Small Big Flowers or *Small and Big Flowers*? Simple Is Better and Roll-Up Is Too Complex for Romanian 5-Year-Olds

Adina Camelia Bleotu and Tom Roeper

1. Introduction

In the current paper, we investigate experimentally how Romanian 5-year-old children handle recursion and coordination of multiple adjectives specifying the same (size) dimension, such as *florile mari mici* 'flowers big small' or *florile mari şi mici* 'flowers big and small'. We show that children perform more adult-like with coordination than with recursion, and, moreover, that children often interpret recursive adjectives as coordinated. Given that children perform more adult-like with prepositional phrase recursion (Avram & Sevcenco 2018, Bleotu 2020) than with adjectival recursion, we further propose that our results can easily be explained if we assume that adjective ordering in Romanian, a Romance language and a mirror of English, is derived through the complex operation of Roll-Up (Cinque 1994, 2005, 2010), unlike the ordering of prepositional phrases, which is the same in both Romanian and English, and involves no such operation.

Recursive rules are definable at an abstract level but engage other properties of grammar like branching direction, morphological triggers, and complex movement rules. Therefore, the child must not only recognize the presence of recursion but hidden rules that distort its output. In this case, movement rules like Roll-Up reverse the order of recursive adjectives, making them harder to acquire.

2. Background on recursion

Our investigation builds on previous studies on recursion, which has been considered a core property of human language (Chomsky, Hauser & Fitch 2001). From a theoretical point of view, we can distinguish between two types of recursion: Direct Recursion and Indirect Recursion (Roeper 2011, Hollebrandse

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& Roeper 2014). Direct Recursion is a default representation in a child's grammar, allowing a category to generate itself (see 1a). Thus, we can easily account for young children's ease with coordination (see 1b).

(1) a. X=> X (and X))
b. 2;8.8 [unhun and its raining on him and I drawed the rain]

Indirect recursion, on the other hand, generates a category indirectly, through another node (see 2). An essential aspect for interpretating Indirect Recursion is the order of merge. For instance, in the case of *the parrot next to the hamster next to the bunny*, the prepositional phrase (PP) *next to the bunny* attaches to the noun *the hamster*, not to *the parrot*.

(2) PP-> P^NP, NP-> N^(PP)

Various studies have approached recursion in language acquisition from an experimental point of view, bringing evidence that Direct Recursion appears as a first stage in acquisition in many Indirect Recursion structures: verbal compounds (*tea-pourer-maker= tea-pourer and maker*, Hiraga 2009), possessives (*Jane's father's bike= Jane's and father's bike*, Gentile 2003, Limbach & Adone 2010, Roeper et al. 2012, Pérez-Leroux et al. 2012, Li et al. 2020, a.o.), prepositional phrases (*the parrot next to the hamster next to the bunny= the parrot next to the hamster and next to the bunny*, Sevcenco et al. 2017, Sevcenco & Avram 2018, Bleotu 2020), adjectives (*second, green ball=second and green ball*, Matthei 1982, Bryant 2006, Gu 2008), and sentential complements (*John thinks that Bill thinks that…=John thinks and Bill thinks that*, Hollebrandse et al. 2008, Hollebrandse & Roeper 2014).

The types of recursion relevant for our current experiment are adjective recursion and prepositional phrase (PP)-recursion. In the case of adjective recursion, according to Gu (2008), children start by using multiple adjectives in coordination ([Adam 2.3]: *I funny little boy*) and only later use them recursively ([Adam 3, 4]: *he got a little big trailer.*). Moreover, Matthei (1982) showed that more than 50% of the 3-and 4-year-olds tested gave a conjoined reading to the structure *the second green ball* ('the second and the green ball') rather than a recursive reading ('the second of the green balls'). Bryant (2006) showed that 4-year-olds interpret *big black balls* as 'big and black balls'.

In the case of prepositional phrase (PP)-recursion, there is evidence that children avoid using recursive-PPs in production (Pérez-Leroux et al. 2012). In terms of comprehension, on the basis of an act-out task, where children had to arrange animals on an iPad after hearing a prompt (such as *the lion by the zebra by the bear*), Sevcenco et al. (2017) show that English children tend to reduce recursion of PP-modifers and relative clause modifiers to coordination. Sevcenco & Avram (2018) further show that Romanian 5-year-old children perform more adult-like with recursive PPs (40.33%) than English children (25.44%). The reason for this is that recursion is subject to parametric variation, and, unlike

English, Romanian has an overt prepositional marker *de* 'of' which acts as a cue to recursion, making it easier for children to cope with recursion. However, Bleotu (2020) showed that accuracy rates with recursive PPs are even higher (77.17%) when Romanian children are exposed in the same task to both recursion and coordination, thus becoming aware of the contrast between the two structures.

Thus, although coordination seems to generally be the default both in the production and comprehension of recursive structures, the availability of Indirect Recursion at an earlier/later stage in acquisition seems to depend a lot on the category involved (prepositional versus adjectival modifiers), as well as the language investigated (English versus Romanian) and the way the task is conducted (testing only recursion, or testing recursion and coordination together).

3. Background on adjectives

Adjectives pose a challenge for acquisition for a variety of reasons. One problematic aspect is that languages differ in whether they refer to properties by means of adjectives or nouns, and, in fact, even within the same language, properties can be depicted either by adjectives or nouns (*red* versus *redness*). Another problematic aspect is related to the placement of the adjective. Whereas the issue of pre-/postnominal placement may seem simple, matters complicate when multiple adjectives are involved. Figuring out the order of adjectives in a sequence like *a beautiful small orange French vase* is no trivial matter, and various (syntactic, semantic or pragmatic) accounts have tried to capture Adjective Ordering Restrictions (AORs) such as the ones proposed by Dixon (1982) (*VALUE > DIMENSION > PHYSICAL PROPERTY > SPEED > HUMAN PROPENSITY > AGE > COLOR*) or Sproat & Shih (1991) (*QUALITY > SIZE > SHAPE > COLOR > PROVENANCE*). Various acquisition studies on AORs show that English children younger than 5 do not yet have stable adjective ordering preferences (see Lee et al. 2018). Interestingly, postnominal adjective languages (like Romance languages) may be argued to pose additional challenges, given that their ordering of adjectives has been claimed to be a mirror image of the ordering in prenominal adjective languages (Cinque 2005), though there is debate about this (Cornilescu & Nicolae 2016, Leivada & Westergaard 2019). In addition, children also have to handle multiple adjectives specifying the same dimension (like *big small*), assigning a recursive interpretation to recursive adjectives. This may be considered generally problematic given children's tendency to reduce recursion to coordination, but even more so in Romance, given the fact that Romance orders recursive adjectives in the opposite order to English.

In our experiment, we approach the question of whether children are able to interpret and produce recursive structures by looking at adjectives in Romanian, a Romance language. Romanian differs from English in several respects:

(i) Adjectives in Romanian agree with the noun in gender and number, unlike adjectives in English, which do not inflect (see 3).
(ii) Adjectives in Romanian are (generally) placed postnominally (Romanian is N Det A), unlike in English, where they are prenominal (English is A N Det)-see 3.

(3) a. (the) big flowers (En)
b. *flori(le)* *mari* (Rom)
flowers.F.PL(-the.F.PL.) big.F.PL.
'the big flowers'

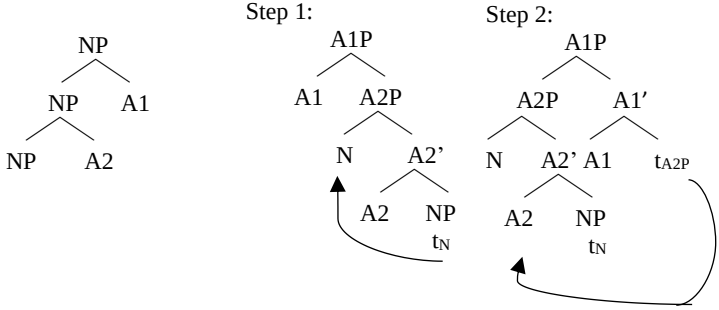
(iii) Adjectives in Romanian occur in the opposite order from English (see 4 for an example with antonymic adjectives specifying the same dimension).

(4) a. (the) small big flowers
b. *flori(le)* *mari mici*
flowers(-the) big small
'the small big flowers'

While the rich morphology of adjectives in Romanian (i) may be thought to pose an extra challenge for children, the grasp of agreement represents a separate matter altogether from the grasp of recursion. In fact, previewing our results, there were no agreement errors, while there were many non-adult-like instances of recursion in the case of Romanian 5-year-olds. The properties relevant for recursion of adjectives are rather those related to word order (ii, iii). Importantly, unlike English, which is A N Det, Romanian is a N Det A language, a fact accounted for by assuming N-to-D movement in Romance (Cinque 1994) and no movement in English. In addition, several accounts have been proposed to capture the ordering of multiple postnominal adjectives (Nevins 2011). According to the Head-Movement-of-N view of postnominal adjectives, the noun in Romanian (and in other Romance languages) simply moves across several adjectives. According to the Adjunction-of-Adj view (Abels & Neeleman 2010, Cornilescu & Nicolae 2016), adjectives in Romanian are right-adjoined to the NP (see 5a), while in a language like English they are left-adjoined. Recursive interpretations are read off from the nodes involved in the hierarchical stacking of adjectives. According to the Roll-Up-of-N view (Cinque 2005), N moves through $\text{Spec}A_2$, and pied-pipes A_2 to $\text{Spec}A_1$, as one can see in (5b). Importantly, scope is read off from c-command in the base order, which explains the scopal facts in languages with pre-/postnominal adjectives.

While Head-Movement-of-N view is unable to capture the mirror ordering of adjectives in Romance (as opposed to English), both Adjunction-of-Adj and Roll-Up-of-N can capture this: Adjunction-of-Adj assumes a different parameter setting and the existence of right-adjunction, while Roll-Up-of-N derives the order via a set of movement operations. The two accounts make different predictions with respect to the acquisition of adjectives, however. Adjunction-of-Adj predicts that Romanian children should behave in the same way with respect to adjective recursion and PP-recursion, since both recursive structures are derived via adjunction. In contrast, Roll-Up-of-N predicts that Romanian children should have more difficulties with adjectives than PPs, since adjective recursion is more complex, deriving Indirect Recursion via Roll-Up.

(5) a. *Adjunction-of-Adj* b. *Roll-Up-of-N*



Importantly, adjective coordination is derived differently from recursion, given that all proposed representations of coordination (see 6), whether headed by conjunction or not, rely on merging distinct items together (see Goodall 2017).

(6) a. *Flat structure* b. *Hierarchical representation*

In order to derive a postnominal position of coordination, the resulting coordinated object can either be adjoined to the right of the noun or it can be adjoined to the left, but the noun then needs to be moved across the object. Either way, the derivation of adjective coordination is simpler than that of recursion. Hence, from a structural point of view, one would expect more difficulties in the acquisition of recursion.

4. Current experiment

4.1. Aim

The current experiment sets out to explore how children handle recursion and coordination of adjectives both in comprehension and production. In so doing, we decided to use antonymic adjectives of the same type, more exactly, gradable adjectives specifying opposite values of the size dimension (such as *small* and *big*) rather than adjectives specifying different dimensions altogether (such as *small* and *red*), in order to make sure we are testing recursion rather than adjective ordering restrictions. Importantly, children as young as 2 have been shown to handle gradable adjectives contextually (Ebeling & Gelman 1994, Syrett et al. 2010). Moreover, stacked adjectives specifying different dimensions (such as *small red flowers*) may have interpretations which are quite similar to coordinative readings (*small and red flowers*), and, hence, they pose a problem for experiments teasing apart the recursive and coordinative readings. In contrast,

stacked antonymic adjectives specifying the same dimension (such as *small big flowers*) favour recursive readings over coordination, as coordinating antonymic adjectives is felt as odd and is generally avoided. For these reasons, we believe antonymic adjectives specifying the same dimension provide an ideal testing ground for the difference between recursion and coordination.

4.2. Participants

The participants were a test group of 20 Romanian monolingual TD children (Age range: 4; 11-6;4, Mean: 5;35, M=10, F=10) and a control group of 20 adults.

4.3. Predictions

In terms of general predictions, based on previous findings indicating that coordination is the default, we expect children to handle coordination better than recursion, and we also expect them to interpret recursive adjectives as coordination to a certain extent. Moreover, we expect levels to matter for both comprehension and production: Recursion and coordination involving three adjectives should pose more difficulty than the same structures involving two adjectives. We also expect production to lag behind comprehension.

In terms of language-specific predictions, Romanian 5-year-olds are expected to not perform adult-like with recursive adjectives if one assumes that the ordering of adjectives in Romanian relies on the complex operation of Roll-Up, unlike in English. Moreover, Romanian children's performance with recursive adjectives is expected to be worse than with recursive PPs, given that recursive PPs occur in the same order as in English, involving no Roll-Up, while recursive adjectives in Romanian represent a mirror image of English.

4.4. Procedure

The experiment consists of a training session and a testing session. The training session familiarizes children with drawing without testing adjective recursion: Children were supposed to draw circles and squares around sets.

In the testing session, children had to help a girl find certain objects and animals for her grandma after hearing various adjective + noun sequences. In comprehension, we used *a drawing method* developed by Emma Merritt and Austin Tero (UMass Amherst) and previously used in experiments on recursion in English and Chinese. Children had to draw circles around objects/animals to identify recursive structures and squares to identify coordinative structures. In production, children had to name certain groups of objects or animals.

Each child was shown 2 out of 4 picture sets on an ipad, depicting 16 flowers (*mare* 'big'/ *mic* 'small'), giraffes (*înalt* 'tall'/ *scund* 'short'), blades of grass (*lung* 'long'/ *scurt* 'short'), squirrels (*gras* 'fat'/*slab* 'thin') (see Figure 1). Children had to answer questions involving structures with 2 or 3 recursive and coordinative adjectives, such as those in Table 1. In the case of coordination, we tested Simple

Coordination (coordination between two adjectives), as well as Mixed Coordination (coordination between one adjective and two recursive adjectives).

Table 1: Example of one list of test items for comprehension and production

Level	Comprehension	Production	Comprehension	Production
I (2 adj)	flori mari mici (3-4) flowers big small 'small big flowers' flori mici mici (7-8) flowers small small 'small small flowers'	flori mari mari (1-2) flowers big big 'big big flowers' flori mici mari (5-6) flowers small big 'big small flowers'	flori mari și mici (1-4, 5-8) flowers big and small 'big and small flowers'	flori mici și mari (5-8, 1-4) flowers small and big 'small and big flowers'
II (3 adj)	flori mari mici mici (4) flowers big small small 'small small big flowers' flori mici mici mari (7) flowers small small big 'big small small flowers	flori mari mici mari (3) flowers big small big 'big small big flowers'	flori mari mici și mici (3-4, 5-8) flowers big small and small 'small big and small flowers' flori mari și mici mici (1-4, 7-8) flowers big and small small 'big and small small flowers' flori mari și mici și mici (1-4, 5-8) flowers big and small and small 'big and small and small flowers' (1-8)	flori mari și mici mari (1-4, 5-6) flowers big and small big 'big and big small flowers'

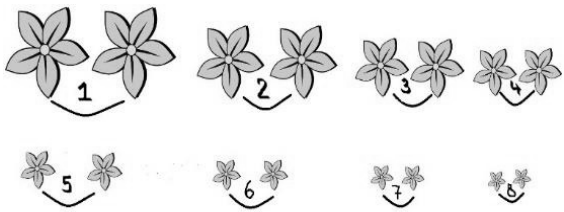


Figure 1: Example of a picture set (numbers added now)

All the questions were carefully introduced. For purposes of brevity, we will only give a few examples. For instance, for the flower picture set in Figure 1, children were first presented with the flowers: "Look, these are *big flowers* (1-4)

and these are *small flowers* (5-8)". After making sure they correctly identified the sets, they had to answer further questions. For comprehension of level I recursion (N A_1 A_2), children heard: "Let's look at the big flowers now. Among the big flowers, some flowers are bigger and some flowers smaller. You see, these flowers (4) are smaller than these (3) are, and these flowers (3) are bigger than them (4). Can you show me *the small big flowers* (3-4), can you draw a green circle around them?". For production of level II recursion, children were told: "If these are small small big flowers (4), how can we call these small big flowers which are bigger than the others? (*the big small big flowers*) (3)".

4.5. Results

Unlike adults, who were almost always at ceiling, children fared better with Simple Coordination than with Recursion (with production lagging behind comprehension) (see Figure 2). However, only Simple Coordination (between two adjectives) is easier for children than Recursion, but not Mixed Coordination (between one adjective and two recursive adjectives). This is as expected given that Mixed Coordination is more complex than Simple Coordination, involving both recursive structures and coordination.

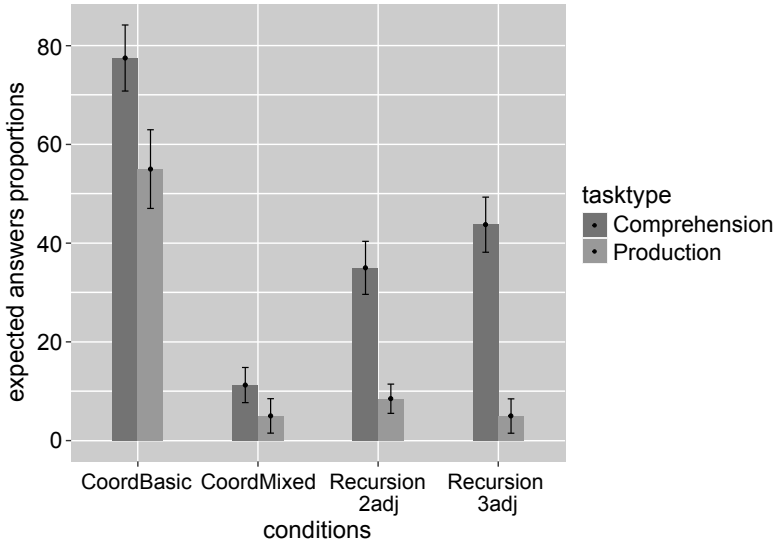


Figure 2: Children's answers for comprehension and production of coordination and recursion

Using R (2018), we fitted a mixed effects model with Error as a dependent variable, group (children/ adults), expected reading (coordination/ recursion), type of task (comprehension/ production) and the interaction between group and expected reading and between group and task type as fixed effects, and random

slopes per object (flower/ squirrel/ blades of grass/ squirrels) and participants. We compared recursion to simple coordination by using the Helmert coding scheme: recursion = 1, coordination = –1, mixed coordination = 0. Linear regression reveals significant differences between adults and children (β = 1.843, SE = 0.3244, Z = 5.683, $p < 0.001$), coordination and recursion (β = –1.706, SE = 0.214, Z = –7.96, $p < 0.001$), comprehension and production (β = –3.659, SE = 1.139, Z = –3.212, $p < 0.005$), as well as a significant interaction between group and expected reading (β = 1.827, SE = 0.248, Z = 7.375, $p < 0.001$), and a significant interaction between group and task type (β = 4.4, SE = 1.164, Z = 3.78, $p < 0.001$). Importantly, when comparing recursion to mixed coordination by using the Helmert coding scheme: recursion = 1, mixed coordination = –1, simple coordination = 0, the interaction between group and expected reading becomes somewhat less significant (β = 4.99, SE = 2.38, Z = 2.099, p = 0.036), with a p-value bigger than 0.01. This suggests that children seem to handle recursion and mixed coordination somewhat similarly, although their performance on recursion is better than with mixed coordination.

In the comprehension of recursive structure, performance with two adjectives was worse than with three adjectives. This runs against the prediction that more levels of recursion should be more challenging. However, the results can be easily explained if one considers the fact that, in Romanian, structures where one adjective occurs twice, such as (*flori*) *mari mari* 'big big flowers' often receive an intensifier reading ('very big'). For same adjective sequences, adults gave 6 intensifier answers out of 40, while children gave as many as 21 intensifier answers out of 40, clearly having a preference for such readings over the recursive ones. The *competition with intensifier readings* problem did not arise for different adjective sequences of 2 or 3 adjectives, where the non-recursive answers provided by children (and adults) were not intensifier interpretations. Rather, most of the non-adult-like answers given by children resulted from coordinative readings (51%- see 7a), followed by identifying the wrong sets (the large set defined by the first adjective-see 7b, a subset of the actual set, or an unexpected set). The coordinative answers mostly reflect situations where participants drew two circles instead of one, as expected for recursion:

(7) Answers (Expected versus Actual Answers)

a. *veveriţele slabe grase*	*veveriţele slabe şi grase*
squirrels-the thin fat	squirrels-the thin and fat
'the fat thin squirrels'	'the thin and fat squirrels'
b. *girafele înalte scunde scunde*	*girafele înalte scunde*
giraffes-the tall short short	giraffes-the tall short
'the short short tall giraffes'	'the short tall giraffes'

In terms of production of recursion, while adults' answers were at ceiling (98.75%), children gave even fewer adult-like answers (8.75%) than in the comprehension of recursion. Children generally produced simpler forms: noun + one adjective answers (referring to the larger set), either simple, comparative or

superlative forms (around 60%) (such as 8a), two adjective answers instead of three (such as 8b), as well as simple nouns (*veveriţe* 'squirrels') or invented nouns (*ninja* instead of *veveriţe* 'squirrels').

(8) a. *florile mici mari* — *florile mici*
flowers-the small big — flowers-the small
'the big small flowers' — 'the small flowers'
b. *firele scurte lungi scurte* — *firele scurte mari*
blades-the short long short — blades-the short big
'the short long short blades' — 'the big short blades'

Unlike in the case of recursion, children were much more adult-like with comprehension and production of simple coordination. In the case of comprehension of simple coordination, children were almost as accurate as adults (80% vs 97.5% correct answers). Importantly, while a considerable number of errors in the comprehension of recursion were coordinative, none of the errors in the comprehension of simple coordination were recursive, but rather indicated coordination among larger sets or subsets of one conjunct. With regards to comprehension of mixed coordination (i.e., coordination among one adjective and a recursive structure involving two adjectives), both children and adults performed worse than in the comprehension of simple coordination and even recursion (Children: 11.25%, Adults: 67.5 %). Like many adults, children gave a number of different answers here: coordination between larger sets (see 9a), recursive structures (where the conjunction *şi* 'and' was deleted from the sequence of adjectives-see 9b) and one adjective answers.

(9) a. *veveriţele grase şi slabe grase* — *veveriţele slabe şi grase*
squirrels-the fat and thin fat — squirrels-the thin and fat
'the fat and fat thin squirrels' — 'the thin and fat squirrels'
b. *firele scurte şi lungi lungi* — *firele scurte lungi lungi*
blades-the short and long long — blades-the short long long
'the short and long long blades' — 'the long long short blades'

In the production of simple coordination, adults made no errors whatsoever, while children made 20% errors and gave 22.5% missing answers. Nevertheless, half of the different answers they produced can be considered correct in a certain sense, since they contain coordination, though they refer to the conjuncts in a different manner than expected (see 10a). Other deviations were errors: answers consisting of one adjective, simple nouns, invented nouns, or answers referring to subsets of a conjunct. With regards to the production of mixed coordination, we notice that, while adults' performance was at ceiling (100%), production lags behind comprehension in the case of children, but not adults. Children produced very few accurate answers (5%), 37.5% missing answers and 57.5% different answers, where they mostly used coordination between a set and a superset (see 10b), or they answered with one adjective, simple or invented nouns.

(10) a. *veveriţele grase şi slabe* *veverite ninja şi veveriţe meteoriţi*
squirrels-the fat and thin squirrels ninja and squirrels meteorites
'the fat and thin squirrels' 'ninja squirrels and meteorite squirrels'
b. *veveriţele slabe şi grase slabe* *veveriţe mari şi mici*
squirrels-the thin and fat thin squirrels big and small
'the thin and fat thin squirrels' 'big and small squirrels'

Thus, children perform considerably worse than adults in the comprehension and production of recursion, while behaving more adult-like in the comprehension and production of coordination. Interestingly, only 6 children were consistently adult-like in the comprehension of recursion (i.e., more than half of their answers were recursive), while none of the children were in the production of recursion. In contrast, 14 children were consistently adult-like with simple coordination.

5. Discussion

The results show that children seem to fare in a more adult-like fashion with simple structures and in a less adult-like fashion with more complex structures. Children's performance is quite accurate with simple coordination, but less accurate with recursion and mixed coordination, i.e., a combination of recursion and coordination. We can shed light upon these results by relying on the notions of External Merge and Internal Merge discussed in Chomsky (2001): External Merge involves two separate objects A and B, while, in Internal Merge (Movement), one object is part of the other. *Adjunction-of-Adj* assumes that recursive structures are derived via External Merge, while *Roll-Up* assumes that they are derived via (External Merge and) Internal Merge. Coordinated adjectives are derived via External Merge, but, given their postnominal position in Romanian, they need to be right-adjoined to the noun (via External Merge), or they need to be left-adjoined, but the noun has to be move across the coordinated adjectives (via Internal Merge). We assume that recursive adjectives are derived through Roll-Up, and the reason why children generally do not do so well with recursive adjectives is because of the complexity of this operation, involving both External Merge and various Internal Merge operations (Head and Phrasal Movements). In contrast, children perform more adult-like with coordination, which is derived in a simpler manner: either solely through External Merge, if one assumes a right adjunction analysis, or through External Merge and, possibly, one Internal Merge operation (noun head movement), in case we assume a left adjunction base order. We propose that acquisition considers *Hierarchies of Syntactic Complexity*, such as in (11):

(11) *Roll-Up > XP-Movement >Head Movement> No Movement/ External Merge*

The lower the syntactic operations are in the complexity hierarchy, the easier it is for children to use them. Children rarely interpret coordination as recursion,

except for mixed coordination, which combines coordination and recursion. Children have a preference for External Merge (and Head Movement) rather than Phrasal Movement or Roll-Up, which explains their coordinative answers in recursive contexts and their ease with coordination. Interestingly, syntactic complexity correlates with semantic complexity as well, as children seem to prefer predicate modification over functional application (see Weicker 2019): In the case of *flori mici mari* 'big small flowers', for instance, children interpret it as *[[big and small] flowers]* rather than *[big [small flowers]]*, choosing to coordinate two sets rather than to apply *big* to the set of small flowers to create a subset.

The expectation that the number of adjectives matters for processing reasons is met for structures involve two different adjectives or three adjectives. However, this is not the case for recursion involving the same adjective. The accuracy rates are affected by the fact that Romanian uses structures with the same adjective twice in order to express intensification, and children prefer such readings.

In spite of the low rates of recursive answers, we must note the fact that there are 6 children who are consistently recursive in the comprehension of recursion. Interestingly, though none of the children who produce recursive structures are adult-like, all of them can handle recursion in comprehension. This indicates that, although most of the children are still at a stage where coordination is the default interpretation, there are some children who have gone beyond this stage. More direct exposure to recursive structures might enable earlier acquisition.

In order to examine formal complexity, we also compare Adj- and PP-recursion in Romanian. As already discussed previously, PP-recursion in Romanian does not involve Roll-Up, as PP-modifiers occur in the same order in Romanian as in English. While the Adjunction-of-Adj view predicts that children should perform the same with PP-recursion as with Adj-recursion, the results do not seem to confirm this prediction. In a previous experiment on PP-recursion, Bleotu (2020) used a picture selection task to test the comprehension of coordinative and recursive PP-modifiers in Romanian. Children heard sentences like those in (12) and had to choose the picture that best matched the description (see Figure 3). Bleotu (2020) found no significant difference in interpretation between children and adults: 18 children out of 24 performed consistently adult-like. 5-year-olds gave recursive answers for recursive structures involving 2 PPs to an adult-like extent (77.17%), much more than for recursive structures with 2 adjectives (35%). Thus, the experiment predicts the acquisition path, with Indirect Recursion via Roll-Up providing a greater challenge than just Indirect Recursion:

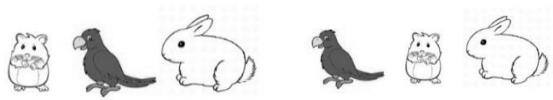


Figure 3. Examples of pictures for testing PP-recursion (Bleotu 2020)

(12) Papagalul de lângă hamsterul de lângă iepuraș este roșu.
parrot-the de next.to hamster-the. de next.to bunny is red.
'The parrot next to the hamster next to the bunny is red.'

Further studies are needed to establish a more solid comparison between AP-recursion and PP-recursion, by resorting to the same experimental methods or even testing both types of recursion within the same experiment. Nevertheless, the results from Bleotu (2020) seem quite conclusive, given that the experiment exposes participants to both coordination and recursion, just as our current experiment on adjective recursion. Hence, this provides one more argument that adjective recursion is syntactically more complex than PP-recursion.

In addition, we must also note that there were no adjective-noun agreement errors in our experiment, although there were non-adult-like answers for recursive structures. This suggests that, even though morphology may act as a clue for adjective category and recursion, triggers for recognition may be independent of derivation itself. Recursion is deeply embedded in the mechanics of language, and children must not only recognize where recursion is present but how it interacts with other complex operations (like Roll-Up, Agreement, a.o.).

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