

Reiko Mazuka

THE

DEVELOPMENT

OF LANGUAGE

PROCESSING

STRATEGIES

A

Cross-Linguistic

Study

Between

Japanese

and English



Psychology Press

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# THE DEVELOPMENT OF LANGUAGE PROCESSING STRATEGIES

*A Cross-Linguistic Study Between  
Japanese and English*

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*For John*

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## Preface

Ever since the notion of *explanatory adequacy* was promoted by Chomsky in his 1965 work, *Aspects*, linguists and psycholinguists have been in pursuit of a psychologically valid theory of grammar. A theory of grammar is said to be explanatorily adequate when it can not only describe the general characteristics of a language but can also account for the underlying psychological processes of acquiring and processing that language. To be considered psychologically valid, a grammar must be learnable by ordinary children (the problem of acquisition) and must generate sentences that are parsable by ordinary people (the problem of processing).

Ultimately, the fields of language acquisition and processing are concerned with the same goal: to build a theory that accounts for grammar as it is acquired by children, accessed in comprehension and production of speech, and represented within the human mind. Unfortunately, however, these two fields developed independently and have rarely been well informed about each others' concerns. The field of language acquisition is primarily concerned with the grammatical knowledge that *children* acquire, and thus theories of language acquisition attempt to explain how a particular item of linguistic knowledge, for example, the head direction of a language, can be acquired. The field of language processing, on the other hand, takes *mature* grammatical knowledge as it is given and investigates the mechanisms by which a person can access grammar to comprehend and produce language in real time.

When we examine the mechanisms of language acquisition, it becomes apparent that the language acquisition problem is the language processing problem. For children to acquire a grammar, they must *process* the language that surrounds them. If they were to be surrounded by Japanese or English, the only way for them to know what kind of language they were exposed to is to process and analyze what they hear. For this, children need a mechanism to process language. Ironically, however, the field of language acquisition has ignored many of the concerns of language processing research—for example, how some sentences are ambiguous or difficult to process—and thus has ended up magically assuming that children are free of such concerns and can process

anything and everything that they hear. This assumption is problematic and must be addressed.

The need for acquisition research to take processing into account was pointed out in early works such as Townsend, Ottaviano, and Bever (1979), and Tyler and Marslen-Wilson (1981). Frazier and de Villiers (1990) made the first full-scale effort to integrate the concerns of the two fields with their edited volume. During the past few years, the field of child language processing has gained some prominence, as evidenced by a special session at the CUNY sentence processing conference in March 1997, where the above perspective was given a particularly forceful presentation by Bever. McKee (1996; McKee & Iwasaki, 1997) advocated similar concerns in her recent papers.

Likewise, the field of language processing has experienced its own difficulties. Conventional models of language processing were almost exclusively built on English, and thus performed poorly when presented with a language like Japanese (cf. Mazuka & Nagai, 1995a). Recently, new models have been developed with full consideration of cross-linguistic diversity and have drastically changed the field. Gone are many of the basic assumptions of conventional models, and in their place a variety of innovative and more flexible assumptions have emerged (cf. Gibson, 1991; Gorrell, 1995b; Inoue & Fodor, 1995; Pritchett, 1992; Weinberg, 1993). However, in their attempt to address cross-linguistic issues, these processing models have yet to fully address the developmental challenge: How can a child without a stable grammar process language and still manage to acquire new grammar?

This book is an attempt to develop a model of language processing that addresses both cross-linguistic and developmental challenges. It proposes to link the setting of a basic configurational parameter during language acquisition to the different organization of processing strategies in left- and right-branching languages. The main part of the proposal was originally developed in Mazuka (1990a). A portion of the proposal, which proposes that children set a Branching Direction Parameter using prosodic cues, was developed in an article that appeared in Morgan and Demuth (1996). A project to extend this model to adult Japanese processing resulted in an earlier edited volume by Mazuka and Nagai (1995a). I received many responses to the original proposal of my dissertation, and I have tried to incorporate my responses to them in various parts of the book.

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—*Reiko Mazuka*

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## Introduction

### THE PROBLEMS

In many language development models, young children are assumed to process language in a qualitatively different manner than older children and adults. For example, in a model in which children learn grammatical rules by bootstrapping from functional categories (e.g., Pinker, 1984), the language processing strategies<sup>1</sup> that are used by young children are assumed to be primarily driven by functional relationships, such as agent and patient, rather than grammatical relations, such as subjects and objects.

In many of the formal models of language acquisition (Berwick & Weinberg, 1984; Gibson & Wexler, 1994; Wexler & Culicover, 1980), on the other hand, it is taken for granted that the processing strategies children use remain unchanged across development. As discussed in detail in chapter 2, this assumption is critical to these models because the basic mechanisms of language acquisition in these models are *parser driven*.

Despite the critical significance that both these models place on language processing strategies, few studies directly investigate the actual processing strategies that young children use in comprehending and producing sentences in a language.

In adult psycholinguistic literature, it has generally been assumed that processing strategies are universal, that is, although the grammar used to

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<sup>1</sup>The term *processing strategy* is used to mean a general heuristic that uses linguistic and nonlinguistic information to comprehend natural language.

process a language differs from one language to another, the strategies that use such grammatical information remain constant across languages.

The processing of natural language by humans is extremely fast. For example, in the classic studies using the shadowing paradigm, Marslen-Wilson (1973, 1975) elegantly demonstrated that English-speaking adults restored semantic anomalies in stimulus sentences while they were shadowing them very closely, that is, within 300 to 800 msec. Evidence such as this has been interpreted to suggest that sentence processing must proceed incrementally, more or less from left to right.

To date, the majority of research in natural language processing, both formal and experimental, has been done on English. As discussed later in detail, English is a right-branching, head-initial language. This means that in principle, a main clause will precede a subordinate clause, and a grammatical head will precede its complement. On the other hand, in a left-branching, head-final language such as Japanese, a subordinate clause will precede a main clause, and a complement will precede its grammatical head. Therefore, when a person hears a sentence and tries to comprehend it incrementally from left to right, the order of constituents that arrive in real time is reversed between English and Japanese.

If processing strategies for natural languages are universal, as has been hypothesized, both Japanese and English should be processed by the same strategies. However, when the processing must proceed extremely quickly from left to right in real time, can two languages be processed by the same strategies if the order of their constituents is essentially a mirror image of each other, as with Japanese and English?

We now know from numerous empirical studies that young children acquiring Japanese and English are sensitive at a very early stage to the systematic, parametric, and structural differences between the two languages (e.g., Lust, 1986, 1987, 1997). If processing strategies remain constant over development, as formal language acquisition models have proposed, young children acquiring Japanese and English should process these languages with the same strategies as Japanese and English adults. However, when children acquire languages that are as diverse as English and Japanese, can they be using the same strategies as English- and Japanese-speaking adults?

Alternatively, if children's processing strategies are qualitatively different from those of adults', do children who are acquiring different languages go through the same developmental course, or do they have to go through different trajectories according to their target languages?

In this book, the twin questions of the universality of natural language processing strategies across languages and over development are examined experimentally. These two questions are rarely investigated together, and the insights of one field are not always taken into consideration in the other. However, these questions can be systematically investigated only by taking

into account both of the factors from the cross-linguistic and developmental variables. In this book, these questions are examined through a study of English and Japanese children's processing of complex sentences.

Linguists and psycholinguists have long been interested in the question of universality in our linguistic *competence*. However, universality of language processing strategies within the domain of language *performance* has rarely been scrutinized with the same intensity. Chomsky (1987) summarized this state of affairs as follows. "It has generally been assumed that the parser . . . is fixed and does not undergo growth and maturation, or learning if such exists. The reasons for assuming this, apparently, are just that nothing is known about the matter, so we might as well adopt the simplest hypothesis" (p. 14).

### THE THEORETICAL FRAMEWORK

In this book, the general framework of the Principles and Parameter Approach to language acquisition (Chomsky, 1975, 1981, 1986) is adopted as the basis of the analysis. According to this framework, Universal Grammar (UG) contains principles that characterize all natural languages, whereas grammatical parameters specify the dimensions along which languages may differ, and what the possible variations may be. Children are biologically programmed to entertain only those hypotheses about natural languages that conform to the principles of UG. They are also programmed to attend to specific types of possible language variation, and set the value of such parameters very early with only limited experience. Once a parameter is set, a child should, theoretically, be able to deduce various aspects of the language.

This approach provided a theoretical framework for numerous studies during the past few decades. A wide variety of studies using this framework have shown that this approach is productive in explaining complex phenomena of language acquisition (cf. Lust, 1986, 1987, 1997; Roeper & Williams, 1987; Wanner & Gleitman, 1982). In the following chapters of this book, various motivations for adopting this framework are presented. Specifically, the particular contrast in the basic structures of the two languages studied in this book, namely, Japanese and English, are captured in terms of a binary configurational parameter, the Principle Branching Direction Parameter (see ch. 4 for the definition of this parameter), and I propose that by linking the setting of this parameter and children's sentence processing strategies, we can provide a model in which the development of language processing strategies by Japanese- and English-speaking children can be accounted for.



## THE STRUCTURE OF THE BOOK

The structure of the book is as follows: In chapter 2, I first discuss the role of *language processing* in models of language acquisition. I show that although few studies have been done on the actual development of children's language processing strategies, most models of language acquisition critically depend on how children process linguistic input in order for a child to acquire grammar. I argue that the assumptions made by these models are paradoxical in the sense that children would have to be able to process not only all sentences that are grammatical according to the grammar the child currently holds, but also sentences that are beyond that.

Chapter 3 turns to models of language processing that have been developed on the basis of English. I show that the syntactic properties of a left-branching language such as Japanese challenges the basic assumptions of these models. In chapter 4, I propose a model in which setting of a basic configurational parameter, the Branching Direction Parameter, is linked to the different organization of language processing strategies for left- and right-branching languages. I first argue that the Branching Direction Parameter can be set preverbally using prosodic cues. As a deductive consequence of setting this parameter, children would adopt processing strategies that are appropriate for their languages.

Chapter 5 reviews alternative models that also attempt to account for cross-linguistic diversities between Japanese and English. The dominant approach in this endeavor is the *single parser* approach, in which the parser is modified to be powerful enough to handle both left- and right-branching languages. I show that the three proposals made within this framework—the head driven approach, minimal commitment approach, and full attachment approach—all share the difficult challenge of constraining the power of the parser such that it can still explain the limitation of human language processing behavior. In addition, I argue that without serious consideration of developmental issues as well, a model of language processing cannot be complete.

In chapter 6, I turn to experimental studies of sentence processing with both adults and children. I focus the review of literature on the processing of complex sentences, because it is the relevant domain over which the proposed model of parameterized parsing is defined. In particular, I focus on a study by Bever and Townsend (1979) that tested English adults' processing of main and subordinate clauses with semantic and lexical probe latency tasks. I show how the experimental data bear on predictions made by the single, universal parsing model and by the parameterized parsing model. These predictions are tested using semantic- and lexical-probe latency tasks (PLT) with matched experiments using English and Japanese children. Specifically, I tested semantic and lexical accessibility to main and subordi-