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#### **Title**

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<https://escholarship.org/uc/item/9nh4450d>

#### **Journal**

Proceedings of the Annual Meeting of the Cognitive Science Society, 43(43)

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#### **Publication Date**

2021

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# *The Parrot next to the Hamster (and) next to the Bunny* Sheds Light on Recursion in Child Romanian

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## Abstract

The current paper brings experimental evidence that Romanian 4-and 5-year-olds are able to understand recursive prepositional modifiers such as *papagalul de lângă hamsterul de lângă iepuraș* ‘the parrot next to the hamster next to the bunny’. 23 children engaged in a picture matching task (PMT) where they heard sentences containing either recursive structures or coordinative structures, and they had to choose between a picture corresponding to a recursive interpretation and a picture corresponding to a coordinative interpretation. Interestingly, children provided recursive interpretations to recursive structures to a quite high degree, though their behavior was not fully adult-like. We argue that this can be accounted for through children’s sensitivity to specific recursion cues that are present in Romanian, as well as to the contrast between recursion and coordination, which is activated through the experimental set-up.

**Keywords:** Romanian L1; acquisition; recursion; coordination; contrast

## Introduction

The current paper takes a look at how Romanian children understand complex recursive structures involving preposition phrase modifiers and argues on the basis of an experiment that, at age 4, they are already able to comprehend such structures and do not reduce them to coordination.

## Background on recursion of prepositional phrases

Recursion has been considered the fundamental property of human language (Hauser, Chomsky & Fitch 2001), and the heartbeat of grammar (Roeper 2007), and a lot of effort has been invested by language acquisitionists into investigating it (Eisenbeiss, 2009; Pérez et al., 2011; Roeper, 2007; Roeper, 2011, Hollebrandse & Roeper, 2014; Sevcenco & Avram, 2018; a.o). While many of the results are supportive of the innateness hypothesis, some results may be considered problematic, given the inherent problem of processing memory load which affects recursion experiments, as well as crosslinguistic variation depending upon functional elements.

The literature on the acquisition of recursive prepositional modifiers brings both longitudinal and experimental

evidence that children tend to initially reduce recursion to coordination both in comprehension and production. Gu (2008) brings examples of children resisting recursive prepositional phrases. In (1), for instance, although the father encourages the child to produce a recursive prepositional phrase, the child resists him and instead produces a structure that is compatible with the coordinative interpretation “in the shelf and in the jar” rather than a recursive interpretation.

(1) Father: in the jar up in the shelf? can you say that?

Child: I can’t

Father: you can

Child: in the jar say in the jar

Child: *up in the shelf in the jar* in the closet in the kitchen

Moreover, Pérez et al. (2012) have shown that, although children older than 3 often understand recursive structures containing prepositional phrases and possessives, they avoid producing them. For example, when asked specific questions which require complex nominals containing recursive prepositional phrase modifiers as answers, children tend to produce simpler forms, involving one single modifier:

(2) Which girl? => the girl with the dog with the hat (correct)

“the girl with the hat dog”

“the girl with, the dog girl, but not the same as the other one”

A further production study conducted by Pérez et al. (2018) reveals that children find double sequential (non-recursive) modification (as in 3a) easier to produce than recursive modification when referring to certain pictures (as in 3b). This indicates that children are sensitive to the complexity introduced by multiple levels of embedding.

(3) a. the plate with oranges under the table

b. the bird on the alligator in the water

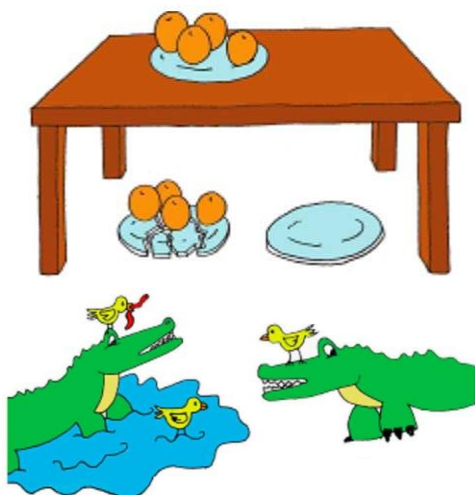


Figure 1: Pictures used by Pérez et al. (2018)

Apart from production evidence, there is also evidence coming from comprehension that children do not handle recursive prepositional modifiers so well.

Sevcenco, Roeper & Pearson (2017) tested English-speaking 4-to 9-year-olds for their understanding of complex nominals containing either recursive prepositional modifiers or relative clauses. They used an act-out task, asking children to order animals on an iPad. For instance, when asked to place animals in the order mentioned in (4), children below 6 often preferred conjunctive interpretations of recursion.

(4) the lion next to the zebra next to the crocodile

Around age 6, however, children start to interpret recursive structures with prepositional phrases and relative clauses as recursive.

Sevcenco & Avram (2018) further conducted a similar study on Romanian 5-year-olds. For instance, children heard a prompt such as the one in (5), and they then had to put animals in an array on an iPad:

(5) pisica de lângă calul de lângă pui  
cat.the de next.to horse.the de next.to chicken  
'the cat next to the horse next to the chicken'

Overall, there were very few recursive answers (40.3%), still more recursive than the corresponding 5-year-old English children (25.44%) (Sevcenco, Roeper & Pearson, 2017). Nevertheless, there was no significant difference between the answers for recursive structures and the answers for coordinated answers ( $p = 0.65$ ). This indicates that, at age 5, children are not adult-like in their interpretation of recursive prepositional phrases. Importantly, children's recursive readings seem to rely not on definiteness, but rather on the presence of *de* 'of' and

*care* 'that/who', which are both argued to be cues to recursion.

The language acquisition data thus seems to suggest that very young children tend to avoid recursion in production and comprehension. Moreover, the alternative interpretation they give is the coordinative reading, which seems to be simpler and more easily accessible to children. However, it may be that the results are heavily influenced by the experimental design, which, on the one hand, asks children to order animals on an iPad according to their default interpretation, and, on the other hand, exposes children only to recursive structures.

## Experiment

### Aim

The current study aims to look at recursion in Romanian through a picture-matching task which exposes children to both recursion and coordination. Previous research on Romanian (Sevcenco & Avram, 2018) has shown that 5-year-olds are not yet sensitive to the difference between recursive and coordinative structures, interpreting recursive structures as coordinative. However, this has been claimed on the basis of an act-out task, where children had to put certain items in order, a task which may be too demanding for children. Importantly, an act-out task accesses the default interpretation available to children (coordination, which is simpler conceptually and structurally than recursion), but it may be the case that children can also interpret the given structures in a different way. In order to avoid this problem, the current paper uses a picture-matching task (PMT), where children are shown two pictures (recursive & coordinative). The claim is that, when faced with a better option (the recursive picture) than the one they have as a default (the coordinative picture), children will be able to recognize this as a more adequate variant. Moreover, unlike the previous study, the current experiment makes use of a design by means of which children are exposed to both recursive and coordinative structures (e.g., *the parrot near the hamster and near the bunny* versus *the parrot near the hamster near the bunny*). The paper hopes to show that an experimental design where contrasts in pictures and structures are present activates children's understanding of recursion and coordination as opposite structures, triggering a preference for pictures corresponding to recursive structure in recursive contexts and pictures corresponding to coordinative structures in coordinative contexts.

### Participants

The subjects were 23 TD 4 and 5-year-olds (Age range: 4;6;3, Mean: 4;9) and 45 adults.

### Method and materials

The method used was a picture-matching task (PMT), where the subjects heard a sentence containing a recursive

(common noun/ proper name)/a coordinative structure (comma/ conjunction) such as (6), and they had to pick the matching picture out of two pictures. One picture corresponded to the recursive interpretation, while the other corresponded to the coordinative interpretation, as can be seen in Figure 2.

(6) a. RECURSION (Common Nouns)

Papagalul de lângă hamsterul  
parrot. DEF. ART. DE next.to hamster. DEF. ART.

de lângă iepuraș este roșu.  
DE next.to bunny is red  
“The parrot next to the hamster next to the bunny is red”.

b. RECURSION (Proper Names)

Papagalul George de lângă hamsterul  
parrot. DEF. ART. George DE next.to hamster. DEF. ART.

Dodo de lângă iepurașul Cici este mov.  
Dodo de next.to bunny. DEF. ART Cici is purple  
“The parrot George next to the hamster Dodo, next to the bunny Cici is purple.”

c. COORDINATION (Comma/ Juxtaposition)

Papagalul de lângă hamster, de lângă iepuraș  
parrot.DEF.ART DE next.to hamster, DE next.to bunny

este verde.  
is green

“The parrot next to the hamster, next to the bunny is green.”

d. COORDINATION (Conjunction)

Papagalul de lângă hamster și de lângă iepuraș  
parrot.DEF.ART de next.to hamster and DE next.to bunny

este galben.  
is yellow  
“The parrot next to the hamster and next to the bunny is yellow.”

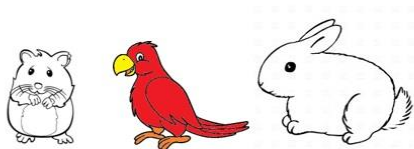


Figure 2: Examples of pictures for the PMT

By offering the child two picture choices to pick from, the PMT translates as a preference task. It does not therefore exclude the possibility that children might actually accept the coordinative picture as a match for a sentence containing a recursive structure, if that were the only picture they had in front of them.

The test involved 16 randomized sentences, involving 4 structures (recursion with common nouns, recursion with proper names, coordination with commas, coordination with conjunction) for each of the 4 following combinations of animals (chicken-hen-duck, mouse-dog-cat, parrot-hamster-bunny, pig-cow-sheep).

We chose to focus on two types of recursive structures (recursion with common nouns and recursion with proper names) in order to investigate the role played by definiteness. We also chose to focus on two types of coordinative structures (coordination with commas and coordination with conjunction) in order to see the role played by the coordinative marker *și* ‘and’.

With regards to definiteness, Romanian has a special property typical of Balkan languages, called the Locative Determiner Omission (Prendergarst, 2007), according to which the definite article is omitted in the context of a locative prepositional phrase (see 7a), unless the noun is further modified by something else (see 7b).

(7) a. Papagalul de lângă hamster  
parrot.DEF.ART DE next.to hamster

b. Papagalul de lângă hamsterul  
parrot. DEF. ART. DE next.to hamster. DEF. ART.

de lângă iepuraș  
DE next.to bunny

c. Papagalul de lângă hamster,  
parrot. DEF. ART. DE next.to hamster

de lângă iepuraș  
DE next.to bunny

This property makes recursion with common nouns in Romanian very easily distinguishable from coordination via juxtaposition, given that, apart from the absence of the comma/pause in the discourse, the structure in (7b) differs from (7c) in one important respect, namely, the presence of the definite article on the intermediate noun. This is a clear

cue for recursion, just as its absence indicates the absence of recursion. In contrast, English locative prepositions always select DPs (8a). Thus, in English, recursion with common nouns is only distinguishable from juxtaposition because of the comma/pause in the discourse (see 8).

- (8) a. the parrot next to the hamster  
 b. the parrot next to the hamster next to the bunny  
 c. the parrot next to the hamster, next to the bunny

This makes the contrast between recursion with common nouns and coordination with commas quite vulnerable in English, but very striking in Romanian. The recursive structure with Proper Names in Romanian creates a situation where all the nominals in the complex structure are actually DPs, and, therefore, it manages to make the difference between the two structures smaller. The contrast between recursion with Proper Names and coordination with commas lies solely in the presence of a comma, paralleling in this respect English.

As far as the coordinative marker *și* ‘and’ is concerned, the coordination structure is by far the most easily distinguishable, since it differs from the recursive structure with common nouns both in terms of definiteness and the presence of the conjunction.

## Predictions

We predict that recursive structures containing common nouns/Proper Names should result in choices of “recursive” drawings, possibly fewer such choices with Proper Names since the recursive structure with Proper Names differs from juxtaposition only through the absence of a comma/break in the discourse. Coordinative structures with conjunctions should trigger choices of drawings corresponding to coordinative interpretations. On the other hand, coordinative structures with commas (marked as pauses in the discourse) should trigger a considerable number of coordinative answers, but some recursive answers are expected, especially with children, given that, because of the absence of the coordinating conjunction, the only difference between coordinative structure with commas and recursive structures with common nouns is the presence of the definite article on the intermediate nominal.

We thus expect the highest number of recursive answers in the case of recursive structures with common nouns and the highest number of coordinative answers in the case of coordination with conjunction. Definiteness and the conjunction act as essential cues for distinguishing the two structures.

- (9) a. Recursion (Common Nouns) > Recursion (Proper Names)  
 b. Coordination (Conjunction) > Coordination (Comma)

Indicating the decreasing order of recursive answers per type of structure, we expect the results to observe the following scale:

- (10) Recursion (Common Nouns) > Recursion (Proper Names) > Coordination (Comma) > Coordination (Conjunction)

## Results

The results show that children are sensitive to the difference between recursion and coordination, and, at an even more fine-grained level, to the difference between recursion with common nouns/Proper Names/coordination with comma/coordination with conjunction, observing the scale we just presented (see Figure 3). Children give recursive interpretations for recursive structures with common nouns to the highest degree (77.17%), followed by recursive structures with Proper Names (60.87%). However, they give fewer recursive answers for coordination structures (42.39%) in the case of structures coordinated through juxtaposition and even fewer for structures involving coordination through a conjunction (16.03%).

A mixed-effects logistic regression was performed by a *lme4* (R 2018). The model used Interpretation as Variable, Structure type and Age Group and their interaction as Fixed Effects, Items and Participants as Random Effects, and used coordination as the reference level. The results reveal that Structure type is significant: Coordination with Comma ( $\beta = 2.902$ ,  $SE = 0.345$ ,  $Z = 8.404$ ,  $p < .01$ ), Recursion with common nouns ( $\beta = 5.414$ ,  $SE = 0.479$ ,  $Z = 11.296$ ,  $p < .01$ ), as well as Recursion with Proper Names ( $\beta = 5.224$ ,  $SE = 0.467$ ,  $Z = 11.289$ ,  $p < .01$ ) lead to significance regardless of the age groups. However, age itself is not significant ( $\beta = -0.1837$ ,  $SE = 0.633$ ,  $Z = -0.290$ ,  $p = .077 > .01$ ). The interaction between Coordination with Comma and Age is significant ( $\beta = -1.1212$ ,  $SE = 0.5311$ ,  $Z = -2.111$ ,  $p = .035 < .05$ ), as is the interaction between Recursion with Proper Names and Age ( $\beta = -2.522$ ,  $SE = 0.6152$ ,  $Z = -4.099$ ,  $p < .01$ ). However, the interaction between Recursion with common nouns and Age is not ( $\beta = -1.699$ ,  $SE = 0.647$ ,  $Z = -2.626$ ,  $p = .008 > .05$ ).

The results suggest that children are not yet fully adult-like in their comprehension of recursion and coordination. However, they seem to do well with Coordination with Conjunction and Recursion with Common Nouns, the two structures that are easier to identify because they are marked by specific cues. This shows that (in)definiteness and the presence/absence of coordinating conjunction are important differentiating triggers in distinguishing structure types.

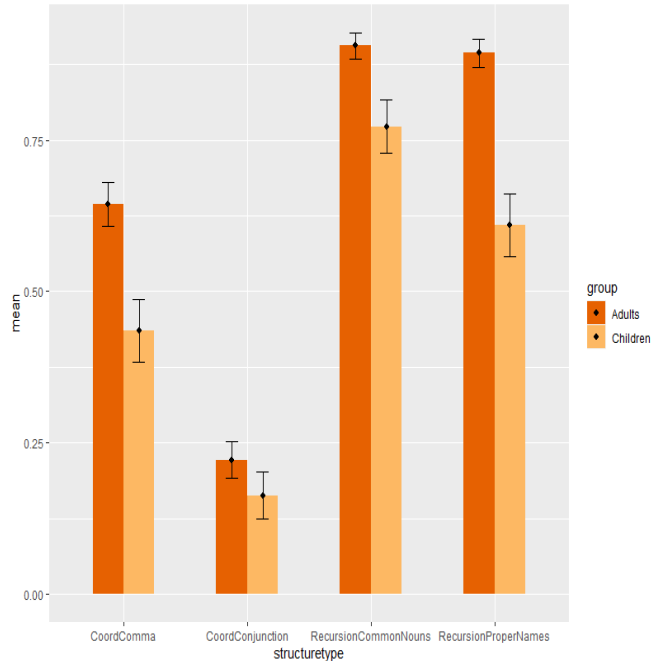


Figure 3. Rate of recursive answers per structure type and age

### Account

The previous ordering task conducted in Romanian (Sevcenco & Avram, 2018) reveals that children's default reading in recursive contexts is the coordinative reading, while the picture matching task in the current paper shows that the subjects' preferred reading is the recursive one. We believe this switch in interpretation is favoured by introducing coordination structures in the test material, along with recursive structures, thus activating the contrast between the two structures and corresponding interpretations. The *contrast activation* account is supported by evidence from experiments on scalar implicatures, where the presence of the alternative (*all*) in the test items seems to activate the  $\langle \text{some}, \text{all} \rangle$  scale, i.e., subjects produce more implicatures when the test contains control items with *all* alongside test items with *some*. To give just a relevant example in this respect, Foppolo, Guasti & Chierchia (2012) present a felicity judgment task (Experiment 5) where children witnessed a competition between two puppets, and they had to decide the winner based on the whether the statement they produced (either a statement with *qualche* 'some' or a statement with *tutti* 'all') was the best description of a certain picture. For instance, children saw a picture displaying five chipmunks taking a shower. One puppet described the picture using the sentence in (11a), which is true but informationally weak in the context, whereas another puppet described the picture using the more appropriate (informationally stronger) statement in (11b).

- (11) a. Puppet 1: *Some* chipmunks are taking a shower.  
 b. Puppet 2: *All* the chipmunks are taking a shower.

The results reveal that children derived considerably more implicatures in cases where they were exposed to both alternatives ( $\langle \text{some}, \text{all} \rangle$ ) than when they were exposed only to sentences with the weaker quantifier *some*. We believe that a similar situation happens for recursion and coordination. By hearing sentences with both recursive and coordinative sentences and seeing pictures which match both recursive and coordinative interpretations, children become more aware of the contrast and handle recursion in a more adult-like fashion.

An aspect that favours the contrast between the two interpretations is children's sensitivity to linguistic cues that are specific for recursion and coordination. While the conjunction is a cue for coordination both in English and Romanian, recursion is much more clearly marked in Romanian than in English. This is because, in Romanian, as we already explained, definiteness is an important cue for recursion, unlike in English, where recursive structures and coordinative structures via juxtaposition differ only through a comma/prosody. Interestingly, Sevcenco & Avram (2018) revealed higher rates of recursive structures than in English in an act-out task where children were not exposed to the contrast between recursion and coordination. When there is exposure to this contrast, the rates for recursive answers go even higher. This is reflected in the number of recursive answers that we obtained per type of structure: children provide considerably more recursive answers for recursion with common nouns than for recursion with Proper Names, but also considerably fewer recursive answers for coordination with juxtaposition, which, in its turn, leads to more recursive answers than coordination with a conjunction.

Nevertheless, there is one problematic aspect which deserves discussion: There is quite a considerable number of recursive answers for coordinative structures via juxtaposition for both children and adults. Since there are fewer recursive answers for coordinative structures with a conjunction, this may be explained through the vulnerability of structures that have no specific syntactic cues.

Another possible explanation could be that participants sometimes have a relative and transitive understanding of spatial relations, drawing the inference that two animals that are not directly next to each other might actually be considered next to each other in a more relative way (see 12):

$$\begin{array}{l}
 (12) \text{ X next to Y} \\
 \quad \text{Y next to Z} \\
 \hline
 \Rightarrow \text{X next Z}
 \end{array}$$

This might happen in spite of the fact that *de lângă* 'next to' tends to resist such a reading. Rather than interpreting next to as immediately next to, subjects may perceive all items as relatively near each other in comparison to others in the world. A similar point of view is proposed by Demiddele, Hayman & Schaecken (2019), who argue that variation in

interpretation might be related to implicatures with immediately: Next to would generate the implicature immediately next to. If the spatial relation expressed by the preposition is understood relatively, this may create a problem for the comprehension of recursive and coordinative structures. However, within this theory which relativizes closeness, we would expect perhaps to have a similar proportion of recursive and coordinative answers for the recursive and coordinative structures. Instead, we find much fewer recursive answers in the case of coordinative structures with conjunction. This indicates that spatial relativization cannot fully explain the results. Nevertheless, in the case of coordination with comma, even adults provided quite a lot of recursive answers (even more so than adults), which could be taken to indicate that the absence of a conjunction may lead to more free, relative interpretations of spatial relations of closeness. Further research is needed in order to see why, in the case of coordination with comma, both adults and children give quite a considerable number of recursive answers.

Children rely on specific linguistic cues in order to tease apart coordination from recursion. The conjunction is an important cue for the coordinative reading. When it is absent, more recursive readings are present. Moreover, definiteness (marked on the intermediate noun) also seems to be essential for understanding the difference between recursion and coordination.

## Conclusion

In conclusion, we have provided experimental evidence that Romanian children as young as 4 and 5 are able to understand recursion to a great extent in a context where they are exposed both to recursive and coordinative structures. This contrast is extremely relevant in Romanian, where recursive and coordinative structures are each distinguished through specific cues such as definiteness or the conjunction.

## Acknowledgments

This work is part of the postdoctoral research entitled “A Colouring Approach to How Children Understand Recursion in Romanian”, conducted by Adina Camelia Bleotu in 2019-2022 at ISDS (Interdisciplinary School of Doctoral Studies), University of Bucharest, and supervised by Larisa Avram. We are grateful to the students from the Faculty of Foreign Languages and Literatures, University of Bucharest, who helped with the experiments, as well as to the director, tutors and children from No. 248 Kindergarten, Bucharest. Many thanks also go to Tom Roeper for his many comments and suggestions, as well as to the audiences at LARC (Language Acquisition Research Seminar), UMass Amherst, and at SLE (Societas Linguistica Europea) Meeting 2020.

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