early grammars are built using simpler structure building operations, such as coordination.[4]

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[2] Roeper (2011) and Roeper and Pérez-Leroux (2011) argue that only Level 2 embedding constitutes true recursion because Level 2 Genitives cannot be represented by simple lexical templates.

[3] Both pictures A and B depict Cookie Monster's sister. Thus, this set of pictures doesn't clearly present an alternative that is inconsistent with the nominal phrase.

[4] Even if recursion is universal and innate it need not be present at the early stages of child language development, since recursion could may be biologically timed to become operational at some later point in development, as with the maturation of teeth and secondary sexual characteristics. Although maturation of recursion is biologically possible, this is not the null scientific hypothesis.

Another representative comprehension study was conducted by Limbach and Adone (2010). These researchers asked groups of 3-, 4-, and 5-year-old English-speaking children and a group of adult second language learners of English to choose the picture that matched the Level 2 Genitive, as in (3). On each trial, there were four pictures for participants to select from, as indicated in (3a-d).

(3)   Jane's father's bike
a. A picture of Jane's bike   (Level 1 Genitive)
b. A picture of the father's bike   (Level 1 Genitive)
c. A picture of Jane's father's bike   (Level 2 Genitive)
d. A picture of a bike belonging to both Jane and her father (Coordinate Structure)

The study by Limbach and Adone reported that the majority (60%) of the child participants consistently chose the correct (adult-like) picture. On approximately 20% of the trials, however, the 4- and 5-year old child participants chose the picture that was associated with a coordinate structure, as in (3d). The same non-adult response was the most common error for the 5-year-olds. The researchers concluded that the grammars of children who produced non-adult responses were unable to generate a recursive structure for complex noun phrases like (3). Consequently, these children assigned a simpler coordinate structure to these phrases.

Young children's difficulties with nominal recursion in experimental studies are not limited to comprehension. A production study by Pérez-Leroux *et al.* (2012) was designed to elicit Level 2 Genitives from children ranging in age between 3 and 6. The main finding was that children across this age range had considerable difficulty producing nominal recursion generally, and were largely incapable of producing Level 2 Genitives. In this study children were encouraged to produce 11 different constructions: 2 training structures; 3 structures with nominal recursion (Level 2 Genitives); 3 structures with PP recursion; and 3 coordinate structures. On a typical trial designed to elicit nominal recursion, child participants were presented with the scenario in (4):

(4) Here is Elmo. This is his sister. And here is Bart and that's his sister. They each have a ball. Their sisters are carrying balls too. They are all going together to the basketball court. But look! Oh, oh.

Prompt: What is broken and flat?
Target: Elmo's sister's ball

The findings are summarized in Tables 1 and 2, which are adapted from Pérez-Leroux *et al.* (2012). As Table 1 indicates, the Pérez-Leroux study elicited only a single Level 2 Genitive from the child participants.[5]

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[5] The low number of Level 2 Genitives produced by adult participants may be indicative of some methodological difficulties with the experimental design.

Table 1. Number of responses per group for Level 1 and Level 2 Genitives

	Level 1 Genitive	Level 2 Genitive
Children (*n*=46)	28	1
Adults (*n*=11)	12	7

Table 2 shows that the single Level 2 Genitive was produced by a 3-year-old child participant, and that no Level 2 Genitives were elicited from the 4- or 5-year-old children.

Table 2. Number and ages of individual participants who produced embedded genitives

	Only Level 1 Genitive	At least Level 2 Genitive
3-year-olds (*n*=16)	3	1
4-year-olds (*n*=16)	1	0
5-year-olds (*n*=14)	1	0
All children (*n*=46)	5	1

3. Experiments

The present study used a Truth Value Judgment Task (Crain & Thornton, 2000) with an elicitation component. There were two experimenters. One experimenter acted out stories in front of the child participant and a puppet, with the puppet played by the second experimenter. Following each story, the puppet described what it thought happened in the story. Whenever child participants rejected a puppet's description they were asked to justify their rejections by telling the puppet what really happened in the story.

Four test trials were designed to elicit Level 2 Genitives. The protocols for these trials were designed to maximize the felicitous use of nominal recursion. Each of the puppet's statements on these trials contained a Level 1 Genitive, and each statement was a false description of the events that had taken place in the story. The story contexts were designed so that a felicitous justification for rejecting these critical test sentences could be formed by embedding a second possessive phrase inside the Level 1 Genitive produced by the puppet. For example, on one trial the puppet's statement (5) contains the Level 1 Genitive *Big Bird's blanket*…. The puppet's assertion, *Big Bird's blanket got dirty*, was false, however, because the blanket that got dirty belonged to Big Bird's cats. To justify their rejections of the puppet's statement, the child participants therefore could simply insert the possessive phrase, *cats',* into the Level 1 Genitive produced by the puppet, yielding a Level 2 Genitive: *No, Big Bird's (cats') blanket got dirty*. In short, when the child responded 'No' (false) on the four critical trials, the experimental context and the puppet's lead-in sentence conspired to elicit Level 2 Genitives:

(5)   Puppet: *I know what happened, Big Bird's blanket got dirty*
        Child: *No, Big Bird's cats' blanket got dirty*

The task was run with both English-speaking children and with Mandarin-speaking children. This enabled us to assess the availability of recursion in the grammars of children acquiring historically distinct languages, and it enabled us to investigate the emergence of recursion in children acquiring grammars that incorporate recursion using different syntactic devices.

3.1. English-speaking children

The participants were 26 English-speaking children (15 male, 11 female, ranging in age from 3;3 to 5;10, with an average age of 4;7). The child participants were recruited from Banksia Kindergarten, Gumnut Kindergarten, and the Macquarie University Neuronauts program. The child participants had no reported history of speech or hearing disorders. Three different kinds of constructions were included, as indicated in (6).

(6)
a. Target Construction   'Big Bird's cats' blanket' – Level 2 Genitive[6]
b. Control Construction   'Elephant's horse' – Level 1 Genitive
c. Filler Construction   True response to Level 1 Genitive

Each child heard 10 stories, with 4 true filler trials, 2 false control trials, and 4 false test trials.[7] The stories were arranged in pseudo-random order.

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[6] In the English study, all of the target constructions had a plural DP2. That is, the second DP, *cats,* is plural in the Level 2 Genitive *Big Bird's cats' blanket*: [DP1 [DP2 [DP3 Big Bird]'s [NP cats]]'∅ [NP blanket]]. This property of the target utterances was made to simplify the phonological demands involved in producing the target phrases. We suspected that having to repeat the possessive marker *'s* in Level 2 Genitives might introduce irrelevant performance difficulties for children.

[7] Neither the puppet nor the experimenter produced any Level 2 Genitives in the course of the experiment in either the English or Mandarin version of the study.

3.2. Example Story (English)

Figure 2. Initial story condition

(7)

Experimenter: This is Gecko and these are his koalas. This is Catboy and these are his koalas.

Gekko: It's dinner time and today we're having hotdogs for dinner with our pet koalas.

Catboy: Let's eat our hotdogs by the side of the road.

Experimenter: Oh no, here comes a motorbike and he's in a hurry. He nearly knocks over Gecko's hotdog, and then he swerves and knocks over this hotdog and it falls out of the bun and is ruined!

Figure 3. Final story condition

Question to puppet: Which hotdog got knocked over?

Blindfolded puppet: I can't see but let me guess. Gecko's hotdog got knocked over!

Target response: No, Gecko's koalas' hotdog got knocked over!

3.3. Results

Table 3 below gives a breakdown of the number of Level 2 Genitives produced by the child participants, by age. The overall finding shows that the child participants produced Level 2 Genitives on 67% of the test utterances, giving a total of 70 Level 2 Genitives.

Table 3. Number of Level 2 Genitives by Age

|	Number of Level 2 Genitives	Percentage of Trials
3-year-olds (*n*=1)	1	25% (1/4)
4-year-olds (*n*=17)	40	59% (40/68)
5-year-olds (*n*=8)	29	90% (29/32)
All children (*n*=26)	70	67% (70/104)
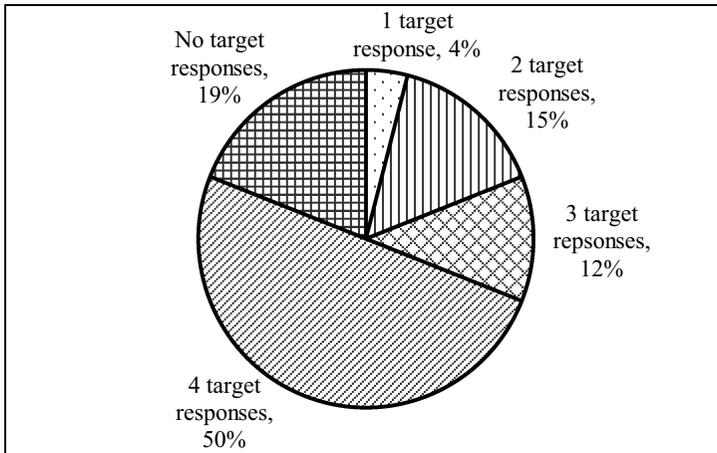
Figure 4. Percentage of target responses for English speaking children

We conclude from the findings of the present study that 3-, 4-, and 5-year-old English-speaking children are capable of producing Level 2 Genitives.

3.4. Mandarin-speaking children

The participants in the Mandarin version of the experiment were 30 4-year-old monolingual Mandarin-speaking children (18 male, 12 female, ranging in age from 4;0 to 4;11, with an average age of 4;5). The child participants were recruited from Taolifangyuan Kindergarten, Beijing, and had no reported history of speech or hearing disorders.

The genitive construction in Mandarin is formed using a possessive *de* marker, as illustrated in (8).

(8)   Jiawei DE laoshi
          Jiawei DE teacher
          'Jerry's teacher'

The Mandarin *de* construction in (8) expresses the possessive relation when the possessor DP precedes the *de* marker.[8] Thus, $DP_1 + de + DP_2$ expresses the possessive relation with DP_1 being the possessor, *de* being the genitive marker, and DP_2 being the possessum (Huang *et al.*, 2009). In both production and comprehension, children acquiring Mandarin have generally mastered the possessive *de* construction by age 4, whereas 3-year-olds are in a transitional stage at which they tend to use the *de* construction to form noun-noun compounds (Shi & Zhou, 2018). For the present study, the target constructions were Level 2 Genitives, while the control and filler constructions were Level 1 Genitives. The Mandarin study also controlled the number of syllables in the possessor DP. The possessor DP of the control construction had four syllables, whereas the possessor DPs in both the filler and target constructions were disyllabic.

(9)
a.   Target construction:
          haidao DE qingwa DE   binggan
          pirate DE frog   DE   biscuit
          'The pirate's frog's biscuit''

b.   Control construction:
          xiaoxiongweini   DE huasheng
          Winnie the Pooh DE   peanut
          'Winnie the Pooh's Peanut'

c.   Filler construction:
          tuzi   DE beike
          rabbit DE shell
          'The rabbit's shell'

Each child heard 10 stories (4 targets, 4 fillers, 2 controls). In half of the stories, the puppet produced a statement that was an accurate description of the events that took place in the story. In the remaining half, the puppet produced false statements. For all of the target trials, where the goal was to elicit Level 2 Genitives, the puppet's false statement contained a Level 1 Genitive. In justifying their rejections, children were expected to produce Level 2 Genitives, with a recursive possessive structure. The stories were presented to the child participants in a pseudo-random order.

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[8] The *de* marker also has other semantic functions, but these do not concern us here.

3.5. Example Story (Mandarin)
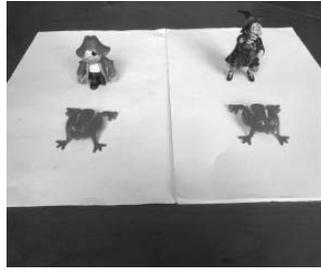
Figure 5. Initial story condition

Experimenter: This is a story about a pirate and a witch. The pirate has a frog and the witch has a frog too. One day, they went into the woods to have a picnic. They each had a biscuit for their lunch. They arrived early but it was not lunch time, so they gathered together to play games, leaving their biscuits behind. There was a caterpillar nearby, and he was very hungry. He saw the biscuits, and wanted to steal the pirate's biscuit, but the pirate discovered the caterpillar trying to steal the biscuit. The caterpillar was still hungry, and he saw this biscuit. This time, he was very cautious and managed to steal it.
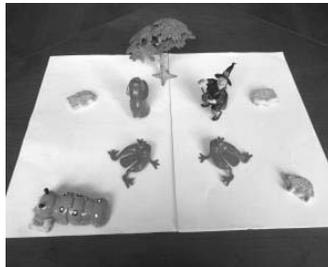
Figure 6. Final story condition

Question to Puppet:	Now it is your turn, Catty. Do you know which biscuit was stolen?
Blindfolded Puppet: (*Catty*)	I can't see. Let's me guess… The pirate's biscuit was stolen
Target response:	No! The pirate's frog's biscuit was stolen.

3.6. Mandarin results

Table 4 summarizes the number of Level 2 Genitives produced by the child participants in the Mandarin version of the study. Level 2 Genitives were produced on 95 occasions or 79% of the test trials. In contrast to previous work, the finding of the present study invites the conclusion that 4-year-old Mandarin-speaking children are capable of producing the Level 2 Genitive construction.

Table 4. Number of Level 2 Genitives

|	Level 2 Genitives	% of trials
All children (n=30)	95	79% (95/120)
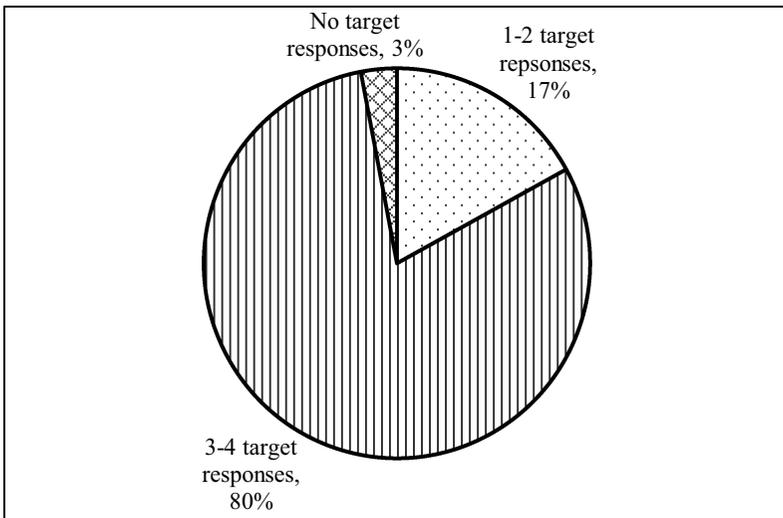
Figure 7. Percentage of target responses for Mandarin speaking children

A control group of 33 Mandarin-speaking adults was also tested using a modified experimental design, but retaining the critical features of the child version of the study. Each adult participant in the control group received 4 false test trails. The main finding was that the adult participants produced 125 Level 2 Genitives (on 94.7% of trials). The 7 remaining responses by the adult participants were acceptable substitutes for Level 2 Genitives. The findings show that the experimental protocols successfully elicited Level 2 Genitives from adults. In view of the absence of this construction in the adult input to children, discussed in the next section, we conclude that the present study made Level 2 Genitives uniquely felicitous for adult speakers of Mandarin.

4. Discussion

The hierarchical properties attested in the speech of adult language users make it evident that recursion is a core feature of human language. However, two observations are widely viewed as problematic for the claim that recursion is a core property of human language. One is the apparent failure of one human language to implement recursion (Everett, 2005; Wolfe, 2016). The second is the reported paucity of sentences with recursion in the adult input to children, a corresponding paucity in children's productions, and the difficulties children have comprehending the recursive utterances produced by adults (see Roeper, 2007; Roeper & Snyder, 2005). The findings of the present study have an important bearing on both of these putative challenges to the claim that recursion is a core feature of human language.

As to the first challenge, Everett (2005) claims that the existence of even one adult language that fails to manifest recursion falsifies the conclusion reached by the Strong Minimalist Thesis: that recursion is a core property of human language. It is worth noting, however, that the adult participants in several previous studies experienced difficulties performing tasks involving nominal recursion (e.g. Limbach & Adone, 2010; Pérez-Leroux *et al.*, 2012). For example, Limbach and Adone note "[a]n intuitive fact was observable when we asked adult native speakers of English about complex possessive phrases especially phrasal possessives; they say that these sentences are harder and that they rarely use them in production" (2010, p. 286). The fact that both children and adults were highly successful in producing nominal recursion in the present study indicates that the design features we introduced made the use of nominal recursion uniquely felicitous, and overcame whatever processing limitations might have inhibited the production of nominal recursion in other experimental tasks and in ordinary circumstances. Caution must be exercised in reaching conclusions about the properties of any adult language based on the observed frequency of particular constructions in spontaneous speech; adult speakers may simply avoid certain constructions in favour of others that convey the same message.

Our results also blunt the force of the second challenge to the proposal that recursion is a core property of human language. The second challenge is the paucity of recursive nominals in the adult input and in children's spontaneous speech, as well as the difficulties children experience when producing and comprehending sentences with nominal recursion in experimental studies. The findings of production and comprehension studies have been interpreted as evidence that the grammars of children younger than 6 lack nominal recursion (e.g. Pérez-Leroux *et al.*, 2012). This conclusion is unwarranted. Negative findings in any experimental task do not constitute a proof that children's grammars lack the property under investigation, since there are so many alternative factors that could be responsible for children's non-adult linguistic behaviour. The present study offers compelling positive evidence that, at least by age 4, both Mandarin- and English-speaking children successfully comprehend and produce sentences with recursive possessive phrases. Thus, our findings invite

the opposite conclusion - namely, that recursion is a likely to be a core linguistic feature of human language.

As noted earlier, another frequent argument in the literature blames children's poor performance with nominal recursion on the fact that the adult input contains few instances of this recursive structure. A survey of parent-child interactions in CHILDES revealed 107 recursive possessive phrases by caretakers; 75 of these phrases (70%) conformed to a simple format: <proper name>'s + <common noun>'s + *name* (e.g., *Sue's baby's name*). A previous survey of CHILDES reported that children younger than 6 do not produce or comprehend possessive genitives (Roeper & Snyder, 2005). We conducted a search of three Mandarin corpora and found no instances of the recursive *de* construction in adult speech to children acquiring Mandarin. Previous findings have led some researchers to propose that children require specific linguistic input to augment their grammars with recursive nominal structures (Roeper & Snyder, 2005). Despite the poverty of the stimulus, however, every English- and Mandarin-speaking child in the present study evinced understanding of sentences with nominal recursion, and over three-quarters of the child participants produced them. In the present study, moreover, the Mandarin-speaking adult participants produced a recursive *de* construction on nearly every trial. These results cast doubt on the claim that "[p]hrasal possessives seem to be one important trigger for English [for children] to acquire the possessive marker *'s* and its possibility to introduce recursive possessive embeddings…" (Limbach & Adone, 2010, p. 287). The findings of the present study indicate that, in felicitous contexts, Mandarin- and English-speaking children can spontaneously produce Level 2 Genitives. In view of the paucity of nominal recursion in the adult input to children acquiring either language, the finding that children can produce sentences with nominal recursive structures constitutes a compelling poverty of the stimulus argument.

The findings of the present study are also at odds with the proposal by Roeper and Snyder (2005) referred to as the Recursion Constraint:

Recursion Constraint: The output of a given operation cannot serve as the input to the same operation.

Roeper and Snyder propose that the Recursion Constraint applies "except when the child's linguistic input provides evidence to the contrary" (Roeper & Snyder, 2005, p. 160). That is, children will refrain from proposing recursive operations in their acquisition of language unless there is direct evidence for a particular recursive operation within the linguistic input. Accordingly, Roeper and Snyder (2005) argue that "children's acquisition of grammar is based on their finding clear evidence that particular grammatical operations have applied recursively" (2005, p. 161). Roeper and Snyder (2005) argue that Universal Grammar allows such a path of acquisition because the language faculty permits parametric variation, including a parameter that governs the availability of recursion in child language. Roeper and Snyder (2005) speculate that the Recursion Constraint is responsible for children's difficulty with Level 2

Genitives. That is, Roeper and Snyder argue that children do not initially analyse Level 2 Genitives using nominal recursion because some languages lack nominal recursion. For example, a permissible Saxon Genitive structure is illustrated by the German example (10) below:[9]

(10)   Maria-s Auto
        "Maria's car"

However, this operation cannot apply recursively in German. If it did, it would produce the unacceptable Level 2 Genitive (11).

(11)   *Hans-ens Auto-s Motor
        "Hans' car's motor"

Roeper and Snyder (2005) argue that the only way a child acquiring German can avoid generating the Level 2 genitive in German is by a lexical prohibition against analysing the possessive marker as 's/D^0. With this prohibition in place, the child is forced to wait to see whether or not they encounter a Level 2 Genitive in the input. If children encounter positive evidence for nominal recursion, then the constraint is violated and therefore rendered inert. As we have seen, however, both English speaking children and Mandarin speaking children readily produce Level 2 Genitives, despite the absence of positive evidence. Of course, questions remain about how adult speakers of German block Level 2 Genitives of the kind witnessed in English and Mandarin. The main point, however, is that children acquiring English and Mandarin manifest recursive nominals early and in the absence of decisive input.[10]

It is interesting to note that our results have implications for some of the more speculative features of the Strong Minimalist Thesis. The evolution of language remains highly controversial and the Strong Minimalist Thesis provocatively proposes that MERGE is a crucial cognitive mechanism and that

> … there is no room in this picture for any precursors to language – say a language-like system with only short sentences. There is no rationale for positing such a system: to go from seven-word sentences to the discrete infinity of human language requires emergence of the same recursive procedure as to go from zero to infinity … similar observations hold for language acquisition, despite appearances. (Berwick & Chomsky, 2016, p. 72)

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[9] This example is from Roeper and Snyder (2005).

[10] It may be objected that children are actually forming a compound structure instead of a true Level 2 Genitive. However, it has long been observed that children almost never allow regular plurals to be positioned within compounds: *rats-eater (Gordon, 1985).

In keeping with this quote by Berwick and Chomsky, the present investigation did not even hint at a stage at which children access a proto-grammar with syntactic operations that are simpler than recursion. More specifically, the findings of the present study run counter to proposals that, at some stage, children analyse possessive phrases as coordinate structures, rather than as recursive structures. This proposal was made, for example, by Roeper (2010, 2011) who argued that Level 2 Genitives (and other constructions) are initially analysed by children as conjoined phrases. On this account, young children cannot assign recursive interpretations to phrases that are analysed as Level 2 Genitives by adults. Instead, children convert these phrases into conjunctions. The findings of the present study argue, to the contrary, that children as young as 4 (and perhaps much younger) successfully assign recursive structures to possessive DPs. This finding obviates the need to postulate a stage of development at which children access a proto-grammar based on conjunction. More generally, the spontaneous emergence of nominal recursion in child language counters the force of the argument by Roeper (2010, 2011) that children and adults sometimes assign different analyses to the same sequences of words, as in the assertion that "the fact that a recursive rule produces a particular output does not guarantee that it is processed that way by a hearer" (Roeper, 2010, pp. 47–48).

We note in conclusion that the spontaneous emergence of recursion in child language has an affinity with another observation by Berwick and Chomsky (2016) about the similarities between language acquisition and language evolution. Just as we have seen that recursion spontaneously emerges in child language, Berwick and Chomsky contend that MERGE spontaneously evolved. Their point is that, as a matter of logic, MERGE could not have resulted from a step-wise biological transition from the preceding stage of evolution, where the precursor to MERGE was some kind of proto-grammar. As a cognitive operation, MERGE could only have evolved once, complete with its generative capacity to create an unbounded number of hierarchical structures. Likewise, the proposal that children could pass through a transitional stage with a proto-grammar as the precursor to a recursive procedure seems just as inconceivable, because there is no way to explain how children could make the transition from a proto-grammar to a recursive grammar. To paraphrase Berwick and Chomsky, the move from a grammar based on coordinate structures to a grammar based on recursion would require the addition of the same recursive procedure that would be needed for children to make the transition from the initial state to the adult grammar. The Strong Minimalist Thesis contends therefore that recursion is the signature feature of the human language faculty. As such, it should be expected to emerge early in the course of language development. The findings of the present study are consistent with this thesis and its empirical consequences for the nature and evolution of human language.

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