Grammar in 3D: on linguistic theory design
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3 DERIVATION

3.1 INTRODUCTION

This chapter discusses the second architectural dimension or D-property, Derivation. In what follows, I offer an account of Derivation in relation to TGG, PA and FDG. I start off with a definition of the term Derivation followed by a short review of the influence that the distributional features categorized as formation rules and levels of representation have upon this second architectural D. Subsequently, I offer an in-depth analysis of the relation between the third, cross-cutting distributional feature, inter-level mapping processes, and any given model’s approach to the second D, Derivation. I offer a definition of the notion of interface and then illustrate the link between the kind of a given interface (flexible or transparent), on the one hand, and that of representational mismatches, on the other. Regarding mismatches, I propose a classification of potential non-homomorphisms that may appear in a model with a flexible conception of its interface processes. Finally, I discuss a possible placement of TGG, PA and FDG along the derivational/non-derivational spectrum.

3.2 GET DIRECTIONS

If a grammatical model were to be seen as a city, the dimension of Derivation would capture the way in which roads, streets and short cuts facilitate, or impose restrictions on, the circulation of the various kinds of vehicles and people from flat x in block y in area z to flat c in block b in area a. Similarly, a model’s conception of its interface processes, i.e. its derivational or non-derivational nature, facilitates and/or imposes restrictions on the way in which the various kinds of linguistic information that are represented in a given model of grammar (hierarchical, non-
hierarchical, syntactic, semantic, etc) circulate: can everyone go
to every house in town, can every car drive on all roads two-
ways? This (Derivation) is also related to the kind of linguistic
information that each model decides to formalize (Distribution):
if a grammar does not have a pragmatic level, then linguistic
information cannot be represented there. Also, there will be
preferred routes, and there may even be central areas you can
simply not avoid going through, no matter where you are or
where you are going. Now, if D-oole maps offer you a single,
predictable route to go from flat x in block y in area z to flat c in
block b in area a, with no short cuts or alternative routes but
certain unavoidable points you necessarily have to go through,
then your city is derivational and traffic is transparent. If, on the
other hand, you may skip certain areas, you can choose the way
you want to go and can take the same way to go and come back,
then traffic in your city is flexible and your city is non-
derivational.

Similarly, the absence or presence of a derivational
mechanism in a given grammatical model between different
levels, say the syntactic and the semantic levels, can be
determined by whether there a calculation can be done between
different levels (Sadock 2003). In other words, if inter-level
interface processes within a theory of language are conceived in
such a transparent, predictable way that one can predict
representations at one or more levels when the linguistic
representation of a certain all-first source (compulsorily initial)
level is given, then the model of grammar is (prone to be)
derivational. If, on the other hand, there is no all-first level (no
single compulsorily initial level from which all linguistic
computation is born) and it is not possible to predict the nature
or quantity of representations at the remaining levels in the
presence of a non-transparent, non-predictable approach to inter-
level mapping processes, then the model is (prone to be) non-
derivational. Whether a model is derivational or non-
derivational can thus be defined in terms of representational predictability. Another way to define derivationality is by
considering whether the model of grammar consists of various steps that operate on a pre-determined order (hence the term “all-first level”) or whether computation is free to end or start anywhere by means of constraints that operate at the same time:

“[A] derivational approach constructs well-formed structures in a sequence of steps, where each step adds something to a previous structure, deletes from it, or otherwise alters it (say by moving pieces around). Each step is discrete; it has an input, which is the output of the previous step, and an output, which becomes the input to the next step. Steps in the middle of a derivation may or may not be well formed on their own; it is the output that matters. By contrast, a constraint-based approach states a set of conditions that a well-formed structure must satisfy, without specifying any alterations performed on the structure to achieve the well-formedness, and without any necessary order in which the constraints apply” (Jackendoff 1997: 12).

3.3 FORMATION RULES: AUTONOMY VS. DEPENDENCY

3.3.1 INTRODUCTION

As discussed in the previous chapter, the number and nature of independent formation rules of a model of grammar determine the number and nature of independent levels of and these, in turn, determine whether one or more levels of representation are responsible for other levels. This has direct consequences upon a given model’s approach to the second D or architectural dimension, Derivationality. In this light, this section offers a review of the number and type of independent formation rules and introduces the number and type of dependent formation rules in order to subsequently account for dependent and independent grammatical levels and the relation between the latter and a model’s derivational or non-derivational character.
3.3.2 NUMBER AND TYPE OF INDEPENDENT VS. DEPENDENT FORMATION RULES

The number and type of independent formation rules are responsible for the autonomous status of a model’s levels of representation, which is in turn responsible for the model’s derivational (or non-derivational) character. In order to introduce the approach that TGG, PA and FDG adopt regarding Derivation, Tables 6 and 7 below offer an overview of dependent and independent formation rules for all three models.

Table 6. Dependent vs. independent formation rules in TGG, PA and FDG: number

<table>
<thead>
<tr>
<th>FORMATION RULES, NUMBER</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPENDENCY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDEPENDENT</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>DEPENDENT</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 7. Dependent vs. independent formation rules in TGG, PA and FDG: type

<table>
<thead>
<tr>
<th>FORMATION RULES, TYPE</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPENDENCY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDEPENDENT</td>
<td>SYN</td>
<td>SYN</td>
<td>SYN</td>
</tr>
<tr>
<td></td>
<td>SEM</td>
<td>SEM</td>
<td>SEM</td>
</tr>
<tr>
<td></td>
<td>PHON</td>
<td>PHON</td>
<td>PHON PRAG</td>
</tr>
<tr>
<td>DEPENDENT</td>
<td>SEM</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>PHON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.4 **LEVELS: AUTONOMY VS. DEPENDENCY**

3.4.1 **INTRODUCTION**

Parallel to what happens with the number and type of formation rules, the number and type of independent and autonomous levels of representation partly determine the derivational or non-derivational character of a model of grammar. This section offers a review of the number and type of independent grammatical levels in order to subsequently account for dependent and independent grammatical levels and the relation between the autonomous or dependent status of the various levels, on the one hand, and the derivational or non-derivational character of a given grammatical model, on the other.

3.4.2 **NUMBER AND TYPE OF INDEPENDENT VS. DEPENDENT LEVELS**

Tables 8 and 9 below offer an overview of the number and type of dependent and independent grammatical levels in TGG, PA and FDG -a direct consequence of the number and type of independent and dependent formation rules offered in Tables 6 and 7 above. Accordingly, there is hardly any difference between Tables 6 and 7 above for the number and type of formation rules and Tables 8 and 9 below for the number and type of levels of representation. This means that, in principle, the number and type of formation rules equals the number and type of levels of representation. However, note that FDG shows four independent types of formation rules (pragmatic, semantic, morpho-syntactic and phonological) and four distinct levels of representation that are quite autonomous, though not fully so (this is why a question mark appears for the number and type of dependent levels in FDG in Tables 8 and 9). This is due to the strong top-down directionality of the model. The pragmatic level has a strong influence upon the semantic, this upon the
morpho-syntactic, and this upon the phonological level, which makes encoding levels be more dependent upon formulation levels than vice versa—although the model is a “form-oriented” functional one, i.e. one in which function prevails in as far as it reflects some encoded form (see Hengeveld & Mackenzie 2008: 5, 26). A consequence to be drawn here is that a model of grammar tends to possess the same number and type of independent formation rules as that of independent levels of formation, unless its approach to directionality contradicts the default correspondence between distributional, derivational and directional features (see section 3.6).

**Table 8. Dependent vs. independent levels in TGG, PA and FDG: number**

<table>
<thead>
<tr>
<th>LEVELS, NUMBER</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENT</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>DEPENDENT</td>
<td>2</td>
<td>0</td>
<td>0 (4?)</td>
</tr>
</tbody>
</table>

**3.4.3 SOURCE, TARGET, AND SOURCE-AND TARGET LEVELS**

In principle, the number and type of independent levels of representation is the same as the number and type of source levels of computation in a given model of grammar. This section offers an account of the number and type of computational source, target, and source-and-target levels for TGG, PA and FDG as a step further on the way to accounting for the models’ approach to Derivation.
Table 9. Dependent vs. independent levels in TGG, PA and FDG: type

<table>
<thead>
<tr>
<th>LEVELS, TYPE</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEPENDENT</td>
<td>SYN</td>
<td>SYN</td>
<td>SYN</td>
</tr>
<tr>
<td></td>
<td>SEM</td>
<td>SEM</td>
<td>SEM</td>
</tr>
<tr>
<td></td>
<td>PHON</td>
<td>PHON</td>
<td>PHON</td>
</tr>
</tbody>
</table>
| DEPENDENT    | SEM |    | (SYN,
|              | PHON|    | SEM, |
|              |     |    | PHON,|
|              |     |    | PRAG)|

Tables 10 and 11 below offer an overview of the number and type of the grammatical levels of representation that are considered to be responsible for starting off the computation-processing mechanism in TGG, PA and FDG, those that receive linguistic information, and those that may do both. Three things are to be noted here. Firstly, that the number and type of source levels is the same as the number and type of independent or autonomous grammatical levels. Secondly, since source levels are independent regardless of whether they are also activated as target levels, the number of levels that are source as well as target levels of linguistic computation equals the total number of target levels minus dependent levels. Accordingly, the number of source and target levels for TGG, PA and FDG is, respectively, 0 (2-2), 3 (3-0), and 4 (4-0). Thirdly, note that there are roughly speaking two possibilities for a model of grammar. Either source levels are not target levels (thus there are either source levels or target levels but not source-and-target levels), or source levels are also target levels (thus source levels are source-and-target levels). In the first case, the number of source levels (independent) plus the number of target levels
(dependent) equals the total number of levels of representation. In the second case, the number of source levels equals the number of target levels, since they are the very same levels. In this case, the total number of levels is not an addition of source levels and target levels but simply the group constituted by source-and-target levels. Note that in FDG, although all levels are source-and-target levels, they are half-dependent due to the strong top-down directionality mentioned above.

Table 10. Source, target, and source-and-target levels in TGG, PA and FDG: number

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>SOURCE</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>TARGET</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>SOURCE-AND-TARGET</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>DEPENDENT</td>
<td>2</td>
<td>0</td>
<td>0 (4?)</td>
</tr>
</tbody>
</table>
3.4.4 ALL-FIRST SOURCE LEVELS AND DERIVATION

The aspects to be taken into account when establishing a model’s approach to derivation take on the previous section and are, in this order: the number and type of source computational levels; the uni- or bi-directionality of those levels (whether they are only source or also target levels); and the order in which source computational levels are to be activated, should there be such an order, and should there be more than one source computational level (levels that must start computing before any other are here called all-first levels). This section illustrates all these aspects for TGG, PA and FDG before giving an account of the presence and type of representational mismatches, as well as on the type of interface these lead to, in the following sections.

Table 11. Source, target, and source-and target levels in TGG, PA and FDG: type

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>SYN SEM PHON</td>
<td>SYN SEM PHON</td>
<td>SYN SEM PHON PRAG</td>
</tr>
<tr>
<td>SOURCE</td>
<td>SYN</td>
<td>SYN SEM PHON</td>
<td>SYN SEM PHON PRAG</td>
</tr>
<tr>
<td>TARGET</td>
<td>SEM PHON</td>
<td>SYN SEM PHON</td>
<td>SYN SEM PHON PRAG</td>
</tr>
<tr>
<td>SOURCE-AND-TARGET</td>
<td>_</td>
<td>SYN SEM PHON</td>
<td>SYN SEM PHON PRAG</td>
</tr>
<tr>
<td>DEPENDENT</td>
<td>SEM PHON</td>
<td>_</td>
<td>SYN, SEM, PHON, PRAG / -</td>
</tr>
</tbody>
</table>
Table 12. Source, source-and-target, all-first source levels in TGG, PA and FDG: number

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE</td>
<td>SYN</td>
<td>SYN SEM</td>
<td>SYN SEM</td>
</tr>
<tr>
<td>SOURCE-AND-TARGET</td>
<td>−</td>
<td>SYN SEM</td>
<td>SYN SEM</td>
</tr>
<tr>
<td>ALL-FIRST SOURCE</td>
<td>SYN</td>
<td>−</td>
<td>PRAG</td>
</tr>
</tbody>
</table>

Table 13. Source, source-and-target and all-first source levels in TGG, PA and FDG: type

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>TGG</th>
<th>PA</th>
<th>FDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>SOURCE-AND-TARGET</td>
<td>−</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>ALL-FIRST SOURCE</td>
<td>1</td>
<td>−</td>
<td>1</td>
</tr>
</tbody>
</table>
Tables 12 and 13 above illustrate the number and type of source computational levels, of bi-directional, source-and-target levels (levels that behave as both target and source strata), and of all-first levels (levels that need to be activated before any other computation takes place) for TGG, PA and FDG. No target level can be an all-first source level. In principle, an all-first source level has to be a source level of computation that necessarily starts off all linguistic processing. This is the case of TGG, in which syntax appears as the all-first source level of computation and semantics and phonology are target levels. Also theoretically speaking, a source-and target level of computation cannot behave as an all-first level of computation. If such a level can also be a target level, computation can be sparked off by a different level. This in turn means that the former is not necessarily an all-first level of linguistic computation. This is the case of PA, in which all levels are source-and-target levels of computation, thus there is no all-first level. According to Tables 12 and 13, however, this assumption is contradicted by FDG. Although all levels are source-and-target levels, the pragmatic level appears as the all-first level of computation. In all linguistic computation that takes part from function to form (top-down), the pragmatic level needs to have started it off (e.g. the computation from semantics into morpho-syntax or into phonology, and the computation from morpho-syntax into phonology). Regarding bottom-up processes (from phonology into morpho-syntax, from morpho-syntax into semantics and from semantics into pragmatics), these take place between non-hierarchical units and are not the default case scenario. This is why the pragmatic level appears as the all-first source level of linguistic computation.

The distribution of a model’s levels of representation into source, target, source-and-target and/or all-first source levels of computation is a parameter that defines the model’s inclination to behave in a derivational manner –and, as mentioned above, it can also be restricted by the model’s directionality. Taking a closer look at the Figures above, the
number and type of source levels, of source-and-target levels, and the presence of an all-first source level can be seen as parameters that progressively restrict a model’s approach to derivationality. The first question to be asked is: are all levels source levels? It is to be noted that, for a model to be fully derivational, the number of source levels of computation needs to be less than the total number of levels. This means, on the one hand, that TGG is derivational, since only the syntactic level appears as source level of computation. The opposite logic, however, does not seem to apply. It is not because a model’s total number of levels coincides with the number of levels that behave as sources of linguistic computation (such as is the case for PA and FDG) that one may conclude that they are fully non-derivational. The second and third parameter help solve the misleading syllogism. If a model’s number of source computational levels does not coincide with its total number of levels, it can be concluded that it is somehow derivational, for some levels will necessarily have to be derived from others. But what happens if the number of source levels of computation and the total number of levels conceived by a theory of language coincide? In order to avoid the inverse logic leading to the false conclusion that in such a case the model is non-derivational, the number and type of bi-directional (source-and-target) levels and of all-first levels of computation are added as second and third restricting criteria.

Accordingly, if a model’s total number of levels and its number of source levels of computation do coincide, and in order to know whether this leads to total non-derivation, the question to be asked is: are all source levels also potential target levels (i.e. source-and-target levels)? That is, are all levels, i.e. all source levels, also source-and-target levels? If the answer is no, then the model will be derivation-prone, since those levels that are source but not target strata will obviously define the model as one that derives linguistic information from only-source levels to only-target and source-and-target levels. If the answer is yes, then the model will be non-derivation-prone,
since derived levels may also theoretically be deriving levels, as is the case in both PA and FDG. Now, if a model’s number of source levels coincides with the total number of levels (first parameter), and so does the number of source-and-target levels (i.e. all levels are both source and target, second parameter), can one conclude that such a model is fully non-derivational?

The third restricting parameter, the number of all-first source levels of computation, further restricts the degree to which a given model may be derivation-prone. The question to be asked here is: are all source-and-target levels also possibly activated as the beginning of linguistic computation (i.e. potential all-first levels)? (Or is there a pre-determined order in the computation whereby certain levels need to be activated before the rest in order to start computing as well?) If the answer is yes, as is the case for FDG, then the model will be more derivation-prone than if the answer is no, as is the case for PA. This is so, since, although all levels are potential sources of computation, there still is computational primacy of some levels over the rest, for certain levels will have to be activated before any kind of computation at the remaining levels takes place.

Accordingly, TGG is obviously derivational, as is clear right from the first parameter. The total number of levels does not coincide with the number of source levels. The one source level, syntax, is thus representationally responsible for the remaining levels, semantics and phonology, from which these two are derived. Derivationality in TGG also applies in an intra-level fashion – formation rules in the syntactic component are themselves derivational, either top-down in pre-minimalist versions, or bottom-up in the MP, see e.g. Jackendoff 2011). FDG offers, as is mentioned above, a less clear case-scenario, since parameters 1 and 2 would define the model as non-derivational, which is then counter-argued by parameter 3. On the one hand, the total number of levels and of source levels do coincide, which means that a) all levels can behave as input givers, and b) all levels can behave as input takers. On the other hand, parameter 3 defines FDG as a model in which there is one
level that behaves as an all-first level, pragmatics (semantics is not considered here, since it may be absent for the representation of certain utterances seen as void of semantic content), that must necessarily be activated before computation at other levels takes place, either in a top-down or in a bottom-up fashion. Finally, PA offers a clear example of a totally non-derivational model, since the answers to questions for parameters 1, 2, and 3 are all positive. That is, all levels are source levels, all source levels are also target levels, and all source-and-target levels may be activated at the beginning of linguistic computation, i.e. there is no pre-determined order.

All of the above-mentioned illustrates three different approaches to derivationality for TGG, PA and FDG. Firstly, TGG illustrates what Jackendoff calls “syntactocentrism” – syntax as the starting computing mechanism from which phonology and meaning are derived (see e.g. Culicover & Jackendoff 2005). Also in the Minimalist Program (Chomsky 1993, 1995), although the D- and S-structures are eliminated, Merge and Move constitute the main, syntactic, component, from which meaning and phonology are derived (ibid: 110, in Burling 2003). In opposition to this approach to derivation, the PA offers an architecture of grammar in which syntax is not the all-first source level of computation –it is not the central level from which meaning and phonology are derived. Finally, FDG offers an in-between case scenario (as illustrated by Tables 12 and 13), since all levels are source-and-target levels, yet there is a strong tendency for the pragmatic level to behave as an all-first source level –to be the level from which meaning, morphosyntax and phonology are derived.
3.5 **INTER-LEVEL MAPPING PROCESSES**

3.5.1 **INTRODUCTION**

Inter-level mapping processes constitute the architectural feature that mostly determines the approach that a given model of grammar adopts regarding the second architectural dimension of this work, Derivation. Another term to refer to inter-level mapping processes is interface processes or, simply, interfaces. In this section, I describe the notion of interface and its relation to derivation. I subsequently discuss two opposite approaches to the notion of interface, flexible vs. transparent, as a derived feature of inter-level mismatch toleration or absence thereof. I propose a classification of inter-level mismatches and finally apply the notions of flexible vs. transparent interface and the presence and types of inter-level mismatches to TGG, PA and FDG by means of a common-place case of arguably syntax-semantics mismatch, quantifier scope ambiguity.

3.5.2 **DEFINITION**

An inter-level interface is a formal interaction or interplay between two levels of representation. In a formal theory of language, an interface can be represented by means of a rule that determines correspondences between the various levels of representation (see Van Valin Jr. 2005 § 5.1 for an example on the syntax-semantics “linking algorithm”). In derivational models, in which inter-level mismatches are not tolerated, interface rules are in principle less complex than in non-derivational models, since the relation between levels in the former is of a one-to-one nature. In non-derivational models, on the contrary, interface rules play a very important role, particularly in non-default cases, in which they are the ones to determine, firstly, how the various levels interact and, secondly, the extent to which the representations at different levels may
differ and still interact in such a way that they represent one and the same linguistic unit.

3.5.3 FLEXIBLE VS. TRANSPARENT INTERFACE

An inter-level\(^9\) interface, i.e. the mapping from one grammatical level to another, can be classified as being transparent or flexible. A transparent inter-level interface is a mapping—a linking mechanism or formal representation— that allows for a straightforward correlation between a pair of levels, from a quantitative as well as from a qualitative point of view. According to a transparent syntax-semantics interface, the “[s]emantic scope of constituents often depends on their syntactic constellation” and “the syntax-semantics interface (SSI) is iconic: Configurational asymmetries of syntactic tree structures are mapped onto semantic asymmetries” (Egg 2004). This is related to semantic compositionality (Frege 1892) and the belief that an expression’s meaning is the result of the meanings of a sentence’s constituents and the way in which they are combined. This means that the representation of a linguistic item can be easily tracked down to its correspondent representation at a different level of representation, since there is no deviation from the following:

1) The expected quantitative one-to-one correspondence between
   a. The number of potential representations at the various levels.
   b. The number of formal items representing one linguistic unit at various levels.

2) The expected qualitative default iconicity between two differing levels of formal representation between

\(^9\) Note that level here refers to stratum (thus also to the sub-levels of which e.g. the syntactic level is made of in TGG).
a. The category of formal items representing a linguistic unit at various levels, should primitives used for the description of the linguistic unit differ at the various levels.

b. The nature of formal items representing a linguistic unit at various levels, should primitives used for the description of the various levels not differ but rather belong to the same descriptive category.

A transparent interface therefore does not allow for inter-level mismatches or non-homomorphisms, since levels relate in an iconic manner. On the other hand, a flexible interface is a mapping -a linking mechanism or formal representation- that may but need not per se allow for a straightforward correlation between the various levels, from a quantitative and from a qualitative point of view. This means that the representation of a linguistic item cannot always be easily tracked down to its correspondent representation(s) at a different level of representation, since there may be a deviation from the expected quantitative one-to-one correspondence, and/or from the expected qualitative default iconicity between two differing levels of formal representation. A flexible interface allows therefore for inter-level mismatches or non-homomorphisms, since levels do not necessarily relate in an iconic manner. For a detailed approach to possible flexible interface processes, see Coheur, Batista & Mamede (2004) and Debusman et al (2004).

3.5.4 MISMATCHES IN INTER-LEVEL MAPPING PROCESSES

3.5.4.1 INTRODUCTION

The (in)tolerance of inter-level mismatches determines whether a model’s approach to its inter-level processes is flexible or transparent. This, in turn, determines to a great extent whether a
model is derivational in nature or not. This section starts off with a definition of the term mismatch and its relation to the notions of interface flexibility/transparency and of derivation. I subsequently propose a classification of the various kinds of mismatches and finally illustrate these for TGG, PA and FDG and their respective approach to quantifier scope ambiguity.

**3.5.4.2 INTERFACES, MISMATCHES AND DERIVATION**

An inter-level mapping process is mismatching if the same linguistic element is represented at different grammatical levels in such a way that an unexpected, non-isomorphic correlation is to be seen between those representations. Thus, mismatches are “mappings between (apparently) incongruent elements or structures, where incongruity is defined relative to some typical or default condition” (Francis & Michaelis 2000). If mismatches are non-default mappings between structures belonging to different levels of representation, then those representations need to be allowed by the governing principles of the theory to be mismatching. Levels are then necessarily autonomous. If, on the other hand, the levels of a theory are not independent but fully depend upon each other for their representation, the occurrence of mismatches is obviously restricted or simply totally avoided by the derivational model at hand. In order to briefly illustrate how a transparent and a flexible interface work and how this affects inter-level mismatch toleration and derivation, an instance of quantifier scope ambiguity is shown below in (1).

---

10 Mismatches considered in this section are mostly grammatical ones – i.e. mismatches that occur between the formalization of one linguistic unit in a given model of language. The mismatch in this case affects the method of study of language. Mismatches may also affect the object of study itself, language – say, an accusative appears where there should be a nominative pronoun. For a discussion on grammatical vs. ungrammatical violations of the canonical syntax-semantics interface, see Francis (1999).
(1) All guys LOVE a confident female.\textsuperscript{11}

Depending on the scope of “all”, (1) can yield at least two possible semantic interpretations\textsuperscript{12}. Predicate logic (see e.g. Hamilton 1978) is used to illustrate this point in (2) and (3) below. The meanings of (2) and (3) are given in (4a) and (4b) respectively.

(2) \( \forall x \left[ \left( G(x) \rightarrow \exists y \left[ \left( F(y) \land C(y) \right) \land L(x,y) \right] \right) \right] \)

(3) \( \exists y \left[ \left[ F(y) \land C(y) \right] \land \left( \forall x \left[ G(x) \rightarrow L(x,y) \right] \right) \right] \)

Whereby

\begin{itemize}
  \item G: guy
  \item F: female
  \item C: confident
  \item L: LOVE
\end{itemize}

(4) a. For all x such that x is a guy, there is a y such that y is a female and y is confident and x loves y.

b. There is a y such that y is a female and y is confident and for all x such that x is a guy y loves x.

(1) above can thus mean “For all x such that x is a guy, there is a y such that y is a female and y is confident and x loves y”, i.e. all guys love a different, confident female. It can also mean “There is a y such that y is a female and y is confident and for all x such that x is a guy x loves y”, i.e. all guys love the same, confident female. A transparent interface would argue for a compulsory one-to-one correspondence between e.g. the semantic and the syntactic levels of representation. This means

\textsuperscript{11} Example taken from online blog: http://EzineArticles.com/1494884.

\textsuperscript{12} An obvious reading could also be that of “any guy loves any female that is confident” (Mackenzie, p.c.).
that any type of ambiguity at one level of representation will have to be accounted for at all levels of representation derived or deriving from the former. Since a sentence such as (1) can have two semantic interpretations depending on whether the quantifier “all” has wide or narrow scope, a model that tolerates no inter-level mismatch will necessarily have to account for such ambiguity as one also at the syntactic level. This would allow for a transparent, iconic correspondence between the semantic and the syntactic levels of representation such that, should (1) be interpreted as in (2) (whereby the universal quantifier has higher scope), the model would yield one syntactic structure. On the contrary, should (1) be interpreted as in (3) (whereby the universal quantifier has lower scope), then the model would yield a different syntactic structure. A transparent interface is thus one that requires a quantitative and qualitative inter-level one-to-one correspondence, which for (1) means that each differing semantic structure would have a varying syntactic counterpart. In turn, a model that requires representational inter-level isomorphism is one that derives certain structures from others, therefore derivational.

The need for syntax-semantics isomorphism has been seen as the source of an underlying level of syntactic structure in the generativist framework so that transparency can be maintained: “syntactic structure reflects (and is iconic to) a not directly visible layer of syntactic structure like Logical Form. This layer may differ considerably from syntactic surface structure, but in this way the iconicity of syntax and semantics could be upheld” (Egg 2004). In the case of quantifier scope ambiguity, “[i]t is standard to assume that the ambiguity of sentences like . . . [Every boy admires some saxophonist] is to be accounted for by assigning two logical forms which differ in the scopes assigned to these quantifiers” (Steedman 1999). By creating two different logical forms (two different syntactic structures that reflect two different predicate logic – semantic – representations, the iconicity syntax-semantics can be namely maintained. In such a transparent interface approach, inter-level
isomorphism is required, since one level (say, the semantic level) is derived from another (say, the syntactic level). Since a sentence such as (1) can have two semantic interpretations, a model that tolerates no inter-level mismatches and whereby the semantic is derived from the syntactic level of representation has to necessarily account for such semantic ambiguity as one also at the syntactic level. This would allow for a transparent, isomorphic correspondence between the semantic and the syntactic levels of representation so that, should (1) be interpreted as in (2), the model would yield one syntactic structure or Logical Form and, should (1) be interpreted as in (3), the model would yield a different syntactic structure or Logical Form. A transparent interface is thus one that requires a quantitative and qualitative inter-level one-to-one correspondence, which for (1) means that two differing semantic structures such as (2) and (3) must each have a different syntactic counterpart or Logical Form each.

On the contrary, a flexible interface would argue for a non-compulsory one-to-one correspondence between, say, the semantic and the syntactic levels of representation. This means that any type of ambiguity at one level of representation does not necessarily have to be accounted for at all levels of representation derived or deriving from the former. Since a sentence such as (1) can have two semantic interpretations, a model that tolerates inter-level mismatches does not necessarily have to account for such ambiguity as one also at the syntactic level. This would allow for a flexible, non-isomorphic correspondence between the semantic and the syntactic levels of representation, so that, should (1) be interpreted as in (2), the model would yield one syntactic structure and, should (1) be interpreted as in (3), the model would yield the same syntactic structure. A flexible interface is thus one that does not require a quantitative and qualitative inter-level one-to-one correspondence, which for (1) means that two differing semantic structures such as (2) and (3) can have a single syntactic counterpart. In turn, a model that does not require
representational inter-level isomorphism is one that does not derive certain structures from others, therefore non-derivational.\footnote{For further discussion on scope ambiguity assuming interface flexibility in a non-monotonic theory of language, see Egg (2007).}

\section*{3.5.4.3 \textit{CLASSIFICATION}}

\subsection*{3.5.4.3.1 \textit{INTRODUCTION}}

Representational mismatches constitute a defining feature of a flexible interface or mapping mechanism that defies inter-level one-to-one correspondence. The deviation from the expected transparency may be quantitative, in that:

a) the number of representations at the various levels is mismatching, and/or  
   b) the number of formal items representing one linguistic unit at various levels is mismatching.

The deviation from the expected transparency may alternatively/in addition be qualitative, in that one linguistic unit is represented as mismatching in nature within one or more levels that:

a) are formalized making use of the same set of formal units/defining parameters, and/or  
   b) are formalized making use of different sets of formal units/defining parameters, in which case the qualitative mismatch will be established taking a pre-determined default correspondence between categorial units at different levels as the defining point. This is illustrated in the categories that appear in Table 14 below\footnote{References to particular examples are given below. This table only provides the English translations. The full original examples are also provided below. It is also to be noted that the list of mismatches does not attempt to be exhaustive but merely illustrative of what I consider to be the main types of mismatch.}. These categories are further explained in the following sections.
### Table 14. Representational mismatches: a classification

<table>
<thead>
<tr>
<th>Mismatches</th>
<th>Quantitative</th>
<th>Inter-Level</th>
<th>Non-Inter-Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal morphology</td>
<td>Bailábamos.</td>
<td>Wir tanzten.</td>
<td></td>
</tr>
<tr>
<td>Absent object markers</td>
<td>'i‘in ‘I’awlimq-sa piskis. 1SG fix-IMPERF door</td>
<td>I am fixing my door. 'i‘in ‘a‘I’awlimq-sa pisk’is-ne. 1SG OBJ-fix-IMPERF door-OBJ</td>
<td>I am fixing a door. (Aoki 1994:381)</td>
</tr>
<tr>
<td>Indefinite subjects</td>
<td>A certain man arrived yesterday. One man (rather than two) arrived yesterday. (Tsai 2001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraposed relative clauses</td>
<td>Three people arrived here yesterday who were from Chicago. Three people who were from Chicago arrived here yesterday. (Francis 2010)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole vs. partial mapping of linguistic units at different levels</td>
<td>Non-intersective modification</td>
<td>Everyone in this room (Egg 2004)</td>
<td></td>
</tr>
<tr>
<td>Qualitative</td>
<td>Inter-level</td>
<td>Intra-level</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td><strong>Mismatch</strong></td>
<td>Categorial – non-default co-relation between categories of different levels of representation (different sets of units/definition parameters for the various levels)</td>
<td>Structural/constructural – non-default co-relation between different levels of representation (same sets of units/definition parameters for the various levels)</td>
<td>Non-default correlation between smaller and bigger units</td>
</tr>
<tr>
<td><strong>Cross-cutting syntactic categories</strong></td>
<td>Cross-cutting syntactic categories</td>
<td>Cross-cutting syntactic categories</td>
<td></td>
</tr>
<tr>
<td>dog: syntax: N</td>
<td>dog: syntax: N</td>
<td>dog: syntax: N</td>
<td></td>
</tr>
<tr>
<td>semantics: Pred</td>
<td>semantics: Pred</td>
<td>semantics: Pred</td>
<td></td>
</tr>
<tr>
<td>semantics: Pred</td>
<td>semantics: Pred</td>
<td>semantics: Pred</td>
<td></td>
</tr>
<tr>
<td>(Sadock 2002)</td>
<td>(Sadock 2002)</td>
<td>(Sadock 2002)</td>
<td></td>
</tr>
<tr>
<td><strong>Cognate objects</strong></td>
<td>Cognate objects</td>
<td>Cognate objects</td>
<td></td>
</tr>
<tr>
<td>Chris sneezed a horrific sneeze.</td>
<td>Chris sneezed a horrific sneeze.</td>
<td>Chris sneezed a horrific sneeze.</td>
<td></td>
</tr>
<tr>
<td>(De Swart 2006)</td>
<td>(De Swart 2006)</td>
<td>(De Swart 2006)</td>
<td></td>
</tr>
<tr>
<td><strong>Structural relations</strong></td>
<td>Structural relations</td>
<td>Structural relations</td>
<td></td>
</tr>
<tr>
<td>John seems to play good.</td>
<td>John seems to play good.</td>
<td>John seems to play good.</td>
<td></td>
</tr>
<tr>
<td><strong>Pseudo-coordination</strong></td>
<td>Pseudo-coordination</td>
<td>Pseudo-coordination</td>
<td></td>
</tr>
<tr>
<td>You drink one more can of beer and I am leaving.</td>
<td>You drink one more can of beer and I am leaving.</td>
<td>You drink one more can of beer and I am leaving.</td>
<td></td>
</tr>
<tr>
<td><strong>Mismatched-case pronomina</strong></td>
<td>Mismatched-case pronomina</td>
<td>Mismatched-case pronomina</td>
<td></td>
</tr>
<tr>
<td>Min bror og mig er gode venner. My brother and me are good friends.</td>
<td>Min bror og mig er gode venner. My brother and me are good friends.</td>
<td>Min bror og mig er gode venner. My brother and me are good friends.</td>
<td></td>
</tr>
<tr>
<td>Mig og min bror er gode venner. Me and my brother are good friends.</td>
<td>Mig og min bror er gode venner. Me and my brother are good friends.</td>
<td>Mig og min bror er gode venner. Me and my brother are good friends.</td>
<td></td>
</tr>
<tr>
<td><strong>Aspect coercion</strong></td>
<td>Aspect coercion</td>
<td>Aspect coercion</td>
<td></td>
</tr>
<tr>
<td>I have been slapping the guy for hours now.</td>
<td>I have been slapping the guy for hours now.</td>
<td>I have been slapping the guy for hours now.</td>
<td></td>
</tr>
</tbody>
</table>
3.5.4.3.2 NUMBER OF ELEMENTS/FEATURES EXPRESSING ONE FEATURE/ELEMENT AT DIFFERENT LEVELS OF REPRESENTATION

This type of mismatch constitutes a discrepancy between the number of features or elements at one level that express or represent another element or feature at a different level of representation. These can be discrepancies between e.g. the number of elements representing the various semantic features of verbal morphology (differing from language to language) or the absence or presence of object markers depending on the morpho-syntactic context. Under this category of mismatch, two phenomena are discussed: verbal morphology and absent object markers.

Regarding **verbal morphology**, languages differ in the way in which they distribute linguistic information. Mismatches may occur whenever a language has e.g. less verbal morphemes than content features attached to the verb. As illustrated in (5) and (6) below, this is a language-dependent characteristic.

In (5), the number of content features mismatches with the number of morphemes attached to the verb (ba-PST, IMP, IND; mos-1, PL). In (6), a similar (though not identical) semantics-morphosyntax mismatch occurs (t-PST; en-PL). Note that such language-specific mismatches are also model-specific, since concepts such as tense, aspect and mood are not inherent to all languages but rather established as relevant by a given linguistic theory. Also, the number of content features is determined by the linguist – i.e. it is not a given truth to be discovered by the linguist. However, if one assumes that the linguistic unit X has Y number of content features, one can compare this number of content features with that of morphemes in a cross-linguistic fashion.

(5) Bailá - ba - mos
    Dance -PST.IMPF.IND - 1.PL
A further instance of quantitative mismatch is illustrated by the morphosyntax-semantics mismatch created in the case of **absent object markers**. Following Rude (1985), Deal (2010a: 11-12, 2010b) observes that marking transitivity and marking possessiveness (when the subject and the possessor of the object co-refer) of objects in Nez Perce are incompatible. (7a) (Aoki 1994: 381) below shows that the verb lacks an object marker, since the subject and the possessor of the object co-refer —cf. (7b) (*ibid*), where the verb is marked for the object. (7a) can be interpreted as a mismatch between semantics and morphosyntax in that the addition of a new semantic feature (possession) results in the deletion of a morphological feature (the object marker).\(^{15}\)

\[
\begin{align*}
(7) & \quad a. & 'iin l'awlimq-sa piskis. \\
& & 1SG fix-IMP door \\
& & I am fixing my door. \\
& \quad b. & 'iin 'a-l'awlimq-sa pisk's-ne. \\
& & 1SG 3OBJ-fix-IMP door-OBJ \\
& & I am fixing a door.
\end{align*}
\]

3.5.4.3.3 **MISMATCHES IN THE NUMBER OF REPRESENTATIONS AT DIFFERENT LEVELS**

One of the most commonly researched types of mismatches corresponds to what is here classified as a quantitative, inter-level mismatch regarding the number of representations that the

\(^{15}\) Deal (2010b) argues for an underlying argument structure and Logical Form in spite of the absence of an overt case-marking for the object (the result of co-reference between the subject and the object’s possessor).
different levels may potentially yield for one linguistic expression. Two phenomena that illustrate this kind of inter-level, quantitative mismatch are indefinite subjects and extraposed relative clauses. Firstly, **indefinite subjects** can be considered to illustrate an instance of syntax-semantics mismatch. Indefinite subjects may be interpreted quantificationally (specific vs. generic readings) and non-quantificationally (non-specific, non-generic reading) as exemplified in (8) below (Tsai 2001).

\[(8)\]  
A man arrived yesterday.

\[a.\] A certain man arrived yesterday.  
(specific)

\[b.\] One man (rather than two) arrived yesterday.  
(nonspecific)

The indefinite subject in (8) can thus be interpreted as in \(8a\) or as in \(8b\), i.e. as being specific or non-specific. The two different readings of the indefinite subject in (8) can be interpreted as being the source of an inter-level, quantitative mismatch between the number of representations at the syntactic and semantic levels of representation—one syntactic representation and two semantic representations. Note that the semantic ambiguity—specific vs. non-specific reading—may also be argued to go hand in hand with a syntactic change of position of the subject quantifier, in which case the mismatch disappears.

A further phenomenon that illustrates an inter-level, quantitative mismatch of the type discussed above is the **extraposition of relative clauses**. (9a) below (Francis 2010) illustrates the extraposition of the grammatically “heavy” relative clause “who were from Chicago”. (9b) is the non-extraposed counterpart of (9a). If no semantic difference is assumed between (9a) and (9b), a mismatch is created in that two different syntactic structures (one extraposed, one non-
extraposed) correspond to a single semantic representation. This is therefore another case of inter-level, quantitative mismatch: it is an inter-level mismatch, since the discrepancy takes place between the formalization of two different levels of representation, the syntactic and the semantic one; and it is quantitative, since two syntactic interpretations (extraposed vs. non-extraposed relative clause) correspond to the same semantic structure. Note that, if a semantic difference is assumed between (9a) and (9b) while the syntactic difference is kept, the mismatch disappears. Note also that, if a single, covert syntactic structure is assumed before extraposition takes place while both structures are assumed to have the same meaning, the mismatch also disappears.

(9)  

a. Three people arrived here yesterday who were from Chicago.

b. Three people who were from Chicago arrived here yesterday.

3.5.4.3.4 WHOLE VS. PARTIAL MAPPING OF LINGUISTIC UNITS AT DIFFERENT LEVELS OF REPRESENTATION

This type of mismatch refers to the way in which different levels of representation operate—the addition of constituents at one level of representation is compositional whereas at a different level they are not. (10) below (Egg 2004) illustrates a case of non-compositional, non-intersective modification. This is shown in (11). (10) illustrates thus a new type of quantitative, inter-level mismatch in that the interface between two different levels of representation (syntax, semantics) takes place in such a way that syntax can operate compositionally ([everyone+ in this room]) whereas semantics does not (“everyone in this room” does not refer to each and every one, all of them being in this
room, but to a certain group within everyone, the sub-group of everyone in this room). This type of quantitative mismatch differs from the previous in that the interface takes place with only part of the semantics of “everyone” in semantics, while “everyone” fully intersects with “in this room” in syntax (see also Kasper 1997).

(10) Everyone in this room.

(11) \[ \forall (x) \mid P(x) \land I(R, x) \]
    Whereby I: in
    P: person
    R: room

3.5.4.3.5 CATEGORICAL MISMATCHES

Categorial mismatches constitute a type of qualitative non-homomorphisms or mismatches. They consist of non-default correspondences between the categories attached to one linguistic unit at different levels of representation that are defined and structured using different units. This type of categorical mismatches can be illustrated in various phenomena, e.g. in syntactic categories that cut across different semantic categories and in cognate objects. Categorical mismatches are thus instances of non-isomorphic, non-default correspondences between categories that belong to different levels of representation. (12) below (Sadock 2003) illustrates N and V as being cross-cutting syntactic categories. Note that his theory of *Autolexical Syntax* (Sadock 1985, 1991, 2003, 2012) is composed of three different grammatical levels (one syntactic, one semantic and one morphological) that are independent from each other. Mismatches may thus arise. Sadock (2003) argues that the syntax-semantics interface can show a mismatch in the different categories represented by lexical items such that the two major syntactic categories N and V crosscut different semantic categories: Predicate, Relation, Operator, and
Note that the syntactic category N cross-cuts the semantic categories of Predicate ("dog"), Relation ("mother"), and Relational Operator ("belief"), while the syntactic category V cross-cuts the semantic categories of Predicate ("bark"), Relation ("love"), Relational Operator ("believe"), and Operator ("seem"). Note also that semantic categories could also be considered to cut across different syntactic categories. Thus, the semantic categories Predicate ("dog", "bark"), Relation ("mother", "love") and Relation Operator ("believe", "belief") cut across the syntactic categories N and V.

(12) a. dog: syntax: N  
    semantics: Pred
b. bark: syntax: V  
    semantics: Pred
c. mother: syntax: N  
    semantics: Rel
d. love: syntax: V [/_NP/]  
    semantics: Rel
e. believe: syntax: V [/_CP/]  
    semantics: RelOp
f. belief: syntax: N  
    semantics: RelOp
g. seem: syntax: V [/_VP/]  
    semantics: Op

A further instance of categorial mismatch is illustrated by cognate objects. Cognate objects are objects that are derived from the same root as the (usually intransitive) verb of which they are an object. (13) below (de Swart 2006) contains three
examples of cognate objects. These examples can be interpreted as a categorial syntax-semantics mismatch in that the default category correlation between the syntactic and the semantic levels of representation is violated. Nominal phrases (syntactic category) such as “a happy life” (13a), “a horrific sneeze” (13b) and “an enigmatic smile” (13c) usually correlate with themes, patients or, generally speaking, with objects that add to the meaning of the verb in question (semantic category). In this case, however, the cognate objects, nominal from a syntactic point of view, correlate with a manner meaning instead of with the default theme/patient semantic relation usually attached to a nominal object. This can be seen by the fact that they can easily be substituted by adverbial phrases (“happily” in (13a), ‘horrifically’ in (13b) and “enigmatically” in (13c)) (Jones 1988, de Swart 2006).

(13)  a. Max lived a happy li[f]e.
    b. Chris sneezed a horrific sneeze.
    c. Jonathan smiled an enigmatic smile.

3.5.4.3.6 STRUCTURAL MISMATCHES

Structural mismatches arise from non-default, unexpected deviations from inter-level correspondences between intra-level structural or scope relations at different levels of representation such that the dependency or hierarchy relations existing between constituents or linguistic units at one level mismatch with those at another level of representation. Some of the phenomena that show this type of qualitative mismatch are raising structures, pseudo-coordinate structures and mismatched-case pronouns. Firstly, raising illustrates a structural mismatch in that the position, structural or scope relations of a linguistic unit to the rest of the utterance varies according to the level of
representation at hand. This is illustrated in (14a). Raising always involves a noun that has arguably been “raised” from a lower, more embedded position (from an embedded clause) to a higher position (the main clause). Such raising is argued because the noun in question appears in the main clause at overt syntax but is thought to be a semantic argument of the embedded clause, i.e. it has been raised from the semantic position in which it receives its semantic role (the embedded clause) up to the position in which it is actually realized (the main clause). The movement from the embedded to the main clause is called raising since the main clause appears higher up in the tree than the embedded clause in formal trees of the generative tradition. The structural mismatch arises thus in that the raised noun appears in a more embedded position at semantics (where it is an argument of the embedded predicate) than at syntax (where it is an argument of the main predicate). Accordingly, the structural mismatch in (14a) arises in that “John” arguably appears in a less embedded position in the syntactic representation than in the semantic representation -with scope over “seems” in the former and under it in the latter. (14b) is an alternative for (14a) in which “John” has not been raised. Note that if a syntactic structure is created in order to reflect the semantic representation (say, Logical Form), the syntax-semantics mismatch disappears –the raised noun would appear in its semantic position at a syntactic level of representation (that mimics semantics). For further discussion on raising see section 5.7.

(14)  a. John seems to play well.

b. It seems that John plays well.

A further instance of structural mismatch is shown in pseudo-coordination (Culicover & Jackendoff 1997, see also Kwon 2004 for pseudo-coordination in Korean). Pseudo-coordination is a case of inter-level, qualitative, structural
mismatch in that one linguistic unit behaves as an independent-coordinate unit from a syntactic point of view and as dependent/subordinate unit from a semantic point of view. This leads therefore to a mismatch in the hierarchical relations that hold at the syntactic and the semantic levels. (15) below (Culicover & Jackendoff 1997: 195) illustrates this type of behaviour. From a syntactic point of view, “you drink one more can of beer” and “I am leaving” are coordinated units, thus they are both syntactically independent and could appear on their own. From a semantic point of view, however, “you drink one more can of beer” is dependent on or subordinate to “I am leaving” (the semantic translation being “if you drink one more can of beer, I am leaving”). The fact that (15) is a case of semantic subordination in spite of syntactic coordination is shown e.g. through inversion tests: *I am leaving and you drink one more can of beer. For further explanation on pseudo-coordination, see section 5.3.2.

(15) You drink one more can of beer and I am leaving.

Finally, mismatched case pronomina offer a further type of structural mismatch. Parrott (2007) discusses the use of object pronouns in subject positions in languages such as Danish. (16a) and (16b) illustrate this phenomenon. The subject pronoun is expressed by means of an object pronoun (“me”). This illustrates a non-default correlation between different levels that share the same classifying parameters if seen as a case where the syntactic level yields a subject position that possesses the morphological behavior of an object. This is so, since the categorizing terms/units for the syntactic and the morphological levels do not differ (SYN: SUB vs. OBJ; MORPH: SUB vs. OBJ) and the correspondences between the two violate the expected syntax-morphology isomorphism (the morphology of a subject for a syntactic subject and the morphology of an object for a syntactic object) since the analysis for “mig” (me) in (14a) and (14b) is: SYN: SUB; MORPH: OBJ.
If, on the contrary, the analysis is as follows, then it may be classified as a qualitative categorical mismatch as those discussed in section 3.5.4.3.5 such that “mig” (me) would be analyzed as follows: SYN: SUB; MORPH: ACC. The classifying terms/units for the syntactic and the morphological levels now do differ (SYN: SUB vs. OBJ; MORPH: NOM vs. ACC) and the correspondences between the two violate the expected syntax-morphology isomorphism (nominative morphology for a syntactic subject and accusative morphology for a syntactic object).

(16)  a. Min bror og mig er gode venner.
   My brother and me are good friends.

   b. Mig og min bror er gode venner.
   Me and my brother are good friends.

   (Parrott 2007: 305)

3.5.4.3.7 INTRA-LEVEL MISMATCHES

The last type of mismatch to be discussed in this chapter involves an intra-level discrepancy or non-default correlation between smaller and bigger units at one single level of representation. Aspectual coercion may be classified as one such mismatch at the semantic level of representation. Thus, “[r]ather than involving a mismatch in the number or constituency of elements at different levels of grammar, aspectual coercion involves a mismatch within the semantics. Specifically, the semantic properties of an aspectual operator (such as progressive -ing in English) conflict with the semantic properties of the sentence in which the operator is used, but the sentence is interpretable anyway” (Francis & Michaelis 2000)16.

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(17a) illustrates a grammatical utterance in which a normally telic verb, “knock”, co-exists with the progressive aspect. On the other hand, (17b) shows that the progressive aspect of “-ing” operator cannot normally co-exist with certain telic verbs because a mismatch between the aspectual operator and the semantics of the whole sentence arises. The grammaticality of sentences such as (17a) lies in the possibility of: interpreting it with a [+volition] entailment as understood by Dowty (1991) (e.g. “I am being stupid” - the experiencer turns into an agent by wanting to be stupid, which is expressed by the abnormal use of the progressive operator with the normally telic verb “to be” used as a main verb); an exaggeratedly durative meaning (e.g. “I am loving it”, as a result of a pragmatic inference resulting again from a violation of the default combination rule non-progressive+telic verb); an iterative meaning resulting from aspectual coercion, whereby an action with an inherent endpoint undergoes a semantic adjustment in order to be interpreted as a durative event of repeated character (see Piñango, Zurif & Jackendoff 1999).

(17)  

a. I am knocking on the door.

b. *I am bumping into him.

A clash between bigger and smaller units at semantics parallel to that illustrated above between the telicity of a whole sentence and that of its aspectual operator appears between the telicity of a sentence, on the one hand, and mass/plural nouns and duration adverbials, on the other. (18) illustrates that the morphology of arguments also plays a role in the (a)telicity and thus on the (a)grammaticality of certain verbal clauses due to a clash between the morphology of the theme/patient, the nature of adverbials and the aspectual operator.
a. (?I slapped the guy in an hour.
   \[\text{perfective aspect} + \text{definite argument} + \text{perfective adverb}\]

b. I have been slapping guys for hours.
   \[\text{imperfective aspect} + \text{indefinite argument} + \text{imperfective adverb}\]

c. (?I slapped guys in an hour.
   \[\text{perfective aspect} + \text{indefinite argument} + \text{perfective adverb}\]

d. (?I slapped the guy for an hour.
   \[\text{perfective aspect} + \text{definite argument} + \text{imperfective adverb}]>\text{coercion}\]

e. I have been slapping the guy for an hour.
   \[\text{imperfective aspect} + \text{definite argument} + \text{imperfective adverb}]>\text{coercion}\]

f. *I have been slapping guys in an hour.
   \[\text{imperfective aspect} + \text{indefinite argument} + \text{perfective adverb}\]

The general impression is that mass and plural nouns seem to require an atelic verb (or at least the atelic interpretation thereof) whereas singular countable nouns implying completeness seem to require a telic verb or the telic interpretation thereof. That is, there seems to be a need for telicity/perfectiveness/completeness consistency all throughout the clause such that the verb, the object and the adjuncts to the verb appear in one of the following combinations: atelic verb + plural / mass nouns + duration adverbs vs. telic verb + singular / countable nouns + period adverbs). Should this combination fail to appear, coercion comes into play. Accordingly, the combination of telic verbs\(^{17}\) with time-frame adverbs and definite arguments (18a) and of atelic verbs with time-span

\(^{17}\) Telic vs. atelic verb used here to refer to telic reading vs. atelic reading.
adverbs and plural arguments (18b) is arguably correct because the completeness/perfectiveness consistency is fulfilled along the clause\textsuperscript{18}. The combination of telic verbs with time-frame adverbs but also plural arguments (18c) and of atelic verbs with plural arguments but also time-frame adverbs (18f) is incorrect because the said consistency is not fulfilled due to the argument’s and the adverbial adjunct’s character, respectively. (18d) constitutes a semantically bizarre clause due to the adverbial adjunct’s character –time-span as opposed to the verb’s telicity. A similar case is illustrated in (18e), although here the operator’s imperfective character coincides with the adverb’s. The intra-level mismatch between the operator “–ing” and the sentence’s semantics (also, the semantics of the verb) is in this case overcome by means of aspect coercion, i.e. by assuming that the event is durative not because the action takes place all along the period of time referred to in the adjunct but because a short action is repeated constantly during that time (iterative interpretation). Note that this type of consistency (or lack of it -mismatch) takes place within the semantic representation –therefore it is an intra-level consistency (or mismatch).

3.6 ALL-FIRST LEVELS, DERIVATION AND MISMATCHES IN TGG, PA AND FDG

This section introduces the notion of “all-first level” as a main architectural feature defining the second architectural dimension of this work, Derivation. It further relates this notion and that of Derivation to representational mismatches as illustrated in the previous section and applies all the former to TGG, PA and

\textsuperscript{18} Note that (18a) may be considered to be ungrammatical possibly due to the semantic incompatibility between “slap” and “in an hour”. (18d) can be interpreted as a case of coercion, thus be considered grammatical.
In order to illustrate where TGG, PA and FDG fall within the spectrum of Derivation, attention is to be given to Sadock’s (2003) classification of grammatical models into two different types of grammatical architecture regarding Derivationality. Firstly, a division can be made between those theories of grammar in which there is a derivational relation of calculation between the different levels of structure and those theories in which, on the contrary, there is no such derivational relation. Within the derivational group, the deriving level or main computational component from which all linguistic computation needs to be born is called the “all-first source level”. Within the latter group, there exist theories that opt for simultaneous representations at various levels instead of starting “with a single, completed representation at one distinguished level, translating it step-wise into another” as well as approaches to grammar that “radically segregate representational levels, deriving each according to its own units and principles with complete, or near-complete disregard for what is going on in the other levels” (ibid: 1). In this non-derivational type of models, there is no “all-first source level” from which all computation needs to be born.

Generative Grammar (Chomsky 1957, 1975, 1981, 1986, 1993, 1995) fits within the category of derivational models of grammar, i.e. of a theory of grammar that accounts for structures at one or various levels of representation as being derived from a different level. This implies that a level can be calculated from the one it has been derived from. Figure 34 below illustrates the target, the source-and-target and the all-first source levels in TGG. Since target and source-and-target levels were introduced in chapter 2, the new feature introduced here are all-first source levels (marked with little crosses). The semantic and phonological levels of grammatical representation in traditional GG are calculated from the syntactic level of representation whereas the opposite (a calculation from the phonological and/or semantic levels of representation) into the syntactic level does not take place. This is also shown by the uni-directionality
of inter-level mapping arrows. This means that: a) the syntactic level of representation is a source, though not a target level; b) the semantic and phonological levels are target, though not source levels; c) the syntactic level is an all-first source level, since computation must necessarily begin from it (in this case, since it is the only mapping source level). This is shown in Figure 34 below. The fact that two levels of representation are translated from an all-first source level of computation allows us to classify TGG as a derivational model. This, in turn, implies that the model will be intolerant to inter-level mismatches or non-homomorphisms, since e.g. the semantic level, being derived from the syntactic one, will have to be accounted for from within the latter.

Figure 34. All-first source levels in TGG

In what follows, I attempt to illustrate the consequences that an architecture of grammar such as the one presented above has upon the representation of a linguistic expression. For this purpose, I discuss the case of quantifier raising and quantifier
scope ambiguity$^{19}$ and relate TGG’s treatment of quantifier scope ambiguity to its architecture, its approach to Derivation and to representational mismatches. The processes behind quantifier raising (May 1977, 1985, see also Tanaka & Kizu 2012) are: a) there is a Logical Form (LF)$^{20}$ derived from the surface structure (SS) that mirrors the formal semantic representation according to the predicate logic of a given linguistic expression; and b) in order for LF to mirror that formal semantic representation, quantifiers at LF are structurally raised in order to mirror their relative position to the predicate in predicate logic. (19) below illustrates a case of quantifier scope ambiguity. (20) and (21) illustrate the two possible semantic interpretations of (19) according to predicate logic - the interpretation in which the universal quantifier “all” has scope over the existential quantifier “a”, and the interpretation whereby the existential quantifier “a” has scope over the universal quantifier “all”, respectively.

(19) All guys LOVE a confident female.  

(20)$\forall$ (x) [ G (x) → [ E(y) | [F(y) ∧ C (y) ] ∧ L (x, y) ] ]  
Whereby G: guy, F: female, C: confident, L: LOVE

$\forall$$\exists$ (universal quantifier has wider scope (over existential quantifier)

“For every guy x, there is at least one confident female y such that x love y”.

(21) $\exists$ (y) [ [ F (y) ∧ C (y) ] ∧ [ $\forall$ (x) | G (x) → L (x, y)] ]  
Whereby G: guy, F: female, C: confident, L: LOVE

$^{19}$ See also Steedman (1999) for an account of quantifier scope in Combinatory Categorical Grammar.

$^{20}$ Mediation between the syntax and the meaning of a sentence, an abstract level of representation derived from surface structure through the same transformational rules as those used to derive the latter from deep structure, see Huang (1995: 127).
Excursus qua (existential quantifier has wider scope (over universal quantifier)
“There is one confidente female y such that for every guy x, x loves y”.

Figures 35 and 36 illustrate two possible syntactic representations at LF mirroring the two possible readings of (19) in (20) and (21). In Figure 35, “all guys” asymmetrically c-commands “a confident female”, whereas in Figure 36 “a confident female” asymmetrically c-commands “all guys”. Since LF offers two possible structures, such an account allows for a one-to-one relation between LF and predicate logic, thus accounting for the disambiguation of scope ambiguity.

However, there still remains one main question: Is semantic ambiguity actually born out of syntactic ambiguity? If it is, the representation of two different Logical Forms is legitimate and it explains the existence of an ambiguity in a derived level. If it is not (if semantic ambiguity is not born from but rather bears syntactic duplication), the order of derivation seems to be misleading—it is the semantic one that leads to a syntactic ambiguity and not vice versa as it appears in Figure 34 above.

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21 In Figures 35 and 36 (and in following Figures), the movement of QP1 and QP2 from their source to their LF positions is expressed by co-indexing them with their respective traces.

22 C-command is a notion that defines the relation between constituent nodes in a syntactic tree. This notion is normally associated to the generative tradition. If node X c-commands node Y, node X is higher up in the tree than node Y and it neither dominates nor is dominated by it—neither is node X born from node Y nor is node Y born from node Y (see e.g. Reinhart 1976).

23 Note that LF may be argued to be a semantically-motivated level of syntax rather than a semantic level—thus a syntactic level of grammar—which leads to a full one-to-one correlation between syntax and semantics: “LF is not to be equated with the level of semantic structure … It expresses only aspects of semantic structure that are syntactically expressed, or that are contributed by grammar” (Huang 1995: 128).
Figure 35. Quantifier raising in TGG: wider universal scope

Figure 36. Quantifier raising in TGG: wider existential scope
Secondly, PA (Jackendoff 1997, 2010a, 2010b, Culicover & Jackendoff 2005) offers a different case scenario. PA is a non-derivational model of grammar, i.e. a theory of grammar that simultaneously accounts for structures at various levels of representation that are not derived from one another but independently. Following Sadock (2003), instead of constraining derivations, a theory of the autonomous type constrains the associations between structures at different levels. Such a model of grammar does not possess an all-first level from which all linguistic computation is born. This is illustrated in Figure 37 below.

**Figure 37. All-first source levels in PA**

![Diagram showing all-first source levels in PA]

Whereby ♦ stands for target levels of computation

♦ stands for source-and-target levels of computation

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are target, but also source levels; c) the syntactic level is not an all-first source level, since computation must not necessarily begin from it (in this case, since it is not the only mapping source level). Computation runs parallel and there is no all-first source level. The fact that all levels of representation may compute simultaneously (no full computation of an all-first source level is needed before proceeding to a following level), the fact that there is not an all-first source level, and that all inter-level mapping processes are bi-directional allow us to classify PA as a non-derivational model. This, in turn, implies that the model will be more tolerant to inter-level mismatches or non-homomorphisms, since e.g. the semantic level, not being derived from the syntactic one, will not have to be accounted for from within the latter.

The architecture of grammar shown in Figure 37 for PA has consequences upon the representation of a linguistic expression. In order to illustrate such relation, I discuss the case of quantifier raising and quantifier scope ambiguity now in relation to PA. I relate this to non-derivational models’ greater tolerance of inter-level mismatches as opposed to derivational theories of grammar such as TGG as discussed above. The ideas behind PA and its syntactic structure (SS) in relation to quantifier scope ambiguity and quantifier raising are a) there is no logical form within syntax derived from the surface structure that mirrors the formal semantic representation of a given utterance but rather two simultaneous, independent syntactic and semantic representations –altogether with the phonological level; and b) since levels are independent, there is no need for the syntactic level of representation to mirror the semantic one by means of universal and/or existential scope raising, but rather the need to compare both structures in order to assess whether they are similar enough so as to correspond to the same linguistic expression. (22) (also in (19)) illustrates a case of quantifier scope ambiguity. (23) and (24) (also in (20) and (21)) illustrate the two possible semantic interpretations of (23) according to predicate logic -the interpretation in which the
universal quantifier “all” has scope over the existential quantifier “a”, and the interpretation in which the existential quantifier “a” has scope over the universal quantifier “all”, respectively.

(22) **All guys LOVE a confident female.**

(23) \( \forall (x) [ [G (x) \rightarrow [ \exists (y) [ [F(y) \land C (y)] \land L (x, y) ]]] \)

Whereby \( G: \) guy, \( F: \) female, \( C: \) confident, \( L: \) LOVE \( \forall > \exists \) (universal quantifier has wider scope / scope over existential quantifier)

“For every guy \( x \), there is at least one confident female \( y \) such that \( x \) loves \( y \).”

(24) \( \exists (y) [ [F (y) \land C (y)] \land [ \forall (x) [ G (x) \rightarrow L (x, y) ]]] \)

Whereby \( G: \) guy, \( F: \) female, \( C: \) confident, \( L: \) LOVE \( \exists > \forall \) (existential quantifier has wider scope / scope over universal quantifier)

“There is one confident female \( y \) such that for every guy \( x \), \( x \) loves \( y \).”

Figure 38 illustrates a single syntactic representation for (22) in SS in PA –the ambiguity being thus possibly reflected by means of two different CS. This is possible, since: a) the distinction between the semantic and the syntactic levels of representation in PA is clear-cut, both levels being fully independent rather than one derived from the other, and there being no LF or a similar level within syntax that mirrors the semantic structure. There is thus no necessity of a notion of logical sequence (i.e. no necessity for an all-first source level) as is the case for syntactocentric, derivational models (see Jackendoff 2010b: 588). The advantages of PA are: a) whether semantic ambiguity is born out of or rather bears syntactic ambiguity poses no representational constraints, since both levels of representation are fully independent and none is derived from one another; thus b) the order of derivation cannot to be misleading, since there is no specific representational
claim of causal sequence; and c) levels are neatly separated, since the syntactic one does not have to account for nor mirror any semantic structure.

Figure 38. Quantifier scope ambiguity in SS in the PA: one single SS

Finally, FDG fits within the category of non-derivational models of grammar, i.e. of a theory of grammar that accounts for structures at various levels of representation which are not derived from one another but which behave independently. This is so, since all levels of representation have their own primitives and calculation rules. This implies that a level cannot be calculated from the one it has been derived from. Figure 39 below illustrates the target, source-and-target, and all-first source levels in FDG. The pragmatic (interpersonal), semantic (representational) and phonological levels of grammatical representation in FDG are not calculated from the morphosyntactic level of representation and the opposite (a full calculation from the phonological and/or semantic and/or pragmatic levels of representation) into the syntactic level does not take place either. This is also shown by the fact that all levels can behave as input and output of linguistic computation, though with certain restrictions for bottom-up processes (see
top-down and bottom-up arrows). Note that, although allowing for bottom-up feedback processes, the model is primarily top-down. Also, Figure 39 illustrates that the pragmatic level behaves as an all-first source level, i.e. all linguistic computation must necessarily begin at the pragmatic level (the representational level is not included as an all-first level of computation of this pragmato-semantocentric model, since the semantic representation can be absent in certain utterances such as interjections). No full computation of the pragmatic level is however needed before computation at lower levels begins (Hengeveld & Mackenzie 2008: 24). This means that: a) the pragmatic, semantic, morpho-syntactic, and phonological levels of representation are source, and also target levels; b) the pragmatic level is an all-first source level, since computation must necessarily begin from it (in this case, it is however not the only mapping source level, and its computation must not be completed before computation at lower levels as is the case for TGG). Computation does not always run parallel but rather top-down and even bottom-up and there is one all-first source level, although levels are somewhat independent and each of them has their own set of primitives and calculation rules, hence the hybrid character of FDG as to the second dimension or Derivation. The latter implies that the model of FDG is a derivational/non-derivational model. This, in turn, implies that the model will be relatively tolerant to inter-level mismatches or non-homomorphisms, since no level of representation needs to be necessarily accounted for within another level. Although relations between the different levels are preferably of a one-to-one nature (ibid: 288) and thus tend to be kept as simple and stable as possible (e.g. a phrase at the ML tends to correspond to a phrase at the PL, different factors can lead to a mismatch (ibid: 287).

The architecture of grammar presented in Figure 39 has consequences upon the representation of a linguistic expression, just as for TGG and PA. In order to illustrate this relation, I discuss the case of quantifier scope ambiguity now in relation to
FDG and relate the model’s treatment of this phenomenon as a consequence of the grammar’s hybrid nature regarding Derivation (in between the derivational and the non-derivational type).

**Figure 39. All-first source levels in FDG**

I also relate the model’s approach to scope ambiguity and to Derivation to its relative tolerance of inter-level mismatches as opposed to other fully derivational or fully non-derivational theories of grammar such as TGG and PA as
discussed above. The ideas behind FDG in relation to quantifier scope ambiguity are a) there is no logical form within syntax derived from the surface structure that mirrors the formal semantic representation of a given utterance but rather four independent phonological, syntactic, semantic, and pragmatic representations; b) the model is pragmato-semantocentric and predominantly top-down, which implies that pragmatics and semantics determine morpho-syntax rather than vice-versa; and c) the difference between a generic and a specific reading is represented at the pragmatic level and allows for an account of the traditional difference universal vs. existential scope by means of specificity and identifiability operators at the interpersonal level of representation.

(25) below (also under (19) and (22)) illustrates a case of quantifier scope ambiguity. The two possible readings (in (26) and (27)) do not yield any syntactic difference but are rather accounted for at the interpersonal level IL as follows: the interpretation according to which TGG advocates for a universal quantifier “all” that has scope over the existential quantifier “a” is accounted for in FDG as a case of non-identifiability for both the speaker and the addressee of both “all guys” and “a confident female” (as judged by the speaker); and the interpretation in which TGG advocates for an existential quantifier “a” that has scope over the universal quantifier “all” is accounted for in FDG as a case of non-identifiability of “all guys” for both the speaker and the addressee whereas “a confident female” is considered as identifiable by the speaker though not by the addressee (as judged by the speaker). The latter is represented in Figures 40 and 41, respectively. Note that FDG proposes four possible combinations of operators regarding the identifiability of referents: $+id +s$ (identifiable for both speaker and addressee); $+id −s$ (identifiable for

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24 Within the FDG framework, “id” stands for “identifiable” (for the addressee, according to the speaker’s judgement) and “s” stands for “specific” (identifiable for the speaker, according to the speaker’s judgement) (see Hengeveld & Mackenzie 2008: 122).
addressee but not for speaker); -id +s (identifiable for speaker but not for addressee); and –id –s (non-identifiable for speaker or addressee). Note that the difference between both readings is represented in the model at the pragmatic level, though no difference is to be seen at the morpho-syntactic level of representation (two different pragmatic representations correspond to one single morpho-syntactic one). This is possible since, although showing a strong top-down approach and sequential order of computation, an all-first source level, and a restriction as to the bi-directionality of inter-level mapping processes, all levels are relatively independent, which means that the model is relatively non-derivational. This in turn allows for all representations to be relatively independent and this, in turn, allows for the correspondence between the various levels of representation to be of a non-one-to-one nature.

(25) All guys LOVE a confident female.

(26) \[ \forall (x) \left[ \exists (y) \left[ F(y) \land C(y) \land L(x,y) \right] \right] \]
    Whereby G: guy, F: female, C: confident, L: LOVE
    \[ \forall \rightarrow \exists \] (universal quantifier has wider scope / scope over existential quantifier)
    “For every guy x, there is at least one confidente female y such that x loves y”.

(27) \[ \exists (y) \left[ \left[ F(y) \land C(y) \land \forall (x) \left[ G(x) \rightarrow L(x,y) \right] \right] \right] \]
    Whereby G: guy, F: female, C: confident, L: LOVE
    \[ \exists \rightarrow \forall \] (existential quantifier has wider scope / scope over universal quantifier)
    “There is one confidente female y such that for every guy x, x loves y”.

(25) All guys LOVE a confident female.

(26) \[ \forall (x) \left[ \exists (y) \left[ F(y) \land C(y) \land L(x,y) \right] \right] \]
    Whereby G: guy, F: female, C: confident, L: LOVE
    \[ \forall \rightarrow \exists \] (universal quantifier has wider scope / scope over existential quantifier)
    “For every guy x, there is at least one confidente female y such that x loves y”.

(27) \[ \exists (y) \left[ \left[ F(y) \land C(y) \land \forall (x) \left[ G(x) \rightarrow L(x,y) \right] \right] \right] \]
    Whereby G: guy, F: female, C: confident, L: LOVE
    \[ \exists \rightarrow \forall \] (existential quantifier has wider scope / scope over universal quantifier)
    “There is one confidente female y such that for every guy x, x loves y”.

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3.7 **SUMMARY**

In this chapter I have introduced the concept of Derivation as a sequential, step-wise computational order with which a grammar accounts for linguistic structure. I have discussed Derivation in relation to Traditional Generative Grammar, the Parallel Architecture, and Functional Discourse Grammar. I have further analyzed the set of architectural features comprised within this first architectural dimension, Derivation, that together with Distribution and Direction account for the 3 D lay-motif of this work. In particular, I have started with an analysis of the distributional features that cut across Derivation. Firstly, I have
analyzed formation rules (number, type and autonomy status) and their relation to Derivation. Secondly, I have analyzed grammatical levels (number, type and autonomy status) in relation to Derivation and in order to classify levels into source vs. target vs. source-and-target vs. all-first source levels. This, I have used to determine the models’ pre-disposition to Derivation through three main questions whose positive answer increasingly diminishes a model’s pre-disposition to be derivational: Are all levels source levels? Are all source levels also target levels? Are all source-and-target levels also possibly all-first levels of linguistic structure computation? Thirdly, I have discussed inter-level mapping processes. After reviewing the concept of interface, I have discussed the two opposite approaches to interface processes, namely flexible vs. transparent interface. This, I have linked to the greater or lesser tolerance of a model of inter-level mismatches or non-homomorphisms. I have offered a definition for representational mismatches and then offered a classification according to two main, cross-cutting parameters: inter-level vs. intra-level mismatches; and quantitative vs. qualitative mismatches. Subsequently, I have discussed the number and type of source, target, source-and-target and all-first source levels that TGG, PA and FDG display and the relation thereof to their approach to Derivation, interfaces, and the degree to which each of the model tolerates representational inter-level mismatches. Finally, I have illustrated the consequences that a model’s architectural choices have upon the representation of quantifier scope ambiguity.