

Mirror symmetry in Dutch

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Abstract

Dutch PPs show mirror symmetry with respect to the embedded verb. In older theories, this was partially accounted for by an extraposition rule known as PP-over-V. In the theoretical framework adopted here, such rightward movements are no longer available. The theory assumed instead is strictly local in that only adjacent elements and elements in an immediate dominance relation can be part of core grammar. The resulting framework is movement- and variable-free and consists of three structural realms: lexical structure, functional structure and parallel structure. Languages differ in the size of the phrases used to check lexical material in the functional realm (Pied Piping). It is demonstrated that, given the other elements of the theory, the properties of parallel structure account for the mirror symmetry phenomena observed in Dutch.

1 The problem

One of the most interesting aspects of the structure of Dutch is the pattern of symmetries and asymmetries with respect to the verb in embedded clauses. If the verb is finite, it undergoes the operation known as Verb Second in root clauses. Under this operation, the original context of the verb is maintained, which was the basis for the arguments that Dutch is underlyingly OV (Koster 1975). In more recent theories, this OV stage is seen as an intermediate level, derived from a deeper, universal structure in which the head precedes the object (VO, see Zwart 1994 and 1993).

In this article, I will particularly focus on the question how we can account for the mirror symmetry as found with sets of PPs with respect to the verb. In the next sentence, according to the least marked word order, the prepositional object *aan zijn vader* (“of his father”, the complement of the verb) must be closer to the verb than the temporal adverbial *tijdens de pauze* (“during the break”):

- (1) a. Hij heeft tijdens de pauze *aan zijn vader* gedacht
 he has during the break of his father thought
 "He thought of his father during the break"
 b. *Hij heeft *aan zijn vader* tijdens de pauze gedacht

The same PPs can also occur to the right of the V, but then the unmarked order is just the opposite:

- (2) a. Hij heeft gedacht *aan zijn vader* tijdens de pauze
 b. *Hij heeft gedacht tijdens de pauze *aan zijn vader*

English only allows such PPs to the right of the verb, but the relative word order with respect to the verb is the same as in Dutch. The complement is closer to the verb than the temporal adverbial:

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- (3) a He thought *of his father* during the break
 b * He thought during the break *of his father*
- (4) * He during the break of his father thought

Schematically, mirror image orders of Dutch PPs with respect to the V show the following pattern:

- (5) a [PP₂ [PP₁ [V]]]
 b [[[V] PP₁] PP₂]

The accounts given so far of these mirror image effects in Dutch (Barbiers 1995, Koster 1974) are not really satisfactory. In what follows, I will therefore propose a new explanation.

2 Theoretical background

2.1 Merge as a means to bridge long distances without variables

Before presenting my proposal, I will first give a short summary of my theoretical background assumptions. According to the theory I have in mind, the core domain of syntax is about local relations that universally have the following form:

- (6) [β α δ]

In this formula, δ (= *dependent*) stands for all dependent syntactic elements, such as traces, anaphors, verbal gaps (in Gapping), etc. Such elements are incomplete in some sense and the missing information is provided by the preceding *antecedent* α. A relation between α and δ is only possible within a domain β, the category immediately dominating α and δ.

What a universal scheme like (6) comes down to, in other words, is that the syntax of natural languages is optimally local: dependency relations are only possible between elements (α and δ) that are strictly adjacent and the only relevant domain is the immediately dominating category β. Syntax is not only about the transfer of properties from α to δ, but also about the selective transfer of properties from α and/or δ to β (percolation).

Another core property of (6) is that α universally precedes δ, which means that any other order found in whatever language indicates that something has been displaced (“moved”).

That Dutch, like all other languages, is underlyingly VO therefore follows from Universal Grammar, which specifies the fixed order as given in (6). According to older theories, languages can be both underlyingly VO (7a) or OV (7b):

- (7) a [VP V NP]
 b [VP NP V]

The relation between the complement (NP) and the head (V) can be seen as a dependency relation and, as such, an instantiation of (6): without the V, the NP has no theta-role and is therefore incomplete. The missing theta-role can be provided by the V and in that sense, the

NP is dependent (as a δ) on the antecedent V (as an α). From the universal scheme (6) it follows that (7a) is permitted while (7b) is not. In other words, (underlying) OV languages do not exist and all languages are VO at the deepest level. As for Dutch, this conclusion is empirically supported by a lack of adjacency between V and NP of the kind found in English (Vanden Wyngaerd 1989, Zwart 1994):

- (8) a * He *saw* yesterday *Bill*
 b Hij heeft *Wim* gisteren *gezien*
 he has Bill yesterday seen

According to universal scheme (6), a verb is adjacent to the complement dependent on it. English is as expected in that respect and violation of adjacency leads to ungrammaticality. In Dutch (8b), however, adjacency is violated without problems, which shows that the Dutch object is no longer in its original complement position.

I assume that all deviations from the universal order head-complement are caused by *overt* movement and that covert movement (LF-movement) does not exist.¹ I furthermore assume that differences in word order among languages are largely due to variation in the *size* of the constituents moved. In other words, word order variation is usually the result of differences in Pied Piping among languages. Nobody knows exactly why, but it is an uncontroversial fact that movements can (or must) involve phrases of different size:

- (9) a *Who*_i did you talk [_{PP} with *t*_i]?
 b [_{PP} *With whom*]_j did you talk *t*_j ?

In English, both the minimal Wh-constituent *who* (9a) can be moved and the whole PP *with whom* (9b), while in Dutch Pied Piping is obligatory:

- (10) a * *Wie*_i heb je [_{PP} met *t*_i] gesproken ?
 who have you with talked
 b [_{PP} *Met wie*]_j heb je gesproken *t*_j ?
 with whom have you talked

In German, it is even possible to move a whole sentence along, as in the classical example of Ross (1967):²

- (11) Der Hund [_{CP} *den zu fangen*]_i ich *t*_i versucht habe
 the dog which to catch I tried have
 “The dog which I tried to catch”

This maximalization of the material moved differs from language to language and, within the same language, from construction to construction (although the phenomenon is heavily constrained and usually limited to material within the minimal clause).



It now happens to be the case that such maximalizations are much more common in grammar than assumed up until recently. Thanks to Pied Piping differences, it is largely

¹ I use the term “movement” here only for expository reasons, for constructions with displaced elements. Movement in the technical sense (as an operation distinct from Merge), I consider superfluous, as will be clear from the text.

² See Van Riemsdijk (1994) for such cases.

possible to derive word order differences among languages from variation in the size of (overtly) moved constituents.

In a number of recent articles, it has been pointed out that the VO order of languages like English indicates the preservation of the original, universal base order (Koster 1999b, 2000a, Koster en Zwart 2000). In Dutch and German, this order was lost by the operation of Object Shift (Scrambling). Object Shift can be seen as a movement required for the checking of the accusative features of the object. If we assume that in English this checking is done under Pied Piping of the whole VP, it follows that, contrary to what we observe in German and Dutch, the object itself remains in its original position within the VP:

- (12) a Dutch (OV): ...[_{AccP} Object_i [_{Acc} [_{VP} V _{t_i}]]]...
- 
- b English (VO): ...[_{AccP} [_{VP} V Object_j] [_{Acc} [_{VP} _{t_j}]]]...
- 

Our working hypothesis, then, is that many fundamental word order differences among languages can be explained not by variation in base order (such as under the old OV/VO parameter) but by varying the size of the checking phrases. As documented in the literature just mentioned, this hypothesis has led to a number of surprising explanations of the word order differences between English and Dutch.

Furthermore, it seems that “invisible” movement, also known as LF movement, can be eliminated from grammar altogether, just by taking advantage of the Pied Piping differences between languages.

It would, incidentally, be a mistake to see Pied Piping (in the sense intended here) as a property of movement (“Move”). It is, on the contrary, the very existence of feature percolation (as in Pied Piping) that makes “Move” superfluous. It is important to realize in this context that the real core operation of grammar, “Merge” (and the idea of projection as expressed by the old X-bar theory), is in fact nothing else than just another case of feature percolation. In Chomsky’s minimalism, the old X-bar theory is replaced by “bare phrase structure” formed by Merge, which does just what Pied Piping does, namely transferring features to the immediately dominating node. In a DP, for example, the features of the head (indicated by *the*) are transferred by Merge to the immediately dominating node (cf. Chomsky 1995, ch. 4):

- (13)
- 

It is worthwhile to have another look at Merge (as applied in (13)) against the background of the universal form that we believe characterizes local syntactic relations of all kinds ((6), repeated here as (14)):

- (14) [_β α δ]

It is easy to see that (13) has the form defined by (14). I concluded earlier in this article that syntactic relations involve an incompletely specified δ which derives its missing properties

from α , for instance, when a DP (δ) derives its missing theta-role from the immediately preceding verb (α). Projection via Merge (as in (13)) means that not only δ , but also the immediately dominating β , can derive properties from α . In other words, the universal scheme (14) minimally allows two kinds of information transfer: *horizontally* (from α to δ) and *vertically* (from α to β).

Practical illustrative purposes aside, it is, by the way, questionable if horizontal feature transfer should be distinguished from vertical transfer. This can be seen as follows: what Merge brings about is what Katz and Fodor (1963) called “amalgamation”. This means that both syntactic and semantic properties of two constituents are selectively combined. In (14), for instance, β combines certain properties of α and δ . Whenever δ misses certain properties (such as lexical content in the case of traces), this incompleteness is unproblematic as long as α provides the necessary features: this would make the incomplete δ complete at β . In other words, by combining properties, Merge also yields a certain form of economy of representation, because certain properties (like a referential identification or lexical content) can be shared by two different functional constituents, so that they have to be represented only once instead of twice.

Strictly speaking, then, it is not necessary to say that δ derives properties from α in (14). It rather is the case that the Merge operation itself completes incomplete constituents (subsuming, as we will see, what was traditionally called “movement”).

Be this as it may, what I have called Pied Piping so far is nothing other than the strictly local (sometimes successive) vertical transfer of properties and, as such, completely on a par with the vertical transfer of head features as brought about by Merge in its creation of phrase structure.

What traditionally has been called movement (“Move”) is based on the fact that not only α but also δ transfers properties to β . It is hard to see what else Merge could be and the standard cases of Pied Piping are a perfect illustration of the phenomenon:

(15) [PP with [NP *whom*]]

This is the English equivalent of the fronted Wh-constituent of the Dutch example (10b). The NP *whom* carries the Wh-feature and this feature is transferred to the immediately dominating PP. In terms of the universal scheme (14), this standard case of Pied Piping involves vertical property transfer from δ to β :

(16) [PP<+wh> with <+wh>]

Represented in tree format, the property transfer is as follows:

(17)

$$\begin{array}{c} Wh \\ \swarrow \quad \searrow \\ with \quad Wh \end{array}$$

In my opinion, movement (“Move”) is, formally speaking, exactly the same process as entailed by Merge: instead of the Wh-features of δ , the lexical incompleteness of δ is transferred to the immediately dominating β , as what we saw with respect to the sentence *What_i did he see [t_i]*:³

³ See Gazdar (1981).



It is of course possible to weaken the minimalist framework with the arbitrary stipulation that only lexically *complete* categories are allowed to vertically transfer their properties, but that does not seem to make sense because incompleteness is one of the core problems that Merge seems to solve in general: Merge combines the properties of two constituents and therefore often overcomes the incompleteness of one of them. This is at the very core of syntax.

Just as categories can derive their referential identity from an antecedent α (as in the case of anaphors) or can derive their theta-role from α (as with objects dependent on a verb), categories can also derive their lexical information from a preceding α . In a sentence like *What_i did he see [t_i]*, the missing lexical identity of the object is provided by the Wh-phrase preceding the trace, so that, in terms of our scheme (14), *What_i* functions as α and the trace [t_i] as δ . Since percolation (via Merge) is repeated, with inheritance of the incompleteness indicated by the trace, it is possible for the Wh-phrase *What_i* (as α) to complete the immediately following incomplete phrase CP/t_i (as δ) under the highest CP. This will be illustrated next.

What makes the independently motivated percolation mechanism interesting is that it becomes possible to replace Move by a Merge process that works entirely without variables (see Koster 2000c for more details). According to the more traditional views of generative grammar, Wh-movement bridges distances considered variable, as indicated by the dots:



It has therefore been standardly assumed that island conditions are conditions on variables (cf. Ross 1967). Thanks to the percolation mechanism, however, each successive application of Merge can transfer the incompleteness to the next category up. This was expressed by Gazdar (1981) in his slash notation, which was taken over by the approach known as HPSG. This makes it possible to formulate postponed lexical identification (as found in so-called movement constructions) in full accordance with (14), i.e., under strict adjacency of the Wh-filler and the following incomplete constituent. In our example *What_i did he see [t_i]*, this would involve the following configuration:



The vertical transfer of lexical incompleteness, the first step of which was shown in (18), goes on all the way to the XP (also a CP, I assume) immediately adjacent to the Wh-phrase *What_i*, followed by completion of XP/t_i (= δ) by *What_i* (= α).

In other words, Merge makes Move completely superfluous, because everything done by Move is already done by Merge under independently motivated modes of application of Merge. The scheme (14) characterizes not only the form of “base structures”, but also the form of “movement” structures, Gapping, Agreement and all other local grammatical process. A further hypothesis assumed throughout this article is that scheme (14) does not only apply to Dutch but to all natural languages. Most word order differences among languages are not due to variation in the underlying structure (14) as such, but to variation in the range of percolation, particularly with respect to the lexicalization of the functional shell in which lexical structures are embedded.

2.2 Lexical structure and functional structure

One of the basic assumptions of current minimalist theories is that lexical projections are universally embedded in functional shells, i.e., each lexical projection is the complement of a functional head in such a way that the resulting functional projection is dominated by further functional projections. Since, according to (14), heads are always to the left of their complements, series of functional heads are universally found only to the left of the associated lexical heads.

For instance, C, AgrS, Tns (and in my opinion also Dat, Acc and Pred) can only be found to the left of the verb, because (14) does not leave any other choice open.⁴ Not only the VP, but every other lexical projection is associated with a set of functional projections in this way.

It is generally assumed that natural languages differ from the artificial languages of logic by the property known as “displacement”, i.e., the occurrence of lexical material away from its natural lexical context. This is the crucial property of natural language that classical movement theory sought to explain. Functional displacement greatly enhances the expressive potential and economy of natural language because it makes it possible to use the same lexical material for different functions.

By way of illustration, consider the following four cases, each showing a different functional use of a DP headed by *boeken* (“books”):

- (21) a *Welke boeken* heeft hij gelezen?
 which books has he read
 b *De boeken* werden gelezen
 the books were read
 c Zij heeft *de boeken* gisteren gelezen
 she has the books yesterday read
 “She read the books yesterday”
 d De studenten wilden gisteren plotseling *boeken* lezen
 the students wanted yesterday suddenly books read
 “Reading books is what the students suddenly wanted to do, yesterday”

In all four cases [_{DP}...*boeken*] (“books”) is taken as the complement of [_v *lezen*] (“read”) in the configuration [V DP]. In (21), the DP has been “moved” to four different functional positions: to the Spec position of a Wh-scope marker (Spec of CP) in (21a), to the subject position (Spec of AgrS) in (21b), to the accusative position (Spec of AgrO or AccP) in (21c) and to the predicate position (Spec of PredP; see Koster 1994) in (21d). In many languages, the distinction between (21c) and (21d) is expressed by two different cases (De Hoop 1992). All in all, one kind of lexical DP can be used in four different functional positions, indicated by the numbers 1-4:

- (22) ...[1 CP [2 AgrSP ... [3 AccP ... [4 PredP [_{VP} V DP]]]]...

It is clear that this variety of functional positions contributes much to the economic use and functional versatility of lexical material in natural languages. Movements (actually, differential lexicalizations of functional structure) not only assign a function to lexical material, they also facilitate interpretation by making the functional structure “visible”. As

⁴ See Koster (1999b) for a partial justification of the structures in question.

mentioned before, the OV structure of Dutch and German is the result of DP “movement” to position 3 or 4, while English preserves the universal underlying VO structure by “moving” the whole VP to position 3 or 4 (Pied Piping). Both solutions have advantages and disadvantages. The solution of Dutch and German is functionally more transparent, while the English solution leaves the interpretively necessary underlying lexical structure more intact.

2.3 Parallel structure

The last, for this article most relevant, assumption that I would like to discuss concerns the so-called parallel structure (Koster 2000b). Parallel structure involves those constituents that do not receive a function directly in some functional projection, but only indirectly, by association with constituents that do receive a functional role in the functional structure itself. Right Dislocation may illustrate this:

- (23) Ik heb *haar* gezien, *die vrouw*
 I have her seen that woman
 “I saw her, that woman”

In this sentence, only the pronoun *haar* (“her”) has been moved to a functional object position. The parallel DP *die vrouw* (“that woman”) has the same Case, but checking is not brought about by movement to an object position but by association with the moved DP *her*, which is licensed in the normal, direct way, namely by movement to a Case position.

Parallel structures have specific characteristics which can be found in a great number of constructions, for instance in certain cases of coordination and in extraposition constructions:

- (24) a Ik heb *Jan* gezien *en Piet*
 I have John seen and Peter
 “I saw John and Peter”
 b Ik heb *de vrouw* gezien *die alles wist*
 I have the woman seen who everything knew
 “I saw the woman who knew everything”

The traditional assumption about extraposition is that it involves rightward movement, which would derive the orders of (24) from the underlying (grammatical) orders in (25):

- (25) a Ik heb *Jan en Piet* gezien
 I have John and Peter seen
 “I saw John and Peter”
 b Ik heb *de vrouw die alles wist* gezien
 I have the woman who everything knew seen
 “I saw the woman who knew everything”

In the theoretical framework assumed here, rightward movement is impossible (see also Kayne 1994). I also consider it impossible to relate the sentences in (24) with the corresponding sentences in (25) by some movement to the left, because the element on the left can be embedded in a PP (or even deeper):

- (26) a Ik heb [_{PP} met *Jan*] gesproken *en Piet*
 I have with John talked and Peter
 b Ik heb [_{PP} met *de vrouw*] gesproken *die alles wist*
 I have with the woman talked who everything knew

These are just more cases of Pied Piping (Koster 1999a, 2000b). The parallel structures in (26) require a target DP, i.e., an associated DP to the left which receives its function directly in the functional structure. This target DP can be adjacent, as in (25), but, as is generally the case with Pied Piping, it can also be embedded in a more inclusive constituent (as in (24) and (26)).

In general, I assume that parallel structures are connected with their target by an (often Boolean) operator ω . This operator can be lexical, like *en* (“and”) in coordinations (24-26), or it can be non-lexical, as in Right Dislocation and extrapositions. In the latter case, I represent the operator by a colon (:, seen as the head of a “colon phrase” :P).⁵ The target of the association is in the Spec of the :P or the *enP*, more generally the Spec of ω P, where ω is the operator. If the target is a DP, it may be the Spec of ω , but it may also be embedded in a more inclusive constituent, for instance a VP. In other words, thanks to Pied Piping, the following empirical generalization holds (see Koster 2000b for details):

$$(27) \quad [\text{Spec DP } [\omega \text{ XP}]] = [\text{Spec } [\text{XP ...DP...}] [\omega \text{XP}]]$$

Applied to (24a) and (25a), this means that the following configurations are equivalent:

$$(28) \quad [\text{Spec } \textit{Jan} [\textit{en Piet}]] \textit{gezien} = [\text{Spec } [\textit{VP Jan gezien}] [\textit{en Piet}]] \\ \text{John and Peter seen} \qquad \qquad \qquad \text{John seen and Peter}$$

Just as Merge can build larger Wh-phrases, it can also build larger “target phrases”. In the more familiar case of Pied Piping, the Wh-features are percolated up to a point, while in the case under discussion, the target features are percolated up to a point. In the notation adopted before, the second part of (28) looks as follows:



Upward preservation of percolated information is by no means unlimited: in general, Pied Piping is limited to the minimal CP or a subconstituent of it. This can be demonstrated with so-called Right Roof phenomena:⁶

⁵ Semantically speaking, the colon can be seen as an indication of further specification, as is sometimes expressed by the word *namely*. Depending on context, the colon corresponds with extension (union, \cup) or with restriction (intersection, \cap).

⁶ Ross (1967) observed that what was called rightward movement at the time was clause-bound. This constraint was usually referred to as the Right Roof Constraint.

- (30) * [_{CP} Dat wij *Jan* gezien hebben] is zeker *en Piet*
 that we John seen have is certain and Peter

In other words, as a target a DP remains available in the Merge process until the first CP up is reached. Similar constraints apply to the percolation of Wh-features. Thanks to the CP-bound percolation mechanism, we can crucially account for the sentences in (26), while traditional movement rules do not work in such cases.

To summarize, I assume that syntactic structures are built up from head-initial structures which are embedded in functional structures which are also head-initial. As instantiations of (14), both types of structure entail binary branching. Lexical material is assigned a function by “movement” to functional structure (actually seen as postponed lexicalization in the Merge process). A main source of word order variation among languages is the parametrization of the size of the phrases “moved” to the functional structure (Pied Piping).

Next to lexical and functional structure, a third type of structure was identified, namely parallel structure. Parallel structures are extensions of functionally licensed material which are complements in *enP* or *:P* and which have their target structures in the Specs of *enP* or *:P*.⁷ As in other cases of the ubiquitous Pied Piping mechanism, the targets can be embedded in constituents larger than those that are minimally necessary. A common upper limit for Pied Piping is the minimal CP.

3 Mirror symmetry and the specification of empty elements

The problem discussed at the outset of this article, the existence of mirror symmetry with respect to the (embedded) verb in Dutch, is basically solved by the possibility to associate functional positions with parallel specifications. Consider the following sentence (with heavy stress on **Jan** (“John”) and **Piet** (“Peter”)):

- (31) **Ján** heeft *Marie* gezien en *Truus*, en **Piét**
 John has Mary seen and Trucy, and Peter

The intended associations are as indicated: *Truus* is associated with *Mary* and therefore an extension of the direct object, while **Piet** is associated with **Jan** and therefore must be understood as an extension of the subject.

It is crucial to see that the intended interpretations involve mirror image symmetry with respect to the verb. If the intended linkings are not mirrored, the sentence becomes entirely ungrammatical:

- (32) * **Ján** heeft *Marie* gezien en **Piét**, en *Truus*
 John has Mary seen and Peter, and Trucy

It is impossible here to interpret **Piet** as the subject and *Truus* as the direct object. In other words, structural parallelism entails mirroring of word order. With the appropriate brackets, (31) looks as follows:

⁷ In this respect, I follow Kayne (1994), who proposed [_{XP} [*en* XP]] as the structure of coordination.

- (33) [[_{IP} **Jan** heeft [[_{AgrOP} *Marie* gezien] [en [*Truus*]]]] [en [**Piet**]]]
 John has Mary seen and Trucy and Peter

Truus is associated with *Marie* by the fact that the Spec of the lowest *en* (“and”), the AgrOP, contains *Marie*. This is Pied Piping with the AgrOP as upper limit. **Piet** is associated with **Jan** by the fact that the Spec of [en [**Piet**]], the entire IP, contains **Jan**. This is Pied Piping with the IP as upper limit.

The CP is an absolute upper limit for Pied Piping, which, among other things, can be illustrated with instances of the so-called Right Roof Constraint (see note 6):

- (34) * Ik heb [_{CP} dat **Jan** komt] altijd betreurd en **Piet**
 I have that John comes always regretted and Peter

Whatever the further constraints on Pied Piping may be, it seems clear that, on the left of the verb, “higher in the tree” usually corresponds with “more to the left”, while the associated parallel structure to the right of the verb is such that “higher in the tree” means “more to the right”.

In the examples discussed so far, parallel elements (like **Piet**) are always associated with a *lexical* element (like **Jan**) in the functional structure. As I have shown elsewhere, it is also possible, as, for instance, with obligatory extraposition of complement CPs, to associate parallel elements with non-lexical, empty categories. Consider, for example, the extraposition of subject sentences:

- (35) Ik denk dat *het* duidelijk is *dat hij komt*
 I think that it clear is that he comes
 “I think it is clear that he will come”

In this case, the CP *dat hij komt* (“that he will come”) is parallel to the “preliminary” subject *het* (“it”), as indicated by the italics. It is also possible to replace *het* by an empty subject, while the parallel association remains the same.⁸

- (36) Ik denk dat [_i] duidelijk is [*dat hij komt*]_i
 I think that clear is that he comes

Similarly, it can be assumed that parallel association with empty objects is possible as well. A verb like *betreuren* (“regret”) shows both possibilities:

- (37) Ik heb (*het*) betreurd *dat hij komt*
 I have it regretted that he comes
 “I have regretted that he will come”

Most verbs with clausal complements, however, do not allow the overt preliminary object *het*:

- (38) Ik heb (* *het*) gezegd dat hij zou komen
 I have it said that he would come

Nevertheless, there are some indications that object sentences in these cases involve an empty object DP as well (see Koster 1999a).

⁸ See Bennis (1986). See also Den Dikken (1992) for convincing arguments that imperatives like *leg neer die bal!* (“put down, that ball!”) involve the specification of an empty object.

What I will assume next is that PP extrapositions formerly accounted for by the rule PP-over-V also involve the specification of empty elements:

- (39) a Hij heeft *aan zijn vader* gedacht
 he has of his father thought
 "He thought of his father"
 b Hij heeft gedacht *aan zijn vader*
 he has thought of his father

In older theories it was assumed that (39a) reflects the deep structure [PP V]. This assumption was based on the hypothesis that Dutch is underlyingly OV and that postulating the underlying position of the prepositional complement to the left of the verb as well would yield the simplest base rule: VP → XP V.

Furthermore, the order PP V is always possible while there are a number of interesting exceptions to the order V PP (light PPs in (40b), idiomatic PPs in (40c), and PPs with a light verb in (40d)):

- (40) a Hij heeft [aan zijn vader] gedacht (aan zijn vader)
 he has of his father thought
 "He has thought of his father"
 b Hij heeft [er aan] gedacht (*er aan)
 he has there of thought
 "He thought of it"
 c Hij heeft [aan de weg] getimmerd (*aan de weg)
 he has on the road carpentered
 "He sought the limelight"
 d Hij heeft Tarzan [in arrest] genomen (*in arrest)
 he has Tarzan in arrest taken
 "He arrested Tarzan"

I would now like to use these exceptions to show that PP-over-V structures also involve an empty element (the complement PP) on the left of the verb. The PPs to the right of the verb are not complements themselves but parallel specifications of the real complements, which are on the left of the verb.

Note first that according to the theoretical assumptions made above it is no longer possible to take [PP V] as a deep structure: according to (14), all head-complement constructions are head-initial. In other words, only [V PP] is a possible lexical structure. Since all complements to the verb must be functionally licensed, I assume that PP complements are obligatorily moved to the left (to the Spec of PredP; Koster 1994). In short, the derivation is as follows:

- (41) $[_{\text{PredP}} PP_i \text{ Pred } [_{\text{VP}} V \text{ } [_{\text{PP}} t]_i]]$



This is the standard derived structure for PP complements, as further illustrated in (42):

- (42) Hij heeft [_{PP} *aan zijn vader*] [gedacht [_{PP} *t*]]
 he has of his father thought

Just as other objects, a PP object can remain empty as well. In that case, a parallel specification is required to the right of the verb in order to lexically identify the complement:

- (43) Hij heeft [[[_{PP} *e*] [gedacht [_{PP} *t*]]] [: [*aan zijn vader*]]]



My hypothesis, then, is that PP-over-V involves a parallel specification of an empty PP, like [_{PP} *e*] in (43). This hypothesis explains the traditional exceptions to PP-over-V. Idioms, for instance, (like *aan de weg timmeren* in 40c) presuppose a fixed lexical combination of PP and V and, in that case, their PP can not really serve as a specification of a non-idiomatic (empty) complement to the V. A PP like *eraan* (“of it”) does not have enough content itself to specify other PPs.

The correctness of this account is confirmed by independent evidence. It happens to be the case that there are a few other constructions in which a constituent (in this case a PP) is supposed to be the specification of another constituent (a PP). Cleft sentences are a case in point:

- (44) Het was [*aan zijn vader*]_i [[*e*]_i [dat Peter [*e*]_i dacht]]
 it was of his father that Peter thought

Since Chomsky (1977) it has been assumed that such sentences involve Wh-movement, or at least the specification of an independent element (here indicated by [*e*]_i) that has undergone A'-movement. Since cases like (44) concern the specification of a separate, empty PP, we expect the same pattern in the data as with PP-over-V (under our analysis). This prediction is borne out. Just compare the following cleft sentences with the exceptions on PP-over-V as mentioned in (40b-d):

- (45) a *Het was [*er aan*] [*e* [dat hij [*e*] dacht]]
 it was there of that he thought
 b *Het was [*aan de weg*] [*e* [dat hij [*e*] timmerde]]
 it was on the road that he carpentered
 c *Het was [*in arrest*] [*e* [dat hij Tarzan nam]]
 it was in arrest that he Tarzan took

The pattern of exceptions is exactly the same. Further confirmation can be found in constructions with Left Dislocations, in which the relevant PPs are also associated with independent PPs:

- (46) a [Aan zijn vader], hij heeft [er aan] gedacht
of his father he has there of thought
b *[Er aan], hij heeft [er aan] gedacht
there of he has there of thought
c *[Aan de weg], hij heeft [er aan] getimmerd
on the road he has there of carpentered
d *[In arrest], hij heeft Tarzan [er in] genomen
in arrest he has Tarzan there in taken

In short, the exceptions to PP-over-V are an instance of a general pattern that we observe whenever PPs specify independent PPs elsewhere in the structure. In the case of PP-over-V, the PPs to be specified can only be empty complements in the (derived) complement position to the left of the V.

The restrictions observed only apply to the subcategorized PP complements of verbs. Non-subcategorized PPs can occur on both sides of the verb (without exception, as far as I know):

- (47) Hij heeft [tijdens de pauze] Marie gezien (tijdens de pauze)
he has during the break Mary seen during the breaks
“He saw Mary during the break”

In these cases, too, I assume that adverbial PPs to the right of the verb are always specifications of (empty) adverbial positions to the left of the verb (where I assume a theory like the one found in Cinque 1998):

- (48) Hij heeft [_{PP e}] Marie gezien *tijdens de pauze*
he has Mary seen during the break

Naturally, these adverbial PPs are –on the left of the verb-- higher in the tree than subcategorized PP complements:

- (49) Hij heeft [_{PP2 tijdens de pauze} .. [_{PP1 aan zijn vader} [gedacht..]]]
he has during the break of his father thought

As soon as these PPs on the left of the V are replaced by empty PPs, with parallel specifications on the right of the verb, we derive the mirror symmetry effect that we sought to explain in the first place:

- (50) [_{PP2} [[_{PP1} [_{VP} V *t*₁]]] [: _{PP1}]] [: _{PP2}]]

This pattern is exactly analogous to what we observed with respect to certain forms of coordination (see (31)).

4 Conclusion

During the last 10 years, on the basis of certain developments in the general theory of grammar, a new conception has emerged as to the structure of Dutch. According to this conception, structures are composed with the operation Merge.

According to the version of the theory assumed here, Merge is sufficient to bridge all long distances in core grammar, including distances that were traditionally bridged by two separate mechanisms independent of base rules: Move and Pied Piping (percolation of features). Instead of three mechanisms we can do with only one, namely Merge. Basically, Merge transfers features to the immediately dominating category, be it under certain limitations. These limitations, the traditional locality principles, can be stated as filters on Merge (not further considered in this article). Thanks to this filtered and recursive percolation mechanism, the principles of grammar can be formulated entirely without variables. There are no “constraints on variables” anymore, because there are no variables.

It has become possible, in other words, to give a strictly local formulation to the grammar of natural language, in which only two adjacent elements can be considered, plus the category immediately dominating these adjacent elements. Furthermore, it is universally the case that of the two adjacent elements, the first one (α) is always the more dominating element, while the second element (δ) is always the dependent element. In short, the following formula defines the form of all syntactic relations of core grammar in all natural languages:

$$(51) \quad [\beta \ \alpha \ \delta]$$

Note that α trivially c-commands δ , but that α also precedes δ in (51). It therefore does not make sense in this framework to say that c-command is more basic than precedence.

The adoption of (51) has led to a substantial re-analysis of the structure of Dutch. It follows from (51), for instance, that all languages are underlyingly head-initial, which only allows the order VO as the deepest order of Dutch.

Word order differences among languages are no longer accounted for by parametrization of the underlying structure (as in the traditional OV/VO parameter), but by parametrizing the size of the phrases –in Pied Piping– that lexicalize the functional structure that universally dominates lexical structure as a shell. “Movement” to the right is also excluded by (51) because it would involve a dominant element α (the head of the chain created by Move) on the right of δ (the trace) instead of on the left.

For the “right side” of the structure of Dutch, a special (but universal) structural dimension was explored, namely parallel structure. Parallel structure is about extensions and further specifications of the standard lexical-functional structure and it encompasses Right Dislocation, certain forms of coordination, clausal extraposition, PP-over-V and many other phenomena. The new theoretical insights made it necessary to re-analyze right-peripheral PPs in Dutch as parallel specifications of empty elements on their left. This re-analysis, required by the new theory, turned out to be empirically fruitful. It not only led to an explanation of the traditional exceptions to PP-over-V in Dutch, it also provided an explanation for the old problem of mirror symmetry of PPs with respect to the verb in Dutch, thereby demonstrating the empirical fruitfulness of the new approach.

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The Symmetry Gallery - A collection of nearly 70 unique molecules with interactive display of all symmetry elements and animation of all operations. The molecules are organized by point group, so you can select examples to demonstrate particular symmetry elements. Includes links to the chemical literature when available. The Symmetry Challenge - Using the same set of molecules from the Gallery, the Challenge includes a flow chart that details the process of determining the point group of each molecule. A great way to practice the point group determination process. Updates: March 2014 - A new m The mirror symmetry conjecture roughly claims that every Calabi-Yau 3-fold has a mirror. In fact one considers (mirror symmetry for) degenerating families for Calabi-Yau 3-folds in large volume limit (which may be expressed precisely via the Gromov-Hausdorff metric). The appropriate definition of (an appropriate version of) the Fukaya category of a symplectic manifold is difficult to achieve in desired generality. Invariants/tools of Fukaya category include symplectic Floer homology and Gromov-Witten invariants (building up the quantum cohomology). Mirror symmetry is related to the T-duality o Mirror symmetry is an example of a general phenomenon known as dual-ity, which occurs when two seemingly dierent physical systems are isomor-phic in a non-trivial way. The non-triviality of this isomorphism involves the fact that quantum corrections must be taken into account. Mathemati-cally, a good analogy is the Fourier transform, where local concepts such as products are equivalent to convolution products, requiring integration over the whole space.Â It is fair to say that we do not have a deep understanding of the reason for the prevalence of duality symmetries in physics. Nor do we have a proof of why a duality should exist in any given case. Most of the arguments in. A history of mirror symmetry. xvii.