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Intervention effects in grammar and language acquisition

Abstract: Intervention effects have been thoroughly studied in formal syntax in the domain of weak islands. They also have recently been appealed to in the study of language acquisition, to capture certain difficulties that young children manifest in the mastery of some object A'-bar dependencies (relatives, questions, topicalizations). Can one unify such distinct utilizations of the concept of intervention under a single formal locality principle? This paper explores the possibility of a unitary approach by proposing solutions for observed discrepancies between the effects in adults and children, and more generally between the different utilizations of the concept of intervention in recent work on adult grammar and language acquisition. Relativized Minimality (RM) is seen as a formal principle penalizing configurations as a function of the distinctness between target and intervener in local relations, where distinctness is precisely expressed as a grammar-based notion. A unitary system consisting of RM and an explicit distinctness hierarchy is argued to be operative in intervention effects in grammar and language acquisition.

Keywords: Syntax, Locality, Intervention, Relativized Minimality, Weak Islands, Relatives, Language Acquisition

1 A unitary approach to intervention effects

Intervention effects have been classically explored in formal syntax in connection with weak-island phenomena: extractions from structural environments such as indirect questions give rise to degraded results (see Szabolcsi 2005 for an overview). In the recent literature, though, other empirical domains have been analyzed as crucially involving intervention effects. For instance, the difficulties that language learners (and speakers affected by language-related pathologies) manifest in producing and comprehending certain object A'-dependencies (object questions, object relatives, object topicalizations) have

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been traced back to intervention. Along similar lines, experimental work in psycholinguistics has shown that such object A'-dependencies are more difficult to process for adult speakers than the corresponding subject A'-dependencies.

These intervention effects have been observed in different populations (adults, children, individuals with language-related pathologies) and through different methods (grammaticality judgments, experiments of comprehension and production, etc.). Do such distinct manifestations of intervention constitute a unitary phenomenon, at least in part? In this paper, I would like to illustrate some results of a research program which explores this question. The research strategy is to take as a starting point the formal linguistic principle which was designed to capture weak-island effects (and other properties of adult grammar), Relativized Minimality (RM; Rizzi 1990, 2004) and try to extend it to the other domains just mentioned (along lines explored by Grillo 2008 with agrammatic patients, Friedmann et al. 2009 with language acquisition, and much recent literature generated by these references). The goal is to find out how far one can go through a unified approach to these empirical areas.

2 Constraints on extraction from weak islands

In languages like English, extraction of a wh-element from an indirect question gives rise to a strongly degraded sentence, compared to extraction from a declarative:

(1)   What do you think John bought __?

(2)   * What do you wonder who bought __?

A traditional intervention approach to this contrast appeals to RM, a principle barring local relations (such as links of movement chains) across an intervener of the same type as the target of the relation, given the appropriate typology of positions. In (2), *who*, a question operator like *what*, determines the intervention effect.

In current theoretical approaches, two kinds of locality principles are assumed: **intervention** locality, expressed by the appropriate version of RM (or its derivational equivalents, such as Chomsky's 1995 Minimal Link Condition), and **impenetrability** locality, expressed e.g. by the Phase Impenetrability Condition in Phase Theory (Chomsky 2001 and much subsequent work; on the two concepts of locality, see Rizzi 2009, 2013b).

Intervention locality provides an intuitively natural line of analysis for (2), but before developing that, it is worthwhile to ask the question of whether the ill-formedness of (2) could (also) be imputed to a violation of Phase Impenetrability.

A Phase Impenetrability analysis of this kind of weak islands would be possible through the assumptions that (1) Complementizer Phrase (CP) is a phase, and (2) a single Spec position is available as an escape hatch in the CP edge, so that, if the Spec of the Phase corresponding to the embedded CP in (2) is filled by *who*, the other wh-element *what* has no escape hatch available for extraction. But such an analysis is not very plausible for several reasons. One clear reason is that the deviance of extractions from weak islands ranges from high to low. This gradation would be unexpected under a phase-theoretic approach, which can only express binary distinctions (either a certain derivation satisfies Phase Impenetrability, or it does not), whereas it may be naturally expressible under RM, along lines which we will discuss shortly. Moreover, if one adopts a cartographic analysis of the CP system, the wh-element in an embedded question does not sit in the Spec of Force (plausibly the phase head), but in a lower zone of the left periphery (see Rizzi 1997, 2013a for crosslinguistic evidence). So, the edge of the phase (Spec of Force) would remain available for extraction. Even putting aside problems with the fine cartographic structure of the CP and adopting "abbreviated" representations with a single CP node, as in much recent minimalist research, the assumption of a unique Spec of C would conflict with standard minimalist analyses, which typically assume the option of multiple specifiers; but then, an escape hatch at the edge of the embedded CP would remain available for the wh-element to be extracted in (2). For these reasons, I will henceforth assume that (2) is excluded by intervention locality, not by impenetrability.

I will assume the following core version of the intervention principle (to be revised later on):

(3) Relativized Minimality:
   In the configuration ... X ... Z ... Y ...
   a local relation connecting X and Y is disrupted when there is a Z such that
   i.   Z is of the same structural type as X, and
   ii. Z intervenes between X and Y   (Rizzi 1990, 2004)

A proper implementation of the principle requires a characterization of what "intervenes" means, and a definition of the structural typology identifying the elements which act as interveners. Various considerations must be taken into account, which I will illustrate in the following sections.

2.1 Hierarchical vs. linear intervention

The intervening element must intervene hierarchically, not just linearly. So, from a baseline sentence like (4)a, extraction of the temporal adjunct *when* is ill formed, as in (4)b, whereas from a baseline like (5)a, movement of *when* is possible, as in (5)b:

(4) a. Bill wonders who left **at five**
     b. *__*When*__ [does Bill wonder [__*who*__ [left ___]]]]

(5) a. The uncertainty about who won dissolved **at five**
     b. __*When*__ [did [the uncertainly [about [__*who*__ won]]] dissolve ___]?

The difference here is that *who* intervenes between *when* and its trace hierarchically in (4)b, in that *who* c-command the trace but not *when*. On the contrary, in (5)b *who* intervenes only linearly, not hierarchically, as it is buried within the complex subject Determiner Phrase (DP). So, this kind of contrast supports a hierarchical definition of intervention, along the following lines:

(6) Z intervenes between X and Y if Z c-commands Y and Z does not c-command X.

Under (6), *who* is not visible as an intervener in (5)b, hence the structure is predicted to be well-formed.

Drawing from much work in the antisymmetry tradition (Kayne 1994 and subsequent work), Kayne (2018) has recently argued that syntactic representations involve linear as well as hierarchical organization (i.e. linear order results not only from a post-syntactic linearization operation, but directly from core syntactic operations like merge). If this is correct, and linear properties are accessible to grammatical principles, one may expect a residual deviance also in cases of purely linear intervention. Is this residual deviance empirically supported?, i.e. is (5)b perceived as (residually) more deviant that corresponding structures without linear intervention (e.g. something like *When did the uncertainty about the result dissolve?*)? This is an area in which controlled acceptability judgments with methods such as those illustrated in Sprouse (2007) and Sprouse, Schutze & Almeida (2013) may be of relevance (see Section 2.3). In this connection, it may be worth mentioning that Franck et al. (2006) and Franck et al. (2007) found both linear and hierarchical interference effects in elicited production of agreement, with significantly stronger effects

with hierarchical intervention, but observable effects also with purely linear intervention.

In the lack of more refined evidence bearing on wh-extraction, I will continue to focus on purely hierarchical intervention, as resulting from (6), and will leave the possibility open of (weaker) linear intervention effects.

2.2 The class of interveners is featurally selective

The initial typology of positions for phrasal movement was the traditional distinction between A-positions and A'-positions (Rizzi 1990). This led to the expectation that every intervening position would induce a minimality effect on any form of A'-movement, but this characterization turned out to be too coarse. For instance, whereas quantificational adverbials like *beaucoup* (a lot) in French would determine an intervention effect on *combien* extraction from the direct object, manner adverbials like *attentivement* (carefully) would not (Obenauer 1983, 1994; Laenzlinger 1998):

(7)   * Combien a-t-il beaucoup consulté [___ de livres] ?
       'How many has he a lot consulted of books ?'

(8)   Combien a-t-il attentivement consulté [___ de livres] ?
       'How many has he carefully consult of books ?'

Analogously in Italian and many other languages a (Clitic Left Dislocated) Topic can freely escape from an embedded clause introduced by a corrective focus, or from a wh-island:

(9)   A Gianni, credo che QUESTO gli volessero dire (non qualcos'altro)
       'To Gianni, I believe that THIS they wanted to say'(not something else)

(10) A Gianni, non so proprio che cosa gli volessero dire
       'To Gianni, I really don't know what they wanted to say'

Conversely, certain cases of A'-movement, e.g. in relative clauses, seem to be able to freely move across a topic:

(11) Ecco una persona a cui penso che, queste cose, non le dovremmo mai dire __
       'Here is a person to whom I think that, these things, we should never say'

All these cases presumably involve A'-specifiers. So, some A'-specifiers do not induce minimality effects on cases of A'-movement, which shows that more fine-grained distinctions than the simple A/A'-typology are needed.

In Rizzi (2004), this point was addressed (building on Starke 2001) through the proposal that, in the calculation of intervention, RM takes into account morphosyntactic features defining syntactic positions (the approach is then sometimes referred to as "featural Relativized Minimality", or fRM). If we focus on specifier positions, the typology will be provided by the features determining external or internal merge of the specifiers. Moreover, morpho-syntactic features are organized into feature classes, such that minimality effects are found within the same feature class, but not across classes. So, the wh-phrase and the manner adverbial belong to two distinct feature classes (in the original terminology, the operator class and the modifier class, respec-tively, the latter including features which license adverbial positions in an approach to adverb syntax like the one developed in Cinque 1999), so that no minimality effect is found in (8). On the other hand, the wh-element and the quantificational adverbial *beaucoup* share an operator feature, and this gives rise to a minimality effect in (7). Topics are licensed by the feature Top, which forms a feature class of its own, so that topics (at least, topics of the Italian kind) do not trigger minimality effects on operator chains nor are they affected by intervening operators, as shown by the well formedness of (9), (10) and (11).

2.3 Graded judgments

One important property of weak-island environments is that they give rise to graded judgments, depending on the nature of the extracted element and of the intervener. One classical observation is that all other things being equal, wh-phrases corresponding to arguments are more easily extractable than wh-phrases corresponding to adjuncts (Huang 1982):

(12) a. ? Which problem do you wonder how to solve __ __?
     b. * How do you wonder which problem to solve __ __?

Of course, these examples differ in several respects. Not only is it the case that *which problem* is an argument whereas *how* is an adjunct: another potentially crucial difference is that the first is complex, and contains a lexical restriction, the noun *problem*, whereas the second is a bare wh-operator. Here, I would like to focus on the relevance of the lexical

restriction. A more minimal comparison between a bare and a lexically restricted wh-element shows a systematic, if slight, preference for the latter in extraction contexts:

(13)   a. * What do you wonder who could buy __ ? __
       b. ?? What book do you wonder who could buy __?

This preference was quantitatively assessed in Villata, Rizzi & Franck (2016) in French: linguistically naïve speakers assigned on average 2.7 points to the equivalent of (13)a and 3.6 points to the equivalent of (13)b in a 7-point Likert scale. The preference is slight, but systematic and reproduced in distinct experiments with different scales. The paper also shows that the amelioration effect in (13)b is independent from D(iscourse)-linking (Pesetsky 1987, 2000), another factor that is often assumed to play a role in the acceptability of weak-island violations: in an experiment in which both lexically restricted and bare wh-elements were contextually D-linked, contrasts of the type (13)a–b were preserved. Acknowledging the fact that other factors have a role (the argument–adjunct distinction, with additional gradations between different kinds of adjunct, Rizzi 1990:91; D-linking; contrast, Lahousse et al. 2014, the finite or non-finite status of the wh-island; etc.), I will focus here on the improvement in acceptability determined by the lexical restriction.

2.4 Gradations of acceptability as a grammatical phenomenon

At this point, the analysis is confronted with an important conceptual issue. Grammatical principles are typically expressed in binary terms: either a structure respects a given principle, and is grammatically well-formed in that respect, or it violates the principle, and is ill-formed. If the grammatical structure is fundamentally binary in this sense, the empirical domain that grammatical hypotheses are built on is typically more complex and nuanced: judgments of acceptability, naturalness, etc. are typically graded, and it is often possible to identify clear gradients of acceptability, such that a given structure A is reliably judged more acceptable than B, which in turn is more acceptable than C, where A, B and C are all judged deviant to some extent, compared to a fully acceptable baseline case D. How can one express such gradations?

A classical approach is to appeal to the competence-performance distinction. Perhaps structures violating a grammatical principle are all marked as deviant by the grammar on a binary (yes, no) basis, and observable differences in degrees of acceptability are a function of grammar-external performance factors. For instance, it could be that ungrammatical structures which are easier to understand, e.g. for the comprehension of theta role assignment (who does what to whom), are perceived as more acceptable than less semantically transparent ungrammatical structures (on this point see Villata 2017).

Understandability or other grammar-external factors may well have a role in modulating acceptability, but there is another possibility to explore. It could be that, in some domain, the grammar offers tools for directly capturing gradients of acceptability. The exploration of this line is not new. A variant of it was proposed as early as in Chomsky (1964), with the notion of grammar-based degrees of grammaticality. And an important part of the discussion on constraints on extraction in Government-Binding analyses (Chomsky 1981) was based on the observation that Subjacency violations are less severe, in terms of acceptability, than Empty Category Principle violations, which in turn implied that certain principles are more "inviolable" than others, a step suggesting again that the pure binary picture was oversimplified.

The next step is the observation that fRM offers particularly promising ingredients for a grammar-based approach to acceptability gradients. We can construe intervention locality as a system that penalizes configurations in which an element is "on the way" in the computation of a local relations, such as the formation of a syntactic chain. The penalty can be linked to the degree of similarity between target and intervener in the local relation: the more similar the intervener, the higher the penalty. How can one define "similarity" in a precise enough way? The featural conception offers a natural grammatical dimension to define the relevant dimensions of similarity. We have seen that the features that are taken into account are morphosyntactic features which define syntactic positions, the features which license external or internal merge; in particular, for specifier positions filled by internal merge (movement), the features which trigger the operation.

We can now look at the set-theoretic relations that may arise between such defining features in the target and in the intervener. Let us consider, in particular, the three set-theoretic relations of disjunction, inclusion and identity. They give rise to a natural ranking of distinctness, expressed by the arrow in the diagram in figure 1:
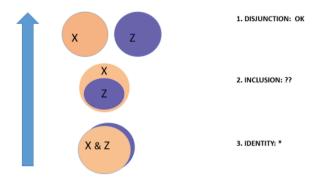
Figure 1: Set theoretic feature relations between x and z in … X … Z … Y… and the distinctness hierarchy.

Given the intervention configuration … X … Z … Y …, let us call X "the target" of the local relation, and Z "the intervener".

Disjunction in relevant features is the case of maximal distinctness: here target and intervener have nothing relevant in common, and no penalty arises. At the opposite, lower side of the scheme we have **Identity**: here the target and in the intervener have all the relevant features in common, hence they are non-distinct, and the maximal penalty arises. **Inclusion** is the intermediate case of distinctness: X has some features distinguishing it from Z, but also some features in common with Z. Here, an intermediate degree of penalty arises.

We may then express these properties through the following revised formulation of fRM:

(14)   Featural Relativized Minimality (revised):
   In … X … Z … Y … a local relation between X and Y is disrupted when
   1.   Z c-commands Y and Z does not c-command X (intervention configuration).
   2.   Z matches X in terms of Relevant Syntactic Features (RSF).
   3.   The degree of disruption is a function of the featural distinctness of X with respect to Z, in accordance with the distinctness hierarchy.

Again, "Relevant Syntactic Features" are syntactic features which define syntactic positions, by licensing applications of external and internal merge.

Let us now illustrate the functioning of the system in connection with the graded acceptability in cases of extraction from an embedded domain:

(15) a   What do you think he could buy __ ?   Disjunction
           +Q

      b ?? What book do you wonder who could buy __? Inclusion
           +Q+N   +Q

      c * What do you wonder who could buy __?   Identity
           +Q   +Q

Example (15)c involves a case of identity, as both target and intervener are characterized by the +Q feature: here target and intervener are minimally distinct, hence a strong level of disruption arises. In (15)b, under the assumption that the lexically restricted character of the phrase is expressed by +N (and that this specification is relevant in the calculation of locality: on this see Section 3), the target properly includes the featural specification of the intervener. This is the intermediate degree of distinctness between target and intervener, giving rise to a partial disruption. Finally, in cases of extraction from a declarative like (15)a, we have potential interveners, the main and embedded subject positions, which are disjoint from the target (in terms of the features taken into account here). No locality-based disruption arises here, and in fact the structure is fully acceptable.

Other set-theoretic relations may be relevant here. In Villata et al. (2016) also cases like the following are considered, dubbed "inverse inclusion", in which it is the intervener's specification which properly includes the specification of the target, rather than the other way around, as in (15)b:

(16) * What do you wonder what student could buy __?   "inverse inclusion"
        +Q   +Q+N

In the controlled acceptability experiment, inverse inclusion turns out to be as degraded as identity (15)c. This is expected, given the formulation of the principle in (14) because X is not distinct with respect to Z in inverse inclusion, much as it is not distinct in the case of identity. This case is important because it shows that what matters is not simply a non-directional distinctness of target and intervener (in which case inclusion and inverse inclusion would be expected to be alike), but the distinctness of the target X calculated with respect to the intervener Z: when the specification of X properly includes the specification of Z, as in (15)b, X is partially distinct from Z, hence an intermediate level of disruption arises. On the contrary, when the specification of Z properly includes the specification of X, as in (16), the target is non-distinct from the intervener (much

as in the identity case), so that a stronger disruption arises. Evidently, the directionality in the calculation of distinctness is crucial here.[1]

3 Relevance of the lexical restriction: Crosslinguistic evidence

Why should the presence of the lexical restriction play a role in modulating intervention locality? According to the featural approach to RM sketched out in the previous sections, the features which are expected to play a role in the calculation of locality are those which participate in the licensing of syntactic positions. I will now review different kinds of evidence showing that the presence of the lexical restriction has clear syntactic effects elsewhere in the grammar, and it participates in defining the exact landing site of wh-movement, so that its involvement in the computation of locality should not come as a surprise. The different kinds of evidence all support the conclusion that, in a fine cartography of the left periphery (Cinque and Rizzi 2010; Rizzi and Bocci 2017), lexically restricted and bare wh-elements may target distinct positions of the complementizer system.

3.1 Positional differences in northeastern Italian dialects

Striking evidence for a positional difference comes from Bellunese and other northeastern Italian dialects studies by Munaro (1999). In the core case, lexically restricted wh-phrases appear at the beginning of the clause, whereas bare wh-elements appear at the end; both cases involve inversion with the subject clitic:

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1 Villata et al. (2016) also analyze cases of "complex identity" like the following, with both target and intervener lexically restricted:

(i) ?? What book do you wonder what student could buy __?   "complex identity"

They would be expected to be as disrupted as bare identity, but in fact in the controlled acceptability experiment they turn out to be less degraded than bare identity, and even slightly less degraded than inclusion. See Villata et al. (2016) and Villata (2017), where different solutions for these cases are proposed and discussed.

Another set-theoretic relation which may be of relevance for intervention locality is intersection, which would be naturally ranked in the distinctness hierarchy in between disjunction and inclusion. Belletti, Brunato, Friedmann & Rizzi (2012) exploit this relation in a crosslinguistic study of intervention in acquisition, in which match/mismatch in number and gender features are also taken into account (on the latter features, see also Adani et al. 2010).

(17) a **Con che tosat** à-tu parlà?
         'With which boy did you speak?'
      b Avé-o parlà **de chi**?   (Munaro 1999)
         'Have you spoken of whom?'

Under Munaro's analysis, both kinds of elements move to the left periphery and trigger subject clitic inversion (notice that (17)b differs from the corresponding French example, arguably involving a genuine "in situ" strategy, in that inversion is triggered). But the two kinds of elements target distinct positions in the map of the left periphery, a higher position (notated +Q+N) for the lexically restricted one, a lower position for the bare wh (notated +Q). Subsequent remnant movement of the Tense Phrase (TP) to the Spec of the intermediate position H determines the clause final position of the bare wh-element in the surface order:

(18)   ... +Q+NP ... H ... +Q .... [$_{TP}$ ....]

3.2 Obligatoriness of inversion in Italian and Portuguese

In Italian, inversion is obligatory with bare wh-elements, whereas lack of inversion becomes possible with lexically restricted wh-phrases (Rizzi 1996, 1997 and Ambar 2003 observe this kind of contrast in European Portuguese):[2]

(19)   * Dove Gianni ha messo le chiavi?
         'Where Gianni put the keys?'

(20)   In che cassetto Gianni ha messo le chiavi?
         'In which drawer Gianni put the keys?'

From this viewpoint, lexically restricted wh-phrases pattern with *perché* (why), which also does not require inversion:

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2 The contrast is clear with PP's. When DP's are wh-moved, the contrast is less sharp, with inversion strongly preferred also with lexically restricted wh-phrases in my judgment:

  (i) a * Chi Gianni ha presentato a Maria?
         'Who Gianni introduced to Maria?'
      b ? Quale ragazzo Gianni ha presentato a Maria?
         'Which boy Gianni introduced to Maria?'

So, both the presence of P and of a lexical restriction facilitate the lack of inversion. Here I am only addressing the second factor (on the role of P, see Greco 2013).

(21)   Perché Gianni ha messo le chiavi nel cassetto?
        'Why Gianni put the keys in the drawer?'

In previous work, I proposed that *perché* occupies the Spec of Int, a functional head also hosting the embedded yes–no marker *se* (if) and occurring higher than Q in the map of the left periphery. In the original analysis, this head is inherently endowed with an interpretable interrogative feature, which does not require checking through T to C movement, whereas the lower +Q position does require checking. If a lexically restricted element targets a higher position +Q+N in the complementizer field, it may also benefit from the high interpretable interrogative feature and be exempted from checking (and inversion):

(22)   ... +Q+N ... Perché Int ... +Q ... [$_{TP}$ ...]

That the lexically restricted position is higher than the bare position is also, and more directly, shown by the fact that, whereas the bare position is strictly incompatible with left-peripheral focus, the lexically restricted position is (at least marginally) compatible with it, much as *perché*:

(23) a * Dove LE CHIAVI hai messo, non le sigarette?
            'Where THE KEYS you put, not the sigarets?'
      b ? In che cassetto LE CHIAVI hai messo, non le sigarette?
            'In which drawer THE KEYS you put, not the sigarets?'
      c   Perché LE CHIAVI hai messo nel cassetto, non le sigarette?
            'Why THE KEYS you put in the drawer, not the sigarets?'

This pattern follows from a representation like (22) if the position +Q is in fact identical to the focal position, so that a left peripheral focus and a bare wh-element are strictly incompatible, whereas *perché* and lexically restricted elements occupy higher positions, compatible (at least marginally) with a focus position. On the (in)compatibility between these left peripheral positions, see Bocci, Rizzi & Saito (2018).

3.3 Co-occurrence with CP-internal that

Bayer and Brandner (2007) have observed that in Bavarian "phrasal wh" and *why* are natural with a post-wh occurrence of *dass* (that), whereas bare wh-elements are not (with some variation):

(24) I mecht wissen...
      'I want to know...'
      a. ... [was fiar a Hosn] dass a se kafft hod
              'what for trousers that he himself bought has'
      b. ... warum dass a se s'Lebn gnumma hod
              'why that he committed suicide'
      c. ... ?? wen dass a troffa hod
              'whom that he met has'
      d. ... ?* wos dass a gmacht hod
              'what that he done has'

This pattern differs from the one of other varieties (e.g. various Germanic and Romance dialects) in which all wh-elements can (or must) co-occur with *that* (e.g. *wie dat* "who that" in Dutch varieties: Haegeman 1994). Apparently, *that*-like elements are versatile elements which can normally occur in the highest position of the C-system expressing declarative force, but also in a very low position, plausibly expressing finiteness, in varieties permitting *who that* sequences, and also in intermediate positions in cases like (24), where *that* is consistent with high wh-positions (lexically restricted and *why*) and inconsistent with low positions. So, the patterns can be captured by a map like (25):

(25)   .... +Q+N ... warum .... dass ... +Q ...

Notice that a similar pattern is observed in standard Italian, not in questions but in exclamatives: *che* can co-occur with an exclamative phrase, but not with a bare exclamative element (on these constructions see Botteri 2018 and references quoted there):

(26) a Che presidente (che) hanno eletto! E' incredibile!
              'What a president (that) they elected! It's incredible!
      b Chi (*che) hanno eletto! E' incredibile!
              'Who (that) they elected! It's incredible!'

3.4 Elicited production patterns in child English

Adult English does not seem to offer direct evidence for positional differences between bare and lexically restricted wh. Nevertheless, experimental work on language acquisition suggests that learners of English actively explore the option of a positional difference of the kind directly illustrated by other adult languages.

For instance, Thornton (1995) and Guasti, Thornton & Wexler (1995) conducted elicitation experiments with children acquiring English, trying to elicit negative wh-questions. Children clearly resist expressing negation on interrogative *do*. When such structures as (27) are elicited, children try out non-target-consistent structures, a typical case being a reduplication strategy, as in (28):

(27)   What **didn't** the spaceman __ like?   (target structure)

(28)   What **did** the spaceman **didn't** like?   (child production)

Just to fix ideas, I would like to speculate here that the child tries to avoid satisfaction of both the Q-criterion and the negative criterion (Haegeman 1995) through the same element, possibly in the attempt to minimize reconstruction: *didn't* in (27) would carry both the Q and the Neg feature, and its higher occurrence would satisfy the Q-criterion, whereas its lower (reconstructed) occurrence would satisfy the Neg criterion, under Haegeman's analysis:

(29)   What didn't the spaceman Op_{Neg} <didn't>   like?
           +Q+Neg   +Q+Neg

(consider also a certain analogy here with the configuration barred by Wexler's 1994 Unique Checking Constraint).

In the reduplicated structure (28) produced by the child, the two criteria are satisfied by distinct occurrences of *do*, with no need of reconstruction (and/or of multiple checking).

Thornton (1995) and Thornton, Guasti & Wexler (1995) show that reduplication is by and large the only systematic strategy followed by children with bare wh-elements, whereas it alternates with two other strategies with lexically restricted wh-phrases:

(30)   a   What food **did** the spaceman didn't like?
       b   What food   the spaceman didn't like?
       c   What food **that** the spaceman didn't like?

Why do lexically restricted wh-phrases have more options? Thornton (1995) argues that lexically restricted wh-phrases may target a higher position then bare wh-phrases, one which does not trigger inversion and may co-occur with the overt complementizer *that*, whereas bare wh-phrases are forced to occur in a lower position, requiring inversion and inconsistent with *that*.

From the vantage point of the phenomena discussed in the previous sections, it is remarkable that English learners hypothesize non-target-consistent structures

which are in fact used in other languages: uninverted structures like (30)b are akin to the Italian–Portuguese structures discussed in 3.2, and the structures with post-wh *that* in (30)c are akin to the Bavarian structures discussed in 3.3 (as well as to the corresponding Italian exclamatives). What makes the parallel particularly striking is that the "special" options are restricted to complex wh-phrases in both child English and the adult varieties taken into account. The crosslinguistic evidence thus provides strong support for Thornton's analysis. What all this suggests is that the learners of English, trying to avoid costly configurations like (28), revert to Universal Grammar (UG) options which may be selectively available only for certain elements. So, they limit the use of the higher +Q+N position to lexically restricted elements, much as many adult varieties do.

3.5 Languages allowing multiple wh-movement

Languages like Bulgarian and other Slavic languages, and also Rumanian, Hungarian, etc. permit (or require) movement of more than one wh-element to the left periphery in multiple questions. Moreover the movement must reproduce the order of elements within the TP structure, e.g. the subject must precede a complement. The phenomenon is illustrated through Rumanian data (Alboiu 2002; Soare 2009):

(31) a Cine cu cine a votat?
        'Who for whom voted?'
    b * Cu cine cine a votat?
        'For whom who voted?'

Many analyses have been proposed of this ordering preserving constraint ever since Rudin's (1988) original observation (Richards 1997; Boskovic 2002; Krapova & Cinque 2008 a.o.). The relevant point here is that the order can be subverted if the complement wh-phrase is lexically restricted:

(32) Cu care candidat cine a votat?
     'For which candidate who voted?'

Whatever mechanism is responsible for the order preservation constraint (e.g. Richards' "tucking in", or Krapova & Cinque's interpretation of RM, etc.), the special status of lexically restricted elements may be amenable to the fact that they target a special position in the left periphery, distinct from and higher than the positions of bare wh-elements, so that the mechanism imposing order

preservation (whatever its ultimate nature) is not operative. The analysis here is only sketched out and many complications should be taken into account; nevertheless, I believe that this sketch suffices to support the view that there are distinct attractors for bare and lexically restricted elements.

In conclusion, different languages offer a varied array of arguments supporting the conclusion that lexically restricted wh-phrases (+Q+N) target a distinct and higher position than the position targeted by bare wh-elements (+Q) in a cartographic map of the left periphery. This systematic finding in turn supports the view that the specification +N (our notation for the presence of a lexical restriction in the phrase) actively participates in the identification of the landing site of wh-movement. Thus, it is not surprising that the +N feature, syntactically active in the triggering of movement, may be taken into account in the computation of locality, e.g. in modulating the acceptability of extractions from weak islands. In the last decade, the presence of +N has been exploited also in connection with intervention effects in language acquisition, which are reported in the next section.

4 Asymmetries in the acquisition of A'-dependencies

It is a well-established fact that young children understand and produce subject relatives but experience serious difficulties with certain object relatives till relatively late in acquisition (Ferreiro et al. 1976; Tavakolian 1981; a.o.). For instance, Friedmann et al. (2009) showed that, in a picture selection task, a group of children acquiring Hebrew (ages 3;7–4;10) select the right picture at 90% with subject relatives like (33), whereas they are at chance (55%) with object relatives like (34):

(33) Show me the elephant that __ is washing the lion   (90% correct)

(34) Show me the elephant that the lion is washing ___   (55% correct)

Similar results have been found in the acquisition of a number of other languages. In the same paper, Friedmann et al. (2009), it is shown that children in the same age range produce subject relatives under elicitation, whereas they have serious problems in producing object relatives. Similar results on production have been replicated in much recent work, e.g. in Belletti and Contemori 2010, 2012; Contemori and Belletti 2014 in Italian. See Belletti and Guasti 2015;

Martini, Contemori, Belletti, Rizzi 2018, Martini in preparation, for a general assessment. The symmetric problem in comprehension and production suggests that these difficulties are unlikely to be mere parsing problems, and may have a grammatical basis that is reflected in both modalities of performance.[3]

Inspired by Grillo's (2008) approach to similar difficulties in agrammatic aphasics (see also Garraffa 2011), Friedmann et al. (2009) have proposed that the selective difficulties with object relatives like (34) may arise from intervention locality. Consider a representation of (34) like the following:

(35)   Show me the elephant that the lion is washing ___
                        +R+N   +N

                                        (inclusion: 55% correct)

Feature +R is the criterial feature for relatives corresponding to +Q for questions. It marks the relative head. Normal headed relatives are also marked +N, expressing the fact that a lexical (nominal) restriction is present in the head. The subject is also marked +N as in this kind of sentences it is a definite description with a lexical (nominal) restriction.

Friedmann et al. (2009) have put forth the hypothesis that what bothers children in this representation is the intervention configuration, and in particular the feature +N that the target (the relative head) and the intervener (the subject) have in common. In terms of our set-theoretic approach, (35) is an inclusion configuration. So, according to this hypothesis, children would be intolerant to even the partial featural overlap between target and intervener instantiated by (35).

In order to test this hypothesis, we manipulated either the target or the intervener, thus turning the inclusion configuration into disjunction. This could be done by replacing the headed relative with a free relative, as in (36), or by replacing the definite description in subject position with a pronominal element, as in (37)

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3 The grammatical nature of the asymmetry is also supported, among other considerations, by the fact that subject relatives are mastered earlier than object relatives, both in production and comprehension, also in the acquisition of Mandarin Chinese (Hu et al. 2015, 2016). Chinese has the rare typological property of being an SVO language with relatives in which the head follows the relative clause. It therefore represents a perfect case to disentangle linear and hierarchical proximity. The earlier mastery of subject relatives thus suggests that the hierarchical proximity between relative head and gap is the crucial factor, not the linear proximity, as a pure parsing approach could lead one to expect.

On the grammatical basis of the effect, see also Friedmann, Rizzi & Belletti 2016.

(36) Show me who the lion is washing __ (disjunction: 79% correct)
           +R   +N

(37) Show me the elephant that someone is washing __
            +R+N

                                          (disjunction: 81% correct)

In the free relative (36), the inclusion configuration is turned into disjunction by taking off the nominal +N part from the relative head; in (37), the configuration is turned into a case of disjunction by leaving the relative head constant, and by replacing the lexically restricted subject definite description with a pronominal element (in fact, a null pronoun with arbitrary interpretation in Hebrew). In both cases, correct comprehension raises from 55% to 79–81%: still not perfect, but greatly improved, and significantly better than chance. This clearly supports the hypothesis that intervention is the key factor in children's difficulties with structures like (35).

Similar considerations are supported by selective difficulties children experience with lexically restricted object questions. The experimental technique used by Friedmann et al. (2009) in this case is character selection in a single picture:

(38) Subject questions:
      a. Who bites the cat?   (no intervention: 81% correct)
      b. Which dog bites the cat?   (no intervention: 78% correct)

(39) Object questions[4]:
      a. Who the cat bites __?   (intervention, disjunction: 75%)
      b. Which dog the cat bites __? (intervention, inclusion: 58%)

Both *who* and *which N* subject questions are quite well understood, not surprisingly, as there is no intervention configuration in this case. Object questions give rise to a split: *who* object questions are relatively well understood, whereas *which N* object questions are problematic. In the latter case, the representation is the following:

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4 These properties were tested in Hebrew, in which main questions do not involve obligatory inversion, which would add an element of complexity. On subject and object questions in the acquisition of Italian, where inversion applies, see De Vincenzi et al. (1999) and Belletti and Guasti (2015). On the acquisition of French, see Bentea 2016; Bentea et al. 2015.

(40) Which dog the cat bites __ ?
     +Q+N   +N

Again, of the four options illustrated in (38)–(39), the only severely problematic case for children is (39)b, which involves an intervention configuration with a featural relation of inclusion. This supports the hypothesis that the inclusion relation is problematic for children.

    The analysis capitalizing on RM must face two problems, one involving the comparison between the functioning of the locality principle in adults and children, and the other internal to the assumed adult system. The problems are addressed in the following two sections.

5 Problem 1: Discrepancies between adults and children

We have argued that there is a common grammatical basis underlying adults' weak-island effects and children's difficulties with certain object A'-dependencies. But the locality principle assumed to have a causal role in the two domains does not seem to work exactly in the same way in adults and children. Object relatives and object questions like (37) and (39)b, problematic for children, are fully acceptable and usable for adults. So, how can this discrepancy be reconciled with the hypothesis that the same locality principle is involved in both cases?

    In fact, I would like to continue to assume that the grammatical structure underlying these locality effects is exactly the same: there is a single version of RM, operating through the same distinctness hierarchy. What varies is that adults' and children's systems involve distinct cutoff points in an otherwise identical gradient of distinctness. Children are more demanding, only tolerate the optimal case of distinctness in an intervention configuration, disjunction; adults also tolerate inclusion, while rejecting the worst case of distinctness, identity, as shown in Figure 2:
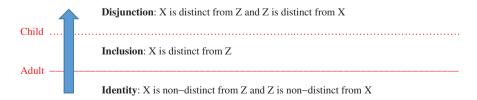

Disjunction: X is distinct from Z and Z is distinct from X

Child ·····

Inclusion: X is distinct from Z

Adult ——

Identity: X is non–distinct from Z and Z is non–distinct from X

Figure 2: The distinctness hierarchy with different cutoff points for adults and children.

In this conception, the same structural principle of locality is indeed involved in adult and child systems, but it is used in a more restrictive manner by children. If we think of intervention locality as a system of penalties associated to the degree of match between Z and X in the intervention configuration ... X ... Z ... Y ..., the child system can be characterized as less tolerant to such penalties. Pursuing this line of reasoning, we may be led to the conclusion that one dimension of development can be seen as the weakening of initially more stringent locality conditions.[5]

6 Problem 2: A discrepancy between two types of inclusion in adult grammar

The second problem is internal to the assumed adult system. Extractions from weak islands like (41) are perceived as degraded, whereas headed object relatives and lexically restricted wh-questions crossing a lexically restricted subject (as in (42)a–b) are fully acceptable for adult speakers:

(41) ??What book do you wonder who could buy __?
      +Q+N   +Q
(42) a What book did the professor buy ___?
         +Q+N   +N
      b This is the book that the professor bought __
            +R+N   +N

In terms of the approach we have developed, both types of structures instantiate an inclusion configuration, and are ranked at the same level of the distinctness hierarchy in Figure 1. So, why is it that inclusion gives rise to a perceived degradation in (41), but not in (42)?

One could try to argue that (41) necessarily involves an extraction from an embedded domain, whereas the two cases of (42) involve A'-movement within the same simple clause, and extraction adds an additional element of complexity to (41). But this is unlikely to be the cause of the perceived degradation: if the

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5 The idea that intervention locality applies more restrictively in children then in adults is somehow reminiscent of Wexler's (2004) approach to the development of impenetrability locality, which also involves a weakening, in development, of an initially more stringent application of phase theory.

examples of (42) are made more complex by adding an extraction step, the acceptability does not seem to be affected:

(43) a What book did you say that the professor bought ___?
         +Q+N   +N
      b This is the book that I think that the professor bought __
            +R+N   +N

A more promising possibility may be offered by the observation that not all syntactic features are equally important for syntactic computations. Consider the two features that we have been focusing on, +Q and +N. +Q is a criterial feature, in the sense of Rizzi (1996, 1997), a feature capable of triggering movement on its own; +N is not criterial, does not trigger movement on its own: it participates in the triggering of movement, as the evidence reviewed in Section 3 shows, but it does so only indirectly, in tandem with the +Q feature. So, we have a natural ranking between the two features, in terms of their effectiveness in triggering movement, like the following:

(44) 1. +Q (criterial)
      2. +N (non-criterial)

Once we have this ranking, we may combine it with the distinctness hierarchy. Disjunction and identity are unaffected, but inclusion is now split into two cases: **non-criterial inclusion**, when the feature in common between X and Z is the non-criterial feature +N, and **criterial inclusion**, when the common feature is the criterial feature +Q. It is natural to consider non-criterial inclusion higher in the distinctness scale because in this case X and Z have in common only the less important non-criterial feature. We thus end up with the following revised distinctness hierarchy:
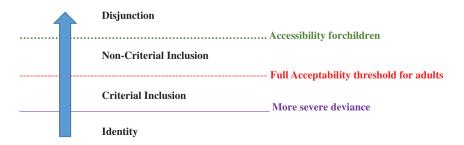

Figure 3: The revised distinctness hierarchy.

This four-degree system now is refined enough to address problem 2. The distinction between non-criterial and criterial inclusion, naturally integrated in the distinctness hierarchy, identifies the threshold separating full acceptability and the perception of ill-formedness. As soon as a criterial feature is shared by X and Z in the intervention configuration, degradation starts being perceived. The perception of degradation is aggravated when the extraction case shifts to the lowest slot of Figure 3, the identity case (examples like *What do you wonder who could buy?*). In this view, degradation thus is a property that emerges at some point of the distinctness hierarchy, and is exacerbated if we go further down the hierarchy.

We have suggested that intervention locality expresses a system of penalties and that the penalties sanction the grammatically determined degree of similarity between target and intervener in the intervention configuration ... X ... Z ... Y.... Then, in accordance with the distinctness hierarchy in Figure 3, non-criterial inclusion involves a weaker penalty than criterial inclusion (as a function of the greater importance of the criterial feature according to the ranking in (44)), with the acceptability threshold crossed by the latter only. When we move further down the distinctness hierarchy and we reach identity, unacceptability is aggravated.

7 Speculations on further questions

In this way of looking at things, two transition points in the distinctness hierarchy have a visible impact in the adult system: the transition from non-criterial inclusion to criterial inclusion marks the beginning of the perception of deviance; and the transition from criterial inclusion to identity marks an aggravated perception of deviance. The question that naturally arises is then the following: does the transition from disjunction to non-criterial inclusion, so crucial for children, have any detectable impact on the adult system?

A complementary question arises for children. The only relevant transition point for them, in the idealized picture expressed by Figure 3, is the transition from disjunction, the only accessible configuration for them in intervention configurations, to everything else. Are there ways to detect a potential relevance of the other distinctions for children as well?

Let us start from the first question. Is there any way to detect the potential relevance of the transition from disjunction to non-criterial inclusion in adult systems? The distinction does not seem to have a clear impact on acceptability: both kinds of structures sound fully acceptable. Nevertheless, much online experimental work in psycholinguistics has shown that structures instantiating

non-criterial inclusion are harder to process than structure instantiating disjunction. For instance, consider the following examples:

(45) The plumber that the electrician praised was happy
         +R+N   +N

                                                    (non-criterial inclusion)

(46) The plumber that you/someone/everyone praised was happy
         +R+N

                                                    (disjunction)

Gordon, Hendrick & Johnson (2001, 2004) showed in a self-paced reading experiment that structures like (45) (our non-criterial inclusion) involve a significant slowing down at the critical words (the embedded verb and the adjacent main verb) with respect to structures like (46) (our disjunction). So, the dividing line between disjunction and non-criterial inclusion has a detectable impact on adult systems, not on acceptability, but on the ease with which such configurations are computed (on this, see also Belletti and Rizzi 2013).[6]

    Considering now the question of whether distinctions lower than disjunction may have a visible impact on child systems, I do not know of evidence directly bearing on this question. Nevertheless, the idea that development may be seen as involving a progressive weakening of intervention locality, and a higher tolerance to penalties, suggests a possibility. At some point, children overcome the difficulty with object A'-dependencies; but it is imaginable that, for some time after becoming able to cope with cases of non-criterial inclusion, they may still not manage to deal with cases of criterial inclusion, i.e. extractions from weak islands. How weak islands function in acquisition is a chapter which remains largely to be explored (apart from a few pioneering contributions such as De Villiers et al. 1990). The approach proposed here leads to the expectation of a stage in which children may be able to compute cases of non-criterial inclusion (the object A'-dependencies we have discussed) while still being unable to compute cases of criterial inclusion (violations of weak islands). I leave the possibility of testing this expectation for future work.

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6 Gordon, Hendrick & Johnson (2001, 2004) appeal to the domain-general effect of "similarity-based interference" to capture the observed pattern. It is conceivable that RM may be looked at as the domain-specific grammaticalization of such a more general effect. It should be noticed that the existence of parallel difficulties in production (see section 4) make it implausible that the observed intervention effects may be looked at as parsing problems solely affecting comprehension.

8 Conclusion

Intervention is a fundamental concept of the theory of locality in formal syntax. Traditionally, it is at the core of research on weak-island phenomena in adult grammars, but recently it has become central also for acquisition research, in attempts to capture difficulties with the acquisition of certain A'-dependencies as intervention effects. In this paper, I have followed much recent literature in assuming that the formalization of intervention locality provided by RM can offer a promising grammatical basis for a unified analysis of adult weak-island phenomena and the difficulties that children experience with certain object relatives and questions.

The fundamental insight is that RM penalizes structures with an intervention configuration on the basis of the formal similarity between the target and the intervener in the relevant local relation. The similarity is precisely expressed through a system of syntactic features, the features which define syntactic positions through the licensing of merge (external and internal). The featural composition of target and intervener is naturally amenable to a hierarchy of distinctness, ranging from maximal (disjunction) to minimal (identity). RM treats disjunction between target and intervener as the optimal case, the one in which the two positions are maximally distinct, and penalizes the other cases, lower down in the distinctness hierarchy, in which target and interveners have features in common.

This system can capture the graded nature of perceived violations in weak-island environments, which can be penalized at different degrees by the formal feature matching of target and intervener. The system also captures the difficulties that children have with intervention configurations in which target and intervener have a feature in common, as in lexically restricted object relatives and questions crossing a lexically restricted subject. The principle of RM and the distinctness hierarchy are uniform for adults and children, but the locality module operates in a more restrictive manner in children's systems, which only tolerate the optimal case, disjunction between target and intervener, rejecting inclusion. Certain discrepancies in the functioning of locality with adults have led to a refinement of the system, through the distinction of criterial and non-criterial inclusion. This refinement generates a four-case distinctness hierarchy, which interacts with RM to offer a fine-grained account of the observed effects in adults and children.

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