Growing trees: The acquisition of the left periphery

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Abstract
We suggest here a growing trees approach for the description of the acquisition of various syntactic structures, based on the main results reported in Friedmann and Reznick (this volume). The heart of our account is that stages of acquisition follow the geometry of the syntactic tree, along the lines of the cartographic analysis of the clause, with early stages of acquisition corresponding to small portions of the adult syntactic tree, which keeps growing with the growth of the child. The lower parts of the tree are acquired first, and higher parts are acquired later. We propose three stages of acquisition connected to the development of functional layers of the syntactic tree, and a fourth stage related to intervention. In the first stage, the IP is acquired, including the lexical and inflectional layers. This allows for the appearance of A-movement structures, including SV/VS alternations with unaccusative verbs, alongside SV sentences with unergative/transitive verbs. The second stage involves the acquisition of the lower part of the left periphery, up to QP, which allows for the acquisition of subject and object Wh questions, some adjunct questions, yes/no questions, and sentence-initial adverbs. In the third stage the rich structure of the left periphery is completely acquired, including the higher CP field. This is the stage in which sentential embedding (of declarative and interrogative clauses), subject and object relative clauses, why questions, and topicalization appear. A final stage, which occurs on the already-grown tree, is the acquisition of intervention configurations, allowing for the mastery of structures involving movement of a lexically restricted object across an intervening lexically restricted subject. We demonstrate the fruitful dialogue between the science of syntax acquisition and the cartography of syntactic structures.

Keywords: syntax, language acquisition, Intervention, Hebrew, psycholinguistics, cartography

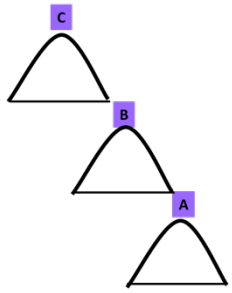
1 Introduction

In the early stages of syntax acquisition, not all syntactic structures are initially available to the child, but they develop gradually. Here we propose an account for the order of acquisition of various syntactic structures. The heart of our account is that the stages of acquisition follow the geometry of the syntactic tree, along the lines of the cartographic analysis of the clause, with special reference to the left periphery, as described by Rizzi (1997), Rizzi & Bocci (2017). The lower parts of the tree are acquired first, and then higher and higher parts of the tree are acquired. Thus, early stages of acquisition correspond to only a small, lower, portion of the adult syntactic tree, which keeps growing with the growth of the child.

We believe that cartographic research and the study of development can interact in fruitful ways. In one direction, cartography provides detailed maps of the fundamental zones of the syntactic tree which may bring to light patterns underlying apparently disparate developmental effects. In the other direction, developmental data may provide original evidence on the organization of complex structural maps. In this paper we illustrate this fruitful dialogue, suggesting an account for the order of acquisition that emerges from the findings of two sets of data gathered through sentence repetition tasks and the analysis of a corpus of spontaneous production (Friedmann & Reznick, this volume).

Under the described growing trees view, young children may be using only lower portions, of various sizes, of clausal structures, without higher layers. In other words, given a complete representation like (1) in the adult grammar, children may use only layer A, creating the treelet as in (2), or layers A and B (3), or all three layers A, B, and C (which then becomes the adult state, as in (1)). Importantly, it is impossible to have a structure in which an internal layer B is missing as in (4), where only A and C appear.

(1)



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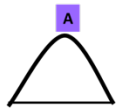

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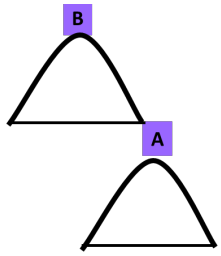
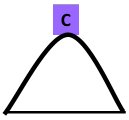
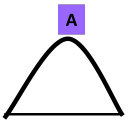


(4) * impossible dangling representation, missing an internal layer





Such direction, from lower to higher layers, is consistent with standard assumptions on the bottom-up nature of syntactic computations, going from the contentive part of the clause, the lexical layer, to the functional ones, the functional spine of the clause.[1]
This logic is akin to the logic of truncation (Rizzi 1993/94), used to capture the structural properties of certain salient non-target-consistent constructions in child language such as root null subjects in the acquisition of a non-null subject language, and root infinitives, and to tree pruning accounts for syntactic impairments in aphasia (Friedmann & Grodzinsky 1997, 2000; Friedmann 2001, 2002a, 2002b, 2006).

The truncation and the growing tree views have in common the idea that lower layers cannot be omitted if higher ones are present. They differ, though, in one crucial respect: under truncation the higher layers of the structure are available (though not necessarily used), whereas under growing trees the higher layers of the tree are not yet available at the particular stage of development under consideration. Under truncation, higher layers could be used, given a structural requirement of the construction, whereas under growing trees, if a layer has not been acquired yet, it would not appear in the child's speech. The two devices are not inconsistent, but the growing tree mechanism may characterize earlier stages of acquisition (see De Lisser et al., this volume, for discussion).

The logic of growing trees is also in line with the conceptualization suggested by several researchers, according to which the early tree is smaller, and the acquisition of syntax involves the acquisition of higher parts of the tree. Some of these researchers suggested that the small, early tree includes no functional nodes, only VP (Lebeaux 1988; Platzack 1990; Radford 1990, 1996; Guilfoyle & Noonan 1992), whereas Clahsen and colleagues (Clahsen 1990/1991; Clahsen, Penke & Parodi 1993/1994; Clahsen, Eisenbeiss & Penke 1996) suggested that the early tree includes a single functional projection above VP. We continue this basic conceptualization with the proposal that the tree indeed grows, but in a multi-staged developmental path, which crucially relies on cartographic representations.

Once cartographic representations are adopted, possible truncation sites and the potential stages in the growing tree are significantly multiplied, so the important empirical question arises of which layers are actually observed in each acquisition stage. In this paper we will focus in particular on the observed growing stages in the left periphery of the clause. Our evidence will be grounded on data from Hebrew. Therefore, we start with presenting the cartographic map for Hebrew (mainly its left periphery), inspired by the one developed for Romance (starting from Rizzi 1997), and based in part on the first sketch provided in Shlonsky (2014). Then, we move to the acquisition data and explain how the observed developmental patterns fit the 'growing trees' approach.

[1] Here we are dealing mainly with the functional structure above the VP and not the lower part, within the lexical layer. It would be interesting, in a future development, to find out whether a similar bottom-up order of acquisition can be detected within the lexical layer as well (which may in turn instantiate an articulated structural map, see e.g., Ramchand 2008).

1.2 On the cartography of the Hebrew LP

Intensive cartographic research over the last two decades led to a detailed map of the higher (so-called left) part of the clause along the lines given in (5) for Italian/Romance (schematic description adapted from Rizzi & Bocci 2017):[2]

(5) Force > Int > Top > Q/Foc > Mod > Fin > IP

Assuming the inventory of functional positions in the left periphery in (5), let us now review some fundamental aspects of the rich map of the periphery of the clause in Hebrew, which will offer some guidance for the interpretation of the developmental findings.

Force > Top

Starting from the uppermost part of the tree, Force is the highest head in Hebrew. This can be seen in the distribution of the complementizer and embedding marker *she-*, marking declarative force. The examples in (6) show that *she-* in Force is higher than Top. (6a) demonstrates this for the declarative embedding marker, which precedes the topic, and (6b) shows the same order for the relative complementizer, with a resumptive pronoun[3] in topic position, an available option in object relative clauses in Hebrew. The opposite order (Top > *she*) would give rise to ill-formedness, as demonstrated by the ungrammatical (6'). So the order Force > Top is established.[4]

(6) a. ani xoshev [$_{\text{Force}}$**she**- [$_{\text{TopP}}$ et ha-glida ha-zo [ha-yalda axla]]]
I think **that**-acc the-ice-cream the-this the-girl ate

b. ha-glida [$_{\text{Force}}$**she**-[$_{\text{TopP}}$ ota [ha-yalda axla]]] hayta yeruka
The-ice-cream **that**-acc-3rd.fem.sg the-girl ate was green

(6') * ani xoshev [$_{\text{TopP}}$ et ha-glida ha-zo [$_{\text{ForceP}}$ **she**- [ha-yalda axla]]]
I think acc the-ice-cream the-this **that**-the-girl ate

Int: Embedded interrogative yes/no question introducer > Top

The introducer of embedded yes/no questions (the interrogative marker *im*), also precedes the topic in Hebrew, an order that is visible in embedded interrogatives with topicalized elements. The order indicated in (7), in which *im* precedes the topic, indicates that the position that is occupied by Int in the surface is higher than the Top position. The point is confirmed by the ungrammaticality of (7'), with Int following Top.

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[2] The main simplification of (5) with respect to the reference quoted is that (5) does not include the proliferation of topic positions which is characteristic of Italian, and only specifies the topic position higher than Q/Foc, which is robustly attested cross-linguistically.

[3] We illustrate the position of the topic with respect to *she-* in an object relative using the resumptive pronoun because other topics inside relatives would produce a mild island effect. When the resumptive pronoun is in topic position this island effect is overcome since the connection is established between the head of the relative and the resumptive pronoun in topic position (and then from the resumptive pronoun to the gap in object position), not across a distinct topic position.

[4] Given that in Hebrew there is no morphosyntactic distinction between topicalization and focalization structures (they differ in interface properties: prosody, and properties of information structure; see Shlonsky 2014, for discussion), in the corpus study we make the simplifying assumption that OSV structures typically are instances of topicalization. We believe this idealization is legitimate because Hebrew, like Romance, uses the left peripheral focus position only for very special focal interpretations (such as corrective or mirative focus: see Bianchi, Bocci & Cruschina 2016, on Italian), whereas run of the mill new information focus is expressed IP-internally (Shlonsky 2014: 329; Belletti 2004). Given the rarity of the special uses, we do not believe our idealization to importantly overestimate the occurrence of topics in the corpus.

(7) Ani toha [$_{IntP}$ im [$_{TopP}$ et nisui ha-xazara ha-arox ha-ze [miri he'rica be-acma]]]
I wonder if acc experiment the-repetition the-long the-this Miri ran by-herself
'I wonder whether Miri ran this long repetition experiment by herself'
(7') *Ani toha [$_{TopP}$ et nisui ha-xazara ha-arox ha-ze [$_{IntP}$ im [miri he'rica be-acma]]]
I wonder acc experiment the-repetition the-long the-this if Miri ran by-herself

We keep Force and Int separate as in (5) because cross-linguistic evidence shows that Int can in fact be lower than the declarative Force marker (Rizzi 2001, 2013). Nevertheless, the distinction does not play a critical role in the Hebrew map: we follow Shlonsky's (2014) analysis and assume that *im* in Hebrew moves from Int to Force, hence it always ends up occupying the highest peripheral position on the surface.

Top > Q

Top, in turn, is higher than Q, the position to which the Wh element of root Wh questions moves.[5] One central property that emerges, language after language, is that when a topic and a Wh phrase co-occur they do so in the order Top > Wh.[6] Hebrew is no exception with regard to this property (see also Shlonsky 2014), as illustrated by the minimal pair in (8), containing a contrastive topic:

(8) (Yoni already presented the acquisition paper…)
….ve-[$_{TopP}$ et ha-maamar al afazia [$_{QP}$ mi roce lehacig]]?
and-ACC the-paper about aphasia who wants to-present?

(8') * …. ve-[$_{QP}$ mi [$_{TopP}$ et ha-maamar al afazia roce lehacig]]?
* and- who ACC the-paper about aphasia wants to-present?

Why > wh, Int > Q

Lama (*why*) clearly differs from other Wh elements in Hebrew in that it precedes the topic:

(9) (You presented the acquisition paper very nicely…)
…. ve-[$_{IntP}$ lama [$_{TopP}$ et ha-maamar al afazia [at lo roce lehacig?]]]
and-why ACC the-paper about aphasia you don't want to-present?

The orderings Why > Top and Top > Wh in (8)-(9) clearly show, by transitivity, that *lama* occupies a position higher than the position of other Wh elements. On the basis of different kinds of evidence, Rizzi (2001) proposed that *perché* (why) in Italian occupies the position of

[5] In the initial cartographic paper (Rizzi 1997), the landing site of Wh movement (called QP in Figure 1) was identified with the Focus position also occurring in the low zone of the left periphery. We do not enter here into a discussion of the connection between Wh elements and focus in main questions (on which see Bocci, Rizzi & Saito 2018, for a possible mixed focus+Q position). What is crucial for the current discussion is the fact that the landing site of the Wh element in main questions is in the low zone of the left periphery, independently from the label of the attracting head.

[6] This is in turn a particular instantiation of the fact that topics are higher than focalized phrases, and Wh and focus in main clauses are often clearly associated across languages (Bocci, Rizzi & Saito 2018, and the preceding footnote). Our evidence here is about Wh, because instances of (non-Wh) focus are not easily identifiable from the corpus study. See fn. 4.

Specifier of the head Int, higher than Q in (5), and also used to express *if*-type elements, introducing yes-no questions. If the Spec/Int hypothesis is extended to *lama* in Hebrew, the contrast (8)-(9) is captured, and confirms the ordering Int > Q for Hebrew, already established (by transitivity) in (7).[7]

Q > Adverb in Mod > subject in IP

Adverbs can be preposed to the LP, and they appear to be hosted in a dedicated position, Mod(ifier), a position distinct from Top (Rizzi 2004). To examine the position of Mod within the LP, we first select adverbs that do not easily topicalize and therefore best illustrate movement to Mod. We then examine the position of such adverbs relative to other layers. *Suddenly* (pitom) seems to be such an adverb: *Suddenly* can appear in the left periphery, as indicated by its position before the subject in (10). To the extent that the subject delimits the highest part of IP, the occurrence of the adverb before the subject shows that Mod is in the left periphery.

(10) Pitom Yoni hitxarfen ve-halax.
Suddenly Yoni flipped-out and left

Mod necessarily occupies a low position in the LP, in fact lower than Q -- the position occupied by Wh elements for argument Wh questions as in (8) (and some adjunct, but not *why*, questions, see discussion above), as shown by the following contrast between (11) and (11'), demonstrating that *suddenly* can follow Wh but cannot precede it.[8]

(11) [$_{Q}$ mi [$_{Mod}$ pitom kam ve-halax?]]
who suddenly stood-up and-left?

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[7] The order why > Top illustrated by (9) is preferred, but the opposite order is not excluded:
(i) ?....ve-[$_{TopP}$ et ha-maamar al afazia [$_{IntP}$ lama at lo roca lehacig?]]
and-ACC the-paper about aphasia why you don't want to-present?

In embedded interrogatives the contrast becomes sharper, with why > Top being the only possible order:

(ii) Ani toha [$_{IntP}$ lama [$_{TopP}$ et nisui ha-xazara ha-arox ha-ze [Hedva he'rica be-acma]]]
I wonder why acc experiment the-repetition the-long the-this Hedva ran by-herself
'I wonder why Hedva ran this long repetition experiment by herself'
(iii) *Ani toha [$_{TopP}$ et nisui ha-xazara ha-arox ha-ze [$_{IntP}$ lama [Hedva he'rica be-acma]]]
I wonder acc experiment the-repetition the-long the-this why Hedva ran by-herself

So, the marginal acceptability of (i) may illustrate the option of an additional clause-initial topic position in main, but not in embedded clauses. That root environments may have more positions than embedded environments is not unfamiliar (see Ross' 1973 Penthouse Principle). We will not further investigate the ordering in (i) here. What is crucial for us is the contrast (8)-(9), which establishes that in Hebrew (as in many other languages) *why* occupies a higher position than other Wh elements.

[8] Some other adverbs, like the temporal adverbial *yesterday* (etmol) can in fact precede Wh/Q. Such adverbials have enough referential properties to make them natural candidates for topicalization, hence for movement to the higher Top position (Rizzi 2004), preceding Q. The fact that adverbs like *yesterday* can naturally move to Top, captures their appearance before Wh elements, as in (i).
(i) (Ba-yeshiva) etmol, mi kam ve-halax?
(In-the-meeting) yesterday, who stood-up and-left?
In contrast, *suddenly* cannot naturally move to Top, this is what makes it a better candidate to examine the position of Mod.

(11') ??[$_{Mod}$ pitom [$_{Q}$ mi kam ve-halax?]]
suddenly who stood-up and-left?

Force, Int, Top, Q, Mod > Fin

In Hebrew there is no overt morphological marker for the Fin head, lexicalizing the Fin position. We take the surface position of the inflected verb in inversion structures as the manifestation of Fin. Following much current literature starting from Shlonsky (1997), we assume that the inversion between the subject and the inflected verb is licensed by the movement of another element to the left periphery. More specifically, we assume that an element that moves to the front passes through Spec of Fin, where it allows for head movement of the inflected verb, much as in V2 type phenomena.[9] Adverbs (12), Wh elements (13), topics (14), and relativized phrases (15a) all pass through spec Fin, where they license movement of the finite verb to Fin, and then continue to their final destinations, where they get their scope-discourse interpretation (we leave it open whether some kinds of elements move to Spec-Fin and stop there).

We can observe in (12) that the adverb in Mod can precede the preposed finite verb, in Fin, which precedes the subject (in the higher part of IP). This order shows that Mod is higher than Fin.

(12) **Adverb in Mod > Fin**

[$_{ModP}$ Pitom [$_{FinP}$ lakax [$_{IP}$ Yoni et ha-duvdevanim ve-halax]]]
Suddenly took Yoni acc the-cherries and-left

The same point can be made about Q and Top. We can observe in (13) and (14) that the Wh element in (13) and the topic in (14) precede the preposed finite verb, in Fin, which precedes the subject. This order establishes that Q is higher than Fin and that Top is higher than Fin. (and, by transitivity, given that Int is higher than Top (7), Int is higher than Fin as well).

(13) **Q > Fin**

a. Argument question: ma axla ha-yalda ba-kikar?
what ate the-girl in-the-square?

b. Adjunct question: eix osa para?
how does cow?

c. Embedded argument question: ani toha ma axla ha-yalda ba-kikar.
I wonder what ate the-girl in-the-square

(14) **Top > Fin**

et ha-glida axla ha-yalda be-teavon rav.
acc the-ice-cream ate the-girl in-appetite much

Verb inversion is possible in Hebrew after the relative complementizer *she-* (15a), establishing Force above Fin (relative complementizers are very high in the structure of the LP, in a position close, or identical to Force, Rizzi 1997, see a more detailed discussion on the analysis

[9] Unlike classic (Germanic) V2, in Hebrew verb movement to Fin is not obligatory. It should be noted that in Samo's (2018) analysis of Germanic V2, the inflected verb moves to Fin and then continues to move to the relevant criterial head (Top, Q, Mod, etc.). If Samo's analysis is applied to Hebrew, the surface position of the inflected verb in inversion structures does not directly manifest Fin, but a criterial position higher than Fin.

of relative clauses below). Interestingly, as shown in (15b), inversion is impossible after the sentential embedding marker *she-*. We assume that the difference between the two types of *she-* stems from the fact that in relative clauses, but not in sentential complements, there is a licenser passing through Spec Fin, the relativized phrase. Under the raising analysis of relative clauses, the relativized NP (the relative "head" in traditional terminology) moves through Spec-Fin, hence allowing the finite verb to move into the Fin head. In contrast, in sentential embedding, inversion is unavailable under the embedding marker *she-* because in sentential complements there is no movement involved, hence there is no passing through Spec-Fin, consequently the movement of the verb to Fin is not licensed.[10] [11]

Relative complementizer (Force) > Fin

(15) a. Relative complementizer
ha-glida she-axla ha-yalda hayta yeruka
the-ice-cream that-ate the-girl was green

b. Embedding marker
* ani xoshev she-axla ha-yalda glida
I think that-ate the-girl ice-cream

In conclusion, Fin is the lowest head within the LP, preceded by all other left peripheral positions identified, Force, Int, Top, Q, and Mod. The above empirical observations yield the order **Force > Int > Top > Q > Mod > Fin** in the Hebrew LP. The emerging design of the tree is depicted in Figure 1.

[10] The distributional difference with respect to triggered inversion in *she*-clauses between relatives and embedded declaratives suggests that reducing declarative embedding to a form of relativization cannot be too direct, as one involves movement, and the other one apparently does not.

[11] Another minimal pair illustrating the dependence of V to Fin on movement is provided by the contrast between topicalization structures and hanging topics (with a resumptive downstream). The first showing island sensitivity and connectivity effects, both hallmarks of movement, whereas the latter does not show such properties (and hence is analysed as a structure without movement). Verb inversion, V to Fin, occurs with the former, but not with the latter. As shown in the contrast between (i) and (ii).

This can be explained if Spec,Fin has to be activated by movement.
Topicalization:
(i) et ha-xaver ha-ze Dan **pagash** ba-gan
Acc the-friend the-this Dan **met** in-the-garden
(i') et ha-xaver ha-ze **pagash** Dan ba-gan
Acc the-friend the-this **met** Dan in-the-garden

Hanging topic:
(ii) ha-xaver ha-ze, Dan **pagash** oto ba-gan
This friend, Dan **met** him in school
(ii')* ha-xaver ha-ze, **pagash** Dan oto ba-gan
This friend, **met** Dan him in school

We thank Yuval Katz for drawing our attention to this argument.

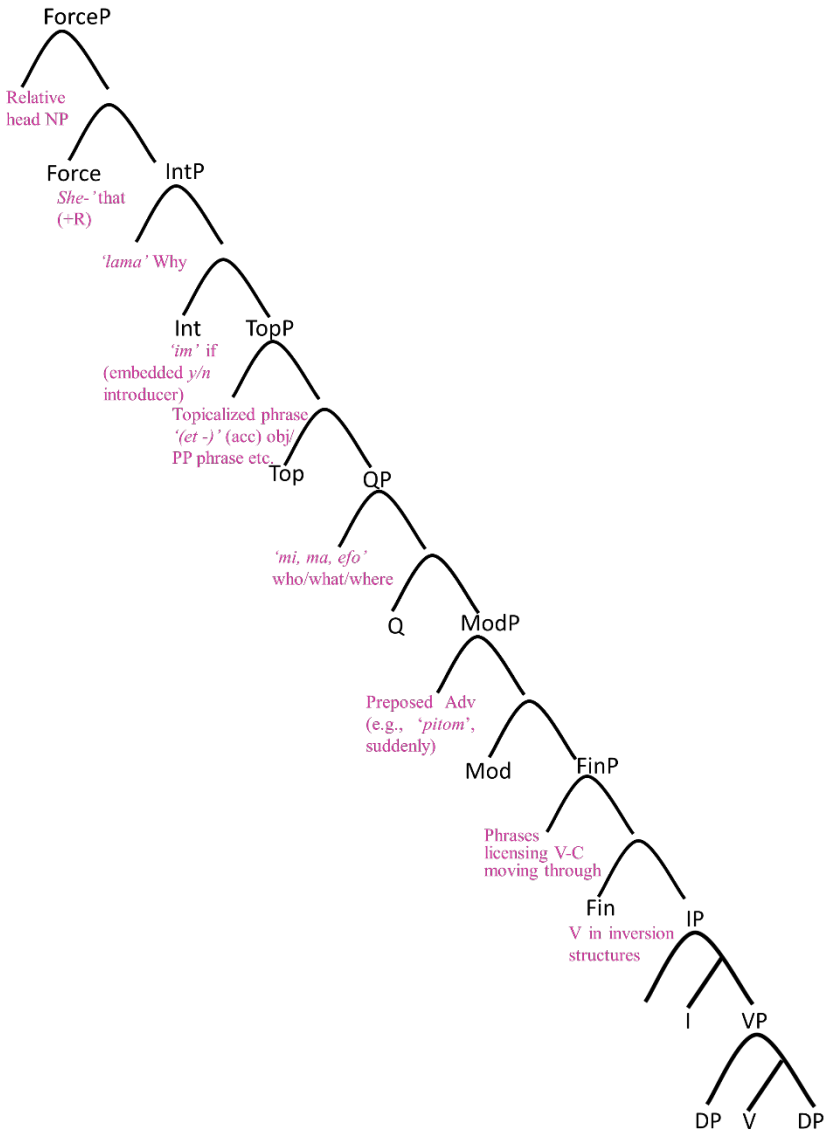

Figure 1: Map of the functional sequence of the clause in Hebrew.

It is interesting to note that the order that emerges from the distributional evidence in Hebrew is essentially the same as the one found for Romance as in the schematic representation in (5) above, as well as cross-linguistically (Japanese, Saito 2012; African languages, Aboh 2004, and more). This is to be expected under uniformity guidelines (Chomsky 2001).

2 The acquisition data

We base our account on the main results reported in Friedmann and Reznick (this volume, where all methodological details are given). In the following we build on these results in view of providing a theory-guided analysis. We also provide new analyses of the data which arise from the theoretical considerations and the descriptive conclusions of the preceding section.

Friedmann and Reznick examined the order of acquisition of various syntactic constructions in Hebrew, using a sentence repetition task in which 60 children aged 2;2-3;10 repeated 80 sentences each, and an analysis of the spontaneous speech of 61 children aged 1;6-6;1, which

included a total of 27,696 utterances. Both methodologies were analyzed using the concept of *Guttman scale* (Guttman 1944, 1950), which revealed the order of acquisition of the various structures. Guttman scales allow for the identification of implicational relations between properties. For example, if properties A and B are organized in a Guttman scale, then if property B is there, property A has to be there as well, but the implication does not necessarily hold in the opposite direction: if property A is there, B may or may not be there. For example, if an exam includes a hard question that requires mastery of three areas of knowledge, a person who answered this question correctly would probably be able to answer a question that involves just two of the three areas. A person who answers correctly a question that requires mastery of two areas would probably be able to answer a question that requires only one of the areas. This creates a Guttman scale between the three questions. Another example may come from number cognition – a child who can count to 100 would also be able to count to 10. A child who can count to 10 would also be able to count to 4. The other direction would obviously not work: not all children who can count to 4 can also count to 10 or 100. These three levels of capacity form a Guttman scale.

In these examples, one capacity includes the other as a subpart, or implies the other. There is a conceptual parallelism between the growing tree logic and the Guttman scale. If we think of structure building as occurring from lower to higher layers, under the growing trees view, higher parts of the tree necessarily include lower parts of the tree, and the acquisition of the higher parts would necessarily imply the acquisition of the lower ones.

The sentence repetition task revealed a set order of acquisition of three types of syntactic movement: the first structures to be mastered (i.e., at least 80% of the sentences repeated correctly) are A-movement (of the internal argument of unaccusative verbs to subject position) together with simple SVO sentences, then A-bar-movement to the left periphery (represented in the repetition task by relative clauses and topicalization structures) are mastered, and finally comes movement of the verb from I to C[12].
The analysis of spontaneous speech revealed the same order of acquisition, and provided further insights into the order of acquisition within the group of constructions with A-bar-movement, and their relation to the acquisition of sentence embedding: 1) A-movement of the internal argument of unaccusative verbs to subject position appears first – first occurrence in the corpus at age 1;7. (From age 2;2 all children who produced an unaccusative verb also used SV order with it). SV order with unaccusative verbs appeared together with simple sentences in SV(O) order with unergative and transitive verbs; 2) the next instances of movement to appear are argument Wh questions, i.e., subject- and object questions, including object questions inquiring about the verb phrase ('*what are you doing*') and some adjunct Wh questions (e.g., *where*), with no difference between subject and object questions

[12] We do not discuss further the late acquisition of I-to-C, as documented in Friedmann & Reznick (this volume, as well as Zuckerman 2001; Friedmann 2007; Friedmann & Costa 2011). It seems that although children are exposed to such structures quite often, for instance when they hear children's books, they do not produce them until quite late. We tentatively suggest that because sentences with I-to-C Inversion in Hebrew are typical of a certain, literary register which may be anchored in a high position in the LP, the acquisition of these structures is delayed until such register is acquired (and the related high position as well). We note, though, that I-to-C Inversion is also used in certain non-high-register sentences, such as "eix osa para" (*How does a cow*), "eix hayta ha-uga" (*how was the-cake*) and indeed, 4 of the children (who were all in Stage 2 of the stages discussed below) produced a few instances of these structures. Given the limited amount of relevant evidence, we do not engage in a proposal at this point, and leave the whole issue of the late acquisition of I-to-C for future work.

or between argument and adjunct questions (of the types that appeared at that stage) – Wh questions first occur in the analyzed corpus at age 1;6, stabilizing at age 2;5 (by "stabilizing" we mean that more than 80% of the children already used them, in this case 92% of the children used Wh questions from age 2;5); 3) In the next stage, relative clauses (headed and free relatives), and topicalization structures appear together, again with no difference between subject and object dependencies. Importantly, this stage is concomitant to the appearance of sentence embedding (of both declarative and interrogative embedded clauses). These structures first appear at age 2;5-2;6 and stabilize between the ages 3;3 and 4;0; 4) Last comes movement of the verb to C, which is acquired after age 6.

Age	A-movement	A-bar-movement	V-C
2;2	50	23	0
2;4	50	73	5
2;6	0	3	10
3;4	40	0	0
2;3	100	27	5
2;4	100	57	5
2;4	100	63	15
2;5	100	57	55
2;7	100	63	0
2;8	80	37	0
2;8	90	57	55
2;10	100	63	5
2;10	100	27	0
3;0	100	7	0
3;1	100	0	0
3;1	100	13	0
3;1	100	43	40
3;1	100	77	35
3;4	100	57	25
3;5	100	67	0
3;5	90	33	0
3;7	100	77	65
3;7	90	0	25
3;7	90	10	0
3;7	90	37	0
2;5	80	80	0
2;5	100	87	0
2;6	100	100	75
2;6	100	87	35
2;8	100	100	0
2;8	100	100	15
2;9	90	93	5
2;9	100	100	55
2;10	100	100	15
2;10	100	100	50
2;10	100	90	40
2;11	100	100	60
2;11	90	87	75
2;11	90	93	0
3;1	100	97	0
3;2	100	97	60
3;2	90	80	10
3;3	100	87	30
3;3	100	87	40
3;4	100	83	25
3;4	100	87	5
3;5	100	93	0
3;5	100	100	70
3;7	100	100	65
3;9	100	97	10
3;9	100	83	30
3;10	90	100	5
2;3	100	100	100
2;7	100	100	100
2;9	100	100	85
2;11	100	73	90
3;0	100	100	95
3;1	100	100	100
3;1	100	100	100
3;4	100	100	100

SV simple	SV unacc	Wh question	Relative clause	Topicalization	Embedding
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
x	0	0	0	0	0
1	0	0	0	0	0
1	x	0	0	0	0
1	x	0	0	0	0
1	1	0	0	0	0
1	1	0	0	0	0
1	x	0	0	0	0
1	0	1	0	0	0
1	0	1	0	0	0
1	1	1	0	0	0
1	1	1	0	0	0
1	1	1	0	0	0
1	0	1	0	0	0
1	x	1	0	0	0
1	1	1	0	0	0
0	1	1	0	0	0
1	1	1	0	0	0
1	1	1	0	0	1
1	1	1	1	0	1
1	1	1	0	1	0
1	1	1	0	0	1
1	1	1	1	0	1
1	1	1	0	0	1
1	1	1	0	0	1
1	1	1	1	0	1
1	1	1	0	1	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	0	1	0
1	1	1	1	0	1
1	1	1	1	1	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	1	1	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	0	1
1	1	1	1	1	1
1	1	1	1	0	1
1	1	1	1	0	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	1	1	1

Figure 2: A summary of the findings from Friedmann & Reznick (this volume). Left: sentence repetition results; right: spontaneous speech samples results. Reproduced from Friedmann & Reznick (this volume).

Figure 2, reproduced from Friedmann & Reznick (this volume), provides a summary of the findings by these authors, and represents the take-off point for our Growing trees approach. On the left is the Guttman scale produced from the repetition of the various types of movement, and on the right is the Guttman scale yielded from the analysis of the spontaneous speech samples.

The results from the repetition task and from the spontaneous speech analyses yield a converging picture regarding stages of acquisition: SV structures, including those derived by A-movement with unaccusative verbs, are acquired first, then Wh questions are acquired, and then relative clauses, topicalization structures, and sentential embedding structures are acquired together.

The three stages emerge in a robust and crystal clear manner, as shown by the fact that the relevant clusters of constructions can be neatly organized in Guttman scales. These results raise further theoretical questions, though:

1. Why does A-movement, illustrated by SV order with unaccusative verbs, occur before any instance of A-bar movement?
2. Why are Wh questions acquired about one year before other A-bar structures such as relative clauses and topicalization?
3. Why are topicalization, relative clauses and clausal embedding acquired at the same time?

It is hard to capture the three structures mentioned in question 3 as a natural class in terms of properties like embedding and movement: two (relative clauses and sentential embedding) are embedded structures and the other is not; two (topicalization and relative clauses) involve movement, but the other does not.

Our goal in the present paper is to provide a principled basis for the analysis of the three stages, also addressing the puzzles just mentioned. The key ingredient is the cartographic representation, which offers a fine-grained hierarchical structure detailed enough to draw the required distinctions. We propose a "growing trees" approach by which the map of the left periphery is acquired gradually, starting from the lower layers, and then moving to higher layers.

In the next section we present our growing trees account and show how it captures the three stages emerging from Friedmann and Reznick (this volume). We then illustrate how further predictions can be derived from the cartographic map and examine them empirically through further analyses of the data. These cartographically-guided analyses will allow us to investigate further the difference in acquisition of root and embedded questions, address the status of yes/no questions compared to Wh questions, and revisit the acquisition of *why* compared to other types of Wh questions. The approach will also allow us to suggest an analysis of the stage of acquisition of sentence-initial adverbs.

3 The growing trees account

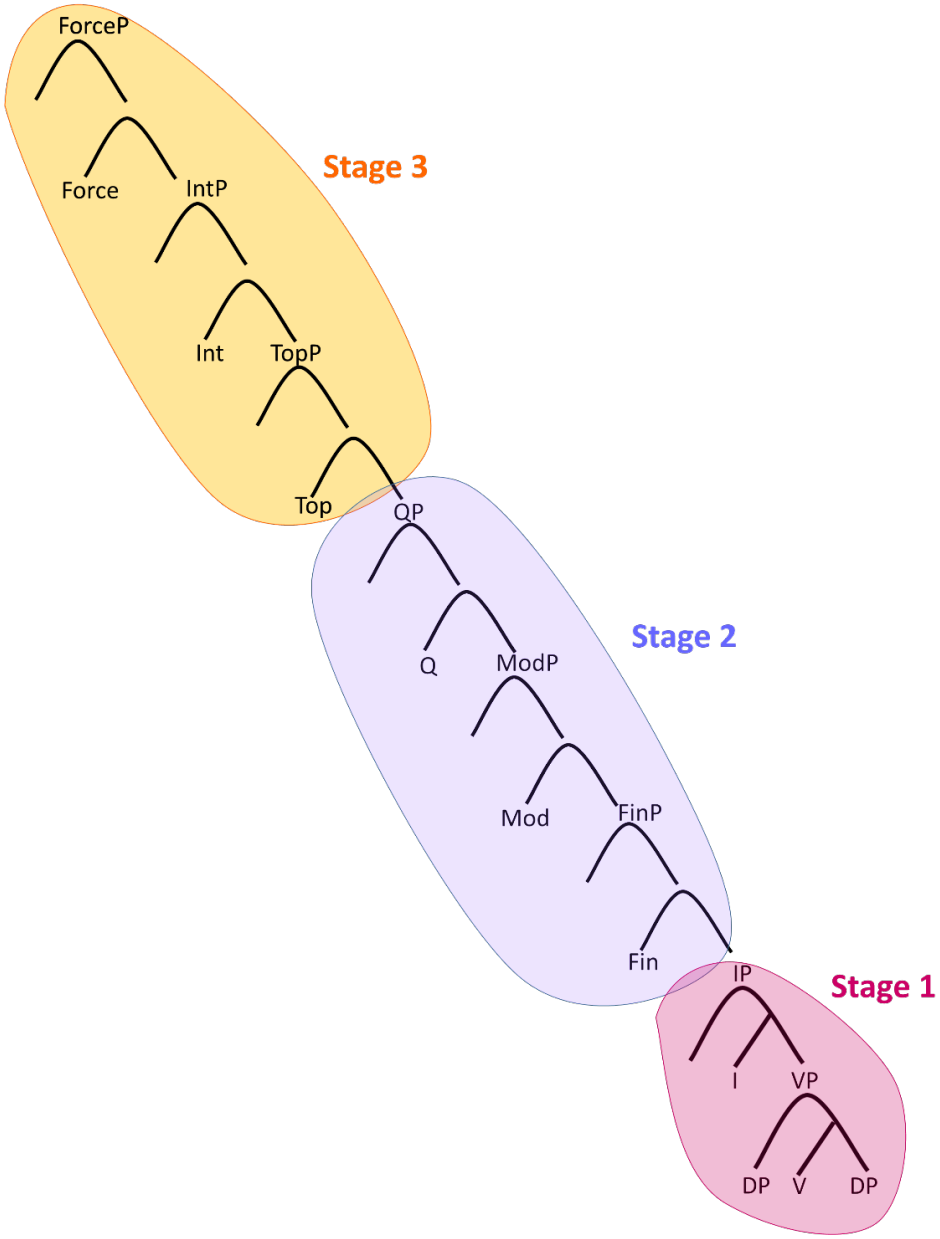

Figure 3: Three stages of acquisition of the syntactic structure of the clausal map

At the heart of our approach to the stages of structure acquisition that emerge from both the repetition study and the analysis of the spontaneous speech corpus is the idea that the stages correspond to specific zones of functional layers in the cartographic tree. Each stage of acquisition corresponds to a larger and larger part of the tree. The lower parts of the tree are acquired first, and then higher and higher parts are acquired.

We ascribe the three stages identified in Friedmann & Reznick (this volume) to three stages depicted on the syntactic tree in Figure 3. Whereas Friedmann & Reznick (this volume) mainly referred to different types of movement (A-movement, A-bar movement, and I-C movement), we propose that what crucially determines whether different movement types are acquired is in fact the acquisition of the layer of the syntactic tree supporting the position implied in

this movement. Cast in cartographic terms, this would correspond to the mastery of the properties of the heads containing the features triggering the different movements.
In **Stage 1** children have **bare IP**s, which include the triggering head of A-movement. Therefore, at this stage, they master A-movement of the internal argument of unaccusative verbs to subject position. At the same stage, the children have acquired simple sentences in SV order with unergative and transitive verbs, which under current assumptions also involve movement of the subject from the thematic position internal to the VP to the subject position of the clause in spec IP.

In **Stage 2**, **the lower field of the left periphery** becomes available. A crucial point for accounting for the pattern of acquisition that emerged from the spontaneous speech was that different A-bar structures were acquired in separate stages. Wh questions are acquired before relative clauses and topicalization. This becomes readily explained by looking at the cartographic tree (See Figure 1 above): whereas root Wh questions move to a lower layer in the LP related to the Q head, relative clauses and topicalization structures move to much higher layers within the LP related to the higher Force and Top heads. Thus, the different layers supported by the various heads identify zones of the left periphery, which we will also refer to as fields. A generalization according to which the lower field of the LP is acquired first, explains the finding that root Wh questions are acquired before relative clauses and topicalization structures. Therefore, Stage 2 is the stage in which **root Wh questions** are acquired, including argument (subject and object) questions, and some adjunct questions.

In **Stage 3**, the next stage of the growing tree, **the higher field of the left periphery** becomes available. This allows for **relative clauses**, and **topicalization structures** to appear, together with **sentence embedding** (both declarative and interrogative embedded clauses). Again, the description in terms of zones of the cartographic tree provides an immediate account for the concurrent appearance of relative clauses and embedding together with root topicalization structures (under the assumption of an appropriate selection mechanism for embedded clauses, on which see below).
We now discuss each of these stages in more detail, derive new predictions from the theory and examine them empirically, and then suggest a further, fourth stage which follows the completion of the acquisition of the tree structure .

4 The three stages in detail

4.1 Stage 1. VP and IP

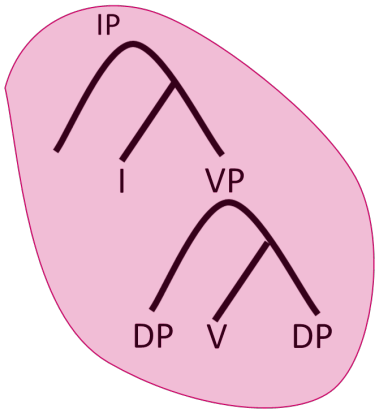

Figure 4: Stage 1 of the growing tree

In **Stage 1,** children have acquired VP and IP (see Figure 4), and this enables them to get the SV order with unaccusative verbs (in addition to the VS order). Given the unaccusative hypothesis (Perlmutter 1978; Burzio 1986), SV order with unaccusative verbs involves movement of the internal argument from the thematic position. The availability of I, endowed with attracting features, makes spec IP available, and allows the children to move the DP from the thematic position internal to the VP to the subject position of the clause in spec IP.
The existence of SV order with unaccusative verbs, then, provides explicit evidence for A-movement. The occurrence of this structure in our Stage 1 supports the view that A-movement is available from early stages (as claimed in Pierce, 1992; Snyder, Hyams & Crisma 1995; Sano, Endo & Yamakoshi 2001; Adragão & Costa 2004; Lorusso, Caprin, & Guasti 2005; Friedmann 2007; Shimada & Sano 2007; Costa & Friedmann 2009, 2012; Friedmann & Costa 2011; and contra approaches like Borer & Wexler 1987; Babyonyshev, Ganger, Pesetsky & Wexler 2001; Machida, Miyagawa & Wexler 2004; Wexler, 2004).

In the data of children who are at Stage 1 we see that they produce unaccusative verbs in both SV and VS orders. The data in our corpus also provide direct evidence that children distinguish between unaccusatives on the one hand and unergatives (and transitives) on the other. At this stage, only with unaccusatives do we also find the VS order, which is the order of merge according to the unaccusative hypothesis (Perlmutter 1978; Perlmutter & Postal 1984; Burzio 1986; Belletti 1988). It is only at Stage 3 (or later) that we find VS order with unergatives and transitives, which, in Hebrew, is a function of I-to-C movement. This finding is in line with data from Italian, Hebrew, and European Portuguese showing early access to the identification of the unaccusative class, and the distinction between unaccusative and unergative verbs (Adragão & Costa 2004; Lorusso, Caprin & Guasti 2005; Friedmann 2007; Costa & Friedmann 2009, 2012; Belletti & Guasti 2015; Belletti & Bianchi 2016).

Another consideration is relevant here. Chomsky (1995, 2000) traced back movement to the fundamental structure-building mechanism. Structure building that incorporates an element from outside the structure is "external Merge", and structure building that uses internal building blocks – elements that have already been incorporated into the tree – are instances of "internal Merge"; internal Merge is commonly referred to as "movement". This approach

suggests, then, that movement and structure building are fundamentally the same: both are instances of Merge.[13] Our data is consistent with this unified view of Merge, as we could not identify a "pre-movement" stage, in which structure building is available, but movement is not yet acquired (see our further discussion of this point in the "Open Questions" Section below).

4.2 Stage 2. The lower field of the left periphery

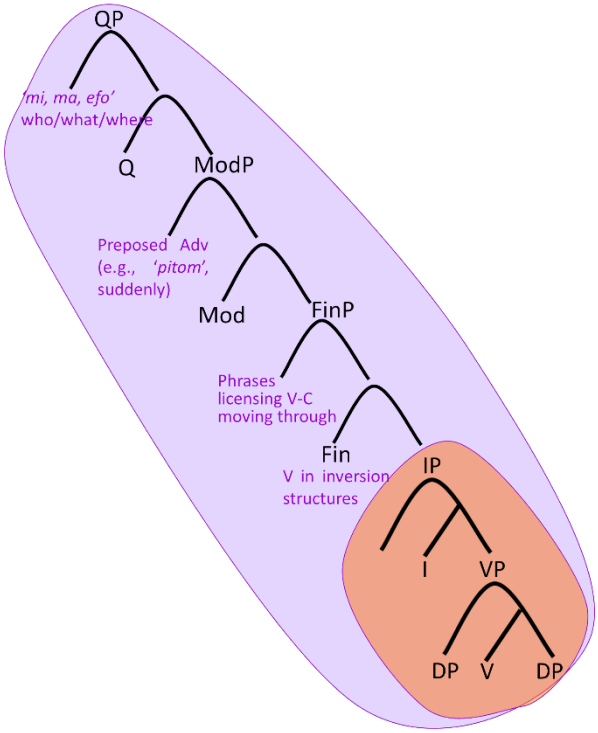

Figure 5: Stage 2 of the growing tree (also including the structures acquired in Stage 1)

From Stage 2 on, we start seeing evidence that part of the structure of the left periphery became available (See Figure 5). The first manifestation of movement to the LP is the early production of Wh questions. Given current cartographic analyses of different languages (see Rizzi 1997 footnote 4; Rizzi & Cinque 2016; Bocci & Rizzi 2017), the lower part of this LP configuration includes the landing site of argument (and some adjunct) Wh questions. This appears to be valid for Hebrew as well, as shown in Section 1.2, see Figure 1. Hence, under the growing trees view, the occurrence of Wh questions is expected as soon as the lower relevant part of the left periphery becomes available, in Stage 2.

At this stage, the children produced root argument Wh questions of various kinds: subject, object, PP object, object questions inquiring about the verb phrase ("what are you doing?"), as well as adjunct *where* (and a few *where-to* and *when*) questions. All these questions appeared at the same stage, without difference between subject and object questions (for similar findings regarding no difference between subject and object questions in early acquisition see Eyal 1976; Stromswold 1995).

[13] This immediately captures the structure-preserving nature of movement (Emonds 1976; see the discussion in Rizzi 2009).

Even though some adjunct questions appeared already at this stage, *why* questions did not. They only appeared later, together with sentential complements, topicalization, and relative clauses; we will discuss why *why* questions appear in Stage 3 in the next section.

Another head that is included in the map of the lower field is Mod. If preposed adverbs move to spec-Mod, then we expect them to also appear in Stage 2, together with Wh questions. And this is precisely what our data show: of the 12 children who were at Stage 2, three indeed produced sentences with preposed adverbs (see Table 1, which summarizes all the data analyzed for the three stages, and example (16)).

(16) axshav ani ekax et ha-dag ha-ze (Uri, 2;5)
Now I take.FUTURE ACC the-fish the-this

Table 1: The acquisition of the various structures organized by stage in which the structure is acquired, and ordered by the stage in which each child has acquired it (rather than by age). Each row summarizes the production of a different child, a blue cell indicates that the child produced this structure; a white cell indicates that the child did not produce any instance of this structure; a grey cell means that the corpus of this child did not include any verb of the relevant type (for example, the corpus did not include any unaccusative verb).

	STAGE 1: VP+IP Structures			STAGE 2: low CP zone structures				STAGE 3: high CP zone structures			
AGE	SV simple	SV unacc	VS unacc	Root Wh argument	Wh adjunct excl why	Adv in Mod	Root y/n	Why	Relative clause	Topicalization	Embedding
23	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0
22	✓	0	✓	0	0	-	-	0	0	0	0
22	✓	No unacc V	No unacc V	0	0	-	-	0	0	0	0
23	✓	No unacc V	No unacc V	0	0	0	0	0	0	0	0
25	No relevant V	0	✓	0	0	-	-	0	0	0	0
26	✓	✓	0	0	0	0	0	0	0	0	0
18	✓	0	0	✓	✓	0	✓	0	0	0	0
20	✓	0	0	✓	✓	0	✓	0	0	0	0
22	✓	✓	0	✓	0	-	✓	0	0	0	0
23	✓	✓	0	✓	0	-	-	0	0	0	0
23	✓	✓	0	✓	✓	✓	✓	0	0	0	0
24	✓	0	✓	✓	✓	0	✓	0	0	0	0
24	✓	No unacc V	No unacc V	✓	0	-	-	0	0	0	0
25	✓	✓	✓	✓	✓	✓	✓	0	0	0	0
26	0	✓	0	✓	0	✓	✓	0	0	0	0
27	✓	No unacc V	No unacc V	0	0	0	✓	0	0	0	0
35	✓	✓	✓	✓	0	✓	✓	0	0	0	0
38	✓	✓	✓	0	0	✓	0	0	0	0	0
29	✓	✓	✓	0	✓	✓	✓	✓	0	0	✓
30	✓	✓	✓	✓	✓	✓	✓	0	✓	0	✓
30	✓	✓	✓	✓	✓	✓	0	0	0	✓	0
30	✓	✓	0	✓	✓	✓	0	0	0	0	✓
32	✓	✓	0	✓	0	✓	0	0	✓	0	✓
33	✓	✓	✓	✓	0	✓	✓	0	0	0	✓
35	✓	✓	0	✓	✓	✓	✓	✓	0	0	✓
35	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
35	✓	✓	0	✓	✓	✓	✓	✓	0	✓	✓
36	✓	✓	✓	✓	✓	✓	✓	0	0	✓	✓
36	✓	✓	0	✓	✓	✓	✓	0	✓	0	✓
37	✓	✓	✓	✓	✓	✓	✓	0	0	✓	0
37	✓	✓	0	✓	✓	✓	✓	✓	✓	0	✓
39	✓	✓	✓	✓	✓	✓	✓	0	✓	✓	✓
39	✓	✓	✓	✓	✓	✓	0	✓	0	✓	✓
39	✓	✓	✓	✓	✓	✓	✓	0	✓	0	✓
41	✓	✓	✓	✓	✓	✓	✓	✓	0	✓	✓
43	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
48	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
51	✓	✓	✓	✓	✓	✓	✓	✓	0	✓	✓
53	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
57	✓	✓	0	✓	✓	0	✓	0	✓	0	✓
58	✓	✓	0	0	0	✓	0	0	✓	0	✓
58	✓	✓	0	✓	✓	✓	✓	✓	✓	✓	✓
59	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
61	✓	✓	0	✓	✓	0	✓	✓	✓	✓	✓
62	✓	✓	0	✓	0	✓	✓	0	✓	✓	✓
63	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
64	✓	✓	0	✓	✓	✓	✓	✓	✓	✓	✓
67	✓	✓	✓	✓	✓	✓	✓	0	✓	0	✓
68	✓	✓	✓	✓	✓	✓	0	0	✓	0	✓
68	✓	✓	✓	✓	✓	✓	✓	✓	0	✓	✓
70	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
73	✓	✓	✓	✓	✓	✓	✓	0	✓	✓	✓

- missing data point, ✓- the structure appeared at least once in the child's sample. 0 – the child did not produce any instance of this structure

4.2.1 *From acquisition data to linguistic analysis: the derivation of yes/no questions.*

The next point to address relates to yes/no questions. In this case, the acquisition data may shed important light on a theoretical issue. In principle, three possibilities exist with respect to the representation of the yes/no feature in the syntactic tree: no feature in the LP, feature in Q, or feature in Int. If the language allows for yes/no questions without an overt morpho-syntactic yes/no marker, and the interrogative interpretation is uniquely expressed through a special intonation at PF, one conceivable option would be that there is no yes/no feature in the LP: the assignment of a special intonational contour could be triggered by an IP-internal featural specification. A second possibility is that the yes/no feature resides where the Wh operator resides, in Q, which is in the lower field of LP. A third option is that the yes/no feature in main questions resides where it resides in embedded yes/no questions, in Int, in the higher LP zone (see the discussion of Stage 3 below).

A way to inform the decision between the three options would be to examine whether yes/no questions are acquired with declarative SV (which would support the no-feature-in-the-LP option), with root Wh questions (which would support the feature-in-Q option), or with embedded yes/no questions (supporting the feature-in-Int option).

The approach we used for the analysis of the data here was the one used in Friedmann & Reznick (this volume). Using speech samples of 56 children (for detailed description of the methodology for data selection and analysis see Appendix A), we analysed, for each child, the structures that were already present in their sample, and looked for a hierarchy of acquisition of the various structures between children. In the logic of Guttman scales, if we found that there were samples that included only structure A, samples that included structures A and B, but no samples that included only B, we could conclude that A is acquired before B.

The results, summarized in Table 1 and Table 2, were that yes/no questions appeared later than declarative SV sentences, earlier than embedded yes/no questions, and we could not determine any order of precedence between yes/no questions and root Wh questions: In the samples of the 56 children in Table 1, none of the children in Stage 1 produced yes/no questions, and 9 of the children in Stage 2, the stage in which Wh questions appear, produced yes/no questions without any indication of the higher LP (no relative clause, topicalization, or embedding, and crucially, no embedded Wh question). This suggests that yes/no questions are acquired at Stage 2, together with root Wh questions.

We also performed a further analysis considering the longitudinal data of two more children who were recorded bi-weekly. Here we could assess, for each child, when yes/no questions first appeared relative to the other structures. The longitudinal data yielded similar results, as shown in Tables 3 and 4: for both children, when they were at Stage 1 they produced no questions, and then at Stage 2 they produced both Wh and yes/no questions, both appearing within two weeks, with no structures that belong to Stage 3 yet.

Table 2: The pattern of acquisition of root and embedded Wh and Y/N questions

STAGE	**Age (months)**	Root WH	Root Y/N	Emb WH	Emb Y/N	Emb decl
2	18	✓	✓	0	0	0
2	20	✓	✓	0	0	0
1	22	0		0	0	0
1	22	0		0	0	0
2	22	✓	✓	0	0	0
0	23	0	0	0	0	0
0	23	0	0	0	0	0
0	23	0	0	0	0	0
2	23	✓	✓	0	0	0
2	23	✓	✓	0	0	0
1	23	0	0	0	0	0
2	24	✓	✓	0	0	0
0	24	0	0	0	0	0
2	24	✓		0	0	0
0	24	0	0	0	0	0
1	25	0		0	0	0
2	25	✓	✓	0	0	0
1	26	0	0	0	0	0
2	26	✓	✓	0	0	0
2	27	0	✓	0	0	0
3	29	0	✓	✓	0	✓
3	30	✓	✓	✓	0	✓
3	30	✓	0	0	0	0
3	30	✓	0	✓	0	0
3	32	✓	0	0	0	✓
3	33	✓	✓	✓	0	✓
3	35	✓	✓	0	0	✓
3	35	✓	✓	✓	0	0
3	35	✓	✓	0	✓	0
2	35	✓	✓	0	0	0
3	36	✓	✓	✓	0	0
3	36	✓	✓	0	0	✓
3	37	✓	✓	0	0	0
3	37	✓	✓	✓	0	0
2	38	0	0	0	0	0
3	39	✓	✓	0	✓	✓
3	39	✓	0	✓	0	✓
3	39	✓	✓	✓	0	0
3	41	✓	✓	✓	0	0
3	43	✓	✓	✓	0	✓
3	48	✓	✓	✓	0	✓
3	51	✓	✓	✓	0	✓
3	53	✓	✓	✓	0	✓
3	57	✓	✓	0	0	✓
3	58	0	0	0	0	✓
3	58	✓	✓	✓	0	✓
3	59	✓	✓	✓	0	✓
3	61	✓	✓	✓	✓	✓
3	62	✓	✓	✓	0	✓
3	63	✓	✓	✓	0	✓
3	64	✓	✓	✓	0	✓
3	67	✓	✓	✓	0	✓
3	68	✓	0	✓	0	✓
3	68	✓	✓	✓	0	✓
3	70	✓	✓	✓	✓	✓
3	73	✓	✓	✓	0	✓

Therefore, the 56 children's speech samples as well as the longitudinal data show that Wh and yes/no questions are acquired at the same stage, Stage 2: after Stage 1 structures (SV sentences), and before Stage 3 structures (embedding, relatives, and topicalization).
Is there any order of precedence between Wh and yes/no questions? The data, summarized in Table 2, which is organized by age, indicated no precedence between the two, namely, that there is no Guttman scale for Wh and yes/no questions. All but one of the ten children in Stage 2 for whom we had raw data for analysis of this question produced both Wh and yes/no questions.[14] Taken together, these data indicate that yes/no questions are acquired together with Wh questions in Stage 2, both appear after Stage 1, where children produce declarative SV sentences, and before Stage 3 where they produce embedded questions.

The finding that yes-no questions appeared simultaneously with root Wh questions supports the possibility according to which the yes/no feature resides in Q, in the lower LP layer. One possible implementation would be to assume, following much literature, that a null yes/no operator is present in polar questions, the null counterpart of the overt Wh operator in Wh questions. This null operator would reside in the specifier position of the Q head, in the lower part of the LP. Once this position becomes available, it may attract a Wh operator, or host a yes/no operator. The findings from acquisition, whereby both types of questions appear together in spontaneous speech, support this kind of analysis.

[14] An additional indication for the close proximity between the appearance patterns of the two types of questions can be seen when analyzing the time of first appearance of each question type in the longitudinal data of nine children (Hagar, Leor, and the other three children reported in Friedmann & Reznick, this volume -- Lior Naama, Smadar -- and 4 additional children who had somewhat fewer samples, but still enough to time the acquisition of questions, Sivan, Ruthy, Hamutal, Asaf from Ravid 2004, with 9-20 samplings and 971-3005 utterances, added here courtesy of Julia Reznick). These data indicate that 3 children produced a Wh question before a yes/no question, 3 had them simultaneously, and 3 had yes/no questions before Wh questions, all within 6 weeks.

4.3 Stage 3. The higher field of the LP

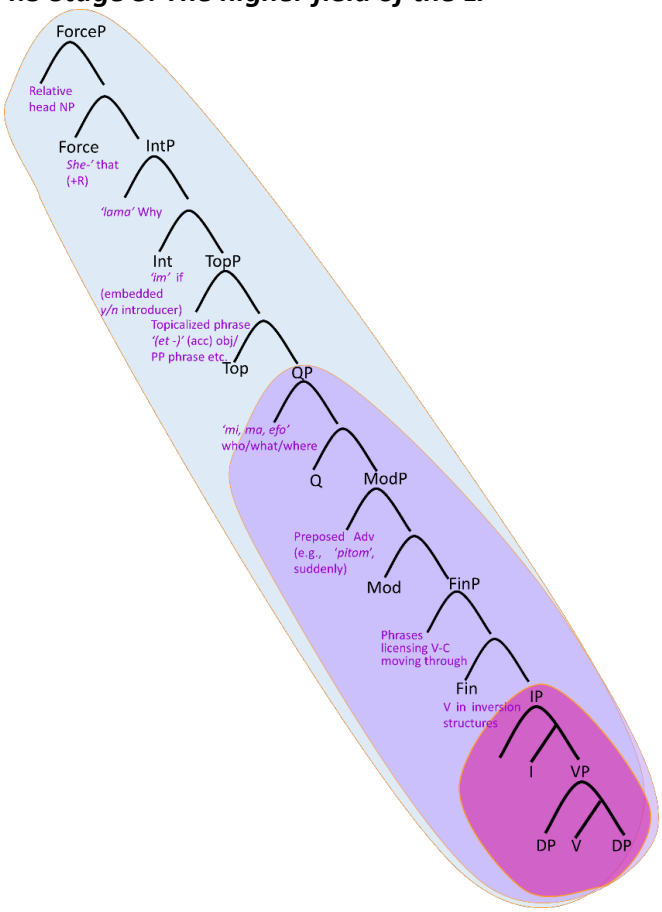

Figure 6: Stage 3, the final stage of the growing tree (also including the structures acquired in stages 1 and 2)

In the next stage, Stage 3, the higher field of the left periphery becomes available (see Figure 6). This allows for the appearance of relative clauses and topicalization structures, together with sentence embedding. As summarized in Table 1, In line with the Guttman Scale generalization, all children who were at Stage 3 and produced any of Stage 3 structures (relative clauses, topicalization, sentential embedding) also produced some structures that belong to Stage 2 (root Wh / yes no questions and Adverbs in Mod), and SV sentences which belong to Stage 1. The same Guttman scale could be seen (in part) also in the repetition task: all children who could repeat correctly the relative clauses and the topicalization sentences could also repeat the SV sentences (with unaccusative and unergative/transitive verbs).

It is not surprising that relative clauses appear together with sentential embedding, because relative clauses are embedded clauses. A more surprising property of the natural production data is the finding that the appearance of root topicalization structures coincides with the appearance of embedded clauses, as topicalization is a typical main clause phenomenon, much as root question formation. We suggest that the co-occurrence of the three constructions is a straightforward consequence of the fact that they all involve positions in the same left peripheral area , constituting the higher field of the LP.
Let us concentrate now on embedding, starting from the most straightforward case, the embedding of selected declarative clauses. A natural assumption about selection is that the selection of finite embedded clauses is categorially uniform, with the selected property

expressed in the highest position of the complementizer system. Namely, all verbs selecting a finite complement select a ForceP, in which the selection properties of different verbs are expressed: *say* selects +declaratives, *wonder* selects +interrogative, *surprise* may select +exclamative. This follows from the classical theory of selection in which selection is satisfied under sisterhood (Chomsky 1965). In minimalist terms, this amounts to saying that external Merge only sees the labels of the categories that undergo Merge and cannot penetrate lower positions, internal to the structure being merged. Therefore, selection does not work through Agree-like relations, which could take place at a distance. In sum, selection (of finite clauses[15]) requires the projection of the whole structure up to the Force layer.

Embedded declaratives in Hebrew are introduced by the complementizer *she-*, which expresses both declarative force and finiteness. This relation between force and finiteness could be expressed through movement of the complementizer from Fin to Force or through an Agree relation between Force and Fin. We do not discuss these two options, just assuming the conclusion that *she-* is in Force, satisfying the selectional properties of the matrix verb.

As for (finite) relative clauses, they are also introduced in Hebrew by the complementizer *she-*, much like Romance *che* and *que*, English *that* (see Kayne 1976, for the classical analysis of the introducer of the relative clause as a complementizer). So, the natural assumption, along the lines of Rizzi (1997), based on Romance distributional evidence, is that the complementizer introducing relative clauses also occurs in the highest position of the CP system, in Force, as illustrated in the Hebrew cartographic Section above (Figure 1).

Figure 7 spells out our basic assumptions with respect to relative clauses. As for the position of the nominal head of the relative clause, we adopt a raising analysis, along the lines of Bianchi (1999) developing Kayne (1994), with D externally merged higher than ForceP. The relative NP moves to the specifier of Force. The Force head of a relative clause is endowed with a +R feature, the criterial feature attracting movement of NP into its specifier.[16]

[15] Note that embedding of nonfinite clauses could involve a reduced structure, not involving the LP, as in the case of modals, restructuring verbs, causative verbs, etc. This type of nonfinite embedding could therefore be available already in Stage 1. We do not deal with this type of structures in the current paper. For the time being we just note that the same verb, "want", which can take a nonfinite or a finite complement, occurs in the Hebrew corpus already at stage 1, but only with a nonfinite complement..

[16] There are analyses according to which the relative head further moves to a nominal position outside CP– possibly to the specifier of a nominal head in between D and C(see Bianchi 1999, 2000). If this is the case, the criterial feature R would be a feature in such a CP-external nominal head. We do not take a stand on whether such further movement is required or not. We assume a raising analysis for concreteness, but do not take a stand on the debate between matching and raising (see Cinque, forthcoming, for a thorough analysis of relative clauses combining matching and raising).

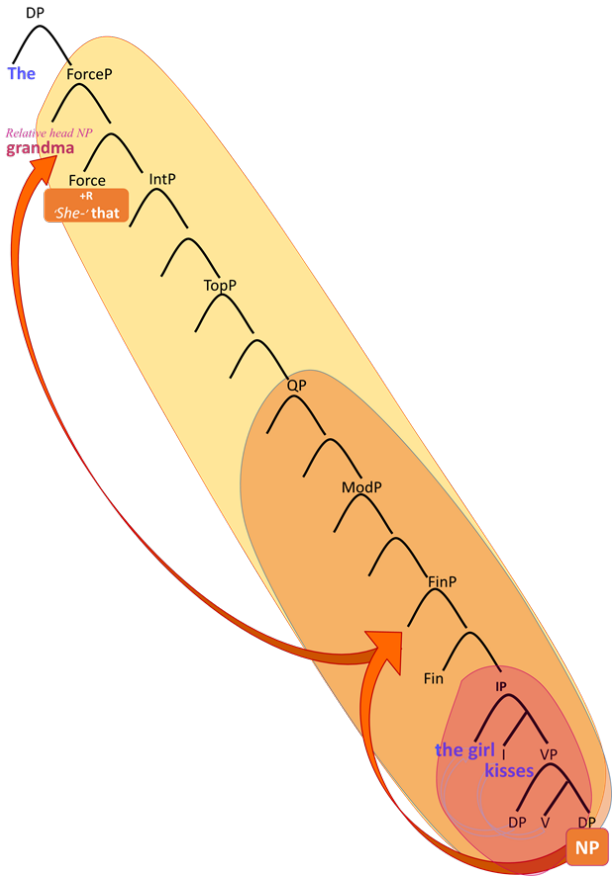

Figure 7: The cartographic structure of relative clauses in Hebrew.

The discussion of selection anchored in Force also directly pertains to embedded questions, which are selected clauses as well. Under the general theory of selection that we are assuming, the selection of embedded questions will also occur in Force. This would mean that in Force there is a question feature. Many languages provide evidence that the Wh element or the embedded yes/no question marker in fact occur in a position lower than the embedded Force head (Puskás 2000, 2018; Rizzi 2013). So, we follow the analysis in Rizzi (2016) and assume an Agree relation between the embedded Force (selected by a higher verb) and Q (for embedded Wh questions), or Int (for embedded yes/no questions). The essential point is that under the simple and general view of selection, embedded questions will be accessible to the child at a stage in which the whole CP structure is available, including the highest layer that contains Force. This predicts that embedded Wh questions and embedded yes/no questions would appear together with embedded declarative sentences, all selected by a higher selector – a higher verb in the case of declaratives and questions (and plausibly the determiner in the case of relative clauses). And indeed, this is the picture emerging from natural speech, as shown in Table 2: embedded Wh questions appear exactly at the same time as embedded declaratives, in Stage 3.[17] Embedded "whether/if" questions also appear

[17] The acquisition of embedded questions later than root ones is consistent also with J. de Villiers (1991)' findings for English, that root argument Wh questions are acquired before embedded Wh questions (and why questions). De Villiers suggested an analysis of this finding according to which root argument Wh questions are produced at a stage in which CP is not yet available (so Wh questions are adjoined to IP), and embedded Wh questions and *why* questions are acquired later, when CP is present. At that point, root argument questions would be reanalyzed as targeting CP. De Villiers' analysis is similar to ours in suggesting structural stages that involve the availability of larger and larger chunks of the tree. Our proposal differs from hers in that it simply capitalizes on

in this stage, with the usual individual age variation (e.g., one girl produced yes/no questions already at 19 months, and another at 35 months).
It is crucial to notice that Stage 3 is not only an "embedding stage". We have already mentioned that root topicalization structures appear in Stage 3. This follows from the cartography of the CP system, in which positions hosting topics cross-linguistically appear in the higher field (see our cartographic Section above demonstrating this order for Hebrew). [18]
In the next section we show that another non-embedded construction, root *why* questions, also appears in Stage 3.

4.3.1 From the growing trees approach to new data on acquisition

4.3.1.1 *Why questions*

A look at the map in Figure 1 immediately highlights another non-embedded construction that crucially involves a position in the higher field of the LP, and hence is predicted to appear at Stage 3: *Why* questions. The Wh element *why* has been shown to occur in a position distinct from, and higher than the Spec/Q position hosting other Wh elements (Rizzi 2001). We have shown in example (8) above[19], that that is the case also in Hebrew: *why* appears above TopP, much as the embedded yes/no marker *im* (if), similarly to what has been shown for Italian, where *perché* (why) can precede a topic (in main and embedded clauses), like the embedded yes/no marker *se* (if). This observation supports the hypothesis that *lama (*and *perché*) and *im (*and *se*) occupy the layer Int, higher than the landing site of other Wh elements, Spec/Q (see Thornton 2008 for supporting developmental data coming from the acquisition of English, and Thornton 2016 for a discussion of the late acquisition of *why* questions; see various contributions in Soare, in preparation, for cross-linguistic evidence supporting the special position of *why*, and). If *why* questions crucially involve Int, we predict *why* questions to appear only in Stage 3, when the Int position becomes available (see Figure 6).
This theoretical prediction led us to analyze the different types of questions in the children's production, and to examine when *why* questions appear relative to the other types of Wh questions, and what the stage of acquisition is of the children who already produce them.

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positional differences in the cartographic representation, and does not require reanalysis of earlier stages when later stages are reached.

[18] The finding that topics are acquired later than (root) Wh questions converges with Tsimpli's observation that topic structures in clitic left dislocation (CLLD) in Greek are acquired later than Focus/Wh. In our system, this distinction follows from the positional properties in the cartographic map and does not rely on feature interpretability. Indeed, Topic features must be visible at LF for interpretation as much as Focus/Q features are. Additionally, topicalization in Hebrew does not include clitic resumption, so the developmental sequence cannot be attributed to the presence of the clitic resuming the dislocated topics.

[19] Another type of evidence for *why* appearing above other Wh elements in Hebrew comes from colloquial Hebrew expressions that include both *why* and *who/what* in that order which, accompanied with the relevant hand gesture (open hand turning face-up), roughly, mean "why on earth should I do that?" or "this is a complete exaggeration".

(i) Lama ma kara?
Why what happened?
(ii) Lama ma?
Why what?
(iii) Lama mi met?
Why who died?

In these examples (i-iii) there is no audible pause between *lama* and *ma/mi*, suggesting that we do not have two separate clauses here.

The acquisition data, summarized in Table 1, clearly show that *why* questions are indeed acquired only at Stage 3. The production of *why* questions perfectly matched the acquisition of other structures acquired in Stage 3: CP embedding, topicalization, and relative clauses, and does not appear for children who produce Wh questions but do not yet show evidence for the acquisition of Stage 3.
There were 16 children who produced *why* questions, all of them were at Stage 3, as indicated by their production of CP embedding with *she-* (all but two also produced relative clauses or topicalization structures). None of the children who were at Stage 2 or 1 produced any *why* questions.

It is worth noticing that the cartographic analysis predicts a split between *why* and all other Wh elements, rather than a split between arguments and adjuncts because adjunct Wh elements other than *why* target the same spec-Q position as do argument Wh elements. The split *why* vs. all other Wh elements is in fact supported by the acquisition data, with *why* questions acquired after all other Wh questions (argument and adjunct). The acquisition data indicates that *where* questions are abundant, from the very early questions the children produced; the children also produced, with lower frequency, *how*, *when*, and *where-to* questions. It is worth noting that *why* questions occur very frequently in the corpus once Stage 3 is achieved (18 of the 34 children in Stage 3 produced *why* questions, and once acquired they appear very frequently in each corpus – for example, Leor produced in a single recording at age 2;11 64 *why* questions). So, the late acquisition of *why* questions is not a function of its rarity in the children production but rather it is tightly related to the position of *why* in the LP. We also see that there is no slow increase in the use of *why* questions with age but rather a sudden appearance corresponding to the acquisition of Stage 3. (Anecdotally, parents often talk about "the why period", which starts abruptly and opens up a stretch of many why questions).

The late acquisition of *why* questions (and of embedding) immediately refutes an alternative account according to which constructions that involve movement are acquired later than structures without movement because structures with movement are harder. *Why* questions, unlike other argument and adjunct Wh questions, presumably do not involve movement (as in Rizzi 2001[20]). Had the movement structures been acquired later than no-movement ones, we would have expected *why* questions to be acquired before, rather than after, other Wh questions. The data, however, shows the exact opposite order, with *why* questions being the last to appear. Similarly, clausal embedding does not involve movement, still, it appears in Stage 3, after Wh questions, which do involve movement (See Hamann & Tuller 2014, for embedding as a factor of complexity).

4.3.1.2 Adverb preposing and topicalization

We can now examine the data with respect to the relation between two types of preposing: adverb preposing and topicalization. In the cartographic section we saw that adverb preposing targets a dedicated position Mod, distinct from and lower than Top, which is targeted by preposed topics.
Given that Mod is lower than Q and given our stage typology, we expect Mod to be available in Stage 2 alongside Wh movement, whereas topicalization is only expected to be available in

[20] See Shlonsky & Soare (2011) for the assumption of a local movement in CP in *why* questions; in any event, no movement from clause-internal position is assumed in either approach.

Stage 3. And indeed, the acquisition data manifest this distinction clearly: there were five[21] children (of the 12 children in Stage 2) who produced preposed adverbs but still no structure related to Stage 3, in particular no topicalization structure. Conversely, no child produced topicalization structures without structures relating to Stage 2 (see Table 1).

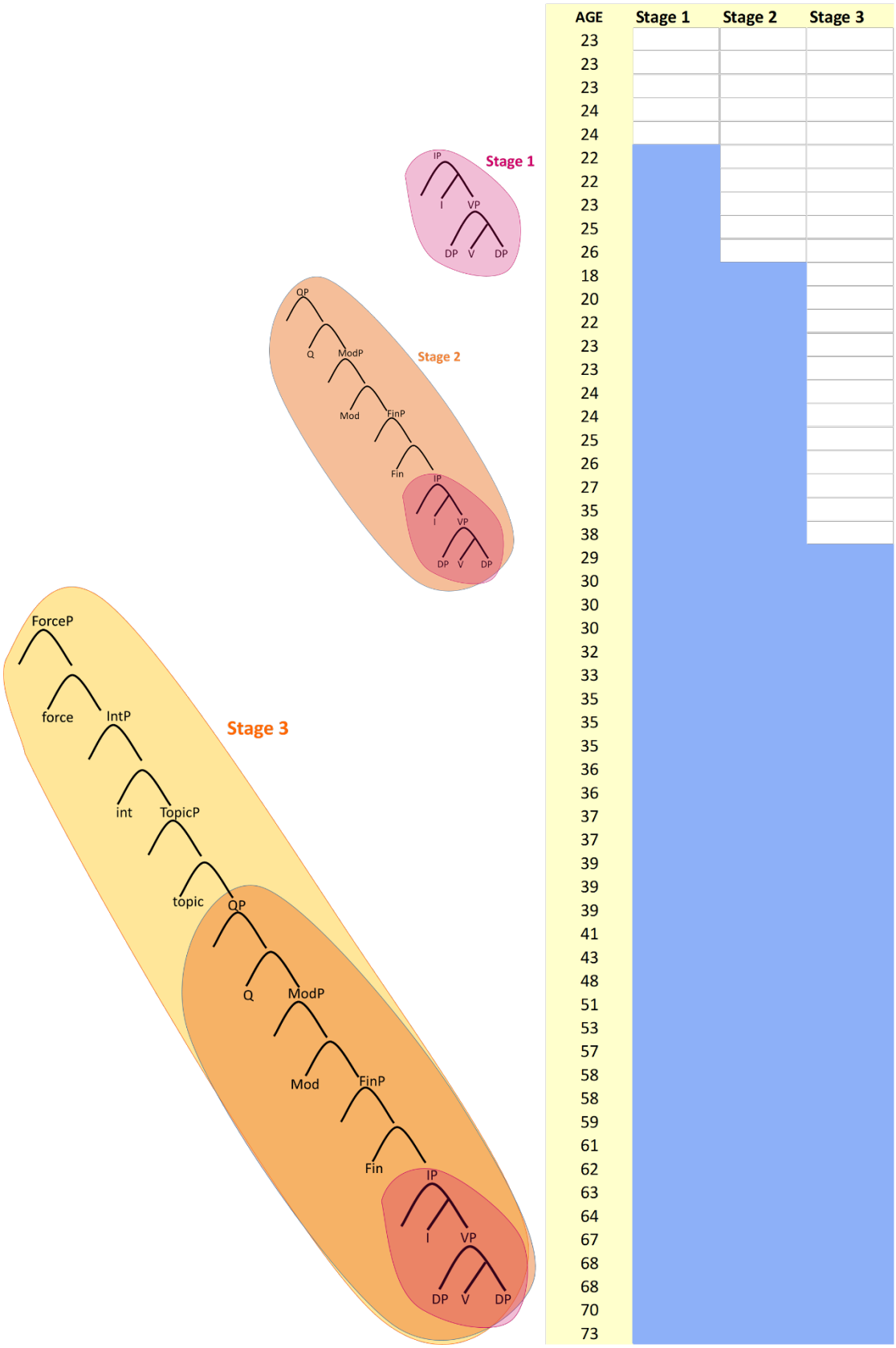
The emerging picture, then, is of three stages of acquisition on the syntactic tree. This emerged for the corpus of 56 children, as detailed for structures according to the zone they target on the syntactic tree in Table 1 and summarized by stage in Figure 7. [22]

[21] Most adverbs the children produced at this stage were "now" and "suddenly". There were also some presentational structures beginning with *"hine",* which roughly corresponds to "here is" in English, or Italian presentational "ecco". For this calculation we analysed *hine* as an adverb in Mod. We base this analysis on the availability of sentences in which *hine* precedes the subject (i), and on Zanuttini's analysis of *ecco* (2017).

(i) hine safta ba'a
Here grandma comes (Leor 2;2)

Even if *hine* turns out not to be analyzable along these lines, the results would change only minimally and for one child (children manifesting Mod in stage 2 would be 4, not 5).

[22] One may wonder what the children who were not yet in Stage 1 were producing. The five children in the corpus who have not yet produced SV sentences, and the two children in the longitudinal data before they produced SV sentences either produced single words (which may correspond to a pre-Merge stage of only lexical terminals), or produced in addition to single words also structures of the form want + object or imperative+object, which may correspond to a single merge stage. In the current paper we do not address the analysis of the children in these very early phases of the development of syntax.



AGE	Stage 1	Stage 2	Stage 3
23			
23			
23			
24			
24			
22	■		
22	■		
23	■		
25	■		
26	■		
18	■	■	
20	■	■	
22	■	■	
23	■	■	
23	■	■	
24	■	■	
24	■	■	
25	■	■	
26	■	■	
27	■	■	
35	■	■	
38	■	■	
29	■	■	■
30	■	■	■
30	■	■	■
30	■	■	■
32	■	■	■
33	■	■	■
35	■	■	■
35	■	■	■
35	■	■	■
36	■	■	■
36	■	■	■
37	■	■	■
37	■	■	■
39	■	■	■
39	■	■	■
39	■	■	■
41	■	■	■
43	■	■	■
48	■	■	■
51	■	■	■
53	■	■	■
57	■	■	■
58	■	■	■
58	■	■	■
59	■	■	■
61	■	■	■
62	■	■	■
63	■	■	■
64	■	■	■
67	■	■	■
68	■	■	■
68	■	■	■
70	■	■	■
73	■	■	■

Figure 7: The different stages as reflected in the corpus: Stage 1 in the table above includes SV structures with unergatives and unaccusatives, SV and VS structures with unaccusatives; Stage 2 includes root Wh and yes/no questions and preposed adverbs; Stage 3 includes relative clauses, topicalization, why questions, and embedded declaratives and questions. (blue cells in the table on the right indicates that a structure belonging to this stage has been produced).

4.4 longitudinal data: the same stages of acquisition

The results summarized in Figure 7 were obtained through a look at different children and the structures each of them was already able to produce. This yielded the three stages of acquisition.
Another way to examine stages of acquisition is to observe the order of acquisition of various structures within the same child, and examine which structure precedes which structure, and which structures appear at the same time. We examine here whether the stages observed in the group of 56 children were also observable at the longitudinal data within a child by analyzing the longitudinal data of the two most densely tested children reported in Friedmann & Reznick (this volume).

Method. We examined the acquisition of the various structures in the production of Hagar and Leor. Hagar was recorded 114 times between the ages of 1;7–2;11, with an average of 219 utterances per sample. Leor was recorded 79 times between 1;9–3;0, with an average of 297 utterances per sample. The total number of utterances analysed for these two children was 16,002. Their data are collapsed to one month periods. For each of the children we examine when each of the structures appeared first in their spontaneous speech.

Results. The structures we examined were acquired at exactly the same order, creating the same stages of growing trees as identified in the group analysis.
The order of acquisition, summarized for Hagar in Table 3, and for Leor in Table 4, included a Stage 1 in which SV structures appeared (Hagar did not produce unaccusative verbs in Stage 1), and then Stage 2 with root Wh questions and yes/no questions, and then Stage 3 with relative clauses, topicalization structures, *why* questions and sentential embedding. Namely, the sample analysis was completely confirmed by the longitudinal analysis.

Table 3: Growing trees: longitudinal data-Hagar

HAGAR	STAGE 1			STAGE 2		STAGE 3			
AGE	SV simple	SV unacc	VS unacc	WH	Y/n	Why	Relative	Topicalization	Embedding
19-19.5	✓			0	0		0	0	0
20	✓	✓	✓	✓	✓		0	0	0
21	✓	✓	✓	0	✓		0	0	0
22	✓	✓	0	✓	✓		0	0	0
23	✓	✓	✓	✓	✓		0	0	✓
24	✓	✓	0	✓	✓	✓	0	0	✓
25	✓	✓	✓	✓	✓		✓	✓	0
26	✓	✓	0	✓	✓	✓	0	✓	✓
27	✓	✓	✓	✓	✓		✓	✓	✓
28	✓	✓	✓	✓	✓	✓	0	✓	✓
29	✓	✓	0	0	✓		✓	✓	✓
30	✓	✓	✓	✓	✓	✓	✓	✓	✓
31	✓	✓	✓	✓	✓		✓	✓	✓
32	✓	✓	✓	✓	✓	✓	✓	0	✓
33	✓	✓	0	✓	✓	✓	✓	✓	✓
34-35	✓	✓	✓	✓	✓	✓	0	0	✓

Table 4: Growing trees: longitudinal data – Leor

LEOR	STAGE 1			STAGE 2		STAGE 3				
AGE	SV simple	SV unacc	VS unacc	WH	y/n	why	relative	topicalization	embedding decl	embquestions
21-21.5	✓	0	✓	0	0	0	0	0	0	0
22-22.5	✓	0	0	0	0	0	0	0	0	0
23-23.5	✓	✓	✓	✓	✓	0	0	0	0	0
24-24.5	✓	✓	✓	✓	✓	0	0	0	0	0
25.5-26	✓	✓	✓	✓	✓	0	✓	✓	0	✓
26-26.5	✓	✓	✓	✓	✓	✓	✓	✓	0	✓
27-27.5	✓	✓	✓	✓	✓	0	0	✓	✓	0
28-28.5	✓	✓	✓	✓	✓	0	✓	✓	✓	✓
29-29.5	✓	✓	✓	✓	✓	0	0	✓	✓	✓
30-30.5	✓	✓	✓	✓	✓	0	✓	0	0	✓
31-31.5	✓	✓	✓	✓	✓	0	✓	✓	✓	✓
32-32.5	✓	✓	✓	✓	✓	0	0	✓	✓	✓
33-33.5	✓	✓	✓	✓	✓	0	✓	✓	✓	✓
34-34.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35-35.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
36-36.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

4.5 *Not only structure: Intervention locality*

A considerable body of experimental work shows that in many languages, including Hebrew, children cannot understand and produce certain object relative clauses, object topicalization structures, and object Wh questions before age 6 (Correa 1982, 1995; de Vincenzi 1991; de Villiers et al. 1994; McKee et al. 1998; Stavrakaki 2001; Friedmann & Novogrodsky 2004; Friedmann, Belletti & Rizzi 2009; Belletti and Contemori 2010; Belletti et al. 2012; Costa et al. 2011, 2014; Biran & Ruigendijk 2015; Bentea 2016). The results that emerged from the spontaneous speech samples seem *prima facie* to contradict these earlier findings, in two important ways. Firstly, these three structures appear early in our samples, with some children producing object questions as early as one year and a half, and some producing object relatives and topicalization structures around age two and a half. Secondly, whereas previous work consistently found subject-object asymmetries, with object dependencies significantly harder to understand and produce than subject ones, the natural data samples showed that subject- and object relatives appear together, and so do subject- and object questions.

How can these seemingly contradicting data be reconciled? We propose that, in fact, there is no contradiction here, but rather a new piece added to the puzzle. In earlier work (Friedmann, Belletti & Rizzi 2009), we proposed that the problem with object A-bar dependencies is not a problem with the A-bar movement or a problem with the object dependency *per se* but rather the problem resides in intervention locality considerations: the difficulty arises in configurations in which a lexically-restricted object DP moves across another lexically-restricted subject DP, an intervention configuration problematic for children, a difficulty captured by the featural Relativized Minimality approach (Friedmann, Belletti & Rizzi 2009; building on Rizzi 1990, 2004; Starke, 2001).

And indeed, a further analysis of the spontaneous speech samples points exactly in this direction: The children produced many A-bar structures, including subject and object relatives, topicalizations, and Wh questions, and from age 3;3 all of them did, but none of the

relatives, topicalizations, and Wh questions in the samples included an intervention structure of the relevant type, with a lexically restricted DP crossing another one.
Instead, all the object dependencies that the children produced were structures without intervention. The object relatives they produced included a pronominal intervening subject, in the form of an arbitrary plural null subject (example (17)), or a referential (null/overt) subject pronoun (examples (18) and (19) respectively). Children also produced free object relatives at this stage (9 of the 14 children who produced object relatives).

(17) Object relative with arbitrary pro subject: ze oxel she-notnim b-a-te
This food that-(arb pro)-give-pl in-the-tea
(18) Object relative with null pro subject: hine ha-gorila she-macat
Here the-gorilla that-(pro)-found-2nd-sg-fem
(19) Object relative with pronoun subject: ani ekax od cura she-ani roce
I take-future another form that-I want

For Wh questions, intervention occurs when the Wh element is of the *which* type, and hence, lexically restricted and the subject also is lexically restricted. The object questions that appeared in the samples were mostly *who/what* questions, and the few *which* questions, which were only produced by the older children, included a pronominal (null or overt) subject (example 20) (many other utterances included "which", but in a simple *which*-NP structure, like "*which* orange?").
(20) eize tinok nasim po levad
which baby (arb pro) put-future-pl here alone
"which baby shall we put here alone?"

Crucially, none of the sentences with object dependencies that the participants produced included a lexically-restricted DP crossing another lexically-restricted DP.

Is it the case that children simply do not use two lexically restricted noun phrases in the same clause, irrespective of the structure? Well, no. That this is not the case can be shown by the fact that 12 of the 20 children who produced subject relatives did so with a lexically restricted relative head and a lexically restricted object, hence with two lexically restricted DPs but not in an intervention configuration (see example (21). For a similar result in Italian see Martini et al. 2018).

(21) Subject relatives with two lexically restricted DPs:
dag be-ceva kesef she-lo maca lo xaverim
Fish in-color silver that-no found for-him friends
"A silver colored fish that hasn't found any friends"

Is it the case that children avoid lexically restricted subjects? Again, no, in their simple SV sentences, 45 children produced lexically restricted subjects.
The fact that we found object relative clauses, object questions, and topicalizations and no subject-object asymmetry is therefore fully consistent both with the growing trees approach and with the approach in terms of locality and intervention.
In fact, this points to another dimension of acquisition: acquisition is not just tree structure growing. Rather, we postulate here another developmental stage (which may be called "Stage 4"), having to do with the development of the ability to compute intervention configurations.

The finding that children in our corpus did not spontaneously produce any intervention structure, even though they did produce so many object dependencies, lends strong support in favour of the intervention approach. It also supports the independence of this developmental dimension from structure building: the tree can be grown, and thus be able to host the relevant landing site positions of an A-bar dependency, but on top of it, the child has to be able to compute intervention locality.

4.6 The developmental sequence

If we now integrate the intervention effect just observed with the previous observations, we come up with the following developmental sequence in terms of types of merge operations (external and internal merge):

1) In the first stage we have identified, both External and Internal Merge are available, but the only observed case of internal merge is A-movement targeting the subject position (as shown by the availability of A-movement with unaccusative verbs). No A-bar movement is available yet.
2) In the second stage, the structure of the lower field of the LP, including the landing site of root questions, becomes available. This allows for the production of (bare) argument and some adjunct Wh questions, as well as root yes/no questions. The position Mod is also available, allowing for the production of preposed adverbs. At this stage, however, A-bar constructions such as relative clauses and topicalization are not available, as the higher zone of the LP involving their relevant landing sites is not accessible, and neither is sentential embedding.
3) At the third stage the structure of the higher LP becomes accessible, permitting embedded clauses to be selected by a higher predicate, and different kinds of A-bar-movement to the higher field. This allows for the production of embedded declaratives and questions, subject- and object relative clauses, (root) object topicalization, and (root) *why* questions. The intervention configuration is still not computed.
4) A fourth stage may be identifiable, not on the basis of tree-structural properties but of locality: in this stage the computation of locality allowing for the featural configuration of inclusion becomes available (in terms of the analysis of Friedmann, Belletti & Rizzi 2009), thus permitting configurations in which a lexically-restricted DP can be A-bar moved across another lexically-restricted DP.[23] (As our children were six years old and younger, we do not have evidence of this later stage in the data presented here).

4.7 An open question: Is there a stage earlier than Stage 1?

Stage 1 of the stages of acquisition of the syntactic tree we presented so far involved a tree consisting of both VP and IP. An open question is whether a stage exists which precedes this Stage 1, that includes an even smaller chunk of the syntactic tree. Three hypothetically

[23] Further stages are possible if other observations and considerations are taken into account. For instance, a possible fifth stage may be identified in which center-embedded relative clauses that is, relative clauses modifying the subject, become available as well. Whereas in Hebrew, for example, final-branching object relatives (in the intervention configuration with two lexically-restricted DPs) are acquired around age 6-7, center embedded relatives (with the relevant intervention configuration), are only mastered around age 10-11 (Friedmann & Novogrodsky 2004 and references therein). This fifth stage may also be the stage in which relative clauses in German and Turkish are acquired (Ruigendijk & Friedmann 2017; Güven & Friedmann 2019).

possible stages preceding Stage 1 are imaginable. Below we describe each of them and address their hypothetical defining properties.[24]

a) A pre-functional stage of bare VP without IP. One option for a pre-Stage 1 stage would be one in which only a bare VP is available, without the IP layer. Such a "pre-functional" stage, with no functional structure (as in Radford 1990, 1992, 1995), would allow the child to produce SV(O) sentences for transitives and unergatives. Predicting whether or not the child would be able to produce SV for unaccusatives would depend on the assumptions one holds with respect to the derivation of SV with unaccusatives: if the internal argument first moves to the edge of VP and then continues to spec IP, SV with unaccusatives would be possible as well. If, in contrast, movement from the internal argument position targets the spec IP directly, then presumably only the VS order would be available at this early stage for unaccusatives (possibly, with observable definiteness effects, given the early sensitivity to such effects: Belletti & Bianchi 2016; Belletti 2017[25]).
More straightforwardly, the hypothetical non-availability of the functional structure of the clause will also have implications for inflection: under the assumption that inflectional specifications such as, in particular, agreement with the subject in Phi features, and also tense inflection on the verb, require licensing of the inflected verb by the appropriate head(s) in the inflectional field, in a hypothetical stage without functional structure, the verb would not be properly inflected.

b) A stage of only lower functional layers above VP. Another option for an early stage preceding our Stage 1 is a stage in which VP is available, together with only lower functional layers (e.g., aspect but not tense in the Cinque 1999, hierarchy), but not including higher IP layers up to the position typically occupied by pre-verbal subjects in the adult system (i.e., Spec SubjP, as in Cardinaletti 2004; Rizzi 2006; Rizzi & Shlonsky 2007). In such a hypothetical stage, the verb would be only partially inflected (e.g., for Aspect, but not for Tense or Agreement. See Antinucci & Miller 1976; Salustri et al. 2004; see also Tsimpli 2005, for findings regarding Asp acquired before Tense). Similar considerations as in a) above would apply for whether the child would be able to produce SV with unaccusatives.

c) *A stage of structure without movement?* A different type of possibility for a stage preceding our Stage 1 might be that the structure (VP+IP) is available but movement is not available yet. Internal and external Merge differ in the need of a preliminary search operation, which is only required in internal Merge. A hypothetically possible situation, then, would be that at an early stage, Merge is acquired but Search is not acquired yet. In this situation, structure building (external merge) will be available but movement (internal merge) will not. There could be a stage, then, in which children already have SVO for transitives, SV for unergatives, as these require structure building but no (explicitly visible) movement, but presumably only VS for unaccusatives, as SV with unaccusatives requires movement from the internal argument position to a higher spec position (with a result similar to a) and b) above). The non-availability

[24] If there is a one-word stage, which would correspond to a "terminal-only" stage, which does not include pre-syntactic devices (Bottari, Cipriani & Chilosi 1993), this could be a pre-functional stage. However, once pre-syntactic devices are present, a pre-functional stage becomes unlikely.
[25] To simplify the issues, here we have stated this hypothesis in terms of VP structures; if v-VP structures are systematically assumed, the options ramify further.

of movement will also have implications for inflectional specifications on the verb, under the assumption that these are licensed through verb movement. In such a hypothetical stage without movement, the verb would most likely not be properly inflected.

In our data, we have not seen any of these hypothetical stages preceding Stage 1– none of the children showed the patterns expected under any of the three: We did not see a stage in which unaccusatives appeared only in VS order – there were no children who only produced unaccusatives in the VS order, without the SV order, contra possibility c) (and also, under certain assumptions of the movement of the internal argument, contra a) and b)).
Additionally, there is evidence that the agreement system is functioning, even for the children who were in the earliest stage of acquisition in our study, as we did not see children who made (number) agreement errors in SV sentences.[26] This means that the functional structure that is responsible for agreement is already in place in their syntactic trees. Under current assumptions, this implies the presence of the relevant functional structure for the checking of agreement.[27]
In conclusion we did not see in our study any of the hypothetical stages considered in this section for a lower chunk of the tree acquired before Stage 1. This does not necessarily mean they do not exist, as it could be the case that their transition to the next stage is so short that our corpus study could not catch them (Radford 1996). It is fair to conclude, though, that we did not find any evidence supporting them.

5 General Discussion

Our research is based on a dialogue between two research domains: the study of the fine details of syntactic structures within the cartographic perspective, and the empirical study of the acquisition of syntax. We have illustrated how this dialogue can be fruitful for both trends of study. Cartography offers a detailed characterization of the functional sequences that constitute major zones of the clausal structure. Such finely articulated representations can offer a structural basis to understand the stage-by-stage unfolding of syntactic development. Reciprocally, the study of acquisition can offer new types of evidence to consolidate and refine cartographic results, and also to address questions that are difficult to adjudicate in purely structural terms by just looking at adults' linguistic data.

[26] In both SV and VS order we have seen some gender agreement errors (10 children produced subject-verb gender agreement errors, not only children who were in Stage 1), which could be a result of the fact that the abstract gender specification of the nouns is not yet fully known to the children (12 children also made noun-adjective gender agreement errors). This contrasts with number agreement, which never occurred in SV structures (just in VS structures), which may be related to the fact that number agreement is a reflex of a relation in the functional structure rather than of a lexical property. And this functional structure is already in place (See the converging conclusion for in Italian in Guasti 1993/1994). In VS orders with unaccusative verbs we did see cases of lack of number agreement, which is in line with a very general phenomenon found in many languages, where VS shows optional agreement, whereas SV agreement is obligatory (Guasti & Rizzi 2002; Biran & Friedmann 2013; Meir 2005).

[27] Another indication for the availability of a functional structure at this stage comes from the children's correct production of object case marking. This can be evinced in the finding that in the repetition task all the 23 children who were at Stage 1 produced the accusative case marker "et" correctly before the definite object in simple SVO sentences. (In the samples of natural productions the children at Stage 1 produced too few definite objects to allow for analysis of case markers production).

The fundamental empirical observation that our analysis is based on is that different kinds of structures appear in a strict sequence in the acquisition of Hebrew: A-movement appears first (with unaccusative verbs), followed by Wh movement in Wh questions, followed by A-bar movement in topicalization and relative clauses, appearing concomitantly with the first appearance of clausal embedding. This sequence is somehow obscured if one compares age-based groups, due to a large individual variation in the speed of acquisition. But it clearly emerges through the use of Guttman scales, which are particularly effective in revealing implicational relations between properties. This is the general picture that results from Friedmann and Reznick (this volume), the empirical study on which we have based our analysis. We have adopted, consolidated, and built on these results in view of providing a theory-guided analysis.

5.1 Dialogue: cartography providing a framework for the description of stages in acquisition

The cartographic representation of the left periphery offers a natural structural basis to understand the stage-by-stage development of syntactic structures.

The functional structure is ordered according to a sequence of functional heads. The key hypothesis here is that the tree grows in the child's mind in the sense that external layers are mastered later than more internal ones, respecting the cartographic hierarchy. Children can produce a certain construction only when they master the relevant functional heads involved in it. As for the acquisition of various types of movement, in a probe-goal approach to movement (internal merge licensed by a probe-goal search operation), the availability of the probing head is essential for a certain type of movement to take place, so the typology of movement reduces (in part) to a structural typology. Therefore, constructions involving functional heads in higher zones and types of movement targeting the higher zones are acquired later.

The first stage identified through Guttman scales thus is one in which only IP internal movement is attested (A-movement to subject position, straightforwardly visible with unaccusative verbs). At this stage we also observe agreement licensed by functional structure, SV structures with unergatives and transitives (and nonfinite complements of verbs, footnote 15). No left peripheral position appears to be active in this stage.

In the second stage, the lower part of the left periphery has become available. Cartographic analysis shows that the Q position is in this lower zone, lower than the topic position, the Int position, and the landing site of relative operators. So, Wh movement to the Q position is found in this stage, as well as yes/no questions (which presumably involve an operator in Q) but topicalization and relativization are not. An additional structure acquired at this stage is the preposing of adverbs, which target Mod, another functional head in the lower LP zone.

Whereas Wh questions are found in this stage, *why* questions are not found yet: this follows from the cartographic observation that *why* is hosted in the Spec of the dedicated left peripheral head, Int, higher than Q (Rizzi 2001). Full clausal subordination is also not found in the second stage. This follows from the fact that full clausal subordination requires a fully developed C-system, projecting up to Force, the head that expresses the clause type (declarative, interrogative, exclamative, etc., see Cheng 1997; Zanuttini & Portner 2003) and

is selected by higher selectors. Because the selected head, Force, is not available, full clausal subordination is not possible.

In the third stage, the whole cartographic structure of the C-system becomes available. Selection from a higher predicate becomes possible, as the Force head is now available, so that we observe full clausal subordination. Topicalization becomes available because the Top head is specified in the higher C-zone, according to the structural map in Figure 4. Similarly for relative clause formation. *Why* questions also become available, as the crucial head, Int, is specified in the higher CP zone.

Notice that the relevant generalization cannot be expressed by the distinction movement / no movement, as some of the constructions that become available simultaneously involve movement (topicalization, relativization), and some do not (clausal selection, and plausibly *why* questions). Nor does the distinction main-subordinate construction provide the right partition: whereas the temporal sequence in the appearance of subordinate questions and relative clauses could evoke such a distinction, it clearly is not sufficient to capture the late appearance of topicalization, which can apply in simple main clauses, nor the late occurrence of root *why* questions. Again the right partition is provided by the cartographic structure, with the Q head appearing in the lower CP field, and Force, Top, and Int occurring in the higher field.

Of course, the hierarchical information provided by cartographic analysis can only offer a partial guidance to the sequence of events in development, and interacts with orthogonal factors of complexity. So, for instance, the capacity to deal with certain intervention configurations in which the moved element and the intervener are both lexically restricted (such as certain object relatives and certain object *which* questions) does not depend on the structural position of the landing site in the cartographic representation, but on the capacity to compute certain intervention configurations (the capacity to compute featural inclusion in the system of Friedmann, Belletti & Rizzi 2009; Belletti et al. 2012). Analogously, the delay of passive with respect to A-movement with unaccusatives (in languages in which both are productively present) is plausibly related to a factor independent from the structural hierarchy (possibly the “smuggling” operation required in passive but not with ordinary unaccusatives: see Belletti 2020). So, as it should be expected, a comprehensive picture of developmental effects in the acquisition of syntactic constructions can only be provided by a multiplicity of factors, with the structural hierarchy interacting with independent factors of computational complexity. In this paper we have focused on the structural hierarchy, proposing that the structural sequences uncovered by cartographic research can offer a fruitful explanatory key in understanding the developmental sequence of events in the acquisition of syntax.

5.2 Dialogue: patterns of acquisition informing syntactic theory regarding tree structure

Beside conforming to the cartographic order of functional heads, which we discussed above, the pattern of empirical findings emerging from the repetition test and the analysis of children's spontaneous speech suggests novel insights into several theoretical issues concerning the syntactic tree.

5.2.1 Zone organization of the functional layers

We found that the acquisition of the various heads follows strict principles:
a) They are acquired according to their position in the cartographic tree, where higher layers are acquired after lower ones. There is no head-skipping – a higher layer (which in traditional terms would be defined by an X-bar projection of a certain head) cannot be acquired before all lower layers are acquired.
b) Whereas it would be imaginable that children would gradually increase their ability to hold more and more layers, head after head, this is not what we have seen. Our data crucially indicate that the functional heads are acquired in "zones" or "fields", where several hierarchically ordered sets of functional heads are acquired together. This empirical finding supports the view that the LP is organized into sub-fields (see Benincà & Poletto 2004). Similarly to the no-layer skipping, there can also be no zone-skipping – a higher zone cannot be acquired before all lower ones are acquired.

The empirical evidence provided by acquisition identifies different stages, corresponding to different zones. The first to be acquired is the IP zone, then the LP is acquired in two steps, defining two zones: first a lower LP zone including Fin, Mod, and Q and then a higher LP zone that includes Force, Int, and Top.
In addition to providing new evidence for the split of the LP in different fields, our data provide new evidence for the major divide between an inflectional system (IP) and a left-peripheral system: our Stage 1 is characterized by the presence of the IP system, whereas the left peripheral system has not developed yet.
Whereas the IP-CP distinction is quite generally assumed, the further distinction between the two LP zones suggests a novel look from acquisition to theoretical discussion: it suggests that each of the two LP zones forms some sort of relatively independent organized unit.
This opens an interesting question of what makes several layers form a zone together, and what dictates the exact point where one zone ends and the next begins. The sub-division of the LP is in fact reminiscent of attempts of identifying distinct LP fields hierarchically organized (such as a topic field vs. a focus field etc., as in e.g., Benincà & Poletto 2004). We just notice that it is not straightforward to identify the property defining the upper zone of the LP as a natural class (e.g., as the "topic field" terminology would suggest) because it includes topics, force markers (embedding markers), and operators such as yes/no operators (in embedded questions), relative clause operators, and *why*, creatures of very different natures.
Furthermore, it would be interesting to see if this division also has a phase correlate, an issue that we leave for future research.

5.2.2 Main Yes/no questions involving an operator in Q

A further issue that the acquisition data shed some light on is the way in which main yes/no questions are expressed in the clausal structure. We showed that the acquisition data can decide between three possibilities for main yes/no questions: an operator in IP, and operator in the lower LP field (in Spec Q), or an operator in the higher LP zone, in Spec-Int. The results, indicating that root yes/no questions are acquired together with root Wh questions pointed to an operator in Q as the appropriate analysis.

5.2.3 Support for the position of *why*

Our results also directly bear on the special status of *why* with respect to other Wh elements. The finding that *why* questions appear in Stage 3, later than other root Wh questions, which appear in Stage 2, and together with other structures residing in the higher zone of the LP,

directly supports the view that *why* occupies a special position in the higher zone of the LP (Rizzi 2001).

In conclusion, our study shows a fruitful dialogue between acquisition and syntactic mapping. We used cartographic insights as a detailed tool to understand the stage-by-stage unfolding of acquisition. Cartographic representations further allowed us to derive new predictions about acquisition that we then examined empirically. Reciprocally, data from development offered new evidence bearing on the cartographic organization, allowing us to adjudicate between alternative analytical hypotheses, and also raised new questions to further explore in the future.

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Appendix A: A description of the data sources from Friedmann & Reznick (this volume) which are studied and reanalyzed here

Our interpretation of the pattern of results in Friedmann & Reznick (this volume) and the new analyses of the raw data from that paper, which are presented in the current paper, were performed on three types of data: a sentence repetition task, a corpus of 56 children, and a longitudinal database of two children. The data are described in detail in Friedmann & Reznick, and here we only provide the essential characteristics of the groups, the methods, and the nature of analysis and samples so that all information needed in this paper can be found in this Appendix. New data and analyses are described in detail in the body of text.

The sentence repetition data: 60 children repeating 80 sentences
A task of sentence repetition which included 80 sentences was administered to 60 children (with a total of 4800 sentences). The study was briefly described in Friedmann & Lavi 2006, and presented and analysed in detail in Friedmann & Reznick (this volume). The experimenter said a sentence and the child was requested to repeat it as accurately as possible. The test included eight types of structures, with 10 sentences per structure: structures with A-movement sentence with unaccusative verbs in SV order, three types of sentences derived by A-bar movement: subject- and object relatives and topicalization structures, and sentences verb inversion in adverb-VS order with unergative and transitive verbs. The test also included and matched SV sentences with unergative and transitive verbs.

The participants were 60 monolingual typically-developing Hebrew-speaking children aged 2;2-3;10. The analysis tested, for each child and each sentence structure, whether the child was able to repeat correctly at least 8 of the 10. Then, for each child, a map of the sentence structures that were repeated correctly and those that the child was unable to repeat was created. The results yielded consistency within movement type and graded acquisition between movement types. Structures that involve the same type of syntactic movement (A, A-bar, V-C) were acquired together – each child either succeeded or failed to repeat all of them. A Guttman Scale emerged from the patterns of repetition according to which some children were only able to repeat A-movement structures (and simple sentences), others could repeat both A-movement and A-bar movement structures, and some children could repeat A, A-bar, and V-C structures. There was no correlation with age, and no children who could repeat V-C without A-bar movement, nor children who could repeat A-bar movement without A-movement.

Spontaneous speech corpus of 56 children

For the analysis of the corpus of 56 children, Friedmann & Reznick (this volume) selected samples of the spontaneous speech of 56 children aged 1;6-6;1. The main criterion for selection of samples was that they will be large enough, so that they allow not only for the appearance of a structures that the child has already acquired, but also so it will be reasonable to conclude that if a certain structure did not appear in the sample, the child probably has not acquired it yet. The children who were 2;5 and older had an average of 151 utterances per sample (SD = 37); Some of the youngest children, aged 1;6-2;3, produced fewer utterances. So only samples in which the children had enough opportunity to produce utterances were included: sample with 50 clauses or less were included in the analysis only if they resulted from interactions that involved at least 100 turns. The average number of turns in samples

with 50 clauses or less was 148. For the sake of comparability of the samples, we also limited the size of the samples that had more utterances to the first 200 utterances. The total number of utterances in the 56 samples was 6400. Friedmann & Reznick analysed, for each sample, whether a list of structures appeared at least once in the sample. The examination of order of acquisition within the corpus relied on a corpus wide analysis of the appearance of structures: if a structure A appeared either alone or with structure B, but structure B did not appear in samples without structure A, we concluded that structure A was acquired before structure B.

Longitudinal corpus of two children

To examine the patterns of acquisition within a single child, Friedmann & Reznick (this volume) analysed the spontaneous speech of 5 children who were recorded several times. In the current paper we selected the two children for whom the data base is the richest: Hagar and Leor. Hagar was recorded 114 times between the ages of 1;7–2;11, with an average of 219 utterances per sample. Leor was recorded 79 times between 1;9–3;0, with an average of 297 utterances per sample. The total number of utterances analysed for these children was 16,002.

In the longitudinal data we could look for each child, we analysed the structures that already appeared in their sample, and looked for a relative timeline of acquisition of the various structures between children.