1
Processability Theory: theoretical bases and universal schedules

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1. Introduction

PT can be seen as a 'progressive' theory, that is, a theory capable of extending its domain, refining its concepts, making its key variables more operational, and attracting more research (Jordan 2004: 227). Even as we write, PT is expanding rapidly, and our presentation must inevitably be limited. But it is limited in four further ways. First, in this chapter we will mention PT's history only when it helps explain some of the incongruities we try to eliminate, or justify our own choices. Secondly, our outline here is not intended as an independent introduction to the theory, in the sense that we will mention only minimally PT's main scope, constructs and processes. These can be found in the original works by Pienemann (1998, 2005b; Pienemann, Di Biase & Kawaguchi 2005; including the more recent Pienemann & Keßler 2011, 2012) and in Pienemann's own numerous shorter presentations (e.g., 2003, 2007) – although with regard to the latter a note should be added to the effect that they mostly refer to the acquisition of English, and rely on older versions of PT, barely touching upon the 2005 extension. Thirdly, although we will mention some problems in the theory, we do not intend to solve them all here. Nor, finally, can this chapter be read as a full review of the rich and varied PT literature.

On the positive side, our ambition here is to offer an outline of PT which is tightly anchored to its two updated psycholinguistic and theoretical linguistic bases and less dependent on the English language for exemplification.[1] So, we aim to offer a balanced synthesis: both critical in pointing out areas of weakness in PT, and enthusiastic in showing how its hypothesised universal schedule can generate paral-

1 Of course, we will continue to use English as the main L2 for illustrating PT, because it is the language familiar to most readers and most studied acquisitionally. Yet when we do so, care is taken to point out its typological peculiarities and present our discussion in such a way as to accommodate the widest possible crosslinguistic variation.

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lel language-specific schedules widely across languages (as part II shows) and in a variety of situations (as indeed the chapters that follow in part III illustrate). Needless to say, our focus here is not so much on the details of PT's developmental schedules as on the reasoning behind them.

In sum, our first main focus here is on integration and coherence among what is at times separately and varyingly treated in PT literature: to wit

- between PT itself and its two theoretical bases (i.e., Levelt's psycholinguistic Model for language production, and LFG for language representation);
- between the original 1998 version by Pienemann and its 2005 extension by Pienemann, Di Biase & Kawaguchi; and
- among studies on different languages which are based on one or the other of these two versions.

This will help us offer our own proposals as a contribution to theory construction, which is the second main aim of this chapter. In turn, this will provide an opportunity for revisiting the earlier developmental schedules of three typologically representative languages in part II of the volume, and preparing the grounds for the new developments and explorations discussed in part III.

The remainder of this chapter is organised as follows: § 2 deals with language production (i.e., Levelt's Model, in § 2.1) and linguistic knowledge (i.e., Lexical Functional Grammar, in § 2.2) in relation to PT; § 3 summarises PT's key concepts; § 4 traces the learner's progress, first for morphology (§ 4.1), then syntax (§ 4.2) according to the Prominence Hypothesis (§ 4.2.1) and the Lexical Mapping Hypothesis (§ 4.2.2), and finally discusses how the morphological schedule and the two syntactic ones may interface; § 5 sets out some methodological issues for testing PT's hypotheses; and § 6 offers some concluding remarks.

2. Language production and linguistic knowledge

Closely paraphrasing Pienemann (1998, 2007), the underlying logic of PT is that L2 learners, at any stage of development, can produce only those L2 forms which the current state of their language processor can handle. This places PT among those SLA theories that see language primarily as a mental construct, like other generative approaches, but unlike most of them it considers the acquisition of an L2 as connected to real time human performance constraints such as those regarding speech processing. It is therefore crucial to base our understanding of language development on PT's two formal models, accounting for (a) language generation, that is, how the processor handles language, and (b) linguistic knowledge, that

is, what is language and how it may be represented in our mind/brain. Given that the anatomy and physiology of the human language processor are universal, if specific languages and their development are described according to a principled architecture, it may be possible to predict broadly similar grammatical trajectories for L2 development across languages.

For language generation, PT relies primarily on Levelt's Model (1989), a dynamic model accounting for language processing in real time and within human psychological constraints, such as the requirement for a very fast word access and, at the same time, the limitations of human memory. Thus a set of psycholinguistic universal constraints comes to bear on L2 acquisition, and provides a framework for PT's universal hierarchy of processing procedures, accounting for why learners seem to follow similar paths in their L2 grammatical development, across languages, whatever their L1 background. For linguistic knowledge, on the other hand, PT relies on LFG as originally conceived by Kaplan & Bresnan (1982) and further developed by Bresnan (2001), Dalrymple (2001), and Falk (2001) among many others over the last three decades. LFG provides a generative, explicit and well-defined, formal theory of language, which contributes towards solving for PT not only the problem of relying on a plausible mental representation of grammatical structure, but also Chomsky's well known 'logical problem': what is the origin of linguistic knowledge? Why do people end up knowing more than they can hear? As Pinker (2004: 949) puts it: "It is the question of how acquisition could work in principle – how a learner can correctly generalize from a finite sample of sentences in context to the infinite set of sentences that define the language from which the sample was drawn." For example, how does a learner know that words can be nouns, verbs, etc., or that in the sentence *The boy who loves Thérèse is Indonesian*, Thérèse may not be Indonesian despite the sequence *Thérèse is Indonesian*? The interface between these two formal theories, Levelt's Model and LFG, allows PT to make language specific predictions about L2 development which can be tested empirically.

These two source theories of PT interface well because LFG is a constraint-based theory of generative grammar (Asudeh & Toivonen 2010) which intends to be psychologically plausible. Indeed, its suitability for psycholinguistic work is supported by the fact that LFG was chosen for language acquisition work, such as Pinker's (1984), as well as Levelt's Model of the speaker. There are good reasons for this compatibility. First, unlike other generativist frameworks, LFG's approach is decidedly lexicalist, declarative and nonderivational, which sits well with the psycholinguistic understanding that processing is formulated in one stage (Pickering, Branigan & McLean 2002), i.e., transformations are unlikely. Secondly, it explicitly connects competence with performance phenomena, in so far as, for example,

LFG's feature unification is related to performance in real time (cf. Rothman & VanPatten 2013). Thirdly, LFG's parallel projection architecture iconically suggests a representation of the dynamic processes temporally modelling language production. In particular, the fact that LFG's interest in typological questions of similarities and differences among languages has been central to its theoretical development (Asudeh & Toivonen 2010) finds parallels, mutatis mutandis, with PT's own history and current developments.

The next two sections (§§ 2.1-2.2) are meant to introduce the reader to those key features of PT's source disciplines that bear most directly on (i) its general architecture, and (ii) some of the issues mentioned in the volume. In no way do these two sections dispense the researcher interested in pursuing the finer details of PT from reading the original works by Levelt and Bresnan, and the ongoing updates by their respective teams – anymore than s/he is dispensed from reading Pienemann's own original works on PT.

2.1. Levelt's Model and PT

The debt to Levelt's Model is already fully acknowledged in the original PT version, when Pienemann (1998: §§ 2.4-2.5) highlights issues concerning the storage of grammatical information during language production, and the general psychological constraints that bear on language development. Thus we now focus on elements of language generation that help us understand PT's newer developments. These concern mainly two aspects of Levelt's Model: the lexicon and grammatical encoding. First, following developments in Levelt's Model itself (Levelt, Roelofs & Meyer 1999), a novel look at lexical access theory allows for a more precise characterisation of the lexicon and its central role in PT, which can now account for the acquisition of a wider range of features and constructions. If Pienemann's main concern in 1998 was the establishment of minimal requirements for reaching a stage, PT can now explore how learners proceed from the emergence of a structure to its mastery, or indeed from the emergence of one or two 'typical' structures in a stage to the mastery of the range of structures in that same stage. This contributes to accounting for development within a stage, which Mansouri & Håkansson (2007) began to explore as intrastage phenomena and we further characterise in this volume as progress through 'soft barriers' (cf. § 5 below, and further ch. 2, § 2 for English, and ch. 3, § 2.2 for Italian). That is, whereas Pienemann (1998) proposed modules other than PT for handling the complexities within a stage, we propose instead to integrate them into PT's explananda. Secondly, we wish to outline that part of Levelt's Model which bears more directly on PT's extension, because the extension of the theory by Pienemann, Di Biase & Kawaguchi's (2005) dealt more fully with its LFG formalism rather than discuss the details of language production.

Levelt's Model, along with other speech production models that have been proposed from various theoretical viewpoints over the last 25 years or so, share the understanding that the speech production process can be described as consisting of three broad components: conceptualisation, formulation and articulation (cf. Grosjean & Li 2013: 51). Levelt assumes that when we intend to say something we select in the conceptualiser the information whose expression may realise our communicative goals – the conceptualiser being the processor where the preverbal message is generated and then fed to the formulator, as the fragments of the preverbal message become available. Since any state of affairs can be expressed in many different ways, in the conceptualiser we also plan the form of the message, in the sense that here we select not only the language and register but also the appropriate speech acts or rhetorical device required (assertion, question and so on), we tag topic and focus, mark the referents as given or new, and so on. Thus, the conceptualiser's output (i.e., the preverbal message) already includes information on a number of choices, including the relative prominence of its elements. All this presents no problem for adult L2 learners, who are already fully competent speakers of their L1, because, in order to produce a preverbal message they can rely on the same conceptualiser for either language, as De Bot (1992) maintains in adapting Levelt's Model of language production to bilingual speakers.[2] On the other hand, grammatical learning begins when then the formulator – which is language-specific – receives input from the conceptualiser, and has the task of mapping the preverbal message onto the appropriate linguistic form (i.e., the formulator is responsible for grammatical encoding), and preparing (through phonological encoding) the phonetic plan, as represented in (1). This task is performed by retrieving out of the lexicon the stored entries that best fulfil the conditions required by the preverbal message. Thus, just as the learner has to learn, however gradually, a language-specific lexicon, so do they also have to build, contextually, a language-specific formulator to process it. Levelt (1989: 103) assumes, in fact, that "[t]here are different formulators for different languages".

Let us then take a look in turn at how lexical entries are stored in the lexicon, and then processed in the formulator.

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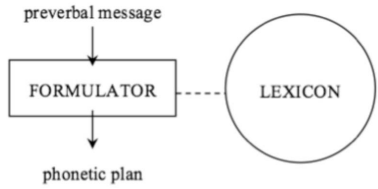
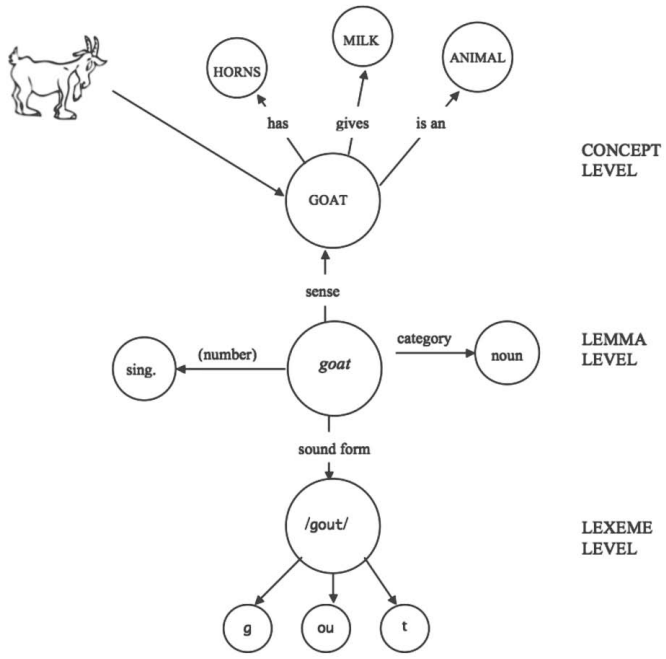
2 Once the language has been specified in the conceptualiser, the output is language-specific because "[w]hatever the speaker tends to express, it should ultimately be cast in terms of lexical concepts, that is, concepts for which there exist words in the target language" (Levelt, Roeleof & Meyer 1999: 8). Despite considerable growth in psycholinguistic experimental research of spoken language processing in bilinguals, "a comprehensive model remains to be developed" (Grosjean & Li 2013: 52).

(1) Language production from preverbal message to phonetic plan (after Levelt 1989: 9)

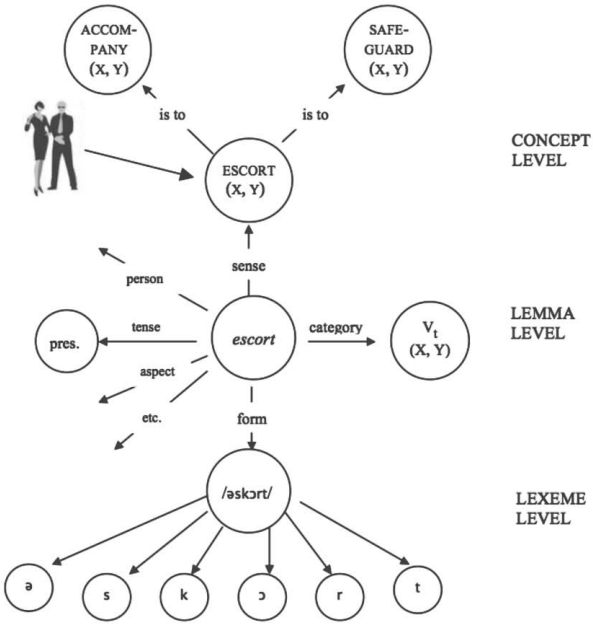


In the lexicon of the adult L1 speaker, according to Levelt, Roelofs & Meyer's (1999) Theory of Lexical Access, words are stored with the full bundle of features involving three types of information, distributed in a three-level system: the conceptual level, the lemma level and the lexeme level. We should point out that the conceptual level was not present in Pienemann's 1998 application of Levelt's Model to PT, nor has it been incorporated in Pienemann's subsequent versions, which retain Levelt's (1989) two-tier system of the lemma and the lexeme. In Levelt, Roeleof & Meyer's (1999) three-tier system, instead, conceptual information include elements associated, for example, with the semantic roles of V (e.g., <*eater, eaten*> for *eat*), rather than infor-

(2) A fraction of the lexical network for the word goat (after Bock & Levelt 1994: 951)



(3) A fraction of the lexical network for the word escort (after Levelt, Roelofs & Meyer 1999: 4)



mation about the number and type of arguments only. Notably, PT's extension would not work without the conceptual tier of the lemma.

In (2)-(3) we give a simplified representation for two lexical entries, the N *goat* and the V *escort*, following respectively Bock & Levelt (1994: 950-952), and Levelt, Roelofs & Meyer (1999: 3-4).

First, at the conceptual level, knowing a word involves knowing its meaning. About a *goat* we know it is a kind of domestic animal that produces milk, etc., and also that it typically de-selects certain other words such as *think* or *smile* typically reserved for humans, etc. About *escort* we know that it is an action related to accompanying, guiding, etc., that it requires the two semantic roles of agent and patient, etc. These are properties of our concepts GOAT and ESCORT.

Secondly, at the lemma level, a word has syntactic properties, a bundle of grammatical features – including also combinatorial information (cf. Sells 2001; Kim & Sells 2008) – which place it in its syntactic frame. The English word *goat* is an N. Its Italian equivalent *capra* is also an N, but in addition it has feminine syntactic gender. The word *escort* is here a V, and Vs are specified for (in other words, they select) the arguments they require, corresponding to their semantic roles (<agent, patient> in this case); thus about *escort* we know that it typically

requires a SUBJ and an OBJ on which to map the required semantic roles. As will be clear further on, these lexically determined requirements of the V for argument and function specifications are of crucial importance for understanding, and operationalising, PT's Lexical Mapping Hypothesis, first advanced by Pienemann, Di Biase & Kawaguchi's 2005 (cf. § 4.2.2 below). Moreover, many lemmas require so-called diacritic features that have to be learned. For example, in English V lemmas have diacritic features of person, number, tense, and mood, which must be valued for further encoding. Hence the lemma *escort* will be realised phonologically as *escort*, *escorts*, *escorted*, or *escorting* depending on the values of its diacritic features. Some values of these features derive from conceptual representation, as when English Vs are marked for tense, or Ns for number, others may be set in the course of grammatical encoding, as we will shortly see below.

Thirdly, at the lexeme level, knowing a word means knowing its formal properties that is, its morphological and phonological shape. The word *goat* is monomorphemic and consists of three phonological segments: /g/, /ou/, and /t/, whereas the Italian word *capra* consists of two morphemes, a stem (*capr-*) and a suffix (*-a*), and five phonological segments: /k/, /a/, /p/, /r/, and /a/. Likewise, in (2), the nodes at the form level represent phonemic segments.

In Levelt's Model, it is the lexicon – with its associated semantic, grammatical and phonological information – that primes the procedures and feeds forward the encoders. As we move on to grammatical encoding, let us remember that all this information is characteristically stored in the mature native speaker's mental lexicon, but learners build up their L2 lexicon gradually. If, on acquiring a new word, learners may quickly be able to associate a 'meaning' at the conceptual level with some (phonological) 'form' at the lexeme level, the same is certainly not true for the lemma level, where features and values may take a long time to emerge[3] and even longer to master. So, whereas it will not take long for English learners of Italian, for example, to learn the word *capra* and get to know what it means (*goat*), it will take them longer to learn that the N *capra* has the value 'feminine' with respect to the N feature 'gender', which in turns combines with 'number' information, and hence, if they want to refer to more than one, they need to use the form *capre* (not *capras*).

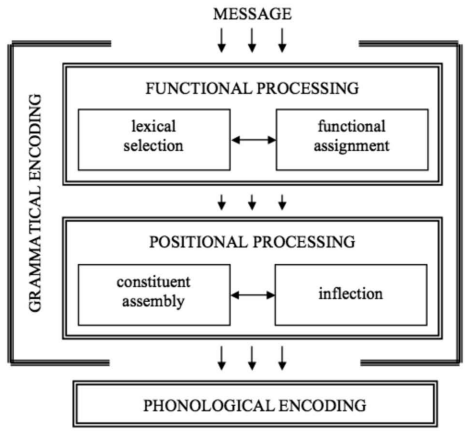
So, unlike many of the components at the conceptual level, which may find a surprisingly high degree of commonality across languages, diacritic features and their values at the lemma level tend to pop up in peculiarly idiosyncratic mixes and with surprisingly different exponents requiring unification or merger over varying degrees of syntactic distance – all very much in language-specific ways. These idiosyncrasies of the L2 lexical features fuel one of the least understood and

3 Emergence can be understood here both as annotation of each feature-value pair in the lexicon and their retrieval during production.

perhaps most confusing issues in PT, as well as in other approaches. The question is why is it that structures that are apparently at the same stage of development (e.g., marking some sort of aspectual feature with *–ing* or tense feature with *–ed*, where both are category level morphemes) should emerge so far apart from each other? Within PT this has been variously cast as 'intrastages' or 'steps within a stage'. In our treatment we choose the term 'soft barriers' to indicate that the learner, having overcome the 'hard barriers' and learned the skill to go past the important constraints imposed by a stage, will then learn more fine-grained lexically-based distinctions. Similarly at the lexeme level, there may well be peculiar lexical class distinctions interacting with specific features at the lemma level that may be rather difficult to acquire for adult learners (cf. Di Biase 2008 for one example of such lexical class-based distinctions, affecting number in Italian nouns and adjectives). We will see below in § 2.2 how the lexicalist orientation of LFG, which indicates feature-value pairs formally, is particularly apt in providing an efficient representation (presence or absence of a particular feature/value) of such phenomena.[4] And we will come across specific examples of soft barriers in the language-specific chapters in Part II.

The formulator – to resume our presentation of Levelt's Model – encodes the utterance first grammatically and then phonologically, as shown in (4). We are interested here in grammatical encoding, whose processes create the skeleton of the

(4) Components of grammatical processing (after Bock & Levelt 1994: 946)



4 As well as exploited by our proposal in the context of L2 learners' progress, LFG's lexicalist orientation, efficiently represented in formal annotation, is pointed out by Schwarze (2002) in the context of (historical) language change.

utterance. These processes are grouped into two sets – one functional and the other positional – each set with its own subcomponents. It may be worth noting that in (4) the arrows represent the flow of information during production (and, in reverse order, comprehension) and depict activation trajectories, whereas in (2)-(3) they represent types of connections within the network and depict permanent relationships in a store.

Functional processing has two subcomponents: lexical selection and functional assignment. Given a lexical concept to be expressed, lexical selection involves retrieving a word, or more specifically a lemma, from the lexicon. Functional assignment involves creating the appropriate syntactic environment for the words by assigning them their syntactic functions. For example, upon selecting the lemma *escort*, its syntax – it is a transitive V with two argument positions, corresponding to its two semantic arguments – will become available for further grammatical encoding (Levelt, Roelofs & Meyer 1999: 4): which of the two arguments will serve as SUBJ, which as OBJ?

Functional assignment is controlled by two kinds of information represented in the message. First, the eventuality conceived in the conceptualiser is associated with thematic or event roles, such as agent (the instigator of an event), patient or theme (the person or object that is affected or moved). This explains why, in organising an utterance, the V lemma chosen during lexical selection is central over other lemmas. Second, the relative prominence among the participants in the event is associated with discourse or attentional roles. These organise the informational distribution in the utterance so as to direct the listener's attention to its components. As Bock & Levelt (1994: 964-965) comment, there are "seductive correspondences" between both thematic and discourse roles and grammatical functions (GFs). That is, agent is most often SUBJ, beneficiary is OBJ, etc., as in (5a), although violations to these default correspondences are possible, as in (5b) or (5c), depending on discourse-pragmatic information tagged in the preverbal message.

(5) a. Romeo gives a rose to Juliet
b. Juliet is given a rose by Romeo
c. Juliet receives a rose from Romeo

Likewise, elements expressing given (or topical) information, which are more readily available, often appear early in the sentence and have great affinity with SUBJ.[5] This is shown in (6), where the same propositional content is expressed with diffe-

5 The developments in LFG since Bresnan (2001) go a long way in representing these processing computation issues by having incorporated hierarchical semantic roles in Lexical Mapping Theory and syntacticised discourse functions in its f-structure, as discussed in § 2.2 below.

rent prominence in (6a) and (6b) by assigning the SUBJ function to a different topical element:

(6) a. [what's going on with the dog?] the dog is chasing the cats
b. [what's going on with the cats?] the cats are being chased by the dog

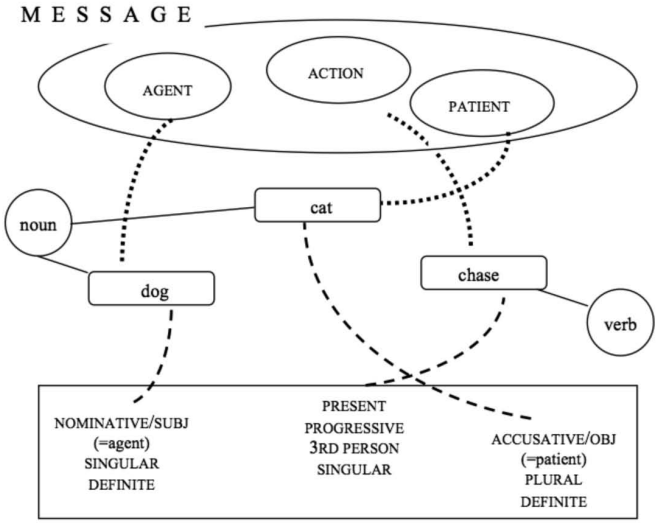
For the number and type of functions assigned during functional assignment, we refer to their LFG representation reported in § 2.2 and shown in (21). Suffice it to say here that, although functions are universal, they may be marked differently in different languages: morphologically by case markers, clitic pronouns, etc., or structurally by position, as shown in (23)-(24). These different ways are not mutually exclusive, and indeed many languages use a combination of means. Even a highly configurational language like English marks the case of personal pronouns morphologically (e.g., by distinguishing between *I* and *me*, *she* and *her*).

Finally, during functional processing, the combination of lexical selection and functional assignment also specifies the value requirements for the diacritic features of individual lemmas. For example, if the speaker intends to produce the sentence in (6a) above, upon selecting the V *chase* and the Ns *dog* and *cat* for expressing this current eventuality in the present involving *dog* as agent and *cat* as patient, functional assignment will determine not only the grammatical relations between the lemmas (i.e., *dog* (the chaser) is SUBJ and *cat* (the chased) is OBJ of *chase*), but also the values of the diacritic features (i.e., *dog*, referring to a single referent, is realised in its singular form as *dog*; *cat*, referring to more than one referent, is realised in its plural form as *cats*; and *chase* is realised in its present, progressive form *chasing* with the auxiliary carrying the required SUBJ number information with singular value).

In sum, functional processing yields an available and activated set of lemmas and a set of abstract syntactic functions, which are linked together via the argument structure of the lemmas, notably that of V (cf. (7) for a schematic illustration of the product of functional processing of the sentence *the dog is chasing the cats*). All this material (i.e., abstract relations or linkages among elements) may contain some indication of the relative prominence assigned to various components, but it is not ordered in any sequence, except for the order in which the fragments become available from the conceptualizer. To convert into an utterance, the fragments of this partial, incomplete structure do not go into the phonological encoder directly as they come out of functional processing, but they are stored temporarily in the memory buffer. The product of functional processing must now be processed positionally.

Positional processing, like functional processing, also has two subcomponents: constituent assembly and inflection. Both involve the creation of a set of

(7) The product of functional processing for the dog is chasing the cats (after Bock & Levelt 1994: 968)



slots which are ordered: the former for lexemes, the latter for morphemes (Bock & Levelt 1994).

Constituent assembly fixes the linear order of word production and captures dependencies among syntactic functions. Ordering is necessary because the output of functional assignment carries no intrinsic order.[6] This becomes clearest not with English, a highly configurational language which marks grammatical functions (GFs) by position, but with less configurational languages, whose constituents may appear in different positions serving the same GFs, often signalled by differences in case marking. Russian and Latin are such languages. In (8) for example, by marking the SUBJ (*Paul*) of the V *amo* ('love') as NOM case by means of the *–us* morpheme, and the OBJ (*Mary*) as ACC case by means of the morpheme *–am*, Latin can place either anywhere, as required by discourse or pragmatics, without changing the propositional content of the message:

(8) a. Paulus Mariam amat
b. Mariam Paulus amat

6 Also LFG's f-structure is not intrinsically ordered (cf. § 2.2).

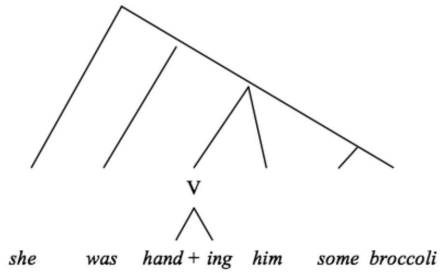
Establishing dependencies among words means organising phrase groupings in a hierarchy. Without them, as Bock & Levelt (1994: 969) point out, there would be, for example, no means to segment sentences such as (9) appropriately, where the listener knows that it is not to be understood that it is the boy who blushed, despite the linear sequence showing *the boy blushed*:

(9) the girl who kissed the boy blushed

This hierarchical organisation (namely, the phrase structure) is assembled bit by bit under the control of the syntactic functions and the grammatical categories of the lemmas that realise them. This means that, for example, given the nominative function and a N lemma to fill it, adequate information is available to create a SUBJ NP in the appropriate position in an utterance. As we will see further on, Bock & Levelt's claim that functional assignment precedes positional constituent assembly in the temporal sequence of language production by the native speaker is crucial for understanding learners' development beyond canonical word order.

Inflection is the last grammatical encoding process, and involves the generation of fine-grained details at the lowest level of the hierarchy of phrasal constituents, as shown in (10). This is a thorny issue, not yet solved in all its facets in Levelt's Model. The debate is around two questions: first, whether in such cases as the English *handing* or Italian *capra* the mental lexicon stores the whole word or its morpheme components; and secondly, whether to consider under inflection not only inflection proper, but also the formulation of function words often associated with grammatical phrases such as determiners for NPs, auxiliaries for VPs, and prepositions for PPs (Bock & Levelt 1994: 972). Suffice it to say here that LFG's principle of lexical integrity considers words as atoms from the point of view of syntax, that is, they are no further divisible into smaller syntactic units (cf. § 2.2). As stated by Asudeh & Toivonen (2010: 430), "[t]he syntax is […] blind to the internal structure of words and it sees only their category". Furthermore, as mentioned above, certain lemmas carry specifications about diacritic features to be valued inflectionally. In some cases these specifications may be under the control of conceptual elements, as when Vs are specified for tense. In other cases the control is syntactic, as when there are dependencies among inflectional features. So, in the sentence in (10) speakers say *she* ***was*** *handing him some broccoli*, rather than *she* ***were***, because here two constituents of the sentence reflect a value (i.e., third singular) of some feature (i.e., person) that triggers inflectional variation. These constituents need not be adjacent. What is necessary is that the agreeing constituents stand in appropriate syntactic-functional relationships. In this English example, the agreement operates between the head of the SUBJ NP and the finite V.

(10) Constituent hierarchy of she was handing him some broccoli (after Bock & Levelt 1994: 946)



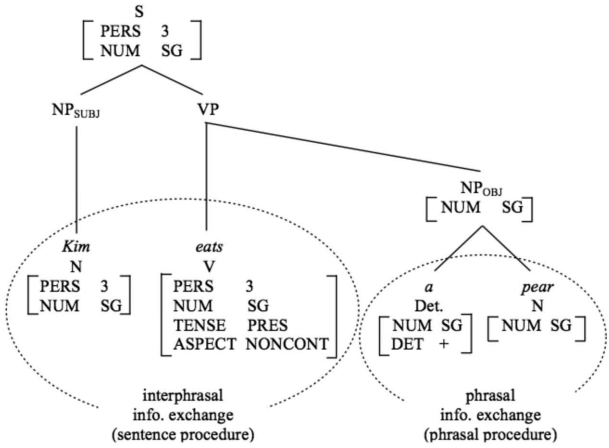
In sum, we can say that, first, functional processing integrates a set of lemma specifications with a set of syntactic functions. Its output is a set of abstract relations and properties which guides the creation of a frame for positioning words. Subsequently, positional processing places words and their inflections into that frame. The output of functional processing, then, is an ordered set of lexemes, formally realising the abstract relations of the functional specifications.

Why do we need to comprehend this complex process in order to understand the way PT explains the learner's progress in acquiring an L2? Though the reason may become clearer in §§ 3-4, we can anticipate here that, whereas mature L1 speakers are able to activate all the encoder's components effortlessly, L2 learners must build them up gradually. If De Bot (1992) is correct in saying that bilingual speakers operate with a different formulator for each language, while the L2 formulator is under construction learners will be able to produce only those structures that can be processed by the components already in place – as well as the lexical material already stored.

Let us now go back to the native speaker. In Levelt's Model this complex process of grammatical encoding for language generation assumes that grammatical information activated by one procedure needs to be stored temporarily in a specialised memory buffer in order to be used by another procedure, so that the two lots of activated information can then be compared by yet another procedure that builds the output of the first two procedures together. How does this process unfold? Following the Incremental Procedural Grammar developed by Kempen & Hoenkamp (1987), Levelt (1989) proposes that grammatical encoding in mature monolingual speakers follows the sequence in (11):

(11) a. the lemma
b. the category procedure
c. the phrasal procedure
d. the sentence procedure

(12) An illustration of processing hierarchy for Kim eats a pear: phrasal and interphrasal procedures



Thus, upon selecting the lemma, the category procedure is instigated, assigning a lexical category to the lemma. Then the category of the head lemma will instigate a phrasal procedure, resulting in a phrase. With the activation of the sentence procedure, phrases in turn acquire their function according to the syntactic frame of their head lemmas. To illustrate these steps with an example, in *Kim eats a pear*, shown in (12), first the lemma *Kim* needs to be assigned to the lexical category N, and its diacritic features (number and person) returned with their respective values (singular and third person). Then the lemma *eats* needs to be assigned to the lexical category V, and its diacritic features (number, person, tense, and aspect) annotated with their respective values (singular, third, present, and noncontinuous). Further, in order to achieve the agreement between the two phrases *Kim* and *eats*, information must be exchanged between them, and the values of the features they share (number and person) must be compatible. Likewise, in generating the NP *a pear*, the selection of the lemma *a* partly[7] depends on the value (singular) of the diacritic feature of the phrase head lemma *pear*, because the common values they share must be checked against each other, at the phrasal node, for compatibility.[8] In this case the value of the diacritic feature of *pear* is stored by the category pro-

7 The choice of *a* vs *the* also depends on the information tagged in the 'discourse model' (in the conceptualiser) determining its new vs old, definite vs indefinite values, and so on.

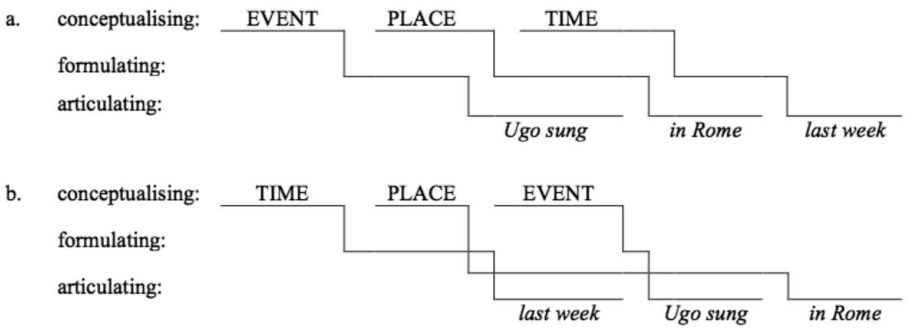
8 This notational innovation showing oly the unifying features and their values at the node where unification is assumed to occur was introduced in LFG by Andrews & Manning (1999).

cedure until it is checked against that of the modifier *a*. Finally, in order to build up the sentence, a GF must be assigned to the two newly created NPs, that is SUBJ for *Kim* and OBJ for *a pear*. This matching, or exchange, of information regarding the values of shared diacritic features among the elements of a sentence is called 'feature unification' in LFG terminology (cf. § 2.2). It is a key LFG concept used in Levelt's Model of the (monolingual) speaker and incorporated into PT to account for the gradual process of L2 development.

Kempen & Hoenkamp's (1987) Incremental Procedural Grammar also assumes that the whole four-step sequence from activating the simple lemma to the sentence procedure is implicational. This means, for example, that in order to activate the phrasal procedure, both the lemma and the category procedures must be activated, but that the sentence procedure need not be active as yet.

Furthermore, the whole process of language generation is incremental. This means that all processors can operate simultaneously in parallel, but they all work independently on different language fragments of the utterance under construction. The final order of articulation may follow the sequence in which fragments are conceptualised, as in (13a), or it may not, as in (13b). Although here the speaker has decided to make some specific circumstance (in this case the context of the event) more prominent, the English formulator will not allow the fronting of both the time fragment and the place fragment (which would produce **last week in Rome Ugo sang*). So the formulator, being the specialist processing component charged with generating grammatically acceptable sentences, will order the fragments accordingly, and produce *last week Ugo sang in Rome*. These types of asynchronies do not create a particular problem or cost for the native speaker, who has automatised the necessary procedures to handle diverse ways of organising the mes-

(13) Incremental production (a) without and (b) with inversion of order (after Kempen & Hoenkamp 1987, as cited in Levelt 1989: 25)



sage online and delivering it in real time.[9] But the processing cost of this very fast process, averaging between two and three words per second (Levelt 1989: 22), can be very high for the learner.

Finally, the theoretical assumption of incremental processing (i.e., of parallel processing activities in the different components of speech generation) hinges on automaticity. Automatic processes have great advantages: they are executed without conscious awareness; they are quick; and they run on their own specialised resources, which means that they do not share resources, so they can run in parallel without mutual interference. If each processor were to require access to attentional resources such as Working Memory, speaking would not be fluent, and between one articulated fragment and the next there would be silences devoted to processing. On the other hand controlled processing demands attentional resources, because we can only attend to a few things at a time. Attending to the process requires a certain level of awareness of what we are doing. Thus human controlled processing tends to be serial rather than incremental in nature, and is therefore slower. Its advantage is that it is not entirely fixated in memory; in fact, controlled processing is quite flexible and adaptable to the requirements of the task at hand. Levelt (1989) accounts for the amazing speed of the speech production process by assuming it is largely automatic. Only the message generation and monitoring activities are controlled processes, that is, normally requiring the speaker's ongoing attention, whereas grammatical and phonological encoding, articulation, and lexical access are usually automatic – the exceptions being, for instance, the retrieval of infrequent words (cf. Poulisse 1997). Here is where the difference between the native speaker and the L2 learner is crucial. Whereas the native speaker effortlessly generates fluent speech, the learner proceeds gradually from painfully slow retrieval of lexical items towards ever more complete grammatical encoding in an increasingly automatic way. The relevance of automaticity versus (attended) control in speech production is a fruitful area for future research.

This is then, in its basic outline, Levelt's Model for language generation in the mature native speaker. What about L2 learners? Summing up, as they develop their interlanguage, learners need to

(14) a. build up the lexical store, and include in it fully mature lexical items; that is, not only increasing the number of words with their meanings and sound forms, but also storing richer lemmas with their relevant diacritic features (semantic, grammatical and formal, as well as categorical and combinatorial) and specific values;

9 Even for native speakers processing less preferred options involves more time, however minimally. E.g., Weyerts et al. (2002) report that German native speakers prefer SVO orders to SOV orders and account for this in terms of the relative higher processing cost of latter as against the former.

b. learn to retrieve and encode these lemmas functionally (LFG's f-structure) and positionally (LFG's c-structure) (cf. § 2.2 below); and

c. automatise increasing numbers of retrieval and encoding processing components for fluent speaking, so as to free up greater attentional resources for semantic and discourse-pragmatic processing.

The sequence in which learners gradually learn to enrich their lexical storage, activate more grammatical procedures, bottom up, and automatise them is precisely PT's domain (cf. § 3). In 1998 Pienemann's main concern was with the learner's progressive activation of grammatical procedures in the formulator. This allowed for PT's explanation of the development of obligatory morphological and morpho-syntactic structures. Then in 2005 Pienemann, Di Biase & Kawaguchi began to focus more sharply on the role played by (a) the conceptualiser in preparing its output with a variety of discourse-pragmatic perspectives, and (b) the lexicon in the grammaticalisation process. Bringing into PT this element of choice the speaker may have in selecting alternative discourse-pragmatic perspectives and alternative lexical items allows for new explanations regarding optional syntactic structures. In this volume the structural consequences of the speaker's choices will be taken a step further (cf. our own formulation of the Prominence Hypothesis and the Lexical Mapping Hypothesis in § 4.2.1 and § 4.2.2 respectively). With regard to automatisation, very little work has so far been done apart from Pienemann (2002) and Kawaguchi & Di Biase (2012). This is an important line of research worth pursuing within PT.

But before describing PT's developmental stages based on implicational procedural skills identified in Levelt's Model, we need to introduce some basic notions of LFG, and integrate them – as far as possible – within this model.

2.2. Lexical Functional Grammar and PT

LFG[10] is committed to the interface between linguistic knowledge and language processing, and is therefore designed to account for linguistic knowledge in a way that is compatible with the architecture of the language processor (Kaplan & Bresnan 1982: 177). This must be the sort of commitment that prompted Levelt to use Bresnan's lexically-based grammatical theory for his Model's lexicalist approach – in the sense that, as we have seen, Levelt assumes that lexical selection activates syntax, that is, it drives the procedures for building the syntactic frame for the current utterance (cf. Kormos 2006: 9-10). So, in the speaker's mental lexicon each

10 Cf. Asudeh & Toivonen (2010) for a concise, up-to-date presentation of LFG.

lexical entry is associated not only with meanings and forms, but also with the full set of their syntactic information.

In addition to its lexicalist assumption, another important principle of LFG is its clear distinction between levels of linguistic representation that a formal model requires in order to describe the complex architecture of natural language adequately. Since the sentence is an expression of several types of linguistic information (semantic, pragmatic, syntactic, phonetic/phonological, etc.), there can be several theoretically distinct structures of formal representation: semantic structure, information structure, and phonological structure, as well as the three syntactic levels: argument structure, functional structure and constituent structure. All these levels exist simultaneously and in parallel,[11] each with their own distinct grammatical module, with characteristic primitives and formal representation. LFG's architecture "postulates a number of simple data structures with mappings defining the relationship between the structures […] (it) is thus typically referred to as a *Parallel Projection Architecture*" (Asudeh & Toivonen 2010: 426, original italics). We will concentrate here on the three syntactic structures: a-structure, f-structure, and c-structure. LFG work on the other levels is more recent and not yet applied to PT, so it will not be further mentioned here except for some rudimentary information structure, which is important for our Prominence Hypothesis (cf. § 4.2.1 below).[12] We first consider the syntactic structures separately, with their specific properties that make each level of representation different and independent from each other, and then we show how they are linked, or mapped, onto one another.

Beginning with a-structure, this level of representation determines many of the basic properties of the sentence in which a predicate occurs – the predicate being the word, typically a V, which names the action, event or state described by the sentence. The a-structure of a predicate encodes information about the number and type of arguments selected by that predicate, as shown in (15). Arguments are thus assigned lexically through the meaning of the V.

(15) *run* <agent>
eat <agent, patient>
love <experiencer, stimulus>
give <agent, theme, recipient>

11 A good discussion and motivation for this architecture may be found in Falk (2001).

12 Further LFG work in this direction might help PT's development, especially concerning i-structure. Cf., e.g., the debt to Choi (1999, 2001) for the Prominence Hypothesis, and to Mycock (2007) and Dalrymple & Nikolaeva (2011) for chh. 7 and 8, this volume.

Because argumenthood is a semantic concept, it is not always as easy to determine the arguments of a predicate as one might expect, and many label sets have been proposed. Suffice it to say here that LFG generally follows Jackendoff (1972), and others, in defining a hierarchy among them which is formally based on two very broad aspects of the way we conceptualise the meaning of Vs: one based on action, the other on space. In the action conceptualisation, an agent has primacy over a beneficiary, because when both are present, the beneficiary is affected by something the agent does. In the space conceptualisation, the instigator has primacy over the theme, which in turn is more prominent than the path, etc. By stipulating also that the action conceptualisation takes over the spatial one, the thematic hierarchy in (16) is derived, typologically validated by Keenan & Comrie (1977) and Hopper & Thompson (1980), among others, and used by Bresnan (2001: 307):[13]

(16) agent > beneficiary > experiencer/goal > instrument > patient/theme > locative

Moving on to f-structure, this level of linguistic representation includes, for every sentence, all the grammatical information needed to interpret the sentence semantically. It consists of two types of information about the syntactic elements (i.e., words and phrases) of a sentence:

- information about grammatical relationships between them; and
- information about their grammatical properties (i.e., features).

That is, in f-structure, abstract GFs and diacritic features attempt to capture universal syntactic principles that may vary crosslinguistically at other levels of representation. We will now have a closer look at these two types of information.

In f-structure encoding, let us look first at GFs, which LFG, uniquely among grammatical theories, considers as primitives of the theory.[14] GFs are cross-classified in several ways. The most basic ones are the argument functions, which express the arguments of predicates. Indeed, they may be directly selected, governed, by the predicate. They are: SUBJ (subject), OBJ (object), OBJθ(secondary object), the OBLθ (oblique) family of functions, COMP and XCOMP (complement). Among them a fundamental distinction is made between core functions, which are SUBJ,

13 Because a thematic hierarchy is not a primitive construct, other rankings have been proposed – all of which, however, almost without exception, rank agent highest. For a discussion of criteria used in constructing a thematic hierarchy and ranking semantic roles, cf. Levin & Rappaport Hovav (2005: ch. 6).

14 For basic definition and examples of LFG's GFs, cf. Asudeh & Toivonen (2010: 432).

OBJ and OBJθ, and noncore functions, which are OBLθ, COMP and XCOMP (cf. also (21) below). Core functions are associated with the central participants of the eventuality expressed by V, and are usually distinguished formally from noncore functions. In English, for example, core arguments have canonical c-structure positions which are occupied only by NPs and DPs; noncore functions are generally expressed by other c-structure categories, such as OBLs by PPs. For example, in the sentence in (17a), *Consuelo* and *her sentiments*, respectively SUBJ and OBJ, are core GFs subcategorised by V, associated with NPs in c-structure, and obligatorily present in the sentence. On the other hand, *to Pablo*, an OBLθ, is a noncore GF associated with PP in c-structure, and optional, as can be seen from the fact that in (17b) it can be left out without affecting grammaticality.

(17) a. Consuelo expressed her sentiments to Pablo quite nicely in writing
b. Consuelo expressed her sentiments quite nicely in writing

Argument functions, like the thematic roles of a-structure, are also hierarchical: SUBJ > OBJ > OBJθ, etc. (Keenan & Comrie 1977; Bresnan 2001). The hierarchical organisation of these two levels of structures (i.e., a-structure and f-structure) is relevant from a processing point of view, as we shall see later.

All GFs other than argument functions are not specifically selected by the predicate but occur freely, subject to other constraints of the theory (Asudeh & Toivonen 2010: 431). One such nonargument function is ADJ (adjunct). Whereas argument functions allow only single instances (e.g., there can be only one SUBJ per sentence), ADJ allows multiple instances. For example, in the sentences in (17) there are two ADJs (*quite nicely* and *in writing*).

All GFs mentioned so far, whether argument or nonargument ones, represent the clause-internal aspect of syntactic organisation. However, GFs can also relate to the wider discourse. So, as a secondary function, a syntactic element can also relate to the role its clause may have in the wider discourse structure. These secondary syntactic functions are discourse functions (DFs) or overlay functions. They are three: TOP (topic), relating the topic of the discourse, mainly old or shared information; FOC (focus), expressing new information; and SUBJ, which is the only DF that, being also an argument function, is also a governable GF (i.e., selected directly by the predicate). SUBJ is often identified in many languages as the default discourse topic.[15] The TOP and FOC functions are not selected by the predicate and map indirectly to f-structure in the sense that they must be co-referential with, or anaphorically linked to, a nondiscourse GF. For example, in (17a-b) *Consuelo* is SUBJ (and default TOP), whereas in (18) the same propositional content topica-

15 For a discussion of subjecthood within the LFG framework, cf. Falk (2006).

lises *in writing*, which is TOP and ADJ; and in Bresnan's (2001: 97) example in (19b), the preposed NP *Rosie* is both FOC and OBJ of its sentence, with FOC relating this sentence to a previous element in (19a):

(18) in writing Consuelo expressed her sentiments quite nicely

(19) a. what did you name your cat?
b. Rosie I named her

Note that DFs are not part of discourse representation, any more than nonDFs are part of lexical semantics, or any more than the notions of SUBJ and OBJ, or 'nominative' and 'accusative', need references outside the sentence in which they operate. DFs are somewhat similar to pronouns, for instance, in so far as they may have an argumental function in the sentence, but refer anaphorically to an entity or referent mentioned previously. It may be worth reiterating here that, in the LFG framework, DFs are *overlay* functions strictly *within* the sentence, and that by default (i.e., in the absence of other GFs specifically marked as TOP), TOP is overlaid to SUBJ, which is both a GF and a DF. These notions may become clearer in the context of Levelt's Model. As we have already mentioned in § 2.1, there are seductive correspondences between thematic and discourse roles on the one hand, and GFs on the other. That is, agents tend to be SUBJs, and elements expressing topical information tend to appear early in the sentence and have great affinity with SUBJ, a function that allows them to lead in the utterance itself (Bock & Levelt 1994: 964; 365). Hence, for example, the sentences below in (25)-(27) need not annotate TOP formally. On the other hand, in the Russian sentence in (28) the overlay of TOP to OBL (as well as of FOC to SUBJ) must be formalised. Conversely, because TOP is an *overlay* DF function, it will not be expressed if there is no nonDF to overlay it to. So, for example, the Italian sentence in (20) has neither TOP nor FOC because neither SUBJ nor OBJ is expressed syntactically – that is, a head-marking language such as Italian can mark them both on V by morphological means, which are part of the lexical entry (i.e., part of the word, rather than the sentence).

(20) lo bevo raramente
['(I) it drink rarely' = 'I drink it rarely']

The reader would thus appreciate that in LFG the DFs TOP and FOC, which have a formal definition in the grammar and are subject to explicit constraints, are quite different from the 'topic' and 'focus' notions in other frameworks that may treat them ambiguously as discourse (rather than exclusively sentence) elements.

The LFG formalisation of DFs plays an important role in solving the functional uncertainty of the clause-initial phrase. In (17), for example, *Consuelo* is simultaneously TOP and SUBJ by default, so there is no need to mark TOP redundantly because SUBJ is already a DF (as well as a GF). On the other hand, in (18) the phrase *in writing* is not SUBJ but an ADJ formally marked as TOP. In this particular case, functional uncertainty is constrained in the interpretation of the sentence because a PP in the c-structure clearly points to an ADJ (or at least a noncore OBL). Uncertainty is more likely to arise, for example, with the topicalisation of a core argument such as OBJ, where TOP_{OBJ} may appear early in the sentence as a bare NP in c-structure. For an Italian example, we refer to (19) in chapter 3; in that sentence, because the first element in c-structure bears both the DF as TOP and the nonDF as OBJ formally in f-structure, LFG's Extended Coherence Condition is satified[16] (Bresnan 2001: 69).

There is a futher crucial clarification we wish to make in order to understand what DFs are in LFG, and hence in PT. On the one hand, TOP and FOC are universal GFs; on the other, their expression varies crosslinguistically.[17] When a declarative sentence expresses TOP, more configurational languages, such as English, and head-marking languages, such as Italian and Spanish, tend to mark it, by default, by placing it in the most prominent position in c-structure, namely the first in the sentence, and may then place FOC after TOP. And this is how TOP is operationalised for these languages in this volume.[18] However, besides position in c-structure, other types of languages may prefer to express TOP by morphological, lexical and, notably, prosodic means, or by a combination of means. For instance,

16 Completeness and coherence are general well-formedness conditions on f-structure (Bresnan 2001: 63-69). Completeness requires that every GF designated by a PRED be present in the f-structure of that PRED. The Extended Coherent Condition requires that all syntactic functions be integrated appropriately into the f-structure. This means that a TOP or FOC function must be integrated either by *identification* with an integrated function (in the case of SUBJ or ADJ which have their own PRED) or by *anaphoric linking* to an integrated function (in the case of argument functions other than SUBJ, such as OBJ and OBL).

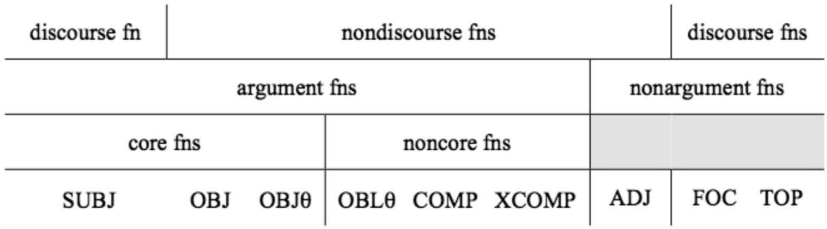
17 In LFG's work, DFs have been investigated linguistically by many scholars (e.g., Bresnan & Mchombo 1987; Kroeger 1993), and formally implemented as the mapping of c-structure onto f-structure by Bresnan (2001), Dalrymple (2001), and Falk (2001). They are also sketched in Levelt (1989).

18 In Italian, for example, TOP may be encoded also in nondefault positions (i.e., noninitial) in c-structure (e.g., *li ha mangiati Pierino i fichi,* 'it was Pierino who ate the figs'). In this case, however, sentences are highly marked pragmatically and display specific prosodic contours. Since no learner considered in this volume produces any of them, they will not be further mentioned.

Japanese and Korean express TOP primarily by morphological means, namely the *–wa* marker and the *–un* marker respectively (for Japanese, cf. ch. 4). In interrogative sentences, which must express FOC, this DF can be expressed by prosodic, lexical (e.g., *wh-* words), syntactic and/or morphological means. More about FOC will be said when questions are treated in language-specific chapters because other important issues are at play here besides configurationality and head/dependent marking, such as whether questions are polar or constituent ones, and whether the latter are fronted or in situ in the specific language. As the reader will appreciate over the remainder of this chapter and the following ones, DFs play a key role in our understanding of the learner's syntactic development when they are used together with Levelt's processing principles, such as the attribution of prominence to an argument function, or to an ADJ – cf. our Prominence Hypothesis in § 4.2.1, (34)-(35).

In sum, (21) shows how GFs in LFG are subdivided into two major dichotomies: argument and nonargument functions on the one hand, and discourse and nondiscourse functions on the other.

(21) Grammatical functions and their subdivisions (after Bresnan 2001: 96-97 and Falk 2001: 60)

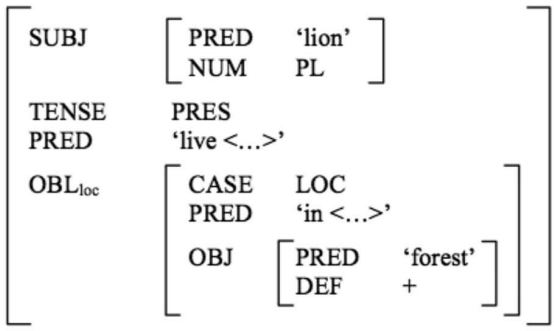


Let us now turn to the second type of grammatical information needed to interpret the sentence semantically, that is, the information conveyed by grammatical properties (or features). As we have seen earlier, these properties are part of lexical entries, and include diacritic features such as number, person, gender, definiteness, case, and tense, which all have their own values: in English, for example, singular and plural for number (e.g., *cherry*, *cherries*); first, second, etc. for person (e.g., *I*, *you*); masculine and feminine, etc. for gender (e.g., *gentleman/he*, *lady/she*); definite and indefinite for definiteness (e.g., *the banana*, *a banana*); nominative, accusative, etc. for case (e.g., *he*, *him*): and present, past, etc. for tense (e.g., *sing*, *sang*).

Thus in LFG, grammatical information in f-structure is represented by a set of attribute-value pairs; that is, given a particular f-structure, each attribute is always assigned a specific value. There are three types of values: (a) atomic symbols,

e.g., SG for singular; (b) semantic forms, e.g., love <x, y>, which stands for a kind of activity involving two arguments; and (c) f-structures, which themselves consist of attribute-value pairs. The f-structure for the sentence *lions live in the forest* is illustrated in (22).

(22) F-structure for lions live in the forest *(Bresnan 2001: 46)*[19]



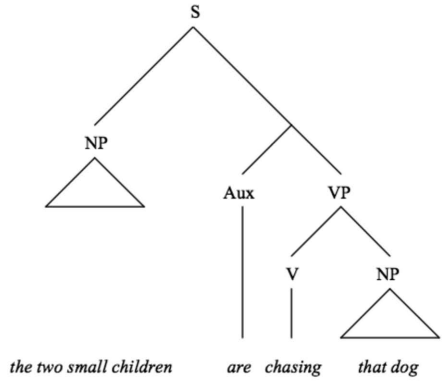
Turning now to c-structure, this is the overt expression of the functions and features that make up a syntactic expression (Falk 2001: ch. 2). It encodes three types of information: (a) word order, (b) constituent boundaries, and (c) the syntactic category of each word and constituent in the sentence – that is, whether a word is a noun, a verb, an adjective, etc., and whether a phrase is NP, VP, AP, etc. It is the level of representation of phrase-structure trees.

In contrast to f-structure, which encodes the invariant (universal) aspects of grammar, c-structure encodes properties that vary a great deal across languages. In this regard, we follow Bresnan (2001) in comparing, for example, English with Warlpiri, an Aboriginal language spoken in northern Australia. In English, c-structure is strictly organised, both linearly and hierarchically. A sentence can thus be made up of identifiable constituents, such as NP or VP, which are placed in specific positions; and GFs are encoded in c-structure configurations, with SUBJ outside of the VP and OBJ inside. Languages such as English are called configurational languages. On the other hand, in Warlpiri GFs are not encoded in c-structure; c-structure is flat, and all arguments are sisters of V. Thus word order is free, "so long as the auxiliary tense marker occurs in the second position" (Bresnan 2001: 6). Languages such as Warlpiri are called nonconfigurational languages. An English phrase structure (hierarchical and endocentric) and a corresponding Warlpiri one

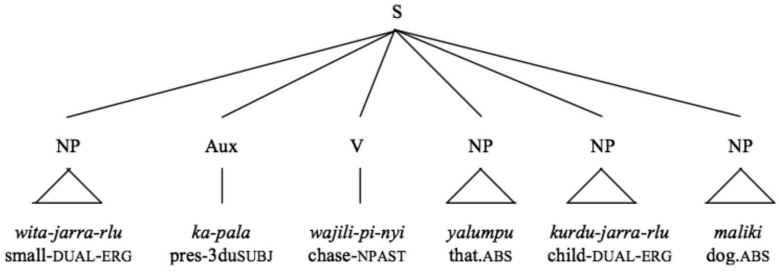
19 The internal structure of PREDS is omitted here, as in the original.

(flat and lexocentric) are illustrated in (23)-(24) respectively.[20] This alternative mode of c-structure organisation, *lexocentricity*, "associates syntactic functions directly with features borne by words rather than with the configurational relations of phrases in syntax" (Bresnan 2001: 109).

(23) Phrase structure of the English sentence the two small children are chasing that dog (Bresnan 2001: 5)



(24) Phrase structure of the Warlpiri sentence glossed in English as the two small children are chasing that dog (Bresnan 2001: 6)



20 The c-structure representations in (23)-(24), as well as others in (25)-(28) in this chapter, keep formalisation to a minimum in order to increase comprehension of the gist of our general presentation for readers who may be unfamiliar with the fine details of LFG annotations. Needless to say, we are aware that there is a great deal of variation in c-structure organisation across languages, and that in many of them what is here marked generally as a sentence (S) – as it is in Bresnan (2001) as a matter of fact – corresponds to IP. Dealing with specific languages, the following chapters will provide more precise and updated LFG formalisation.

In the Warlpiri sentence in (24), the actual word order is 'two-small are chasing that two-children dog', with the NP_{SUBJ} split by the V complex 'are chasing' and 'that', and with 'that' referring to 'dog' rather than to the adjacent 'two children'. So, it is clear that (in Warlpiri, as in other nonconfigurational languages) the coherence of a conceptual unit is indicated by means of word *shapes* rather than word *groups*. Noncontiguous words that form a conceptual unit must share the same formal endings marking agreements. Indeed, the richness of the inflectional endings marking relationships between words and groups allows for great permutation of words and phrases in the sentence according to the speaker's discourse-pragmatic needs. Such 'sharing' of inflectional features is the basis for the exchange of information that allows for feature unification. In terms of Levelt's Model for language production, the greater the distance (in terms of syntactic levels[21]) between the words needing feature unification, the higher the cognitive cost of unifying them.

Typological variation between configurational and nonconfigurational languages sets up "competition between words and phrases expressing the same f-structure information" (Bresnan 2001: 101-102). This means that morphology and syntax play complementary roles, in the sense that morphology-rich languages show preference for lexical over syntactic expression for grammatical encoding, and vice versa: morphology-poor languages show preference for syntactic over lexical expression. However, as Bresnan (2001: 132) is quick to remark, along the typological continuum from strictly configurational to strictly nonconfigurational languages, natural languages may freely mix modes of organisation.

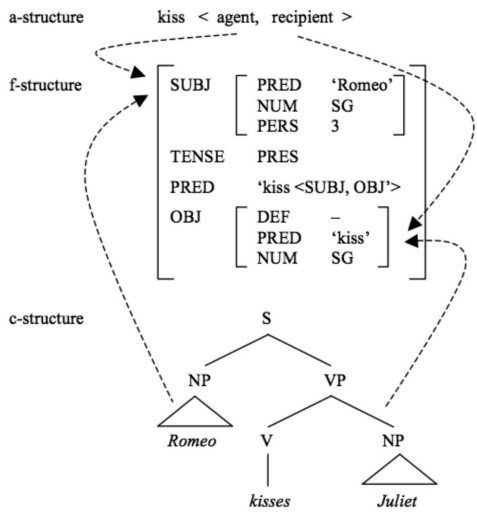
So far we have presented a-structure, f-structure and c-structure separately. This is possible, because each of these levels of representation is independent from the others, in the sense that they exist simultaneously and none is derived from any other. However, because each provides only a partial description of a sentence, it is important to specify the correspondence, or mapping, between the elements of these parallel structures. According to LFG, the main problem of a syntactic theory is to "characterise the mapping between semantic predicate-argument relationships and surface word- and phrase-configurations by which they are expressed" (Kaplan & Bresnan 1982: 174). Thus LFG grammatical formalism is essentially based on the correspondence architecture with which a sentence maps a- and c-structures onto the grammatical relations and properties in f-structure. Because each structure has its own primitives and hierarchy, the mapping between them can align in more than one way (Sells 2001), both across languages and

21 As Asudeh & Toivonen (2011) point out, even such extreme nonconfigurationality as found in Warlpiri appears to preserve some kind of ordering principle; e.g., in this language, AUX must be in second position.

within a specific language. For example, on the one hand, the default correspondences between the SUBJ function and the arguments can vary typologically along several dimensions; that is, in active languages like English, SUBJ maps by default onto the semantically most prominent role in a-structure; in accusative languages like Japanese, onto the argument in control of the eventuality; or in ergative languages like Dyirbal, onto the argument most affected by the eventuality. What all these possibilities have in common is the hierarchical prominence of the SUBJ argument on the selected dimension compared to other arguments (Bresnan 2001: 95). On the other hand, the SUBJ function takes no single universal form. Expression of SUBJ includes the NP in a certain phrase-structure configuration, as in configurational languages like English (cf. ch. 2); verbal inflection morphology, as in head-marking nonconfigurational languages like Italian (cf. ch. 3); and nominals bearing a specific case, as in dependent-marking nonconfigurational languages like Japanese or Russian and Serbian (cf. chh. 4, 5 and 6 respectively).

The mapping among the three structures is unmarked (or default) when the most prominent thematic role (i.e., agent) is encoded in the highest available GF (i.e., SUBJ) and occupies the most prominent position in c-structure, that is, the first position (Choi 2001). Levelt (1989: 266) calls this "congruent encoding". An illustration of such mapping convergence is provided in (25) for the sentence

(25) Canonical correspondences of a- and c-structures onto f-structure for the sentence Romeo kisses Juliet



Romeo kisses Juliet, where the most prominent argument in a-stucture, the agent, and the most prominent constituent in c-structure (the one in first position), both map onto the most prominent function in f-structure (the SUBJ). Less prominent thematic roles, if required, link onto less prominent functions in less prominent positions.

However, correspondences among the three structures can vary a great deal, and be more or less marked. In any language, for a variety of pragmatic reasons, the same propositional content can be expressed taking different perspectives, as we have seen in § 2.1. Such perspectives trigger different structural realisations. In most languages, sentences may vary between declarative and interrogative, between active and passive, and so on. Speakers may also choose to place a constituent in prominent position by topicalising or focusing it, or they may choose not to do so. Many of these structural choices are devices for directing the hearer's attention (Levelt 1989), and contribute to the representation of meaning, making communication more effective. However, how and how often these devices are deployed is language-specific.

Correspondence between the elements of the three levels of representation can be between arguments and GFs (mapping of a-structure onto f-structure) or between constituents and GFs (mapping of c-structure onto f-structure). The technical, formal details of these linking rules are complex, and well beyond the scope of this chapter (for their formalisation, cf. Bresnan 2001; Dalrymple 2001). We will illustrate in (26)-(27) one example for each type of correspondence, bearing in mind that GFs are here considered the 'relators' of c-structure to a-structure.

With regard to mapping a-structure onto f-structure, LFG proposes the Lexical Mapping Theory (Bresnan 2001: ch. 14; Dalrymple 2001: ch. 8, Falk 2001: ch. 4), which systematically explains how the conceptual representation of the thematic roles, represented by a-structure, is mapped onto GFs. In (25) we have seen an example of how this linking is predictable. But the eventuality described there can be realised differently, if speakers wish to establish a different perspective or point of view on the event they intend to communicate. For example, they may express the matter from the recipient's point of view, and prioritise *Juliet* over a demoted *Romeo*. This can be done by choosing a different lexical item, such as an intrinsically 'exceptional' V or an alternative 'nonbasic' V form. Let us clarify these two expressions, both borrowed from Pinker (1984).

Exceptional Vs are such because they "fail to respect canonical correspondences between thematic roles and grammatical functions" (Pinker (1984: 300). *Receive* is such a V. Other common exceptional Vs in English describe a psychological state or reaction, and include *please*, *delight*, *bore*, and *bother*. So, the eventuality of Romeo kissing Juliet, as well as canonically by the V *kiss* in (25), can be expressed noncanonically by means of the exceptional V *receive (a kiss)* in (26). On the other hand, it can be expressed also by a nonbasic V form, in this case the passive V *be*

given, as in (27). Like exceptional Vs, also nonbasic V forms fail to respect canonical correspondences between thematic roles and GFs. So what is the difference between them? Without venturing into the intricacies of lexical-semantics, it may be said that nonbasic V forms require nondefault mapping of a-structure to f-structure and may be morphologically derived from a more basic form which exhibits default mapping. For instance, in English the (active) V forms *give* and *scold* are morphologically related to the alternative (passive) forms *be given* and *be scolded* respectively, or in Italian the V forms *lavare* ('wash') and *abbracciare* ('embrace') are morphologically related to their reflexive and reciprocal nonbasic alternatives forms *lavarsi* ('wash oneself') and *abbracciarsi* ('embrace each other') respectively. Exceptional verbs also require nondefault mapping, but their alternative forms, if available, are not morphologically related. For instance, in English *receive* may be a nondefault mapping V alternative to the default mapping V *give*, like in Italian *insegnare* ('teach') may be to *imparare* ('learn'). Another exceptional V in Italian is *pentirsi* ('repent'), but in this case, despite the *–si* form, no more basic form *pentire* exists.

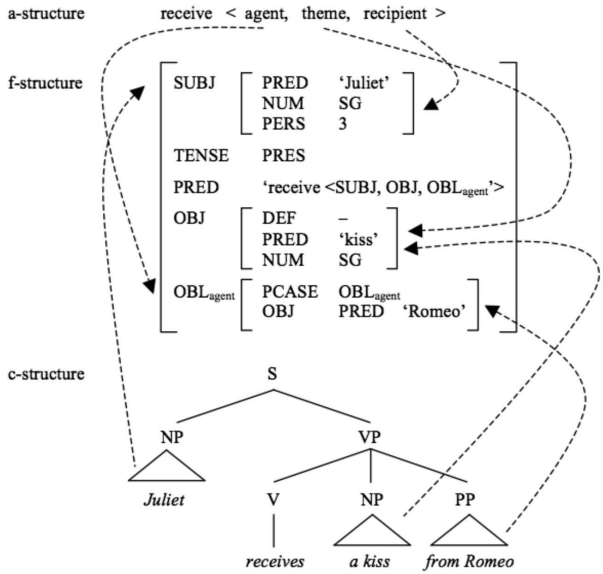
In any case, with both exceptional Vs and nonbasic V forms, it is important to note that – whether or not alternative forms are available, and whether or not alternatives are morphologicaly related – current LFG considers them all as separate lexical V entries which select their own set of arguments. In essence, a phenomenon such as passivisation "is a lexical relation change, not involving syntactic transformation, in that it can feed lexical processes of derivational morphology" (Bresnan (2001: 30). In fact, LFG follows a standard assumption in morphology: word formation processes such as derivation, compounding and conversion are morpholexical and not syntactic, and are thus the inputs to those processes. Consequently,

> in many languages passivization, causativization, and other relation changing processes are inputs to lexical processes of derivational morphology such as nominalization, adjective formation, and compounding. It is not just the verb *forms* that are input to the lexical processes, but all their attendant syntactic effects such as changes in transitivity. (Bresnan 2001: 30, original emphasis – cf. also pp. 31-36)

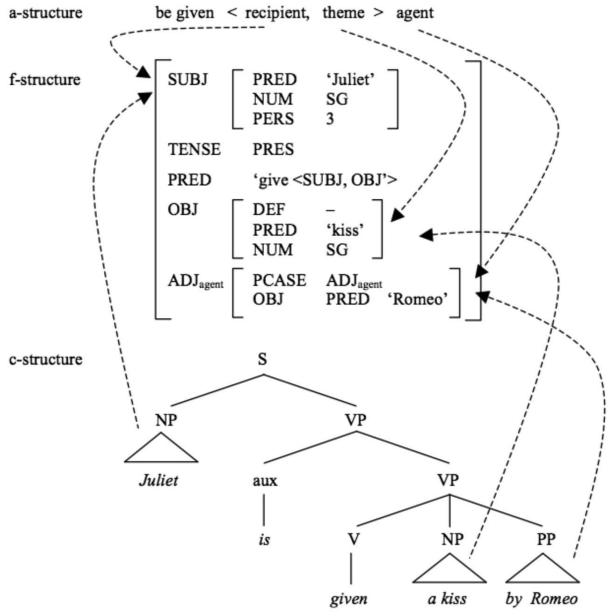
This is fully compatible with Bock & Levelt's (1994) and Levelt, Roelofs & Meyer's (1999) description of the nature and internal structure of the lexicon and its role in the formulation of the message in speech processing (cf. § 2.1 above).

Going back to our examples in (26) and (27), in either case, nondefaulteness is due to the fact that it is the recipient, a less prominent thematic role than the agent, that is linked to SUBJ, the most prominent GF. The difference between *receive* in (26) and *be given* in (27) is that the passive V suppresses the agent, which then may be optionally mapped as ADJ (Bresnan 2001: 310). Yet notice that, in either case, with regard to c-structure, both sentences exhibit basic, canonical word order pattern – which, in the case of English, is SVO.

(26) Nondefault mapping of a-structure onto f-structure for the sentence Juliet receives a kiss from Romeo

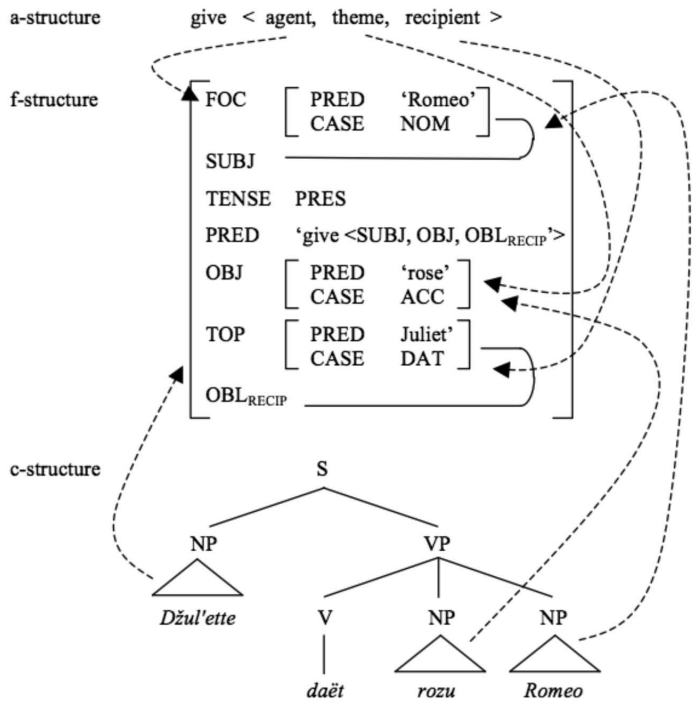


(27) Nondefault mapping of a-structure onto f-structure for the sentence Juliet is given a kiss by Romeo



With regards to mapping c-structure onto f-structure, we reiterate that, whereas f-structure functions are largely universal, c-structure configurations are language-specific. Language specificity is manifested in two ways. First, all languages have their typical (unmarked) canonical word order for core functions. For example, canonical order is SVO for English and Italian, SOV for Japanese, and VSO for Moroccan Arabic. Secondly, languages can be placed in different positions along the typological continuum from configurational to nonconfigurational languages, as we have just seen with the examples of English and Warlpiri in (23)-(24) at opposite ends. Among the European languages, Russian is less configurational than English, so we will use it to illustrate an example of noncanonical word order. In the eventuality of Romeo giving a rose to Juliet, if Russian speakers wish to assign prominence to *Juliet* (or better, *Džul'etta*) over *Romeo*, besides choosing the exceptional V *polučat'* ('receive') in a similar way to English, they can also choose to topicalise OBL and focalise SUBJ, as in (28). This involves a marked correspondence between c- and f-structures, with *Juliet* realised as TOP$_{OBJ\text{-}RECIP}$ preverbally, and

(28) LFG: noncanonical correspondences between c-structure and f-structure for the Russian sentence Džul'ette daët rozu Romeo [to Juliet gives a rose Romeo]



Romeo as SUBJ postverbally. Thus word order is noncanonical, and the argument function SUBJ is no longer associated by default with the DF TOP. On the other hand, notice that the mapping of agent as SUBJ and recipient as OBL remains canonical.

In concluding this brief presentation, we may summarise LFG as a lexically driven, psychologically plausible grammatical theory which provides an architecture for describing typologically diverse languages in a formal way. LFG provides PT with two fundamental concepts, ensuring that the different parts of a sentence actually do fit together:

(29) a. the different syntactic levels – i.e., lexical level, phrasal level or sentence level – within or across which their elements require unification or merging of diacritic features and values, a process which iconically reflects performance; and

b. the correspondences among a-, c- and f-structures; or more precisely, the ways in which elements in a-structure map onto those of f-structure, and elements in c-structure map onto those of f-structure.

The first of these two concepts, already incorporated into Levelt's 1989 Model, provided Pienemann in 1998 with the means to describe the learner's progress in the development of obligatory morphological and morphosyntactic structures (cf. § 4.1). Then in 2005, thanks to the second of these LFG's key concepts, Pienemann, Di Biase & Kawaguchi began to focus more sharply on optional syntactic constructions afforded by the alternative ways in which languages handle mapping their c-structure and their a-structure onto f-structure (cf. PT's 2005 Topic Hypothesis, which we propose to expand into the Prominence Hypothesis in § 4.2.1, and the Lexical Mapping Hypothesis in § 4.2.2). We should note, in concluding this part, that DFs and Lexical Mapping Theory were 'officially' formalised in LFG around 2001, that is, after two decades or so of research into many typologically disparate languages, including Australian Aboriginal languages. Yet, Levelt (1989) had already incorporated into his processing Model of the speaker considerations (a) about the default way in which, for example, the topical fragment available early from the conceptualiser corresponds to the earliest retrieved lemma(s), which in addition may receive primacy in grammatical encoding and is commonly generated as SUBJ NP in sentence-initial position, and (b) about how the speaker's perspective may direct attention and establish prominence and/or speaker's perspective otherwise. Furthermore, we should also note that the hierarchies of LFG's parallel structures (a-, c- and f-structures) iconically represent cognitive processes, and as such lend themselves to supporting processing interpretations of speaking.

3. PT's key concepts

On the basis of its feeder theories, PT describes, explains and predicts the development of morphology and syntax for any typologically different L2 by focusing on the development of the processing procedures (described by Levelt's Model) required for the production of L2 structures (described by LFG).

One of PT's central claims in Pienemann (1998) is that the sequence with which learners develop their grammar is not at all arbitrary but follows the time course with which the grammatical encoding of the lexicon unfolds in Levelt's Model. Hence the language processing sequence described for L1 mature speakers in (11) above foreshadows the developmental progress described for L2 learners in § 4 below. The sequenced activation of the processing procedures allows for the production of language structures, first those structures that do not require any exchange of information among constituents, later on those that do require it at the phrasal level, and finally at the sentence and higher levels. Exchange of information is a key concept here.

PT, then, spells out the hypotheses for the developmental sequences of L2 morphology and syntax in learners' interlanguage. That is, if learners are able to apply processing procedure x, they will be able to produce morphological or syntactic structure y using procedure x. Subsequently, if learners are able to use processing procedure x^n to produce structure y^n using that x^n procedure, it means that they are also able to use the preceding procedure x and produce structure y accordingly; that is, the process of building up procedures and corresponding structures is cumulative. Implicational hierarchy is a key concept here.

Based on the activation of implicationally arranged processing procedures, PT conceives L2 acquisition in terms of sequential progression through a series of stages. For morphology, progression is operationalised in terms of feature unification, and measured by the syntactic level on which lie the elements requiring feature unification, that is, exchange of grammatical information, in the target language (Pienemann 1998). For syntax, it is operationalised in terms of word order in c-structure, and the degree of flexibility in the mapping of a-structure onto f-structure measured by the canonical/unmarked vs noncanonical/marked sets of correspondences among these structures (Pienemann, Di Biase & Kawaguchi 2005).

Implicit in the amount and type of information that needs to be grammatically encoded, and then finally produced, is the cognitive cost of temporarily storing in the syntactic buffer the bits of partially encoded information that will be later required for further encoding. Processing cost is a key concept here. The more information needs to be exchanged, and the longer it needs to be kept available in the syntactic buffer of working memory, the greater the processing

cost for the learner.[22] Crucially, the more costly the encoding of the structures, the more difficult the learning, and the later these structures will develop in the learners' interlanguage.

However, the cost of grammatical encoding to learners decreases as processing procedures become automatised through frequent activation. Thus the learners' progress depends on both the ability to activate new procedures along their implicational sequence, and the automatisation of previously emerged components. In the meantime, while more advanced procedures are not yet available and earlier ones not yet automatised, the least costly solution for learners is to resort to default (or unmarked) structures involving the simplest one-to-one relationship between form and function, as long as there are words in the lexicon that match the conceptually generated message. Defaultness – (un)markedness, or canonicity – is yet another key concept in understanding PT.

4. The learner's progress

Having briefly summarised PT's theoretical bases in §§ 1-2 and key concepts in § 3, we now look at how these shape the learner's progress along the development path.

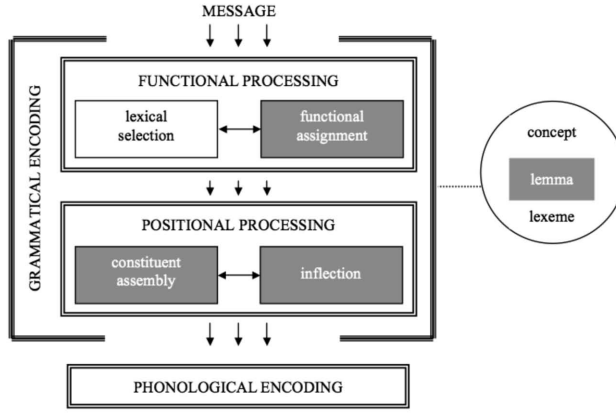
Briefly stated, PT hypothesises that, in converging towards the target language, L2 learners initially encode words and formulas phonologically but not yet grammatically. That is, they are produced in the order in which they become available in the conceptualiser, as long as the lexicon stores lemmas (in whichever state) that match (or approximate) the preverbal message. Grammatical encoding begins with words exhibiting minimally categorial features, and conceptual structure mapping onto surface structure canonically according to "prominence hierarchies" (Choi 2001: 24). This corresponds to Levelt's notion of "congruent grammatical encoding" (1989: 266), which entails the mapping of the highest role in the thematic hierarchy (the agent) onto the highest GF (the SUBJ) in the most prominent c-structural position (the first in the clause). Grammatical encoding develops further when words acquire more features, and learners become able to process discourse-pragmatic requirements that require noncanonical correspondences among the three hierarchies. A case in point is a passive structure, where a thematic role lower in the hierarchy (e.g., the patient) maps onto SUBJ); another is topi-

22 For the native speaker hardly any cost is involved here because this process is proposed by Levelt (1989) to be largely automatic and hence requires no attentional resources (cf. Poulisse 1997: 204).

calisation, when a GF lower than SUBJ (e.g., OBJ) is placed in the most prominent c-structural position (first in the clause).

In (30) we reproduce the components of grammatical processing already illustrated in (4) as fully activated in mature native speakers. Here, a grey shadow in the relevant components shows graphically the early learners' limited annotations in the lexicon and their limited ability to assign functions to thematic roles and constituents, and values to features. Learning progresses as the L2 formulator is built up (cf. De Bot 1992), and these areas become gradually clearer and more actively involved. The task of building up an L2 formulator – or indeed the very existence of a totally different formulator for each language – may vary according to the learners' L1, as De Bot (1992) notes. If the two languages are typologically unrelated the task is more arduous and the learning slower. If they are closely related, it may even be doubtful whether a whole new formulator is needed, and in any case many of the categories and procedures needed for speech may already be in place and operative. This would result in faster learning.

(30) Levelt's Model: components of grammatical processing at an early stage of L2 acquisition (after Bock & Levelt 1994: 946)



Although the sequences in the parallel learning of morphology and syntax certainly interface in important ways (cf. § 4.3), we present them separately in §§ 4.1 and 4.2 respectively.[23] In the introduction to this part I of the volume we have already

23 There is some evidence across languages for L2 syntax to emerge, consistently, before morphology. Bonilla (2014) for instance found that syntax emerges before morphology in all her Spanish L2 learners.

stated that the reason for doing so is that the two developmental sequences, as proposed for PT in Di Biase & Kawaguchi (2012), depend on two different sets of motivations. On the one hand, we have the original psycholinguistic procedures of Kempen & Hoenkamp (1987) and Levelt (1989) modeled in LFG by the mechanisms of feature unification, and adopted for PT in Pienemann (1998). On the other hand, we have the different kinds of correspondences among the three parallel LFG a-, c-, and f-structures, adopted for PT in Pienemann, Di Biase & Kawaguchi (2005).

In our presentation of both the universal schedules in this chapter and the language-specific ones in the following chapters, we prefer to avoid the use of numbers for identifying stages, unlike most tables presenting PT sequences in the considerable volume of PT literature since Pienemann (1998). Two reasons guide us in this decision. First, although conveniently synthetic, numbers are not used consistently, especially whenever authors feel the need to highlight stages within a stage. This is particularly evident when, in languages such as English, the activation of phrasal procedure includes the emergence of both NP morphology and VP morphology, whose relative sequence is not clear (cf. ch. 2, § 2). This may not be relevant in languages without VP. Secondly, as well as the sequence for morphological development, PT has now added two other sequences for syntactic development, as we shall see in § 4.2 in this chapter. Because the correspondences among these three parallel lines of development are very much an empirical issue crosslinguistically, and may well turn out to exhibit differences, these should not be pre-empted. Thus the conveniently synthetic use of numbers for stages may become cumbersome if it were necessary to specify which of the three sequences was actually being referred to, and whether or not it may correspond to the same-numbered stage across lines of development.

4.1. Morphological development

PT hypothesises that the availability of increasingly more demanding processing procedures defines the learners' progress through a sequence of stages which depend on the increasingly greater syntactic distance (i.e., in terms of hierarchical levels) between the linguistic elements requiring exchange of information for their approriate grammatical production.[24] This postulated universal sequence is shown in (31). Of course what exactly is unified over what syntactic distance must be defined language-specifically. Once the linguistic exponents are hypothesised – that is, what language-specific structure requires what procedure (belongs to what stage) – then these hypotheses are tested on spontaneous speech produced by learners of the

24 Franck, Vigliocco & Nicol (2002) managed to separate experimentally the role of syntactic distance vs linear distance in sentence processing.

particular language. Language-specific sequences and examples will be presented and discussed in §§ 2.1, chapters 2, 3 and 4 for English, Italian and Japanese respectively. Sequences for other languages (German, Russian, Serbian and Spanish) are also hypothesised, though less extensively, in subsequent chapters.

(31) PT: hierarchy of processing procedures – morphological development (after Pienemann 2005b: 14)

STAGE	T1	T2	T3	T4	T5
S-BAR PROCEDURE	–	–	–	–	interclausal information exchange
SENTENCE PROCEDURE	–	–	–	interphrasal information exchange	+
PHRASAL PROCEDURE	–	–	phrasal information exchange	+	+
CATEGORY PROCEDURE	–	lexical form variation	+	+	+
LEMMA ACCESS	words & formulas	+	+	+	+

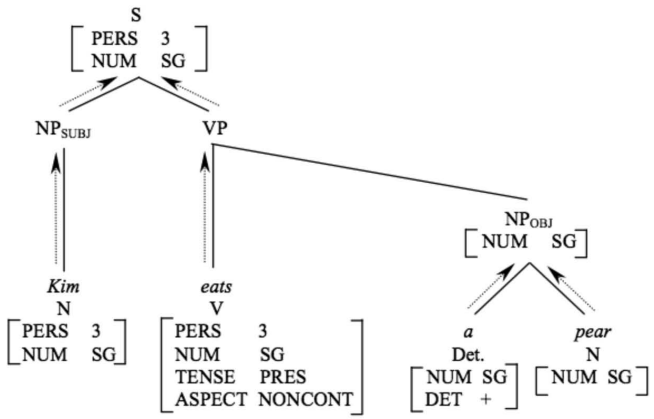
Initially, as soon as one or more words are appropriated by the learners, the only L2 procedure they can activate is lemma access, which is sufficient to allow the production of the word. Unable to activate any further grammatical procedure, with regard to morphology they produce only formulaic expressions or single words with no overtly meaningful formal variation. The main reason for this inability is that, at this early stage, the L2 word or formula is learned as a whole and is not further analyzed. Or, putting it in another way, and paraphrasing Bock & Levelt's (1994) and Levelt, Roelofs & Meyer's (1999), the three-level system of the mature L1 speaker's lexicon, represented in (2)-(3) above, is reduced to two out of the three levels: the conceptual level (meaning) and the lexeme level (sound).

At the next stage, learners begin to annotate their lexicon, and develop a system of lemmas whereby lexical concepts acquire a syntactic category and later its characteristic diacritic features. This feeds the process of syntacticisation and activates the category procedure to grammatically distinguish, for instance, Vs from nonVs. The values distinguished earlier by learners are usually those of diacritic features expressing the more transparent conceptual representation with phonologically consistent and possibly frequently occurring forms – such as plural marking for Ns, or aspect/tense for Vs (in languages that do mark such differences). At this

category procedure stage, then, overtly meaningful formal variation begins to emerge but the grammatical information thus annotated does not carry beyond the word level. In the V lemma, in languages such as English for example, tense and aspect markers remain contained within the word and may serve more as categorial markers to differentiate Vs from Ns than as actual markers of tense, aspect (cf. Johnston (1994) for a discussion of the categorial role of *–ing* in early ESL learners). This means that the relevant diacritic feature is available in the same location where the morpheme for the marking of aspect (*-ing* in English, for example) must occur. Because there is no exchange of information taking place, nothing is stored for further use somewhere else in the sentence. For those lexical entries which are not yet fully annotated, the learner will likely use default or citation forms, the least marked and most available in the input, such as (but not necessarily for all lexemes) the singular form in languages that mark number, the nominative form in those that mark case, non-past forms for tense, and so on.

With the next step forward learners reach the phrasal procedure stage. If the category of the head lemma is N, then the NP procedure can be called in order to produce an NP. If a determiner or modifier is added, the value of the head plays a key role. That is, the grammatical information of the head lemma N must be temporarily stored in the NP procedure to be checked against that of the other constituent(s) within the phrase. In order to do this, information must be exchanged among the words that in the target language require feature unification. For example, in the English phrase *a pear* in (12) above – here reproduced in (32) with the addition of arrows showing the path/process of the unification –, DET and N share the feature number, and require feature unification (represented at the NP node in the LFG diagram), which in this case concerns the value singular.

(32) An illustration of processing hierarchy for Kim eats a pear showing phrasal and interphrasal procedures



At the sentence procedure stage, the phrase needs to be attached to the S(entence)-node (i.e., the mother node in the tree structure – although, notice that S is not necessarily the appropriate mother node in all languages or for all sentence structures; in English, e.g., it is typically IP – cf., e.g., Dalrymple 2001: 53-54, 60-61; Falk 2001: 40), with the sentence procedure ensuring, in any case, the functional destination of the NPs associated with the argument roles of the V, such as NP_{SUBJ} or NP_{OBJ}. Here again, the required information relating to a phrase's values must be stored until the diacritic feature is assigned to the appropriate place elsewhere the sentence and the values checked for compatibility. For example, in the English sentence *Kim eats a pear* in (32), the NP_{SUBJ}'s number (SG) and person (3^{rd}) values are kept in the syntactic buffer (short-term memory store) until the appropriate V form, with the bound morpheme *–s* is retrieved for the V *eat*. The S-procedure then checks the compatibility of the information coming from N and the V phrases. In this example, number and person come from the N *Kim* inside the NP_{SUBJ} and the V *eat*, with its person and number values, from inside the VP. As the arrows indicate, this information travels over different phrasal nodes first, is carried up to the S-node and then checked for compatibility, that is, the person and number values in the V must be compatible with those of the NP_{SUBJ}, for the required interphrasal exchange of information.

Further along the morphological developmental path, at the last stage, learners activate the subordinate clause procedure (if the target language requires one at all). They thus become able to exchange information about the values of relevant diacritic features between elements in different clauses related to each other by subordination (i.e., the main clause and the dependent one). For example, interclausal information exchange is required in the subjunctive mood reading of the rather rare and formal English sentence in (33), where the information exchanged is that the subordinate clause does not require feature unification between SUBJ and V (*Kim eat*), whereas the main clause does (*Ann suggests*).

(33) The doctor suggests that Kim eat less

In this volume the complex area of subordination will not be addressed. It is an important research gap in PT, which requires further theoretical elaboration and focused empirical investigation.

As we can see from the examples above, the exchange of information within and across constituent boundaries can entail unification involving grammatical operations of different nature. Unification includes morphological concord (e.g., *fiori-PL.MASC profumati-PL.MASC*, 'scented flowers', in Italian), semantic compatibility (e.g., *these books*; *three cats*; *many people* in English), and grammatical government (e.g., *has gone* vs *is going* in English; *s babuškoj-INSTR.*, 'with grandmother' in Russian).

4.2. Syntactic development

For syntax, as for morphology (cf. § 4.1), PT hypothesises a staged development (Pienemann, Di Biase & Kawaguchi 2005). This comes about as learners gradually develop from default, fixed solutions in linking arguments and constituents to GFs towards noncanonical, more flexible solutions. That is, they gradually learn to (a) annotate ever more detailed and specific lexical requirements and (b) grammaticalise discourse and pragmatic information. After the initial stage of single words and formulas, there are two parallel paths ahead for syntactic development, both of them leading to the enrichment of f-structure: on the one hand, after learners begin to map c-structure to f-structure in a canonical way, they start ordering constituents more freely, as required by discourse and pragmatic reasons. On the other, after they begin to map a-structure to f-structure in a default way, they then startmapping semantic roles more freely on GFs as required by exceptional lexicon and/or by discourse and pragmatic reasons.

In other words, one path develops the ability to assign GFs to constituents by anchoring them at first to a fixed position in the linear order of the clause (SUBJ in initial position then OBJ), and later on disengaging them from it – thus allowing, for example, the learner to place a GF other than SUBJ in first position. This path was originally formulated as the Topic Hypothesis in Pienemann, Di Biase & Kawaguchi (2005). However, two important problems arise from that formulation. One is the operationalisation of TOP as a GF different from SUBJ, and the other is the neglect of FOC, the third DF. After Mycock's (2007) work on constituent questions in the LFG framework and its deployment in recent work within the PT framework (e.g., Bettoni & Di Biase 2011; Di Biase & Bettoni 2015), it may be useful to recast the original Topic Hypothesis more generally, such that it embraces all three grammaticalised DFs. This would then include, besides TOP for the development of declaratives, also FOC for the development of interrogatives. In an attempt to account also for processing as a basic constraint within which speakers – and naturally enough, learners – construct their utterances from intention to articulation (to paraphrase Levelt), we propose to replace the 2005 Topic Hypothesis with our Prominence Hypothesis. In previous drafts of this volume, as well as in Bettoni & Di Biase (2011) and Di Biase & Bettoni (2015), this latter hypothesis was called the Discourse Functions Hypothesis. Its current fine-tuning as Prominence Hypothesis owes a lot to the stimulus provided by discussions with Gabriele Pallotti. In changing its label we realise, of course, that the Lexical Mapping Hypothesis may also be motivated by discourse concerns with prominence. However, as we will see, in the Lexical Mapping Hypothesis there is more at stake than just prominence. The Prominence Hypothesis deals, then, only with such prominence as achieved by precedence relations on c-structure alignment, that is, by adding the required discourse information in f-structure and the corresponding c-structure elements.

The second path is heralded by the 2005 Lexical Mapping Hypothesis, which traces the ability to assign GFs to thematic roles first in a default way (e.g., agent to SUBJ, theme/patient to OBJ) and later in a nondefault way. What motivates nondefault lexical mapping? Unlike the Prominence Hypothesis path, this path is primarily lexically motivated. So, non-default mapping is lexically required either by specific verbal predicates, such as intrinsically exceptional Vs or alternative non-basic V forms, to use Pinker's (1984) terminology, but recalling that it is not just the 'form' of the V entry to play a role but, primarily, its attendant conceptual-syntactic information (Bresnan 2001: 30), as we have seen in § 2.2 above. Then, of course, languages may well allow speakers to combine both types of resources; this would require operating both on word order in c-structure and on argument mapping, which entails a high level of development and automaticity. We will not go into this presently.

Some readers may have concluded by now that this treatment of syntactic development along the two schedules based on the Prominence Hypothesis and the Lexical Mapping Hypothesis makes one of the hypotheses in Pienemann, Di Biase & Kawaguchi's (2005) extension, namely, the Unmarked Alignment Hypothesis, redundant. This is, indeed, a desirable result in theory construction because it is more parsimonious to put forward fewer hypotheses to cover the same (or a greater) area. Furthermore, as we said in the introduction to this volume, the Unmarked Alignment Hypothesis actually conflates c- to f- and a- to f-structure mapping at the first grammaticalised stage following the single-word and formulaic one. This, however, may be misleading conceptually because – as Conroy (2007) remarks – it assumes that canonical word order in c-structure necessarily entails default mapping of thematic roles onto GFs, thus conferring an unintended universality to that particular convergence (i.e, agent-SUBJ mapping in first position, followed by the theme/patient-OBJ mapping). On the other hand, the Prominence Hypothesis and the Lexical Mapping Hypothesis account for their own respective paths independently from each other from the very beginning of the grammaticalisation process.

In the next two sections, we spell out the two hypotheses in further detail and illustrate the two developmental sequences respectively in (34)-(35) and (42)-(43). Then in § 4.3 we discuss the interfaces between them and with morphological development.

4.2.1. The Prominence Hypothesis

This hypothesis accounts for the staged grammaticalisation of the DFs TOP and FOC at the sentence level. When the activation of the category procedure takes place and distinguishes at least between Vs and Ns, Vs begin to acquire their pivotal role in the sentence frame, and participants in the eventuality begin to be

aligned according to the specific canonical word order of the target language, as learners follow positive evidence in the input. But, what is canonical order? Is there a universal one?

The notion of canonical order has been hotly debated at least since Greenberg (1963) – see Song (2012) for a historical and theoretical account. In a 402-language sample based on a database of 1063 languages, Tomlin's (1986) typological work found two prevalent linear orders for SUBJ, V and OBJ: SVO and SOV, with no statistically significant difference between the two orders (41.79% vs 44.78% respectively). The third order was VSO (9.2%) leaving the remaining three possible orders (VOS, OVS, OSV) with less than 5% between them. On the other hand, working on language genetic groupings (genera) rather than languages as single entities, Dryer (1989) found a preference for SOV, confirmed with an extended database of 1377 languages in the *World Atlas of Linguistic Structures*: 41% SOV languages, 35% SVO, 7% VSO and only about 3% distributed over the other three possible order, with the remaining 14% or so languages displaying no dominant word order (Dryer 2013). All these findings nevertheless confirm that in the great majority of languages SUBJ precedes OBJ. So the typology of word order would tend to support Keenan's (1979) *Subjects Front Principle*. And this principle can be further supported if we consider the order of precedence in the widely accepted GF hierarchy proposed by Keenan & Comrie (1977): SUBJ > OBJ > OBJθ > OBL > ADJ (cf. also Choi 1999, Bresnan 2001, and § 2.2 above). In sum, excluding the position of V, on typological accounts (whether numerical or genealogical) and hierarchical accounts, SUBJ should be structurally more prominent than non-SUBJ GFs, and, in the absence of other arguments, OBJ will follow as the closest sister of V.

Canonical word order is then the optimal (and prevailing) order with which each language organises its basic constituents in the c-structure of the prevalent type of strings (i.e., simple, active, affirmative, declarative, minimally presuppositional, and pragmatically neutral sentences). Thanks to its very predictability, L2 learners can produce canonical word order with minimal processing cost, and minimally specified functional assignment.[25] That is, at an early stage functional assignment may be purely positional, with a nonhierarchical, flat structure. Not surprisingly, the L1 or L2 learner's initial reliance on the canonical word order of the target language is well attested by a large number of corpus-based longitudinal and cross-sectional studies of typologically different languages, outside of the PT framework (e.g., Bever 1970; Sano 1977; Slobin & Bever 1982; Clahsen, Meisel & Pienemann 1983; Pinker 1984; Johnston 1985a; Cook 1993; Sasaki 1998), and

25 Readers may also note in this connection that all learners will already have the notion of SUBJ and OBJ in their L1 though with their own language-specific characteristics.

within PT (e.g., Di Biase & Kawaguchi 2002; Itani-Adams 2009; Kawaguchi 2005, 2011; Mansouri 2005; Medojević 2014; Pienemann & Håkansson 1999; Yamaguchi 2010; Wang 2010; Wirbatz 2014; Zhang 2005) – where L1-L2 transfer occurs it is developmentally moderated, as Pienemann, Di Biase, Kawaguchi & Håkansson (2005) show across a range of typologically different languages. We also assume that canonical order is language specific: for example, SVO in English and Italian, and SOV in Japanese.

We also admit that all languages studied so far exhibit the canonical SO order – and that it would be extremely interesting to test PT's hypotheses on OS languages, which are in any case very rare. Rather than the nature of canonical order itself, however, what we wish to stress here is that canonical correspondences between linear positions and GFs and DFs are typically learned before noncanonical ones.

The assumption that at the initial syntactic stage learners can produce canonical word order – whose default solution is to make the first NP the SUBJ/TOP, and the second NP the OBJ/FOC – would imply that the S-procedure is already operative in their interlanguage. This creates some confusion (cf. also Kempen's 1998 critical remarks), which Pienemann (1998: 87) tries to disentangle by labelling this canonical ordering principle a 'simplified' S-procedure. Without entering into detail about procedures, which crucially determine morphological development (cf. § 4.1), we make the point here that the kind of GFs emerging at this stage are primarily positionally determined. That is, although learners are now able to assign GFs to sentence constituents, they are unable to operationalise the full range of functional assignment exponents apart from position. In other words, at this first syntactic stage of development, they can produce only one frame: a canonical string mapping c-structure to f-structure in a fixed correspondence. Unable to mark GF/DFs by other means than position, the only frame learners can produce is fixed: SUBJ/TOP precedes OBJ/FOC.

In configurational languages such as English, position may be more or less the full story, but not so in nonconfigurational languages. The learner's gradual progress from functional assignment dependent on position in a fixed frame to functional assignment independent from position depends on the availability of the necessary resources (e.g., inflectional morphology). In this regard, it is useful to keep in mind the temporal sequence in which Bock & Levelt (1994) clearly indicate that functional assignment precedes inflection (cf. (29) above), and our interpretation of the interfacing between syntactic development and morphological development in § 4.3, as well as language specific exemplifications in part II of the volume.

Let us then move on to consider richer frames and more flexible word orders. In order to enhance their expressiveness, speakers may wish to give prominence to a particular entity in the eventuality they intend to communicate to their interlocutor. There are various ways in which they can do this, such as by prosodic, lexical or syntactic means (Levelt 1989: 266-67) in various combina-

tions. We would add here, morphological means (e.g., topic marking in Japanese, Corean, etc.). The way learners progress through the staged development of syntax – away from the rigidity of canonical word order towards the flexibility of optional choices allowed by their L2 – was spelled out by Pienemann, Di Biase & Kawaguchi in their 2005 Topic Hypothesis, which we now propose to replace with a more inclusive Prominence Hypothesis in (34). This is schematically summarised in (35).

(34) *Prominence Hypothesis*. In second language acquisition learners will initially not differentiate between grammatical functions (GFs) and discourse functions (DFs), for example, between SUBJ and TOP. Differentiation begins when an element such as an XP, or other lexical material, is added to the canonical string in a position of prominence in c-structure, that is, the first in the sentence. This element may be TOP in declaratives or FOC in interrogatives leaving, crucially, the canonical string unaltered. At the next stage, learners will be able to construct noncanonical strings assigning prominence to any constituent in an unequivocal way.[26]

(35) PT: syntactic development based on the Prominence Hypothesis

STAGE	STRUCTURES
NONCANONICAL WORD ORDER	TOP_{XP} marked orders FOC_{XP} marked orders
XP_{DF} CANONICAL WORD ORDER	TOP_{XP} SVO / SOV / ... FOC_{Wh-} SVO / SOV / ...
CANONICAL WORD ORDER	SVO / SOV / ... [QUE^{P} SVO / SOV / ...]
LEMMA ACCESS	single words; formulas [QUE^{P} single words; formulas]
QUE^{P} = the QUE feature is realized by prosody alone	

Our formulation of this hypothesis represents a significant expansion on its 2005 version, in so far as (a) it incorporates a processing principle explicitly, that is, the

26 This formulation of the Hypothesis may not account for all aspects of languages with in-situ constituent questions, an issue which should be resolved empirically.

fact that the sentence-initial position has higher prominence; and (b) it coherently includes interrogative as well as declarative sentences, and may thus be applied to a wider typological range of languages.

But what exactly may the learners be learning when attributing prominence? Here we follow Choi (1999: 133), who uses i-structuring constraints operating on c-structure to identify the contextual (discourse) dimensions of novelty and prominence, and marks each of them by a binary feature, respectively [±NEW] and [±PROM], as shown in (36).

(36) Information structuring constraints (i-structure/c-structure correspondence)

NEW: [–New] should precede [+New]
PROM: [+Prom] should precede [–Prom]

These feature-value pairs would enable the identification of SUBJ in its default initial position as [–New] and [+Prom] preceding a default OBJ [+New] and [–Prom], whereas a topicalised OBJ would be assigned [+Prom]. So the informational status of the V arguments in a given f-structure, characterised by their informational feature structure, should predict the optimal alignment of the arguments in c-structure. Readers may recall that the f-structure does specify functional assignment and, if necessary, the overlaid DFs (TOP, FOC), but f-structure is unordered, hence underspecified in terms of alignment. If the arguments do not differ in informational status, the canonical word order prevails, but if they do differ, the optimal structure should result from the appropriate ranking of the constraints. See Choi 1999, 2001 for a treatment of information structuring within Optimality Theory and LFG. The information status of the arguments cannot be derived on the basis of their referential (semantic) features alone, but also by the speaker's perspective. As Dalrymple & Nikolaeva (2011: 14, original emphases) put it, topicality, for instance, "is not an inherent property of the referent, and although it correlates with the role played by the referent in the preceding discourse […] it depends on the speaker's assessment of its saliency within a given **communicative context**". They then assert that "[s]ince we view information structure as part of grammar, we treat grammaticality as including pragmatic well-formedness." An example of the different information status of the elements in the same eventuality is shown in (37). In this example by Choi (1999: 46-47), in answer to the *where* question in (37a), the FOC *on the table* is the only element marked with the [+NEW] feature in (37b-d). But why are there three different answers? The differences are due to the speaker's manipulation of prominence through the values of the [±PROM] feature.

(37) a. where did you put the knife?
b. I put [the knife] [on the TABLE]
c. [the knife] I put [on the TABLE]
d. [on the TABLE] I put [the knife]

	[*I*]	[*put*]	[*the knife*]	[*on the TABLE*]
	[–New]	[–New]	[–New]	[+New]
a.	[–Prom]	[–Prom]	[–Prom]	[–Prom]
b.	[+Prom]	[–Prom]	[–Prom]	[–Prom]
c.	[–Prom]	[–Prom]	[+Prom]	[–Prom]
d.	[–Prom]	[–Prom]	[–Prom]	[+Prom]

Let us now proceed to illustrate the Prominence Hypothesis summarised in (35) in a general way, mentioning only some representative structures of English. For more detail and language-specific schedules and examples, the reader is referred to the chapters in parts II and III.

At the very first grammatical stage after the single-word and formula stage, we include the possibility for learners to also produce questions. Constituent questions may be produced by placing the wh-word in situ, that is, in the same position as their declarative equivalents, irrespectively of whether their target language marks FOC in situ or clause initially. Polar questions are grammatically marked by prosodic means, represented in the table by a prefixed QUE (for the development of questions, cf. Yip & Mathews (2006), and chh. 2 and 8, this volume, for English and Italian examples respectively). Typical additions to declarative sentences at this stage are time and place specifications (cf. the notion of Stage Topic in Erteschik-Shir 2007), normally placed to the right of the clause, thus leaving unaltered the default association of the DF TOP with SUBJ, as in (38).

(38) I eat lunch in park

The next stage of XP canonical word order comes about when, for discourse or pragmatic reasons, learners become able to add to the canonical string an XP (that is, a phrase of any category) in the sensitive initial position. Using English to exemplify, the DF assigned to this phrase will be TOP in declaratives or FOC in interrogatives, as in (39a-b).

(39) a. in Libya the people not drink beer
b. where you buy this?

This fronted addition plays a crucial role in the learner's development because it promotes a differentiation between the DFs TOP or FOC and the canonical string. That is, in declarative sentences the TOP function will now be assigned to this new

constituent, rather than to SUBJ by default. The less costly choice in declaratives is that this new constituent be ADJ rather than an argument of V. And indeed Pienemann, Di Biase & Kawaguchi (2005: 232) report that empirical studies of the development of a range of languages identify ADJ among the first nonSUBJ constituents to occur in sentence-initial position – but see chapter 9, this volume, for a study including both declaratives and questions. What matters most, at this XP canonical word order stage, is that, whereas earlier on the identification of SUBJ/TOP by (first) position on c-structure did not allow for the differentiation of SUBJ and TOP (and indeed there was no need to distinguish between them: if there is only canonical order, TOP is SUBJ), now the appearance of an XP in the most prominent position before the canonical string triggers a dislocation of SUBJ from its canonical first position which interferes with the close connection between SUBJ and TOP: the TOP function is assigned to the prominent constituent, which is followed by SUBJ and the remaining constituents in canonical order.

Although the fronting of a circumstantial element bearing the nonargument function ADJ (usually expressed with an adverb or a PP) may be common, learners may occasionally introduce in first position yet a different new element expressed with a bare NP, co-referential with one of the argument functions such as SUBJ and OBJ, as shown in (40a-b). Such topics, however, at this stage, are 'external' (cf. Bresnan 2001: 69) because the remaining part of the sentence (*they read the newspaper*) not only displays fixed canonical word order, but it is also complete and fully coherent on its own.[27]

(40) a. the women, they read the newspaper
b. the newspaper, the women read the newspaper

In constituent questions, the added XP includes the DF FOC. Asudeh (2004: 49) uses the term UDF, unbounded dependency function – FOC or TOP – to generalise across unbounded dependencies. Fronted FOC typically occurs with languages such as English, as shown in (41b, d).

(41) a. Carmen is licking an ice cream-FOC/OBJ in the garden
b. what-FOC/OBJ is Carmen licking in the garden?

c. Carmen is licking an ice cream in the garden-FOC/ADJ
d. where-FOC/ADJ is Carmen licking an icecream?

27 When the topicalised NP is internal to the clause and not in its canonical position (and hence ambiguous), its functional uncertainty (Bresnan 2001: 67) is resolved differently in different languages, e.g., by clitic marking on V in Italian (cf. ch. 3), and case marking on N in Japanese (cf. ch. 4).

And, indeed, it is a well-attested fact in English interlanguage that learners can front their question words at this stage. What they cannot do yet is disrupt the canonical word order frame.

At the next stage, the crucial step forward is the ability to scramble the elements of the canonical word order. What enables this to happen is that the learner can now assign a GF to each of the arguments autonomously, that is, abstracted from the fixed position they occupy in the canonical order frame (e.g., by unequivocally identifying SUBJ through agreement with V). This makes argument functions other than SUBJ sufficiently independent as to receive, themselves, the assignment of TOP or FOC. All this certainly needs the S-procedure to be firmly in place. If no functional assignment markers (such as those provided by morphological resources, cf. § 4.3) were to signal to listeners that the first NP is not SUBJ, they might interpret it as SUBJ, and misunderstand the message. Conversely, the S-procedure being in place does not guarantee that the learner is also able to topicalise OBJ or other argument functions.

In sum, in order to capture the learner's syntactic progress from the simple and strict canonical word order frame to a richer and more flexible one, the Prominence Hypothesis predicts three stages: first, word order is canonical, any other additional information may be placed after it. TOP and SUBJ coincide by default, with minimal (positional) specifications. Second, word order is still canonical, but because an XP is added as TOP or FOC, DFs and GFs are differentiated. Finally, word order may be other than canonical, and GFs are further specified.

Empirical evidence for the Prominence Hypothesis is reported in several studies across different languages and situations, such as Kawaguchi (2005, 2010) for Japanese, Di Biase (2007) and Bettoni & Di Biase (2011) for Italian, Zhang (2007) for Chinese, Yamaguchi (2008) for English, and Itani-Adams (2009) for Japanese-English bilingual acquisition, all of them within the PT framework.

4.2.2. The Lexical Mapping Hypothesis

As we have just seen in dealing with the Prominence Hypothesis, the speakers' assessment of which referent may be salient in the current communicative context will contribute to the assignment of prominence to a particular argument, whose alignment may yield a noncanonical word order construction aiming to achieve a given pragmatic effect. Similar discourse-pragmatic effects may also be achieved by selecting a verbal lemma or construction that requires nondefault mapping between thematic roles and GFs. Importantly, though, topicalisation or focalisation actually preserve the semantic role hierarchy. So, if agent is mapped on SUBJ, topicalisation does not affect this relationship, as we have seen in the Russian sentence in (27) above, which topicalises OBL_{GOAL}. On the other hand, according to LFG Lexical Mapping Theory, the default mapping of thematic role onto GFs may be

altered when, for example, the patient role (rather than the agent) maps onto SUBJ, at the same time leaving canonical word order unaffected (i.e., SUBJ may still be in first position). An important set of verbs marking saliency through non-canonical mappings are the passive verbs, which are present in many languages. Also the so-called exceptional verbs with intrinsic lexical features that require non-canonical mapping as their 'normal' (i.e., pragmatically unmarked) realisation are present in many languages. We have already illustrated both an exceptional verb and a passive one in (26) and (27) respectively in § 2.2.

With regards to the learner's progress, the Lexical Mapping Hypothesis was originally proposed by Pienemann, Di Biase & Kawaguchi (2005: § 3.8) to trace the way learners progress through the staged development of syntax beyond the rigidity of canonicity towards a fuller flexibility of the optional choices allowed by their L2 in assigning GFs to thematic roles. We now formulate an explicit and substantially expanded Lexical Mapping Hypothesis interfacing syntax with both discourse and semantics in (42)[28], summarise it in (43), and then comment on it.

(42) *Lexical Mapping Hypothesis.* Second language acquirers will initially map the highest available role in the thematic hierarchy (e.g., agent, experiencer) onto minimally specified SUBJ/TOP. We call this *default mapping*. Next, they learn to add further arguments mapped onto grammatical functions (GFs) differentiating them from SUBJ (and OBJ, if present). They may also learn some exceptional verbs at this second stage. Finally, they learn to impose their own perspective on events, that is, to direct the listener's attention to a particular thematic role lower in the hierarchy by promoting it to SUBJ, and defocus the highest role by mapping it onto a GF other than SUBJ, or suppress it altogether. At this last stage learners may add further role information regarding causality, benefit, or adversity. They may also add to their lexicon particular subsets of Vs, such as unaccusatives, as well as further intrinsically exceptional Vs requiring their own mapping schema. We call this *nondefault mapping*.

(43) PT: syntactic development based on the Lexical Mapping Hypothesis

STAGE	CONSTRUCTIONS
NONDEFAULT MAPPING	unaccusatives, passives, causatives, exceptional verb constructions, etc.
DEFAULT MAPPING AND ADDITIONAL ARGUMENTS	agent/experiencer mapped on SUBJ, patient/theme mapped on OBJ, and other members of the a-structure hierarchy, such as goals and locatives, mapped on OBL
DEFAULT MAPPING	agent/experiencer mapped on SUBJ and patient/theme mapped on OBJ
LEMMA ACCESS	single words formulas

28 An earlier formulation of the Lexical Mapping Hypothesis is found in Kawaguchi & Di Biase (2005).

To begin with, soon after the stage of single words and formulas, a default choice for learners is to map the agent or experiencer role as SUBJ (positionally prominent) and the patient or theme, if present, as OBJ. This indicates, minimally, that SUBJ and OBJ are differentiated.

Then, after the initial default mapping stage and before the final nondefault mapping stage – differently from the Pienemann, Di Biase & Kawaguchi (2005) hypothesis, repeated almost unaltered in Pienemann (2011c: 48, fig. 3.13) – we hypothesise an intermediate stage. At this stage, crucially, learners add a further argument role such as a goal/beneficiary, instrument, or locative, mapped onto an OBL GF. Should learners add this further argument without functional marking, confusion could arise as to who does what to whom in the eventuality, especially if there are two animate or human participants as in (44a). But if they add it with functional marking, they are able to differentiate between core and noncore arguments: typically NP vs PP, as in (44b), but also by means of position, as in (44c).

(44) a. *Romeo gives a rose Juliet
b. Romeo gives a rose to Juliet
c. Romeo gives Juliet a rose

At its final stage, the Lexical Mapping Hypothesis is quite broad and undifferentiated, as can be gathered by the wide range of verbs and verbal constructions listed in the highest row in (38), which includes causatives, benefactives, and unaccusatives, among others. These verbs and constructions are arguably among the most language-specific. Within this framework, what unites them, both within a language and across languages, is that the nondefaultness of the mapping of a-structure to f-structure is determined either by the speaker's lexical selection alone or by lexical selection in conjunction with discourse-pragmatic reasons. By contrast the noncanonicity in the last stage of the Prominence Hypothesis is determined exclusively by discourse-pragmatic reasons. What unifies them from a language acquisition point of view is that, until GFs are unequivocally assigned to thematic roles, canonical word order associated with nondefault thematic mapping can mislead the hearer, especially when both participants are animate, as in (45a), where the speaker's intention is to communicate the message in (45b).

(45) a. *[call your Mother,] she worries you
b. you worry her / she worries about you

The sequence in which all these exceptional V and nonbasic V forms are learned within the nondefault mapping stage is a widely open empirical question. It may well be, for example, that learners acquire at least some exceptional Vs earlier than

passive Vs, because in the case of exceptional Vs the motivation for the Lexical Mapping Hypothesis is triggered exclusively by their intrinsic lexical nature (features) – that is, each particular V must be learned as an exemplar –, whereas in the case of nonbasic passive V forms learners may find out, eventually, that the passive construction is generalisable across transitive Vs. However, the assumed sequence needs to be tested crosslinguistically.

Empirical evidence for the Lexical Mapping Hypothesis comes mainly from Kawaguchi's study of Japanese L2 (cf. Kawaguchi 2005, 2007, 2009a, 2010), two studies on the acquisition of passives in English L2, namely Keatinge & Keßler (2009) and Wang (2009), and one by Bettoni, Di Biase & Nuzzo (2009) on the acquisition of postverbal SUBJ in Italian L2. Less robustly supported by crosslinguistic empirical evidence than the Prominence Hypothesis, this Lexical Mapping Hypothesis needs further testing across different languages and communicative situations.

4.3. Interfacing developmental schedules

As we have seen, with regard to morphology PT claims that progress is constrained by the syntactic level of the constituents whose features require unification (cf. § 4.1). This means that learners develop first lexical, then phrasal, and finally interphrasal, morphology – we do not deal here with interclausal morphology because, as mentioned in § 4.1, the complex area of subordination remains a gap in PT, and requires further theoretical elaboration and focused empirical investigation. With regard to syntax, progress is determined by the type of correspondences that map constituents (c-structure) and argument roles (a-structure) onto GFs (cf. § 4.2). This means that learners develop from a rigid canonical word order to more flexible choices, and from default mapping between thematic roles and GFs to nondefault mapping. How then may the parallel schedules we presented separately in (31), (35) and (43) interface? When in 2005 Pienemann, Di Biase & Kawaguchi added their extension to Pienemann's original PT version, the interface between "morphosyntax" in 1998 and syntax in 2005 was often mentioned, but not worked out in any detail, nor has this been treated further by Pienemann (2011a, b, c) more recently. Here we can only state the problem in its broader form, because the details will necessarily be language specific (cf., e.g., the early mention for L2 Italian in Di Biase & Kawaguchi 2002; the treatment of case in L2 Russian and L2 Serbian, and of Spanish Differential Object Marking, chh. 5, 6 and 7 respectively, this volume).

We assume that initially, when the activation of the category procedure distinguishes at least Vs from Ns, the general tendency for learners would be to organise their utterances syntactically by mapping their a-structure roles onto GFs in a default way, and sequencing them in canonical order in c-structure. However, on

the one hand, the category procedure (i.e., differentiation in the lexicon) is a necessary resource for both canonical word order and default mapping. On the other hand, canonical word order and default mapping do not necessarily share the same constraints. As a matter of fact, under pragmatic pressure, learners may not map the highest thematic role available (e.g., the agent) onto the most prominent position or the highest GF, and this provides a good reason for us to abandon the 2005 Unmarked Alignment Hypothesis. For example, under clear pragmatic conditions urging the learner to topicalise the theme argument rather than the agent argument, learners at this early stage may well produce sentences such as (46a), where the $SUBJ_{THEME}$ V OBJ_{AGENT} string would show nondefault mapping with canonical word order – leaving the interlocutor with an ambiguous or uninterpretable meaning, although in this particular example animacy reduces the conflict. (For further examples and discussion on this point, cf. ch. 3 on Italian, § 3.1, this volume).

(46) a. *the lettuce eat the goat
b. the goat eats the lettuce

At an intermediate level, in order to progress beyond canonical word order, learners need to differentiate between SUBJ and TOP or FOC. This may be achieved lexically. That is, as long as the lexicon includes temporal or spatial adverbials such as *yesterday* and *in Libya* (cf. (39a) above) to express TOP_{ADJ} in declaratives and question words such as *what* to express FOC in interrogatives, learners may not need to be beyond the category procedure stage. Likewise, progress beyond default mapping may be achieved lexically in many languages by distinguishing between unmarked OBJ and an OBL marked by a preposition. On the other hand, the phrasal procedure would be necessary within the VP in languages which mark GFs by case rather than by PP (cf. the discussion for Russian L2, ch. 5, § 3, this volume). Finally, with regard to the interface between the two syntactic schedules, there seems to be no reason why the addition of an XP before canonical word order should presuppose the ability to add another argument to the verbal frame, or vice versa.

As we have just seen, language specificity plays an important role in the interfaces among the schedules at the intermediate level. This is even more evident at the advanced level. Here the key issue is mature, unequivocal functional assignment. The means – or, more precisely, the mix of means in competition with each orther (cf. Bresnan 2001) – that languages deploy to assign GFs and DFs to thematic roles and constituents include, typically, morphological means, but also lexical, syntactic, as well as prosodic means. Prosody is a big player here (cf. Levelt 1989), but this area is beyond the current scope of PT. This variety of means entails that progress beyond the initial stage along the three schedules may vary

substantially from language to language, as the three chapters in part II of this volume will illustrate.

Even within a single language it may be premature to predict implications among the schedules. In English, for example, learners will have to reach the sentence procedure stage in order to produce sentences with either noncanonical word order or nondefault mapping, but with regard to the interfacing between the Prominence Hypothesis and the Lexical Mapping Hypothesis (Kawaguchi & Di Biase 2012), it is empirical evidence that should show the sequence, if any, in which structures such as those in (47b-d) will be learned after (47a).

(47) a. *canonical word order* Juliet kisses Romeo
b. *topicalisation* Romeo Juliet kisses
c. *passive verb* Romeo was kissed [by Juliet]
d. *exceptional verb* Romeo received a kiss [by Juliet]

Suffice it to mention here three issues affecting the interface between the two hypotheses. First, what motivates them? We assume that, with regard to the Prominence Hypothesis, canonical vs noncanonical word order is triggered only by discourse-pragmatic motivation, independently from the feature structure of the V lemma. On the other hand, with regard to the Lexical Mapping Hypothesis, default vs nondefault mapping is triggered either exclusively by the intrinsic lexical nature of V (e.g., in the case of exceptional Vs), or by the lexical features of V in interaction with discourse-pragmatic attribution of TOP or FOC (e.g., in the case of passives). Secondly, Vs requiring 'only' intrinsically nondefault mapping may be relatively easy to acquire. The English V *receive* is one of them. Although it requires that the beneficiary, rather than the agent, be mapped onto SUBJ, the beneficiary is the highest role in its <beneficiary, theme> a-structure, and the theme (which is hierarchically lower) is regularly mapped onto OBJ. Moreover, word order is canonically SVO. Conversely, some other Vs are much harder to acquire. The Italian V *piacere* is one of them (Bettoni, Di Biase & Nuzzo 2009). This may be related to the complexity of their lexical features, which must be learned V by V. Exceptional Vs, in fact, involve what Skehan (1998) calls "exemplar-based knowledge", as opposed to "rule-based knowledge", because the behaviour of each of them cannot be rule-generated and is not generalisable to other Vs. Since exemplar-based knowledge occupies a larger memory storage than rule-based knowledge, it is less economical for online language production. Thirdly, the alternatives in (47), as well as others not exemplified there, are not all available in all languages, nor do different languages show the same preferences among all available options – as the awkwardness of some of the English ones in (47) imply.

5. Methodological issues

Parts II and III of this volume will empirically test, language-specifically and on a wide typological range of L2s, the broad learner's progress outlined in this chapter within its universal, processability-based framework. Before proceeding, however, we need to mention at least three methodological issues of crucial importance to PT: (a) the type of data required for testing the hypotheses; (b) the type and number of structures which can be diagnostic for a given stage; and (c) the operational criteria used for determining the acquisition of specific structures.

The first issue concerning the type of data needed to test PT hypotheses is the least controversial. PT is a theory of SLA which explains the learner's development on the bases of speech processing procedures – and can thus, in Ellis' (1994: 682) words, be defined as a "transition theory" (i.e., concerned mainly with the dynamic mechanisms responsible for the changes in the development from one system to the next) rather than a "property" theory (i.e., concerned mainly with describing static systems of linguistic knowledge). As such, PT relies primarily on spontaneous speech data, produced online, in order to infer developmental patterns, as already proposed in Pienemann (1998), and – we may add – in most L1 acquisition research, where there might be very little point in trying, for instance, grammaticality judgment methods. Indeed, also linguists interested in knowledge acquisition, whether L1 acquisition or biligual L1 acquisition, rely heavily on children's performance data to infer knowledge patterns. Thus PT does not use as primary evidence other types of data such as grammaticality judgements or introspective comments used for instance by property theories working within Typological Markedness or Universal Grammar frameworks (cf., e.g., Doughty 1991; Gass 1994; Sorace 2003; White 1989). Such data, usually cross-sectional, is elicited in order to assess the speaker's grammatical knowledge (Loewen 2009), whereas PT is more interested in accounting for performance. It would be also rather difficult for grammaticality judgements (which are comprehension-based) to deal, for instance, with optional DFs or features that rely on speaker-induced choices in production. Sure enough, measures from laboratory data such as reaction time, used also in Pienemann (2002), may be very useful for testing whether some particular elements are, or have become, part of learners' procedural knowledge, but they may not be as useful for looking at developmental patterns. Inferences about development are ideally drawn from oral longitudinal data, although cross-sectional data is also often used, recruiting informants over a range of proficiencies. Again, ideally, cross-sectional data may best be used to confirm developmental patterns inferred from longitudinal data.

PT's primary reliance on spontaneous spoken data does not rule out the use of specifically devised communicative tasks to elicit structures which occur less frequently in natural conversation or emerge only in highly specific contexts, as is

often the case for optional structures which are highly marked and depend on the speaker's particular pragmatic choices. What PT requires is the assurance that the sentences uttered by learners are computed online thanks to their speech-procedural skills, at whatever stage of development they may be. For this reason spoken production, which moves at a rate of between two and three words per second (Levelt 1989) is privileged in PT over written production, which allows for much longer processing time.

The second issue concerns the type and number of structures needed as evidence that a learner has reached a given stage. The answer to the number of structures is fairly straightforward: one is sufficient. In fact, according to PT, learners are deemed to have reached a certain stage when they show their ability to activate the relevant procedures in their L2, and such evidence can be obtained by producing a single type of structure, for example, single words and formulas, canonical order, and so on. The answer to the question of which type of structures the researcher chooses is more delicate because not all structures belonging to a stage will be acquired at the same time, and we may well find that the 'earliest' (i.e., easiest) structure at the following stage is acquired before the 'last' (i.e., most difficult) of the previous stage. This is what Pienemann (1998: 153), following Larsen-Freeman & Long (1991), calls 'scouting' and 'trailing'. The best choice for a diagnostic structure on an untried language should fall on a structure that displays possibly the clearest one-to-one relationship between form and function, or the most representative, or default, structure of a stage in a particular schedule, the one with the most transparent conceptual meaning. Language specificity plays a crucial role here. Let us take morphological development in a language such as Russian as an example. Russian requires number, gender and case agreement between noun and adjective within the NP. So, in order to place a learner at the phrasal procedure stage, any of these three features would do, and there is no theoretical need to limiting or pre-empting the search – provided, of course, that in a fusional language such as Russian the concept of "factorisation" (Pienemann 1998: 159) is used to disentangle the three features. However, the number feature is conceptually more transparent than either gender (which is lexically assigned) or case (which is structurally and/or lexically assigned). Number is also more common typologically. So it would seem to make sense to pick this feature to begin with. If we were to choose the gender feature, for example, we may well find that it is acquired after the emergence of number agreement at the higher sentence procedure stage, which may lead researchers to conclude that PT's prediction is wrong. Charters, Jansen & Dao (2011) is a case in point: they notice that Vietnamese children learning English produce numerical phrasal plural before categorial plural, and claim that this conflicts with PT's hierarchy (i.e., categorial before phrasal procedure). But, before venturing into that claim and inval-

idate PT, they would have to show that when numerical phrasal plural is produced no other categorial marking (e.g., *–ing* for V-like items) has emerged in the L2. It could well be that Vietnamese children may have a further barrier with English plurals but not with categorial marking *tout court*.

All this does not mean, of course, that researchers should focus only on the 'earlier' structures of a stage. It is indeed desirable to gain an understanding of the range of structures that may belong to a particular stage, but the bottom line is that the implicationality of the staged development can be tested on just one structure for each stage in a kind of 'rapid profile' (cf. Pienemann & Keßler 2012). On the other hand, this cannot be the full story for PT. Indeed some researchers (e.g., Mansouri & Håkansson 2007) working on Arabic and Swedish respectively, found that some structures within a particular stage appear to emerge regularly after others, which prompted them to conceptualise an 'intrastage' sequencing. We believe that intrastages are likely characteristic of almost any stage in any language. These may be due to a range of reasons: intrinsic lexical features, such as with exceptional Vs or N classes in particular languages (cf., e.g., Di Biase 2008 specifies extra features for the production of certain plurals due to N class in Italian), or particular extra steps linked to the processing of certain structures (e.g., computing tense and aspect choices in VPs). In this volume we propose to call these 'extra' processing barriers within a stage 'soft barriers'. This means that, once the hard barriers across stages have been crossed, language specific soft barriers within that stage can be identified, and attendant hypotheses may be entertained and tested. In later chapters language-specific patterns may be found to exemplify this phenomenon. For a puzzling example, see in chapter 2 the late acquisition of the so-called 'regular' past marker *–ed* in English, which belongs to the categorical stage but whose emergence coincides with much later stages. In other words, as Lardiere (2009) puts it, "(a)ssembling the particular lexical items of a second language (L2) requires that the learner reconfigure features from the way these are represented in the first language (L1) into new formal configurations". Within PT, we would wish to know the relative position in the sequence of any L2 grammatical structure and, possibly, pinpoint the feature (bundle) that may cause them to occur when they do.

The third issue is more controversial and concerns the definition of acquisition criteria that allow us to determine operationally whether a given structure has been acquired or not. Since its inception, PT has used the emergence criterion, that is, "the point in time at which certain skills have, in principle, been attained or at which certain operations can, in principle, be carried out" (Pienemann 1998: 138). For a critical review of Pienemann's theoretical and empirical construct and a thorough discussion of how the emergence criterion can be best formulated and operationalised with regard to morphology, we refer to Pallotti (2007). Suffice it to say here that the authors of the following chap-

ters in this volume all follow the emergence criterion. However, generally following Pienemann (1998: 133), their way of operationalising it for morphology differs from the one used in syntax. On the one hand, the obligatory nature of morphological structures allows us to determine the contexts in which a particular structure occurs, and hence to observe and compute their distribution over the corpus, that is, whether they are supplied or not supplied in obligatory contexts, and/or produced where they are not required. On the other hand, this is not possible for syntactic structures, whether default or optional, since they mostly depend on pragmatic choices. Hence only the positive evidence of the number of their valid instances can be counted.

In general terms, we may say here that, for morphology, we accept as evidence of emergence the production of two occurrences of a structure, provided there is formal and lexical variation among the two. This means both morphological variation (e.g., *go* vs *goes*, a kind of structural minimal pair) and lexical variation (*goes* vs *eats*, a sort of lexical minimal pair), as Pienemann has always stated – although Keßler & Pienemann (2011: 95) do not commit themselves to any number, simply saying in their example that "various" Vs are needed for lexical variation, and "different morphological forms" are needed for "some of these verbs". This principle of structural and lexical variation is designed to flush out exclusively formulaic use. When agreement structures involve more words, a greater number of occurrences may be in order, but the design principle remains the same: minimal evidence of structural and lexical variation is required. For syntax, following a long tradition from ZISA (Meisel, Clahsen & Pienemann 1981) to PT, as in Pienemann, Di Biase & Kawaguchi (2005) we accept one example as evidence of the emergence of a structure. For further details, we refer to the individual studies reported in the chapters to follow.

Let us then finally describe in (48) how the implicational scales in the subsequent chapters of this volume organise the empirical data for testing PT's hypotheses.

(48) a. We follow Pienemann's long tradition of indicating progress vertically by placing the earlier structures at the bottom row, and then proceeding upwards to the most advanced ones at the top. Similarly, the learners' progress in time is shown by proceeding left to right, that is, from t1 to tn in longitudinal studies, and from the least advanced learner to the most advanced one in cross-sectional studies.

b. The lighter horizontal lines mark the divisions between the stages, thus grouping together all the structures within each stage. We call these interstage divisions *hard barriers* for the learner to negotiate.

c. The numbers of occurrences for morphological structures are entered in the tables with a plus (+) sign if the structures are supplied in obligatory contexts; with a

minus (-) sign if not supplied in obligatory context; and with the greater-than (>) sign if supplied in a context that does not require it; an empty cell marks no context for a structure. As for syntactic structures, their optional nature makes it futile to establish obligatory contexts. So the relevant cells only mark their presence, and show either clear numbers or empty cells, unless a structure is attempted but produced in an interlanguage form, in which case the number is preceded by a minus (-) sign. For example, in *the green fish eaten by red fish*, a passive structure is attempted, but the auxiliary is not supplied.

d. In order to highlight the implicationality of the learners' progress, thicker vertical lines mark at which time (longitudinally) or by which learner (cross-sectionally) a particular *stage* has been reached – in other words, whether the acquisition criteria are not satisfied (to the left), or are satisfied (to the right). These vertical lines are drawn for the whole stage, that is, regardless of whether only one or more of the stuctures belonging to that stage have emerged for that stage. Because – as we have just mentioned above – one contrastive token for syntactic structure (or two lexically contrastive tokens for morphology) is sufficient evidence for declaring that a *stage* has been reached, it may well be that negative evidence for a different structure belonging to the same stage appears to the right of the vertical line. When this is the case, a zigzag vertical line marks at which time (longitudinally) or by which learner (cross-sectionally) a particular *structure* has been acquired. We have called these intrastage divisions *soft barriers*, which the learner has to negotiate further within the stage. To illustrate this, we offer the following table:

STAGE	STRUCTURE	T1	T2	T3	T4
4	E			-1	+2
3	D	-1	-2	+2	+3
2	C		-2	-1	+3>1
	B	-1	+2-1		+4
1	A	+2	+3-2>2	+4-1	+5

Here stage 1 is reached at t1, stage 2 at t2, stage 3 at t3, and stage 4 at t4. At t2, however, only one (structure B) of two structures in the same stage is acquired. The other (structure C) is acquired at t4, that is, after the soft barrier is overcome, and after structure D of stage 3. In English L2, for example, the *–ed* morpheme for regular past, which belongs to the category procedure stage, is usually acquired only when higher stages are reached (cf. ch. 2).

e. Where appropriate, a scalability statistical test (cf. Hatch & Lazaraton 1991: 204-216) is used to show the existence of hierarchical relationships among structures.

6. Conclusion

In 1998 Pienemann defined his theory as 'lexicalist'. Yet, PT's main concern was then limited to the procedural activities of Levelt's formulator and did not deal with the lexicon in sufficient detail except for its diacritic features. Further, 1998 PT was powerful in explaining obligatory morphological variation, but did not tackle syntactic issues of marked word orders or mapping. Thus it could not explain why structures such as topicalisation or passives emerge in interlanguage much later than their canonical SVO/SOV or active counterparts respectively. Pienemann, Di Biase & Kawaguchi's 2005 extension brought into the scope of PT structural consequences triggered by discourse-pragmatic and lexical requirements, which inevitably interface with syntax. In this chapter, we have proposed an updated PT formalism, and made more explicit connections between PT and Bock & Levelt (1994), as well as Levelt, Roelof & Meyer's (1999) Theory of Lexical Access on the one hand, and Bresnan's (2001) and other LFG scholars (e.g., Dalrymple, Falk) formalisation of grammaticalised DFs and Lexical Mapping Theory on the other. We have thus coherently broadened the scope of PT to include FOC in addition to TOP in the syntactic schedule, as well as recast the syntactic hypotheses, and generally tidied up the schedules resulting from the Prominence Hypothesis and the Lexical Mapping Hypothesis, both of which could not be coherently understood, nor formalised in fact, without the later psycholinguistic and grammar-theoretical works just mentioned.

We have also proposed a more explicit interface between morphology and syntax. The acquisition of obligatory morphology is explained in Pienemann (1998) by the sequential activation of Levelt's category, phrasal and inter-phrasal procedures modelled in LFG by the formalisation of feature unification. Ultimately, this also explains the later acquisition of structural alternatives, because their noncanonicity is marked by some morphological or other (nonsyntactic) means in many languages, including those with scant morphology, such as Chinese, for instance, where a small number of particle markers become crucial as indicators of mature functional assignment.[29] Indeed, it would be interesting for research to look at the applicability of our Prominence Hypothesis to so-called topic-prominent languages (Li & Thompson 1981) such as Chinese. Compared to their canonical or default counterparts, the later acquisition of the noncanonical or nondefault structures accounted for by the Prominence Hypothesis and the Lexical Mapping

29 Prosodic means are of course important. However, in order to deal with them in a formal way, PT researchers will require further work within LFG and Prosodic Phonology (Nespor & Vogel 2010).

Hypothesis does not by itself determine higher stages in interlanguage; noncanonicity and nondefaultness however are dependent on morphological resources, in the sense that their fluent deployment implies the automatisation of morphological components.[30] So Pienemann's (1998) PT remains, in any case, foundational.

The crucial question in order to move from 'descriptive adequacy' to 'explanatory adequacy' is what motivates alternative syntactic structures. According to Levelt's Model, the preverbal output of the conceptualiser guides the order and type of lexical choices. When learners must compute them online, including their phonological and prosodic shapes, along with discourse-pragmatic information and/or lemmas with richer feature structures, and integrate them all within an executable frame for oral production, these extra processing computations add to the cognitive cost for the learner (and natives, though minimally, cf. Weyerts et al. 2002). However, the cost of effective communication is reduced by automatisation, and if one can handle the phonology and syntax automatically, then more attention can be paid to processing semantic, pragmatic, and sociolinguistic levels of communication (cf. Segalowitz 2003). This is a processing area that cries out for integration in a theory which has processability at its heart.

Part II of the volume will now illustrate how our view of PT interacts with language specificity.

30 This point is not uncontroversial and invites focused research.