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CROSS-LINGUISTIC VARIATION AND EFFICIENCY

John A. Hawkins

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JOHN A. HAWKINS

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To the memory of my father, Eric William Hawkins,
qui a éveillé ma passion pour les langues étrangères

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Preface

Have the rules of grammar been shaped by ease of processing and communicative efficiency? Can the differences between languages be explained by a usage-based theory of grammar? A growing body of research in several areas of the language sciences over the past fifteen years has answered these questions in the affirmative. My 2004 OUP book *Efficiency and Complexity in Grammars* can be situated within this research tradition. In it I gave detailed evidence for the profound role of performance in shaping grammars and I showed how many typological patterns and universals of grammar can be explained in this way. Not only is grammar *not* autonomous from performance, I argued, but the rules and conventions of grammars appear to be systematically aligned with preferences that can be observed in language use.

The present book is an updating and extension of the research program that was laid out in 2004. Since then my collaborators and I have investigated many new areas of grammar and of performance, other linguists and psycholinguists have tested some of my claims and predictions further, and there has been invaluable theoretical discussion and critical feedback in the literature. Meanwhile the fields of language processing, of grammar, language typology, and historical linguistics, all of which I have been trying to integrate, have each moved forward. It is time to bring this research program up to date, to present new data, and to address certain issues. At the same time I wish to carry forward the basic Performance–Grammar Correspondence Hypothesis (PGCH) of the 2004 book and the three principles that gave substance to it: Minimize Domains (MiD); Minimize Forms (MiF); and Maximize Online Processing (MaOP). These principles will be repeated here with illustrative supporting data. A considerable amount of new material has been added to the present book with the result that this is now a new book rather than a second edition.

The research program that my collaborators and I have been engaged in for over twenty years (see below for detailed acknowledgments) has been broadly based and involves an empirical and interdisciplinary approach to cross-linguistic variation. We have been systematically comparing variation patterns *within* and *across* languages, i.e., in usage and in grammars. At the same time we make extensive use of generative principles of the kind that Chomsky and his followers have given us, and of typologists' generalizations as developed by Joseph Greenberg, Matthew Dryer, Martin Haspelmath, Bernard Comrie, and many others. These grammatical principles and patterns

have been integrated with models of language processing in psycholinguistics and with experimental and empirical usage data collected by linguists and psycholinguists.

There are two reasons why this methodology has proved fruitful. First, a general correlation has emerged: the patterns of preference that one finds in performance in languages possessing several structures of a given type—for example, the preferences for different word orders or for different relative clause types when relativizing on different positions—appear to be the same patterns found in the fixed conventions of grammars, in languages with fewer structures of the same type (e.g., with more fixed word orders and more restrictive relativization options). These preferences, and the quantitative distribution of less preferred structures, show striking correspondences between usage and grammar.

Second, this correlation has far-reaching consequences for language universals, for the theory of grammar, and for psycholinguistic models of language processing. It provides an argument against the autonomy of grammar from performance (see Chomsky 1965). It enables us to make predictions from performance data for grammatical conventions, and the grammatical patterns predicted are often unexpected from grammatical considerations alone. It helps us understand both why there are universal patterns across languages, and why there are often exceptions to these and when they will occur. It adds a much-needed cross-linguistic component to theories of language processing, and provides both usage data and grammatical regularities from languages that are very different from those on which current processing theories have been built. These data can lead to a rethinking of a number of processing assumptions derived from more familiar languages. They can also pinpoint precise areas that should now be tested using experimental paradigms on native speakers of other languages.

Joseph Greenberg was the first to draw attention to correlating patterns between performance and grammars (in morphosyntax, in his 1966 book *Language Universals, with Special Reference to Feature Hierarchies*, Mouton, The Hague). In my 1994 book *A Performance Theory of Order and Constituency* (CUP) I argued that the preferred word orders in languages with choices are those that are productively conventionalized as fixed orders in grammars permitting less freedom. And in the present book and in 2004 I examine many more grammatical areas in a systematic test of the Performance–Grammar Correspondence Hypothesis. Specifically, the data from these books support the following conclusions:

- Grammars have conventionalized syntactic structures in proportion to their degrees of preference in performance, as evidenced by patterns of

selection in corpora and by ease of processing in psycholinguistic experiments.

- These common preferences of performance and grammars are structured by general principles of efficiency and complexity that are clearly visible in both usage data and grammatical conventions; three of these principles are defined and illustrated here: Minimize Domains, Minimize Forms, and Maximize Online Processing.
- Greater descriptive and explanatory adequacy can be achieved when efficiency and complexity principles are incorporated into the theory of grammar; stipulations are avoided, many exceptions can be explained, and improved formalisms incorporating significant generalizations from both performance and grammars can be proposed.
- Psycholinguistic models can benefit from looking at languages that are structurally very different from English; psycholinguistics has traditionally not paid enough attention to cross-linguistic variation, though this is starting to change; more corpus data and experimental data need to be gathered from different languages, whose usage preferences sometimes differ radically from those of English, and psycholinguists can also look to grammatical rules and conventions for ideas about processing, precisely because of the correspondence between them; psycholinguists can in the process help linguists to better understand the rules and conventions that are the cornerstone of the field of linguistics.
- The patterns of cross-linguistic variation presented here point to multiple processing factors interacting with one another and to degrees of preference and relative strength that can usefully guide theorizing about the interaction of principles in a multi-factor model.

Some of these conclusions will be controversial, I realize. But the claimed autonomy of grammar from performance, which many linguists still believe in, does need to be subjected to empirical test, and grammars and grammatical variation do need to be examined from a processing perspective. This is what the research program described here and in previous books is all about. And my finding is that there is a deep correspondence between performance data and grammars. Psycholinguistics, meanwhile, can benefit from becoming more cross-linguistic. There is a long tradition of cross-linguistic work in language acquisition, spearheaded by Dan Slobin and his colleagues. Language processing needs to follow suit. Psycholinguists can also help linguists with their fundamental task of better understanding how linguistic rules and conventions work, and why they have the properties they do, precisely because they have been profoundly shaped by processing.

There are many people I am indebted to for feedback and assistance of various kinds while writing this book. I must first acknowledge the detailed and extremely useful reviews of the first draft provided by Martin Haspelmath and Chris Cummins. Their comments led to significant rewriting and to many improvements. With respect to data collection and theory development I must also mention especially Matthew Dryer, Luna Filipović, Kaoru Horie, Stephen Matthews, Fritz Newmeyer, and Tom Wasow, all of whom have helped me with key aspects of the present book. Many others provided feedback and help on various points, including Gontzal Aldai, Elaine Andersen, Raul Aranovich, Theresa Biberauer, Paula Buttery, Bernard Comrie, Peter Culicover, Patrick Farrell, Fred Field, Giuliana Fiorentino, Elaine Francis, Ted Gibson, Laura Gonnerman, Anders Holmberg, Florian Jaeger, Ed Keenan, Ruth Kempson, Johannes Kizach, Ekkehard König, Lewis Lawyer, Christian Lehmann, Maryellen MacDonald, Brian MacWhinney, Edith Moravcsik, William O'Grady, Masha Polinsky, Beatrice Primus, Ian Roberts, Dan Slobin, Jae Song, Aaron Sonnenschein, Lynne Stallings, Harry Tily, Peter Trudgill, Sten Vikner, Caroline Williams, and Fuyun Wu. I am extremely grateful to all these individuals, none of whom is of course implicated in the theory presented here or in any errors that remain. I must also thank John Davey of Oxford University Press for his support and professionalism in getting this book published. John is the best linguistics editor in publishing today and our field owes him an enormous debt.

At an institutional level I must thank the German Max Planck Society which has supported my work over a long period, first at the psycholinguistics institute in Nijmegen and then at the evolutionary anthropology institute in Leipzig. Most of the 2004 book was written in Leipzig and I am grateful to that institute, and to Bernard Comrie in particular, for the opportunity to complete it there. The University of Southern California in Los Angeles also supported me for many years prior to 2004. Thereafter the University of Cambridge and the University of California Davis have provided generous support for the research and writing that have culminated in this book, in the form of research grants, research assistance, travel support, and teaching buyouts. I thank them both.

JAH
Davis, California

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List of Abbreviations

A	appositive
ABL	ablative
Abs/ABS	absolutive
Acc/ACC	accusative
Adj	adjective
AdjP	adjective phrase
Adv	adverb
Ag	agent
AH	Accessibility Hierarchy
AP	argument precedence
Art	article
Asp	aspect
Aux/AUX	auxiliary verb
C	complementizer
CL	classifier
Classif/CLASSIF	classifier
Comit/COMIT	comitative
Comp	complementizer
Cont/CONT	continuative
Correl/CORREL	correlative
CRD	constituent recognition domain
CV	consonant–vowel (syllable)
CVC	consonant–vowel–consonant (syllable)
Dat/DAT	dative
Def/DEF	definite determiner
Dist.Past	distant past
DO	direct object
DP	determiner phrase
DS	different subject
EIC	Early Immediate Constituents
Erg/ERG	ergative
F	form
Fem/FEM	feminine

FGD	filler gap domain
F:P	form–property pairing
FOFC	Final-Over-Final Constraint
Fut	future
G	grandmother node
Gen/GEN	genitive
Gen-DO	genitive within a DO
Gen-SU	genitive within a SU
H	hierarchy
HM	head before modifier
IC	immediate constituent
ICL	longer IC
ICS	shorter IC
Impf/IMPF	imperfective
Instr	instrument
IO	indirect object
L TO R	left to right
LD	Lexical Domain
Loc/LOC	locative
M	mother node
Masc	masculine
MaOP	Maximize Online Processing
MH	modifier before head
MiD	Minimize Domains
MiF	Minimize Forms
mPP	a PP with head-initial preposition
MPT	manner before place before time
N	noun
Neut	neuter
Nom/NOM	nominative
Nomlz/NOMLZ	nominalizer
NP	noun phrase
NPo	a direct object head-final NP
NRel	noun before relative clause
NSRC	non-subject relative clause
O	(direct) object
O	operator
OBJ	object
OBL	oblique
oNP	a direct-object head-initial NP

OP	online property
OP/UP	online property to ultimate property (ratios)
OS	object before subject
OV	object before verb
OVS	object before verb before subject
P	preposition or postposition
P	property
Part/PART	particle
Pat	patient
PCD	Phrasal Combination Domain
Pd	dependent PP
PGCH	Performance–Grammar Correspondence Hypothesis
Pi	independent PP
Pl/PL	plural
Plur	plural
Poss/POSS	possessive
Possp/POSSP	possessive phrase
PP	prepositional or postpositional phrase
PPL	longer PP
PPm	a PP with head-final postposition
PPS	shorter PP
Pres/PRES	present
Pret/PRET	preterite
PS	phrase structure
Q	quantifier
R	restrictive
R-case	rich case marking
Recip	recipient
Refl/REFL	reflexive
Rel	relative clause
Rel/REL	relativizer
RelN	relative clause before noun
S	sentence
S	subject
S′	S bar
Sg/SG	singular
Sing	singular
SO	subject before object

SOV	subject before object before verb
SPLT	syntactic prediction locality theory
SVO	subject before verb before object
SU/SUBJ	subject
T	tense
UG	universal grammar
UP	ultimate property
V	verb
vf	finite V
VO	verb before object
VOS	verb before object before subject
VP	verb phrase
VSO	verb before subject before object
WALS	*World Atlas of Language Structures*
X	an oblique phrase
XP	an arbitrary phrase

1

Language variation and the Performance–Grammar Correspondence Hypothesis

1.1 The Performance–Grammar Correspondence Hypothesis

This book explores the kinds of universals of language that Greenberg introduced in his seminal 1963 paper on word order. They took the form of implicational statements defining patterns of cross-linguistic variation: if a language has some property (or set of properties) P, then it also has (or generally has) property Q. For example, if a language has subject–object–verb (SOV) order, as in Japanese, it generally has postpositional phrases ([the movies **to**] **went**), rather than prepositional phrases as in English (**went** [**to** the movies]). When implicational universals were incorporated into generative grammar, in the Government–Binding theory of Chomsky (1981), they became known as 'parameters' and the innateness claimed for absolute universals (Chomsky 1965; Hoekstra and Kooij 1988) was extended to the parameters (Lightfoot 1991; J. D. Fodor 2001). It was proposed that the child's linguistic environment 'triggered' one innate parameter rather than another.

The status of these variation-defining universals in generative grammar has been questioned following the publication of Newmeyer's *Possible and Probable Languages: A Generative Perspective on Linguistic Typology* (2005). Newmeyer argued that the major parameters proposed hitherto, the head ordering parameter, the pro-drop parameter, and others, had systematic exceptions across languages, were probabilistic, and were not part of UG, which is concerned with defining possible versus impossible languages. Haspelmath (2008b) has given a similar critique of parameters. In effect, these authors recognize what Greenberg (1963) first recognized: the majority of his implicational statements hold only with more than chance frequency, and most of those he formulated as exceptionless have turned out to have exceptions (Dryer 1992). Clearly, if these parameters are not correct descriptively, they are not innate either, and the kind of environmental trigger theory for

language acquisition built around them fails, if the basic premise fails (the existence of exceptionless parameters of variation).

The question now arises: where do we go from here in order to better understand cross-linguistic grammatical variation? A number of generative theorists are trying to improve the empirical adequacy of earlier predictions. Cinque (2005) is a laudable example which combines Kayne's (1994) antisymmetry principle with painstaking typological work. The work of Biberauer, Holmberg, and Roberts (2007, 2008) developing the 'Final-over-Final Constraint' is another welcome example of research bridging formal grammar, typology, and also historical linguistics in this case (see §§5.6–5.8 in this volume for a detailed discussion and assessment). A different research program, more in line with Newmeyer's (2005) proposals, is the one I presented in my 2004 book *Efficiency and Complexity in Grammars*, which built on my 1994 *A Performance Theory of Order and Constituency*. The present study updates this general program and incorporates many new findings, ideas, and criticisms. Together with several collaborators I have been pursuing a strongly empirical and interdisciplinary approach to language universals, comparing variation patterns *within* and *across* languages. We have been examining variation both in usage (performance) and in grammars. This program makes extensive use of both generative principles and typologists' generalizations (Comrie 1989; Croft 2003), and integrates them with psycholinguistic models and findings.

There are two reasons why this has proved fruitful. First, a general correlation has emerged: the patterns of preference that one finds in performance in languages possessing several structures of a given type (different word orders, relative clauses, etc.) look very much like the patterns found in the fixed conventions of grammars, in languages with fewer structures of the same type. In other words, grammars appear to have conventionalized the structural variants that speakers prefer to use. Numerous examples will be summarized in §1.2 and many more will be discussed in greater detail in subsequent chapters.

Second, this correlation has far-reaching consequences for language universals and for the theory of grammar. It makes predictions from performance data for grammatical conventions, and the grammatical patterns predicted are often unexpected from grammatical considerations alone. It helps us understand why these patterns are found across languages, and also why there are sometimes exceptions and when they occur.

Greenberg (1966) was the first to draw attention to correlating patterns between performance and grammars in his discussion of markedness hierarchies like Singular > Plural > Dual > Trial/Paucal. Morphological inventories across grammars and declining allomorphy provided evidence for the

universal hierarchies, while declining frequencies of use in languages with rich inventories suggested not only a correlation with performance but a possibly causal role for it in the evolution of the grammatical regularities themselves (Greenberg 1995: 163–4). Givón (1979: 26–31) meanwhile observed that performance preferences in one language, e.g., for definite subjects, may correspond to an actual categorical requirement in another. In Hawkins (1994) I argued that the preferred word orders in languages that allow flexibility are those that are productively conventionalized as fixed orders in languages with less flexibility. The 2004 book examined many more grammatical areas and proposed the following general hypothesis:

(1.1) *Performance–Grammar Correspondence Hypothesis (PGCH)*
Grammars have conventionalized syntactic structures in proportion to their degree of preference in performance, as evidenced by patterns of selection in corpora and by ease of processing in psycholinguistic experiments.

In the past fifteen years we have seen mounting evidence from several areas of the language sciences for the role of performance in shaping grammars, and even for a basic correspondence between them along these lines. Haspelmath (1999a) has proposed a theory of diachrony in which usage preferences lead to changing grammatical conventions over time. Bybee and Hopper (2001) document the clear role of frequency in the emergence of grammatical structure. There have been intriguing computer simulations of language evolution, exemplified by Kirby (1999), in which processing preferences of the kind assumed for word order in Hawkins (1990, 1994) are incorporated in the simulation and lead to the emergence of observed grammatical types after numerous iterations (corresponding to successive generations of language users). There have been developments in Optimality Theory, exemplified by Haspelmath (1999a) and Aissen (1999), in which functional motivations ultimately related to processing are provided for many of the basic constraints. Stochastic Optimality Theory (Bresnan et al. 2001; Manning 2003) incorporates the preferences of performance ('soft constraints') as well as grammatical conventions ('hard constraints'). Newmeyer (2005) advocates replacing generative parameters with principles derived from language processing, while Phillips (1996) and Kempson et al. (2001) incorporate the online processing of language into the rules and representations of the grammar itself.

But despite this growing evidence for performance–grammar correspondences, the precise extent to which grammars have been shaped by performance is still a matter of debate. There are different opinions in the publications

cited here. Even the question of whether performance has shaped grammars at all is still debated. See §3.6 for a discussion and critique of recent work within Chomsky's Minimalist Program which explicitly denies such a causative role for performance and which maintains the asymmetry between competence and performance that was first advocated in Chomsky (1965), as detailed in §1.2.

In this book I adopt a data-driven approach and focus on the empirical evidence for the PGCH. My goal is to try to abstract away from current disagreements and unresolved issues in grammatical models and in processing theories and to convince the next generation of researchers that there is a real generalization here that needs to be incorporated into theories of grammatical universals. In the next sections I briefly summarize a range of observed performance–grammar correspondences supporting the PGCH (§1.2) and I define its predictions and consequences (§1.3). Subsequent chapters examine many areas of grammatical variation across languages in more detail from this perspective.

1.2 Examples of proposed performance–grammar correspondences

The Keenan and Comrie (1977) Accessibility Hierarchy (SU>DO>IO/OBL>GEN; see Comrie 1989) has been much discussed in this context. Grammatical cut-off points in relative clause formation possibilities across languages follow the hierarchy, and Keenan and Comrie argued for an explanation in terms of declining ease of processing down the lower positions on the hierarchy. As evidence they pointed to usage data from languages with many relativizable positions, especially English. In such languages corpus frequencies declined down the hierarchy while processing load and working memory demands have been shown to increase under experimental conditions (Keenan 1975; Keenan and S. Hawkins 1987; Hawkins 1999; Diessel and Tomasello 2006); see also §2.2.3.

More generally, filler-gap dependency hierarchies for relativization and Wh-movement across grammars appear to be structured by the increasing complexity of the permitted gap environments in the lower positions of these hierarchies. The grammatical cut-off points in these increasingly complex clause-embedding positions for gaps correspond to declining processing ease in languages with numerous gap-containing environments (including subjacency-violating languages like Akan: Saah and Goodluck 1995); see Hawkins (1999, 2004: ch. 7) and §8.1.

Reverse hierarchies across languages for conventionalized gaps in simpler relativization domains and resumptive pronouns in more complex environments (Hawkins 1999) match the performance distribution of gaps to pronouns

within languages such as Hebrew and Cantonese in which both are grammatical (in some syntactic positions), gaps being preferred in the simpler and pronouns in the more complex relatives (Ariel 1999; Matthews and Yip 2003; Hawkins 2004); see §2.2.3.

Parallel function effects (whereby the head of the relative matches the position relativized on) have been shown to facilitate relative clause processing and acquisition (Sheldon 1974; MacWhinney 1982; Clancy et al. 1986). They also extend relativization possibilities beyond normal constraints holding in languages such as Basque and Hebrew (Aldai 2003; Cole 1976; Hawkins 2004: 190); see §2.2.3.

Declining acceptability of increasingly complex center embeddings, in languages in which these are grammatical, is matched by hierarchies of permitted center embeddings across grammars, with cut-offs down these hierarchies (Hawkins 1994: 315–21); see §5.5.

(Nominative) subject before (accusative) object ordering is massively preferred in the performance of languages in which both SO and OS are grammatical (Japanese, Korean, Finnish, German) and is also massively preferred as a basic order or as the only order across grammars (Hawkins 1994; Gibson 1998; Tomlin 1986; Primus 1999; Miyamoto 2006); see §3.5 and §8.5.

Markedness hierarchies of case (Nom>Acc>Dat>Other) and number (Sing>Plur>Dual>Trial), etc., correspond to performance frequency hierarchies in languages with rich morphological inventories (Greenberg 1966; Croft 2003; Hawkins 2004: 64–8); see §2.2.1.

Performance preferences in favor of a definite rather than an indefinite grammatical subject, e.g., in English, correspond to a categorical requirement for a definite subject in others (e.g., in Krio: Givón 1979).

Performance preferences for subjects that obey the Person Hierarchy (1st, 2nd > 3rd) in English (whereby *The boy hit me* is preferably passivized to *I was hit by the boy*) have been conventionalized into a grammatical/ungrammatical distinction in languages such as Lummi (Bresnan et al. 2001). Sentences corresponding to *The boy hit me* are ungrammatical in Lummi.

The distinction between zero agreement in local NP environments versus explicit agreement non-locally in the grammar of Warlpiri matches the environments in which zero and explicit forms are preferred in performance in languages with choices: for example, in the distribution of zero and explicit relativizers in English (Hawkins 2004: 160); see §2.2.2 and §6.3.1.

These are just the tip of a large iceberg of performance-motivated cross-linguistic patterns. If these correspondences are valid, then the classic picture of the performance–grammar relationship presented in Chomsky (1965) needs to be revised. For Chomsky the competence grammar was an integral

part of a performance model, but it was not shaped by performance in any way:

> Acceptability . . . belongs to the study of performance . . . The unacceptable grammatical sentences often cannot be used, for reasons having to do . . . with memory limitations, intonational and stylistic factors, . . . and so on. . . . it would be quite impossible to characterize unacceptable sentences in grammatical terms . . . we cannot formulate particular rules of the grammar in such a way as to exclude them. (Chomsky 1965: 11–12)

Chomsky claimed (and still claims: see §3.6) that grammar is autonomous from performance and that UG is innate (see Newmeyer 1998 for a full summary and discussion of these points). The PGCH in (1) is built on the opposite assumption that grammatical rules *have* incorporated properties that reflect memory limitations and other forms of complexity and efficiency that we observe in performance. This alternative is supported by the correspondences above, and makes predictions for occurring and non-occurring grammars and for frequent and less frequent ones. It accounts for many cross-linguistic patterns that are not predicted by grammar-only theories, and for exceptions to those that are predicted. Subsequent chapters will illustrate the PGCH and this research method in greater detail.

1.3 Predictions and consequences of the Performance–Grammar Correspondence Hypothesis

The PGCH makes predictions, which we must define. In order to test them we need performance data and grammatical data from a range of languages involving the same grammatical structures. This research program proceeds as follows. First, find a language whose grammar generates or permits a plurality of structural alternatives of a common type. They may involve alternative orderings of the same constituents with the same or similar domination relations in the phrase structure tree, e.g., different orderings of NP and PP constituents in the free-ordering postverbal domain of Hungarian, or [PP NP V_{VP}] vs [NP PP V_{VP}] in a verb-final language like Japanese. Or they may involve alternative relative clauses with and without an explicit relativizer, as in English (*the Danes whom/that he taught* vs *the Danes he taught*), or alternations between relativizations on a direct object using a gap strategy vs a resumptive pronoun strategy, as in Hebrew.

Second, check for the distribution of these same structural patterns in the grammatical conventions across languages. The PGCH predicts that when the

grammar of one language is more restrictive and eliminates one or more structural options that are permitted by the grammar of another, the restriction will be in accordance with performance preferences. The preferred structure will be retained and 'fixed' as a grammatical convention; the dispreferred structures will be removed. Either they will be eliminated altogether from the output of the grammar or they may be retained in some marginal form as lexical exceptions or as limited construction types. So, for example, if there is a general preference in performance for constituent orderings that minimize the number of words on the basis of which phrase structure groupings can be recognized, as I argued in Hawkins (1994), then I expect the fixed word orders of grammars to respect this same preference. They should permit rapid immediate constituent (IC) recognition in the normal case. Numerous adjacency effects are thereby predicted between sister categories in grammars, based on their (average) relative weights and based on the information that they provide about phrase structure online (through, e.g., head projection). Similarly if the absence of the relativizer in English performance is strongly associated with the adjacency of the relative clause to the head noun, while its presence is found frequently when the relative clause is both adjacent and non-adjacent to the head, then I expect that grammars that actually remove the zero option altogether will do so in a way that reflects the patterns of preference in performance: they will either remove the zero option and require an explicit relativizer only when the relative clause is non-adjacent to the head, or they will remove zero under both adjacency and non-adjacency, but they will not remove zero and require explicit relativizers only when they are adjacent to the head. And if the gap relativization strategy in Hebrew performance provides evidence for a structural proximity preference to the head noun, compared with the resumptive pronoun strategy, then it is predicted that the distribution of gaps compared to pronouns across grammars should be in this same direction, with gaps being more or equally proximate to their head nouns.

These are illustrations of the research strategy of this book. The major predictions of the PGCH that were systematically tested in Hawkins (2004) are the following:

(1.2) *Grammatical predictions of the PGCH* (Hawkins 2004)

(a) If a structure A is preferred over an A' of the same structural type in performance, then A will be more productively grammaticalized, in proportion to its degree of preference; if A and A' are more equally favored, then A and A' will both be productive in grammars.

(b) If there is a preference ranking A>B>C>D among structures of a common type in performance, then there will be a corresponding

hierarchy of grammatical conventions (with cut-off points and declining frequencies of languages).

(c) If two preferences P and P' are in (partial) opposition, then there will be variation in performance and grammars, with both P and P' being realized, each in proportion to its degree of motivation in a given language structure.

These predictions will be exemplified further in this book and it will be argued that the PGCH (1.1) is strongly supported descriptively. This approach can also provide answers to explanatory questions that are rarely raised in the generative literature such as: Why should there be a head-ordering principle defining head-initial and head-final language types (Hawkins 1990, 1994, 2004)? Why are there heads at all in phrase structure (Hawkins 1993, 1994)? Why are some categories adjacent and others not (Hawkins 2001, 2003, 2004)? And why is there a subjacency constraint and why is it parameterized the way it is (Hawkins 1999, 2004)?

These questions can now be asked, and informative answers can be given, within this framework. The basic empirical method involves conducting a simple test: Are there, or are there not, parallels between universal patterns across grammars and patterns of preference and processing ease within languages? The data of this book suggest that there are and the descriptive and explanatory benefits for which I argue then follow.

Let me end this chapter with some general remarks on bigger issues that are raised by this research program. We can distinguish between variation-defining universals and absolute universals of the form 'all languages (or no languages) have property P.' These latter have been at the core of Universal Grammar (UG) in generative theories from Chomsky (1965) through Chomsky (1995) and beyond. Increasingly the range of such absolute universals has been scaled back; cf., e.g., Hauser, Chomsky, and Fitch (2002). Whatever absolute universals of syntax are currently recognized can, in principle, be innately grounded in the species. But innate grammatical knowledge is not, I suggest, plausible for variation-defining universals, both because innate parameters are not plausible in principle and because they are largely probabilistic (Newmeyer 2005). But notice that it is still plausible to think in terms of Elman et al.'s (1996) 'architectural innateness' as constraining the data of performance, which can then evolve into variant conventions of grammar. The architectural innateness of the human language faculty enters into grammars indirectly in this way. Absolute universals can also, in principle, be innately grounded as a result of processing constraints on grammars. When complexity and efficiency levels are comparable and tolerable, we get the variation between grammars that we will see. But within and beyond certain

thresholds I would expect universals of the kind 'all languages have X' and 'no languages have X', as a result of processability interacting with the other determinants of grammars. The Performance–Grammar Correspondence Hypothesis is no less relevant to absolute universals, therefore, with the extremes of simplicity/complexity and (in)efficiency being inferable from actually occurring usage data. Some interesting proposals have been made recently by Mobbs (2008) for incorporating the efficiency proposals of this book into Chomsky's (1995) Minimalist Program. The efficiency principles are now recast as general cognitive constraints on the 'internal computations' integrating linguistic and other mental entities, rather than as principles of performance as such, and are seen as having shaped cross-linguistic parameters in a way not unlike that proposed by Hawkins (2004). This proposal, which brings the two research traditions closer together, is discussed and critiqued in §3.6.

There can also be innate grammatical and representational knowledge of quite specific properties, of the kind summarized in Pinker and Jackendoff 's (2009) response to Hauser, Chomsky, and Fitch (2002). Much of phonetics, semantics, and cognition are presumably innately grounded and there are numerous properties unique to human language as a result. See Newmeyer (2005) for the role of conceptual structure in shaping absolute universals, and also Bach and Chao (2009) for a discussion of semantically based universals.

The precise causes underlying the observed preferences in performance require more attention than I can give them here. Much of psycholinguistics is currently trying to develop appropriate models for the kinds of performance data I discuss in this book. To what extent do the preferences result from parsing and comprehension, and to what extent are they production-driven? What is the role of frequency sensitivity and of prior learning in online processing (see, e.g., Reali and Christiansen 2006a,b)? What is the relationship between predictive and 'surprisal' metrics on the one hand (Levy 2008; Jaeger 2006) and more 'integration'-based ones on the other (Gibson 1998, 2000)? These issues are discussed further in Chapter 3.

A performance explanation for universals has consequences for learning and for learnability, since it reduces the role of an innate grammar. UG is no longer available in the relevant areas (head ordering, subjacency, etc.) to make up for the claimed poverty of the stimulus and to solve the negative evidence problem (Bowerman 1988). The result is increased learning from positive data, something that Tomasello (2003), connectionist modelers like MacDonald (1999), and also linguists like Culicover (1999) have been arguing for independently. These converging developments enable us to see the data of experience as less impoverished and more learnable than previously thought. The grammaticality facts of Culicover's book, for example, pose learnability problems that are