8 Sentence Processing Strategies in Adult Bilinguals

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Bates and MacWhinney and their colleagues (1981, 1982, 1984) have shown that native speakers depend on a particular set of probabilistic cues to assign formal surface devices in their language to a specified set of underlying functions. The research program encompassed by their approach to language processing has extended from describing crosslinguistic processing differences in even typologically similar languages (e.g., English and Italian, both SVO languages), to charting the pattern of acquisition of grammatical "rules" in the first language, and more recently to crosslanguage investigations of "characteristic" neurological-based language deficits.

A natural extension of this broad experimental effort is in a field that involves issues of both language learning and sentence processing in adults: late second language acquisition. Given the large volume of data already collected from monolingual speakers, we are now in a position to begin exploration into bilingual sentence processing strategies. In this chapter we report on sentence processing experiments carried out with adults who speak two or more languages. The notion that cues vary in strength has proven valuable in describing the psychologically relevant features of different kinds of languages; it may also provide a window into the psycholinguistic properties of second language acquisition.

Students of language study come from many schools; not all share our assumptions or biases regarding the kinds of questions that are germane to second language acquisition, nor what constitutes an answer to those questions. For this reason, we will briefly review a small part of the history of second language acquisition research that lies behind the work presented here. We will focus on two issues: the influence of first language acquisition research on work in second language learning, and the role of rules in characterizing language acquisition of either kind.

The Roots of Second Language Acquisition Research

The study of second language (L2) acquisition has closely followed developments in first language (L1) research. In this regard, the central empirical issue has been whether the paths taken by the learner during the course of L1

vis-à-vis L2 acquisition are fundamentally different, or, in important ways, the same. Many, if not most, attempts to answer this and related questions employ proven research paradigms borrowed directly from L1 research. For example, a replication (Dulay & Burt, 1974) of Roger Brown's (1973) now-classic "morpheme order studies" showed that nonnative speakers from very different language backgrounds acquire a subset of English grammatical morphemes in a characteristic order, much in the same way children learning English as L1 do. Although it is not within the scope of this chapter to explore the long-standing relationship between L1 and L2 research, this one influential study serves to remind us that L1 and L2 research are both concerned with types of language acquisition (Anderson, 1984). The emphasis placed by L1 researchers on universals spilled over into L2 research, with a corresponding deemphasis on language differences.

The more recent emphasis in first language acquisition research on crosslinguistic comparisons of L1 learning has had undeniable impact on work in L2 acquisition. For the first two decades of child language research as a field in its own right, the vast majority of studies were carried out in English. It was recognized by many researchers that problems arose when general claims were based on language specific findings. Slobin and his colleagues (1967, 1973, 1977, 1982, 1985) spell out clearly the need to collect systematic data from a wide range of languages before we can hope to gain a sound understanding of the principles underlying language acquisition. Berman (1984), in a review of Slobin's contribution to the crosslinguistic study of L1 acquisition, points out that the same rationale applies to L2 research: the most fruitful approach involves applying the same types of research paradigms to two or more languages. What is more, this approach to bilingual language use offers an important contribution to crosslinguistic research in general: the processing system(s) employed in the service of two languages can be evaluated within single subjects, who provide their own control for many of the extraneous factors (e.g., cognitive level, socioeconomic status) that contribute to variance in most studies. The studies we report below are precisely of this kind.

The Role of Rules

Formal linguistics has long provided child language researchers with at least some of the theoretical tools necessary to ply their trade. In spite of having to deal with frequent shifts in linguistic theory, L1 researchers have borrowed heavily from formal linguistics to describe the state of the language systems they observe. Not surprisingly, the descriptions are typically in terms of rules, which are defined for the present purposes as a statement of the conditions that require, in discrete and categorical terms, the presence or absence of a given linguistic form. As we shall see, a formal description of language acquisition

may be possible in terms of rules, but rules may be a less useful construct in building a performance model that accounts for the developmental aspects as well as the "steady-state" features of first and second language acqusition.

Like the majority of models of L1 acquisition, most models of L2 acquisition also emphasize the role of rules. Though different models may disagree or remain vague on how the learning mechanism that manipulates rules works, they do agree in principle on the end result: a language is acquired when the rules of the target language are internalized.

One such model in which rules play a central role, the Interlanguage Hypothesis (Selinker, 1972; Selinker, Swain, & Dumas, 1975; Corder, 1983), has been and continues to be influential in both theoretical and applied linguistic areas. According to the Interlanguage Hypothesis, a second language learner has at any given point in the acquisition process an interim stage grammar. This interim, or interlanguage, grammar changes in response to incoming data, so that with continued exposure to sufficient and appropriate input, the interlanguage grammar, by a series of successive approximations, moves closer and closer to the standard grammar of the target language. The interlanguage grammar is described in terms of its component rules (which may be derived from the target language, from the native language, or "invented" by the learner). At any one point in time, however, the L2 speaker's interlanguage grammar is relatively static. One of the advantages to this characterization of L2 acquisition is that it helps to account for the fact that many L2 learners seem to stop making much progress after some point (which varies from learner to learner), and never move beyond the final interlanguage grammar they acquire. In Selinker's terms, the interlanguage "fossilizes." We will return to the issues raised in the interlanguage literature in the discussion section, where we will point out several ways in which a probabilistic model of language processing can account in a somewhat different way for much of the same data.

The notion of a rule may, however, be too rigid to adequately capture a process as complex and dynamic as language acquisition. Rule-based models have two major shortcomings. First, they tend to be "all-or-nothing": Either a rule is present or it is not. We are often faced with the problem of how to talk about having "some but not all" of a language, but it is decidedly unsatisfactory from a formal theoretical perspective to frame the issue as learning or losing "part" of a rule. A second language learner may use or comprehend a passive in the appropriate discourse context only about half of the time, or usually but not always apply a vowel harmony rule correctly. But what position could half of a passive, or seventy-five percent of a vowel harmony rule hold in a learner's L2 grammar? Second, rule-based models derive from theoretical accounts of single linguistic systems, considered one at a time. This is desirable from a linguistic point of view, but it may not account in a natural way for the real-time processing considerations that constrain actual language use, for a learner's

incomplete (L1 or L2) grammar, or for the possibility of interference and transfer between linguistic systems.

If we choose to characterize the expanding language system of a second language learner in terms of rules, we risk overemphasizing the aspects of language performance which easily fit the rules we have adopted, and missing other, potentially crucial aspects of the acquisition process which do not conform to our rule system. This is clearly the case with both aphasia and L1 acquisition (especially in light of recent crosslinguistic findings in these areas; this volume), but it is perhaps most obvious in L2 acquisition. For this reason, we will discuss the L2 learner in terms of a "partial" language system, as compared with the complete L1 system in the same individual, or in native speakers of the target language. Unless language acquisition follows the lines of linguistic rules absolutely, we may be forced to reconsider the usefulness of linguistically derived rules in describing such cases; when behavior deviates from the rules, our explanations become necessarily ad hoc.

An alternative approach to linguistic description goes under the heading of functional linguistics (Givón, 1979; Dik, 1978). The main tenet of functional linguistics is that forms in any natural language perform in the service of function. The strongest version of functionalism holds that a one-to-one relationship exists between form and function in a language. In fact, as we shall see, many-to-many mappings are the rule in natural languages. The functional approach bears quite different implications for the acquisition and processing of language than a rule-based account. On the latter version, acquisition is characterized by the internalization of the abstract rules which govern relationships between grammatical entities in the target language. Once in place, the rules themselves are an integral part of the processing system. A functional account does not necessarily entail the rejection of rules as components at a formal level of description. However, rules need not constitute the actual substrate of acquisition or processing. According to a functional account, the learner must pay attention to the way in which particular forms map onto particular functions. When form–function mappings are clear and direct, they can, like rules, operate in a discrete, categorical fashion. However, as we shall see, discrete, categorical behavior does not always characterize the the language processing system, nor its operation at any stage of (first or second) language acquisition.

It is important to note that a functional view of language acquisition does not necessarily entail the summary rejection of rules. Labov (1975, 1986) discusses the notion of variable rules, which allow for considerable variability in the application as well as the acquisition of grammatical features. This may be one way to bridge the gap which currently exists between models of language performance, such as the Competition Model, and accounts of language learning based on competence-oriented linguistic theories.

A functional perspective may thus help explain what appears to be a "partial" language system in a second language learner. Certain form–function mappings may be learned before others due to a variety of factors (attention, availability, etc.), so that the L2 learner may appear to have only part of a rule. A model of language performance which provides a principled account of what it means to have a "partial" language system is the "Competition Model" of Bates and MacWhinney. This model is a probabilistic theory of grammatical processing which developed out of a large body of crosslinguistic work in adult and child language, as well as in aphasia (Bates & MacWhinney, 1981, 1982, 1984, etc.). Since the studies discussed here are interpreted on the basis of the Competition Model, we will briefly describe the features of the model relevant to a study of bilingual sentence processing.

The Competition Model

The Competition Model derives from a consideration of the functional aspects of mapping linguistic forms to underlying meaning. Since this is a performance model, which attempts to describe real world language behavior, the resolution of form–function relations during processing must take place in real time. The model adheres to functionalist tenets in that form–function mappings are made as directly as possible. However, the strong functionalist position which posits one form to one function is rejected in favor of a multiplicity of form–function mappings: natural languages rarely make use of one-to-one mappings; rather, a single form can map onto many functions, and a single function can map onto several forms. The probabilistic feature of the Competition Model leads to the treatment of statistical tendencies and obligatory rules as quantitatively rather than qualitatively different. This is important because relations between surface forms and functions can be described in terms of strength or degree of interaction. Particular instances within the system of many-to-many form–function mappings in a given language are assigned weights in this model. This is done according to the statistical distributions of certain constructions, for example, how often or how reliably a given form is used to perform a given function. The sources of information a listener uses to decide which function is meant to be expressed by a given form are referred to as "cues." The usefulness of a particular cue is determined by its availability and reliability. For example, animacy may be heavily depended upon when an animate–inanimate distinction is present, as in "The boy broke the window," but not in "The ball broke the window."

A related feature of the Competition Model for the study of bilingual sentence processing is that it predicts the gradual emergence of conventions or rules, via a continuous increase in the strength or "determining force" (MacWhinney, Bates, & Kliegl, 1984; McDonald, this volume) of statistical form–function

assignments. The implication for L2 acquisition is a strong one: The application of cues in form–function mapping in L2 ought to approach distributionally predicted levels as fluency in L2 increases. However, as noted earlier, L1 strategies may strongly interfere or interact with appropriate L2 strategies.

The Competition Model allows for a test of at least four hypotheses of bilingual sentence processing.

1. First language (L1) strategies may be applied to both languages.
2. A second set of strategies is acquired and applied exclusively in the context of L2, so that the learner behaves essentially as a monolingual in each language.
3. L2 strategies are not only applied to L2 but may even supplant L1 strategies.
4. New strategies may be adopted in the course of L2 learning, and become assimilated into one amalgamated set that is applied to processing in both languages.

These are not mutually exclusive in a developmental model; each of these possibilities might be true at some point in the process of acquiring a second language. Furthermore, these different hypotheses point out that a single level progression from beginner to fluent bilingual is only one of several possible courses for second language acquisition to follow. If L2 learning turns out to be more or less unidimensional, it would be rather convenient for the model we have adopted here. If, on the other hand, there are many routes to fluency, any model will have to be considerably more complex than the the Competition Model in its current form, whether rules are incorporated in some form or not.

In what follows, we will examine the evidence from a number of studies derived from the Competition Model, including L1 and L2 speakers of English, German, Italian, Spanish, Dutch, and Japanese. As we proceed, we will track which of the above hypotheses receive support from the data and which do not. As we shall see, results do support the use of probabilistic models instead of rule-based models, to capture the "in-between" status of the processing characteristics in second language users. At the same time, however, the second language results also look quite different than comparable studies of first language acquisition within the Competition Model, and may suggest some further constraints on the learning component of that model.

Before we begin, it will be useful to first establish a convention for referring to the various language groups included in these studies. We shall adopt the following terminology: For example, in referring to a group of native English speakers whose second language is Dutch, we will use the label ED (English-Dutch), placing the native language first and the second language second. Likewise, native Dutch speakers whose second language is English will be referred to as DE. Similarly, when a DE group is tested in their first language (Dutch), we will use the label DE1 (Dutch-English in L1); when DE subjects are tested in their second language (English), we will use the label DE2 (Dutch-English in L2).

Experiments in the Competition Model Paradigm

In this section we will examine six studies which use variations of a sentence interpretation task designed to set up various "coalitions" and "competitions" among a restricted set of grammatical entities (e.g., word order, animacy, agreement, case inflections, etc). Though the studies reported here vary in details, in each one we are interested in the probabilistic nature of processing strategies in bilingual individuals. In particular, we are concerned with the question of whether L1 strategies "invade" into processing in L2. Taken together, their findings may give us some insight into what it means to have a "partial" language system.

The first studies from the point of view of the Competition Model asked whether first language (L1) strategies "invade" into processing in the second language (L2). In other words, does an adult bilingual depend to some extent on L1 strategies in order to map surface forms onto functions in L2? If this kind of process proves to be available to skilled bilinguals, then we can address a further set of questions regarding the acquisition process at earlier stages (e.g., what does it mean to be "between" languages? What influence does the processing structure of L1 have on L2? Does this influence vary as a function of fluency, age, and context of L2 acquisition?).

Case studies of Italian-English and German-English bilinguals

Having performed numerous investigations of sentence processing in adults and children in a variety of different languages, Bates and MacWhinney (1981) extended their Competition Model paradigm to look at whether L1 strategies impinge on processing in L2 (or vice versa) within a single individual. They carried out a pilot study with native German and native Italian speakers using a sentence interpretation task adapted from earlier studies of sentence processing in monolinguals. Subjects heard sentences containing two nouns and a verb, orthogonalized along the dimensions of order (NVN, NNV, VNN), agreement (first noun, second noun, or neither noun agrees with the verb in number), and animacy (both nouns animate, first animate and second inanimate, first inanimate and second animate). The result is a 2(language) × 3(word order) × 3(agreement) × 3(animacy) design in which cues are set into competition and coalition with one another. The task was to simply identify the actor ("who did it?") in each sentence heard.

From the pattern of responses to the test questions set up in this manner, a picture of the relative strength of different combinations of cues to sentence interpretation emerges. Although too few subjects participated for extensive statistical analyses, the results of these case studies, shown in Figures 8.1, 8.2, and 8.3, were very much in keeping with the idea that L1 strategies play a central role in early L2 processing. The performance of the Italian bilinguals

in English exactly paralleled results from monolingual Italians: Agreement was stronger than animacy, which was in turn stronger than word order. One German subject also used monolingual German processing strategies to interpret English sentences. The other German subject, also an extremely fluent bilingual, used processing strategies similar to native speakers of English (comparable testing of the same individuals in German was not carried out). These pilot results suggest that L1 strategies operate during processing in L2, and that use of language-appropriate strategies may interact with level of fluency.

The fact that processing strategies appropriate to L1 carry over to L2 provides strong support for the form–function model of representation in the Competition Model. However, at least one problem also emerges at this point: Despite many years of exposure and a high level of fluency in English, one native German still interpreted English sentences on the basis of form–function mappings appropriate to German. Such persistence of L1 strategies is not accounted for by the current version of the Competition Model; it seems instead to reflect an extraordinary insensitivity to cue validity in L2. We will return to this and other problems for the Competition Model raised by second language acquisition research in the discussion. We turn first to another study which provides further evidence for the invasion of L1 strategies into L2 processing.

Sentence Processing in English-Chinese Bilinguals

Miao (1981) studied the role of two cues, word order and animacy, in the processing of Chinese by native Chinese speakers and by English-speaking second language learners of Chinese. The basic word order in Chinese is SVO, and there are no inflectional markers for transitivity. Other word orders, such as SOV and OSV, also occur in colloquial speech, but these are accompanied by obligatory morphological marking with respect to subject/object roles. Furthermore, the topic, which may not be the subject or the agent, is often associated with the first position in Chinese sentences, whereas subject roles are frequently not expressed overtly at all (Li & Thompson, 1976).

Subjects in Miao's study were eight native Chinese speakers and eight native English speakers who had studied Mandarin for more than three years (six had been in China for two or more years). Subjects enacted simple sentences consisting of two nouns and a verb in Chinese, drawn from a list of animate and inanimate nouns (without morphological markers) and transitive action verbs, and varied orthogonally in order (NVN, NNV, VNN). Miao hypothesized that word order ought be a dominant cue in sentence interpretation in Chinese. Contrary to expectation, however, she found that native Chinese speakers relied more heavily on semantic cues than on syntactic ones. Although there was a slight tendency to choose the first noun in NVN sentences (68.1% of the time, compared with 42.4% in VNN and 56.3% in NNV sentences), these

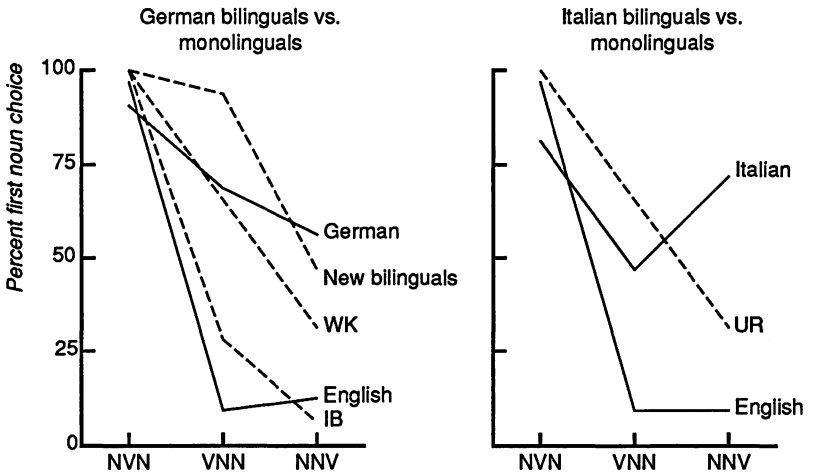

Figure 8.1. Word order main effects (for items that are ambiguous with regard to agreement and animacy) for native speakers in their first languages (solid lines) and for bilinguals tested in English as a second language (broken lines).

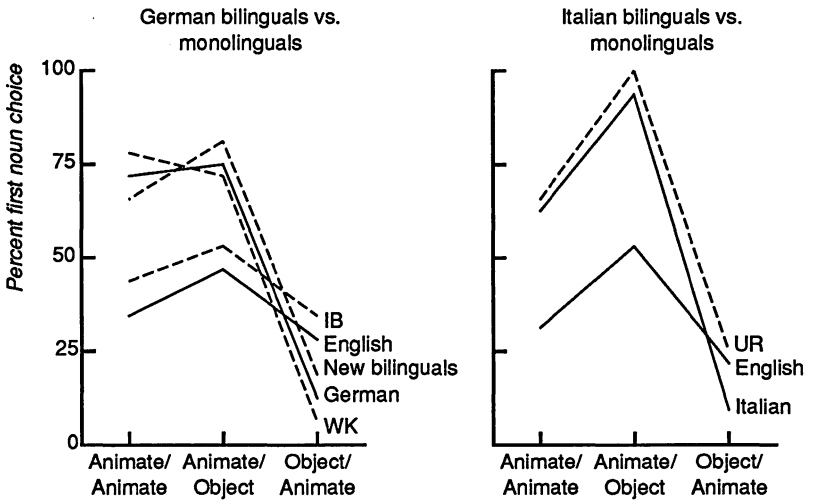

Figure 8.2. Animacy main effects (for items that are ambiguous with regard to agreement, summed across word order conditions) for native speakers in their first languages (solid lines) and for bilinguals tested in English as a second language (broken lines).

differences did not reach significance, suggesting that word order is not a particularly important source of information in Chinese sentence processing. Compare these findings with those from the use of the animacy cue: Chinese subjects chose the first noun 86.1% of the time if it was animate and the second

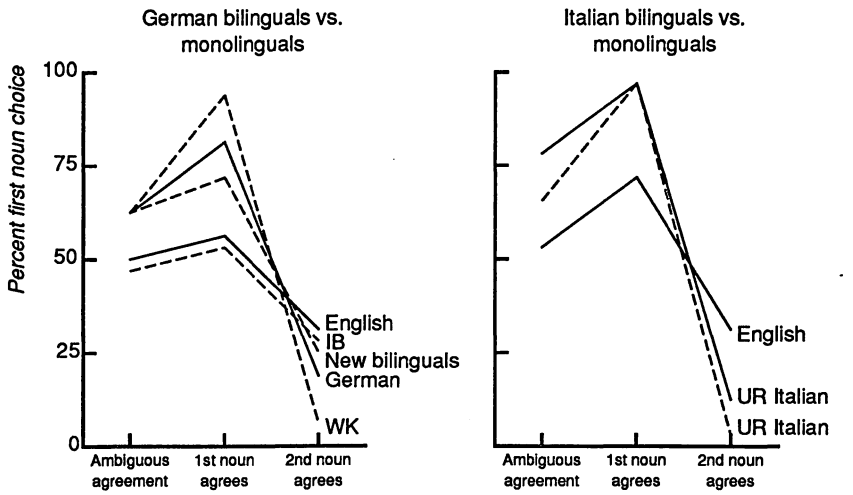

Figure 8.3. Main effects of subject–verb agreement (summed across word order and animacy conditions) for native speakers in their first languages (solid lines) and for bilinguals tested in English as a second language (broken lines).

noun inanimate. When the first noun was inanimate and the second animate, the *second* noun was chosen as agent 81.9% of the time. When both nouns were animate, performance was near chance level (62.5%). Clearly, Chinese subjects make more use of semantic cues than word order cues in interpreting simple sentences, contrary to initial expectations based entirely on typological considerations. However, given what we know about the low reliability of word order in informal Chinese, perhaps this is not surprising (see below).

In contrast to native speakers of Chinese, Miao found that EC2 speakers did rely heavily on word order as a cue to sentence meaning. Regardless of animacy relations, EC2 subjects consistently chose the first noun of NVN strings as the agent (91% first noun choice). In VNN orders, the first noun was chosen 33% of the time, and in NNV orders 72.2% of the time. EC2 speakers also tended to choose the animate noun over the inanimate noun as agent (84% first noun choice in AI, 40.3% in IA, 72.2% in AA), but this bias was less overt than in the strategies adopted by native speakers.

Why did native Chinese speakers depend most heavily on semantic features in Chinese, a language which provides consistent word order information? There are at least two factors that may militate against a strong word order strategy in native Chinese speakers. Although the apparent weakness of word order as a cue to sentence meaning seemed surprising at the time, we have since learned that on-line competition from other word order types within the language diminishes the strength of the canonical order, even in morphologically

impoverished settings (see below). Second, as Miao points out, the dominant role played by the subject-as-agent in other SVO languages such as English may be partly undermined by the importance of the topic feature in Chinese. As noted earlier, the subject is often omitted altogether in Chinese sentences, and is explicitly marked when it occurs in noncanonical orders. The topic, which tends to occur in sentence-initial position and may or may not be the subject or the agent of the sentence, may be afforded a relatively high status in real-time processing strategies in Chinese. These findings have been replicated by Tzeng and Hung (1984).

Word order was the primary cue for EC2 speakers in Miao's study, however. These subjects are native speakers of English, a language in which, as we have seen, word order as a cue to sentence meaning typically "wins" overwhelmingly in competition with other cues. Miao's study provides evidence that processing strategies appropriate to L1 may carry over to processing in L2. However, while we can be fairly certain that at least some transfer such as this is likely to occur, the characteristic second noun strategy in English NNV sequences was not found in Chinese NNV sequences, which suggests that simple transfer cannot completely account for the L2 findings in Miao's experiment.

Sentence Processing and Cue Validity

McDonald (1986, 1987a, this volume) developed a model of cue mapping which posits that the the first cues to be assigned form–function mappings in a language-to-be-learned will be the most valid ones over all sentences, and that a cue's final mapping strength will depend on how it performs when it is in conflict with other cues in a sentence. McDonald obtained validity and strength estimates from samples of texts in each language tested. Using this model to predict trends in second language learning, she examined the notion that as fluency increases in a second language, the cue weights (i.e., a measure of the consistency with which a particular cue wins in competition with other cues) used by the learner gradually shift from the first language norm to that of the second language.

The cues tested by McDonald included word order, animacy, and case inflection, presented in the context of NVN sentences, relative clauses, and dative constructions. Subjects were first and second language learners of German, English, and Dutch, grouped according to their overall proficiency in L2, who performed a sentence interpretation task in both L1 and L2. The results showed that as the level of fluency increased, cue weights approached those predicted by frequency counts in the target language. In other words, L2 strategies were built up gradually in a more or less linear fashion following the principles of cue validity. Although different languages provide different

strategies, the same principles apply to the establishment of form–function mappings in L1 and in L2.

To recap the findings so far, we have seen that transfer of L1 strategies to L2 processing does occur; however, L2 strategies are adopted as well, and may be accounted for in terms of the strength and reliability of cues in the target language. These results support predictions made by the Competition Model. In the sections to follow, we will review further evidence from a variety of languages. As we shall see, although generally supportive, the data raise several challenges to the Competition Model account of acquisition and performance in L2.

Sentence Interpretation in Dutch-English Bilinguals

On the surface, Dutch and English, both Germanic languages, have many features in common. Both locate articles and other modifiers before the noun, both make case distinctions only only on personal pronouns, and the canonical word order for simple, active declarative sentences is Subject-Verb-Object (SVO). Given the large degree of similarity between English and Dutch, we might expect to find little crosslanguage variability in processing strategies. However, there are some important differences between Dutch and English which, depending on what kind of model we choose to explain processing behavior, lead to different predictions about how the two languages are processed.

One such difference is the relatively rich morphological system in Dutch, versus the impoverished one in English. Dutch provides a fairly regular set of distinct markings, mainly on verbs, for tense and number agreement. English has vestiges of such a system, but morphological cues in English are neither consistently available, nor consistently reliable when they do appear. Another difference is related to word order. The basic or canonical word order for Dutch as well as for English has typically been considered to be SVO. Whereas English fits this classification rather cleanly, Koster (1975) has shown that Dutch may fit the formal category of SOV better, chiefly because the presence of an auxiliary (e.g., *zullen* "shall" to mark the future, or *zijn* "be" to mark the passive and some types of past tense) requires that the main verb in infinitive or participle form be postposed:

No auxiliary:	*Piet*	*ziet*	*de*	*kat.*	
	SUB	VERB	ART	OBJ	
	Pete	sees	the	cat	
	"Pete sees the cat."				
Auxiliary:	*Piet*	*zal*	*de*	*cat*	*zien.*
	SUB	AUX	ART	OBJ	VERB
	Pete	will	the	cat	see
	"Pete will see the cat."				

Other sentence forms are also possible in Dutch. For example, a very frequent form for questions in Dutch is VSO:

Ziet	*Piet*	*de*	*kat?*
VERB	SUB	ART	OBJ
Sees	Pete	the	cat?

"Does Pete see the cat?"

In English, VSO is not a possible configuration, if the V is taken to be a main verb, rather than an auxiliary. Verb-final clauses also occur in Dutch, but only in subordinate clauses, such as sentential complements and relative clauses (the latter of which requires an obligatory relative pronoun [e.g., *De man, die de vrouw sag was...* – The man (whom) the woman saw was...]).

If language processing is based on the application of rules, then we would not expect to find a difference between Dutch and English on simple, auxiliary-free SVO forms, which map onto the same functions in each language. However, the Competition Model holds that processing strategies in a particular language are a product of the processing system's sensitivity to the full distribution of form–function mappings in that language. A particular form's distribution will overlap with that of other forms in the language to the extent that the two are structurally similar, on the one hand, and functionally similar, on the other. So an incoming sentence form activates all of the potential interpretations which are, to a greater or lesser degree, compatible with the input. The greater the degree of compatibility, the more a particular form is activated, and eventually only one interpretation "wins." If the presence of partially overlapping structures (e.g., SOV and SVO word orders in Dutch) in a language can impinge on sentence interpretation, then we ought to find that Dutch, which allows much more word order variation than English, differs from English in this dimension.

Kilborn and Cooreman (1987) presented sets of Dutch and English sentences to native Dutch speakers who were advanced (post-graduate) students of English. Twenty subjects each received 54 sentences in each language consisting of two nouns and a verb, and indicated which noun they thought was the actor or subject. The independent variables were language (Dutch and English), word order (NVN, VNN, NNV), agreement (Ag0, Ag1, Ag2), and animacy (AA, AI, IA).

Although there were main effects of each of the three main variables, the most important findings here involve the interactions in which the language variable participated. Language interacted independently with word order and with agreement, and it also participated in one three-way interaction (language × animacy × word order). We will limit our discussion here to the language × word order interaction, as it nicely illustrates the direction of the findings in general.

The solid lines in Figure 8.4 show the Language × Word Order interaction for the Dutch-English bilinguals. Three word order permutations were possible: NVN, VNN, and NNV. In both Dutch and English, SVO is the basic or canonical word order for active, declarative sentences (no auxiliary forms were presented),

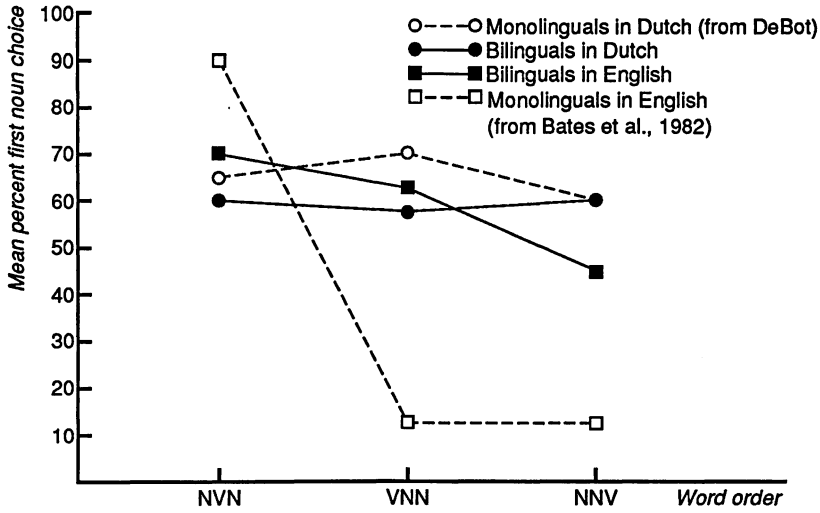

Figure 8.4. Language by word order interaction (noun choice): comparison between bilinguals and monolinguals in Dutch and English.

which corresponds to NVN. Nevertheless, a difference in percent choice of first noun as actor emerged across languages in the canonical NVN word order: Subjects chose the first noun as actor 61% of the time in Dutch, in contrast to 68% choice in English. In the noncanonical order conditions, subjects chose the first noun 59% and 58% of the time in Dutch for VNN and NNV, respectively. In English a different picture emerges: First noun choice rate was 62% in VNN, but dropped to 44% in NNV orders. A post hoc analysis showed that the source of the interaction was in the different interpretations given NVN and NNV orders for English as compared with Dutch.

The broken lines in Figure 8.4 illustrate data from similar sentence interpretation tasks carried out in a monolingual setting with native speakers of Dutch (De Bot, personal communication) and English (Bates et al., 1982; MacWhinney et al., 1984). These results provide a useful reference point against which we can compare the performance of bilingual subjects in each of the languages in question. Overall, our subjects' performance in Dutch closely parallels the results reported by De Bot for native Dutch speakers in a Dutch-only version of the sentence interpretation task, which clearly indicates the robustness of the paradigm. The monolingual English data shown have been replicated a number of times; the effects of word order, animacy, and agreement in English are surprisingly consistent across studies (Bates et al., 1982; MacWhinney et al., 1984).

The Dutch bilingual subjects' performance in English suggests further evidence for invasion of L1 into L2: the results are markedly "Dutch-looking" in

both languages. However, when the results in English do diverge from those in Dutch, it is in the direction of the monolingual English findings. Figure 8.4 shows that DE2 subjects, like native English speakers, preferred the first noun in NVN strings, although to a lesser extent. (broken lines show data from Bates et al, 1982, for comparison). DE2 subjects, again like monolingual English speakers, also showed a second noun strategy in NNV sentences, although again less pronounced. The main difference emerged on VNN sentences: DE2 subjects chose the first noun 62% of the time, in contrast to only a 15% first noun choice by English monolinguals.

Two factors contributed to these findings. First, word order does not appear to command as much attention in Dutch as do animacy and agreement cues. In order of relative strength, processing cues in Dutch line up as follows: agreement > animacy > word order. Thus, even in English, DE2 subjects continued to exhibit Dutch-like processing biases, and so were not much affected by variations in word order. This is consistent with the fact that Dutch, which has a relatively rich verb agreement system, allows more word order variation than English. Second, the first noun bias on VNN sentences can be accounted for in terms of transfer from Dutch. In particular, VNN strings were interpreted as VSO, which happens to be the predominant question form in Dutch. For these subjects, the relative strength of the frequent Dutch question form may "win" in competition with other potential interpretations, including English VOS.

One difference between this study and previous ones was the use of a within-subject design, providing a control for much of the extraneous variance introduced when comparisons are made simultaneously across subjects and across languages. This underscores even more strongly the finding that L1 strategies invade into processing in L2, providing more support for the Competition Model account of second language acquisition. However, one other aspect of the results from this study deserves mention. Within the constraints just described, Kilborn and Cooreman identified two subgroups of Dutch speakers who appeared to attend more consistently to either animacy cues or agreement cues, and a third subgroup which used an amalgam of those two cues. Subjects in each subgroup applied their biases to both Dutch and English. As we shall see, the potential for individual differences poses special challenges to the Competition Model. We will return to this issue in more detail when we discuss similar subgroup differentiation observed in different language groups by Harrington (1987) and Wulfeck et al. (1986).

Sentence interpretation in Spanish-English bilinguals

In a recent study, Wulfeck et al. (1986) examined the performance of Spanish-English bilinguals on a sentence interpretation task. Twelve subjects each received 54 sentences in each language. Sentences consisted of two nouns

and a verb, and subjects were instructed to indicate which noun they thought was the actor or subject. The four factors manipulated as independent variables included language (Spanish and English), word order (NVN, NNV, and VNN), animacy contrasts (AA, both nouns are animate; AI, first noun animate and second noun inanimate; and IA, first noun inanimate and second noun animate), and agreement contrasts (ambiguous agreement, Ag0, in which the verb agrees with both nouns, versus first noun agreement, Ag1, or second noun agreement, Ag2).

Recall the four possible outcomes that we suggested at the outset: (1) Bilinguals may use interpretation strategies appropriate to their native language in both L1 and L2 (i.e., depend on L1 cues to sentence meaning in L2); (2) they may switch over and apply L2 strategies to both languages; (3) bilinguals may look just like monolinguals in each of their languages; and (4) bilinguals may apply a combination of L1 and L2 cues, resulting in a strategy amalgam that is neither exclusively L1 nor L2 in character.

The results from this study supported not one but two outcomes: One group of subjects did not employ distinct processing strategies for either language, but rather seemed to apply an amalgam of processing strategies drawn from Spanish and English. A second, distinct group applied Spanish-like strategies to the same degree in both languages. Figures 8.5 and 8.6 show the findings for both groups with respect to word order and agreement, respectively. The solid lines represent the bilingual subjects from this study. The broken line shows findings from an earlier study of this type with monolingual speakers of English (Bates et al., 1982), and serves here as a useful point of reference. Group 1 adopted word order, the dominant cue from their second language (English), followed to a lesser extent by agreement and animacy, which are generally the strongest cues in Spanish. These subjects seem to operate with the same merged hierarchy of strategies for both languages. Group 2 showed only slight sensitivity to word order cues, instead depending heavily on agreement, followed by animacy cues. This Spanish-dominant processing strategy was also applied equally to both languages. The difference between merged-hierarchy and Spanish-dominant strategies could not be explained in terms of any obvious group factor (e.g., age of second language learning, fluency, educational level).

Taken singly, either a Spanish-dominant processing strategy or an amalgam of English and Spanish strategies would present no problem to the Competition Model account of language acquisition. They might each represent different stages along a continuum of sensitivity to L2 cues. However, given that the observed differences between individuals in this study cannot be related to fluency or other factors, we are faced with having to account for these differences in bilingual processing styles. Crosslinguistic work has shown that there is tremendous variability in the way natural languages divide up the tasks of assigning surface form to underlying function. The processing mechanism

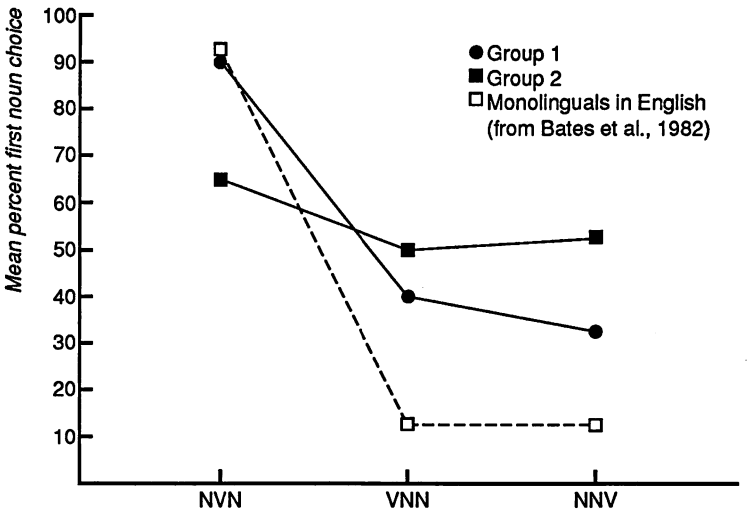

Figure 8.5. Group × word order interaction in English.

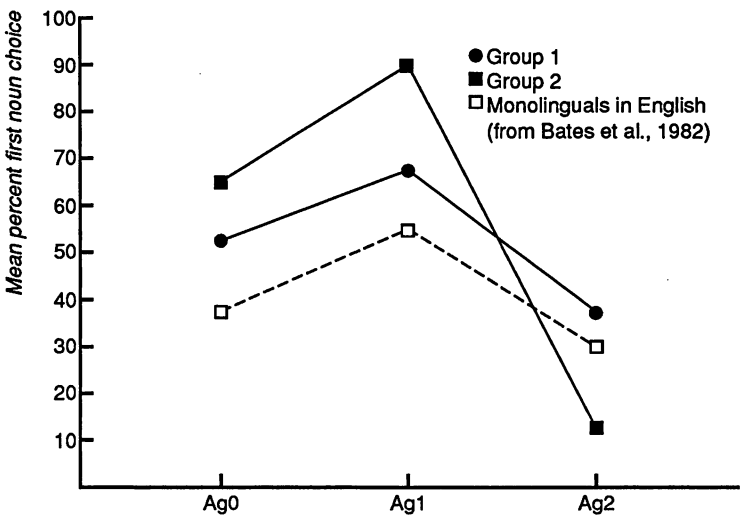

Figure 8.6. Group × agreement in English.

that must deal with such potential variability must also possess considerable flexibility. The findings reported by Wulfeck et al. (1986) provide solid evidence for such flexibility within individual speakers, indicating that alternate routes are available to L2 learners, rather than a series of way stations along a single learning process. We will get back to the issue of individual differences and alternate learning routes shortly.

Sentence Processing in Italian-English and English-Italian Bilinguals

Gass (1987) looked at sentence interpretation strategies of L2 speakers of English (L1 Italian) and L2 speakers of Italian (L1 English). Subjects heard sentences containing two nouns and a verb, in which three cues, word order, animacy, and topic, were varied orthogonally. Topicality was indicated by the phrase, "As for X," which preceded each sentence. Subjects were instructed to indicate which noun they thought was the actor or agent in the sentence.

Gass found that in Italian, native English (EI2) speakers tended to adopt animacy as the primary cue to agency, the same cue that native Italians used most. In English, however, Italian-English (IE2) bilinguals continued to depend heavily on animacy relations, in contrast to native English speakers, who focused instead on word order. Gass claims that these results reflect a potential universal in second language acquisition. Specifically, semantics may be a stronger or more central strategy than one based on syntax. For this reason, it is in some sense easier for native English speakers to drop word order and pick up animacy in Italian than it is for native Italian speakers to let go of a semantic strategy when they interpret English sentences.

While a "semantic primacy" effect is an interesting proposal, we shall see in the next section that the picture is not so simple. Gass's findings are contradicted by the results of English-Japanese bilinguals, who appear to apply a "meta-word-order" strategy which overrides the semantic bias in Japanese.

Sentence Interpretation in Japanese-English and English-Japanese bilinguals

We will review two studies in this section. Harrington (1987) investigated sentence processing strategies in Japanese L2 speakers of English, with monolingual control groups in both English and Japanese. The cues to sentence meaning in Harrington's study included word order, animacy, and contrastive stress. In the second experiment, Ito (in preparation) looked at advanced and beginning L2 speakers of Japanese and English, and included monolingual control groups in each language as well. Word order and animacy were systematically varied, and an additional factor, morphological marking of topic (the particle *wa*) and subject case (the particle *ga*), was included as well. Before turning to these studies in detail, we will briefly discuss some relevant typological differences between Japanese and English.

1. Word Order. As we discussed earlier, English is a rigid SVO language. Recall that although some minor variation occurs in colloquial speech (e.g., such as OSV and VOS orders in left and right dislocations), other possible orders (OVS, SOV, VSO) are not acceptable. Also, as we have seen, English lacks a rich system of inflectional morphology. Consequently, word order is the primary source of information about case roles in English sentences.

Japanese is an SOV language. However, in contrast to English, considerable word order variation is permitted, providing the verb remains in last position and the appropriate grammatical morphemes are included when required. The role of word order is not to mark case relations, as in English. Rather, word order serves pragmatic purposes in Japanese, highlighting particular elements of a sentence.

2. *Animacy.* English permits a wide range of noun types to function as subjects. Other languages, however, are much more restrictive, typically allowing only animate entities to be subjects. This is the case in Japanese, in which only humans and some higher animals are permitted to be subjects.

3. *Stress.* In English, contrastive stress is used for pragmatic purposes, mainly to focus attention on certain elements in a sentence. As Harrington (1987) succinctly points out, the subject in English does not usually receive contrastive stress, since the subject position is "typically associated with given information." Japanese, on the other hand, may or may not provide contrastive voice stress to this same end. Instead, contrastive particles such as *wa* play the role in Japanese filled by stress in English (see Kuno, 1973).

4. *Case/topic marking.* Japanese also has a set of noun-suffixing particles which function as case and topic markers. The subject marker *ga* and object marker *o* are nonobligatory, and are usually used to indicate ~~old~~ new information. These case particles are often replaced by the topic marker *wa*, which conveys ~~new~~ old information. Much of the word order variation in Japanese is due to the presence of these particles (see Clancy, 1985). In addition, since animates are more likely to be topics due to discourse-pragmatic reasons (Givón, 1979), the topic marker *wa* is more likely to be attached to animate elements in a sentence than to inanimate ones. Since topics tend to be animate *and* are typically marked by *wa*, the distributions of "animate" and "topic" overlap, making it difficult to distinguish in practice between dependence on Japanese morphosyntactic features and more general semantic strategies during processing.

Sentence Processing in Japanese-English Bilinguals

Harrington (1987) performed a sentence interpretation study in which word order, animacy, and contrastive stress were set into competing and converging combinations. Subjects tested in English were 12 native English controls and 12 native Japanese ESL learners, all of whom had been enrolled in an English program for a maximum of five months. An additional 12 native Japanese subjects were tested in Japanese. Each subject received 81 test sentences, which were adapted from Bates et al. (1982).

The results included a language × word order interaction. The native English controls (E1) exhibited the characteristic pattern of noun choice across the three word order types: In NVN, the first noun was chosen 81% of the time, compared with 35% for NNV and 33% for VNN. In native Japanese (J1), word order had virtually no effect on noun choice: The first noun was chosen in Japanese NVN 59% of the time, in NNV 56%, and in VNN 54%. In the L2 test group (JE2), native Japanese speakers performing the task in English chose the first noun 68% of the time in NVN sentences, 59% in NNV, and 56% in VNN. Note that neither Japanese group exhibits any bias toward the canonical word order in Japanese, SOV (=NNV). However, although it was not reported whether the difference between groups on NVN was significant, the JE2 group did appear to lean toward the first noun in English NVN (68%), falling midway between English and Japanese L1 speakers. This suggests the possibility that the JE2 learners in this study were at least aware of the utility of word order as a cue in their second language, and is compatible with the pattern of within-subject divergence reported earlier for Dutch-English bilinguals.

The animacy condition yielded differences across languages as well. In Japanese, native speaker controls (J1) chose the animate noun over the inanimate noun overwhelmingly, 98% first noun choice in AI, and .03% in IA. In AA combinations, first noun choice was 69%, suggesting a weak first noun effect. In English, animacy produced much less pronounced differences. Monolingual English controls (E1) chose the first noun in AI pairs 75% of the time, compared with 23% in IA pairs, while selection was random (50%) in AA pairs. By contrast, the JE2 group appears to have used an amalgam of native English and native Japanese animacy strategies. First noun choice for AI and AA pairs paralleled the results for Japanese, 93% and 67%, respectively. In IA pairs, however, JE2 speakers chose the inanimate noun 23% of the time, which was just as often as the native English controls. This suggests that even in these novice L2 speakers, there is some sensitivity to the acceptability of inanimate nouns as subjects, contrary to convention in their native language.

There was no effect of stress in either language. According to Harrington, trends in the data suggest that there was some avoidance of the first noun when it was stressed, which is consistent with the pragmatic function of stress to signal new information (case and topic particles were not included in this study).

To summarize, there were two areas in which Japanese L2 learners of English differed from monolingual controls. First, JE2 speakers showed a bias toward the first noun in canonical NVN sentences in English, but no second noun strategy in noncanonical orders. This is consistent with all of the studies that we have reported, so far, in which bilinguals show any sign at all of sensitivity to processing strategies characteristic of native English speakers. Second, JE2 learners depended more heavily on animacy cues in English than E1 native speakers, in keeping with the use of a semantic strategy by monolingual controls

in Japanese. However, JE2 subjects showed as much willingness to select an inanimate noun as subject as monolingual English E1 speakers, in strong contrast with J1 controls. Thus, evidence both for transfer of L1 strategies and acquisition of L2 cues was found.

One apparent inconsistency also emerged from the findings with monolingual English controls. Although native Japanese speakers did evidence a strong tendency to use animacy as a cue to sentence meaning in both Japanese and English as L2, English speakers in this study also used the animacy cue to a greater extent than was found in previous studies. Harrington, noting this difference, performed post hoc analyses which revealed that the lean toward animacy in English was due to the use of that cue by one subgroup of English speakers, whose performance closely paralleled that of the Japanese groups. We have already seen evidence from both Spanish-English and Dutch-English bilinguals for individual differences in bilingual processing which carry across languages; these recurring within-language differences point to a need to account in a principled way for individual differences in L2 acquisition. We will return to this issue later.

We turn first to two experiments by Ito (in preparation) which also involved English and Japanese. In Part 1, two groups of native Japanese speakers, one fluent and one nonfluent in English, and a native English control group (i.e., advanced JE2, novice JE2, and E1, respectively) performed an English sentence interpretation task in which word order and animacy cues were systematically varied. In Part 2, two native English groups, one fluent and one nonfluent in Japanese, and a native Japanese control group (i.e., advanced EJ2, novice EJ2, and J1, respectively) performed a similar task with the same cues in Japanese, but with the additional cue of topic/case particle (*wa/ga*).

Sentence Processing by Japanese-English Bilinguals in English. Three groups participated in this part of Ito's study, a monolingual English control group (E1), an advanced Japanese-English bilingual group (native Japanese speakers studying at an American university, advanced JE2), and a novice Japanese-English bilingual group (native Japanese speakers in a Japanese university, novice JE2).

The group × word order interaction in English is shown is Figure 8.7 (for purposes of comparison, the results from monolingual Japanese speakers on the same task are included as well). Native English speakers exhibited the characteristic first noun strategy on NVN sentences (87% first noun choice), and the equally characteristic second noun strategy in noncanonical strings (18% first noun choice in VNN, 23% in NNV). By contrast, both groups of Japanese-English bilinguals made much less use of word order distinctions. The advanced JE2 group did exhibit a preference for the first noun as agent in NVN orders (86%), but choice fell within chance levels for VNN (42%) and NNV (47%).

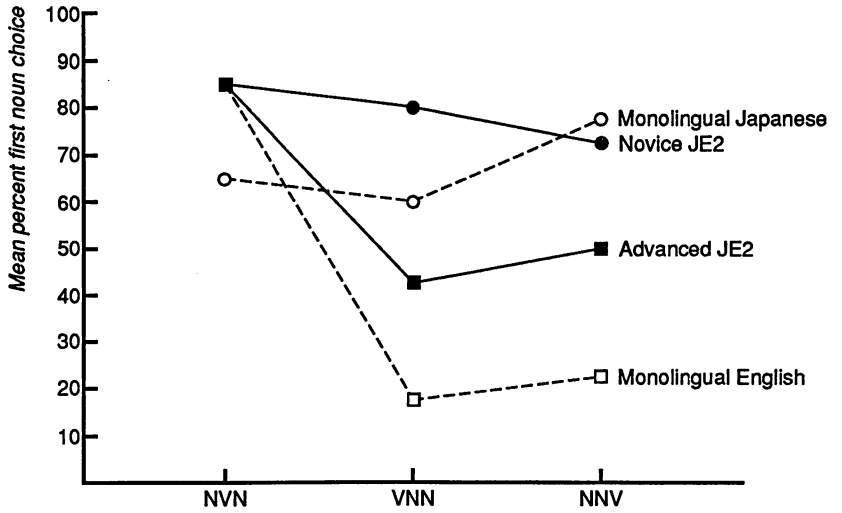

Figure 8.7. Group × word order interaction in English.

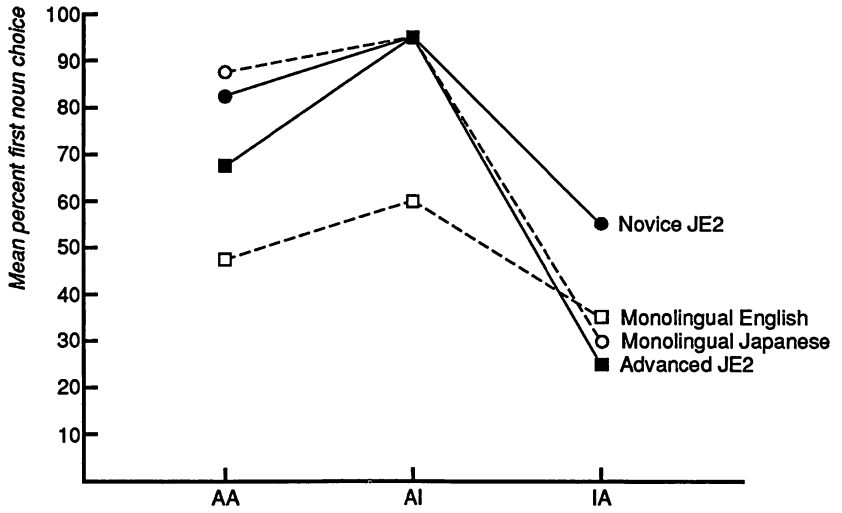

Figure 8.8. Group × animacy interaction in English.

The novice JE2 group tended to choose the first noun regardless of word order (85% in NVN, 79% in VNN, and 72% in NNV). The absence of a consistent word order strategy in these bilingual subjects suggests that sentence processing in English is guided by some other factor.

The group × animacy interaction, illustrated in Figure 8.8, shows clearly what that other factor is. Both advanced and novice JE2 groups depended heavily

on animacy as a cue to sentence meaning in English. When an animate noun preceded an inanimate one, the animate noun was chosen 96% of the time by both advanced and novice JE2 subjects. When an inanimate noun came before an animate noun, the inanimate one was chosen only 23% of the time by advanced JE2 subjects, and 55% (at chance) by novice JE2 subjects. This reflects the tendency of the latter group to select the first noun in all sentence types in English, and probably also reflects more differentiation between canonical and noncanonical orders in the advanced JE2 group. When both nouns were animate, some preference for the first noun emerged in both bilingual groups, 69% for the advanced and 84% for the novice JE2 group. In contrast, the animacy cue played a relatively minor role in the sentence processing strategies of monolingual E1 speakers. Native English controls chose the first noun in AI pairs 60% of the time, compared to 33% of the time in IA pairs. Choice in AA pairs was random.

The strong preference for animacy as a cue to sentence meaning in English in Ito's study provides further evidence for the transfer of a semantic strategy characteristic of Japanese into processing in English as a second language. These results essentially replicate the findings reported above from Harrington (1987), and they are consonant with Gass's claim about a "universal" semantic bias. Also, a weak but consistent first noun strategy in English NVN sentences was evident in Ito's findings, as well as the lack of a second noun strategy in noncanonical NNV and VNN strings. However, as Figure 8.7 shows, both bilingual groups tended, albeit weakly, to move away from the native Japanese norm in the direction of the native English use of word order, which suggests that even though the bilingual subjects made more use of animacy than word order, both advanced and novice bilingual groups may be sensitive to the role of word order as a cue in English. We will return to this point later.

This tendency was somewhat more pronounced in the advanced bilingual group than in the novice group, suggesting that overall level of fluency may be an important factor in the use of language-specific strategies. When the advanced JE bilinguals diverge from the novice group in the use of word order, it is even further in the direction of the native English controls. This suggests that, even though their overall pattern of responses is more similar to Japanese than to English norms, the more advanced speakers of English as L2 are using English-like strategies a greater proportion of the time than novice speakers.

Sentence Processing by English-Japanese Bilinguals in Japanese. In this experiment, three groups, native English speakers who are teachers of Japanese (advanced EJ2), native English speakers who are students of Japanese (novice EJ2), and a monolingual Japanese control group (J1), performed a sentence interpretation task. The factors varied included word order (NVN, VNN, NNV) and animacy (AI, IA, AA). In order to investigate the role of morphological

markers for nonnative speakers of Japanese, Ito introduced the case-marking particles *wa* and *ga* as an additional factor in this experiment. We will discuss this factor separately. We turn first to the use of word order and animacy in L2 speakers of Japanese.

Japanese sentences without particles. Figure 8.9 shows the group × word order interaction. This figure shows that both advanced and novice EJ2 speakers are affected more by the word order cue than J1 speakers. The monolingual J1 subjects chose the first noun 67% of the time in NVN, 63% in VNN, and, in keeping with a view of Japanese as an SOV language, 77% of the time in canonical NNV orders. (Note that this is somewhat contradictory with Harrington's results, in which J1 subjects showed no preference across all of the orders.) In contrast, advanced and novice EJ2 subjects chose the first noun in NVN as subject 58% and 67% of the time, respectively. In the other two word order conditions, the nonnative groups were nearly identical, preferring the first noun only 44% (advanced) and 43% (novice) of the time in VNN orders, and 88% (advanced) and 90% (novice) of the time in NNV orders. This pattern of responses by the EJ2 subjects is not what we would expect if subjects were relying on English strategies, particularly in the case of NNV orders. We will return to this finding shortly.

Figure 8.10 shows the group by animacy interaction. In Japanese, EJ2 speakers depended on animacy as a cue to sentence meaning, as did the J1 controls. This contrasts with the JE2 groups in the above studies by Ito and by Harrington, in which subjects were found to continue to rely in English on the same cue (i.e., animacy) that "wins" in their native language. Animacy is a cue which is normally assigned peripheral status in native English processing strategies. This appears, then, to be evidence that these EJ2 speakers were able to acquire the use of a cue that is appropriate to processing in Japanese.

However, several interesting differences emerged between the nonnative speakers and the native controls, differences which point to L1 intrusion into L2 processing. The effect of animacy seems to have been compromised in EJ2 subjects by a tendency to choose the first noun in IA combinations. In particular, in the IA condition, animacy competes with an interpretation based on the canonical SOV word order in Japanese. Japanese control subjects were much more likely to continue to depend on animacy in these cases, ignoring competition from the word order cue. EJ2 speakers, however, were more likely than their monolingual J1 counterparts to choose an inanimate noun if it came first, making them less consistent in their application of the prevalent Japanese strategy. The solution settled on by these EJ2 subjects indicates an elevated sensitivity to word order, which might be expected given the extreme weight placed on word order as a cue to sentence meaning in their native English. Recall that both advanced and novice EJ2 groups interpreted NNV sentences as SOV. However, an SOV word order strategy (appropriate for Japanese) runs

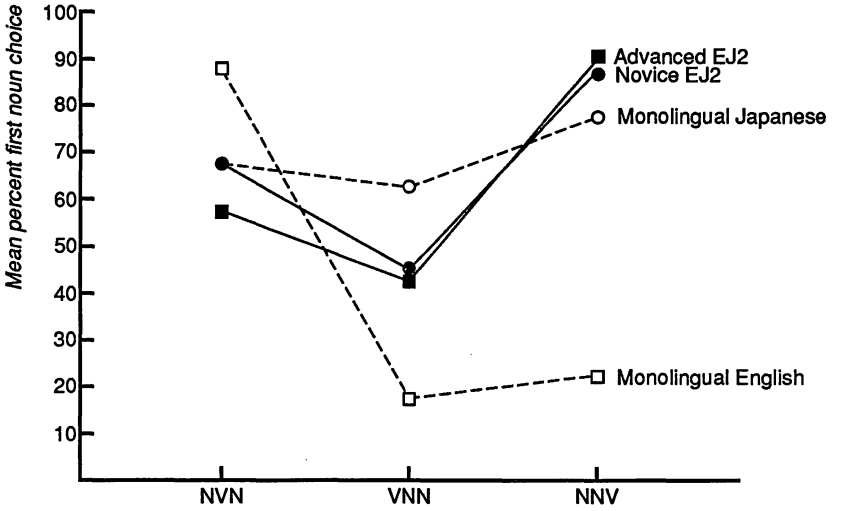

Figure 8.9. Group × word order interaction in Japanese.

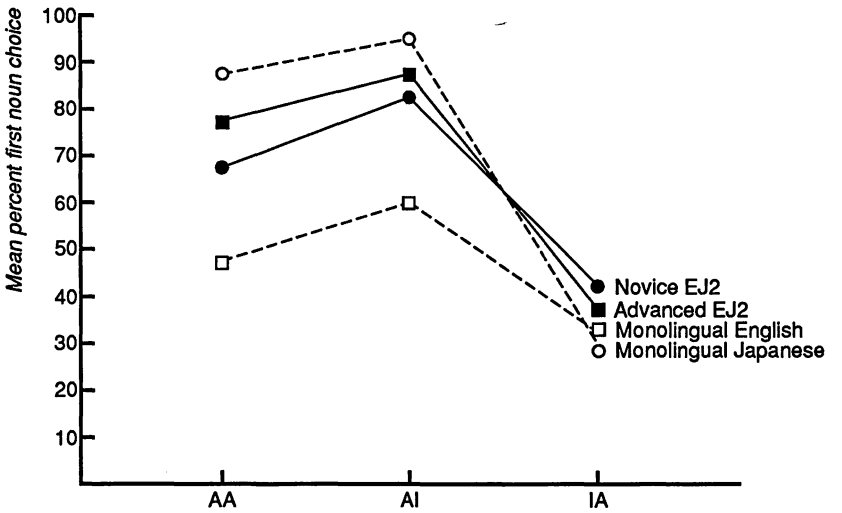

Figure 8.10. Subject group × animacy interaction in Japanese.

directly counter to the OSV bias native speakers apply to English. This provides a third kind of problem for the Competition Model.

We would like to suggest that the direct transfer of L1 strategies to L2 sentence processing, which is predicted by the Competition Model, is not the only kind of transfer. In particular, what may account for this finding is not the intrusion of a *language-specific* strategy, but rather an awareness of the potential for word

order as a cue to thematic roles in sentences. This suggests a new kind of transfer: The L2 speakers in this study may have adopted a "meta-word-order" strategy in their approach to processing in Japanese. The instantiation of this strategy may indeed reflect the use of a word order strategy, but one based on knowledge of the canonical order in L2, and not on the particular orders found in L1. This suggests some potentially important complications for the Competition Model, to which we shall return shortly.

Japanese sentences with particles. In order to investigate the role of morphological markers for nonnative speakers of Japanese, Ito introduced the case marker *ga* and the topic marker *wa* as an additional factor in the original design. As a reminder, recall that *ga* normally marks the syntactic subject, whereas *wa* signals the topic. Three separate combinations of *wa* and *ga* particles were constructed: sentences including *wa*/*ga* versus *ga*/*wa* particles (appended to the noun phrases in that order) were set up in order to test the relative "strength" of each particle in competition with the other and in different orders; in other sentences, each particle was included by itself, appended to either the first or second noun (*wa*/0 versus 0/*wa*, and *ga*/0 versus 0/*ga* combinations), in order to establish the individual contribution of each particle in different sentence positions. Percentage of first noun choice by advanced and novice EJ2 speakers and by monolingual J1 subjects in each condition is shown in Figures 8.11, 8.12, and 8.13.

Sentences with ga *alone.* The percentage of choice for nouns with *ga* as agent in 0/*ga* and *ga*/0 sentences are shown in Figure 8.11. Although all of the groups significantly preferred the noun with *ga* to the unmarked noun, differences across groups emerged only when the subject marker was attached to the first noun in the sequence. In this condition, Japanese monolinguals always chose the marked noun as agent (100% for *ga*/0), whereas the marked noun was chosen by advanced EJ2 subjects about 82% of the time, and by novice EJ2 subjects 75% of the time.

Sentences with wa *alone.* As shown in Figure 8.12, all subjects tended to choose the noun marked with *wa* more than the unmarked noun, but differences between groups were not statistically significant. If we compare the results from *ga* sentences, Japanese monolinguals appear to prefer *ga* over *wa* as the agent marker, whereas no difference is apparent in the use of these two markers in isolation by EJ2 subjects.

Sentences with ga *and* wa. When these topic and subject particles are set into competition with one another, considerably more variation across subject groups emerges. Figure 8.13 illustrates this group by particle interaction. When *ga* and *wa* appeared together in a sentence, these two particles worked competitively as cues to agency. Japanese monolinguals tended to choose *ga* considerably more than *wa* as the agent-marking device, and the same tendency, albeit weaker, was evident in the advanced EJ2 subjects. Japanese monolinguals preferred *ga*

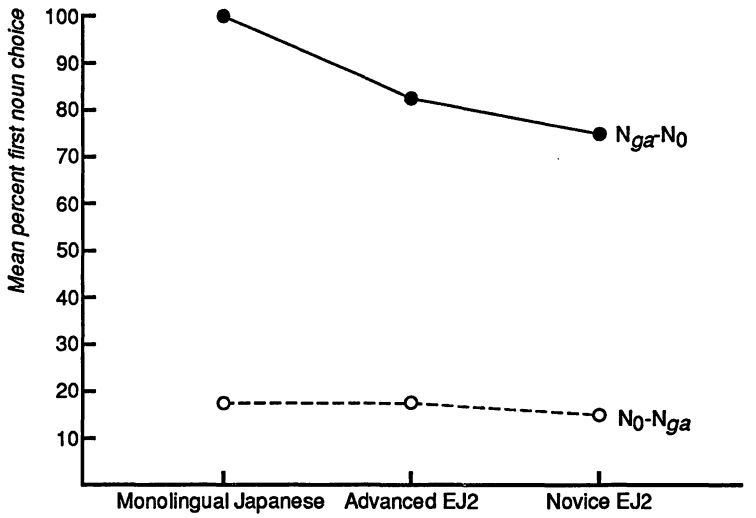

Figure 8.11. Group × sentence type ($N_{ga} - N_0$ vs. $N_0 - N_{ga}$) interaction.

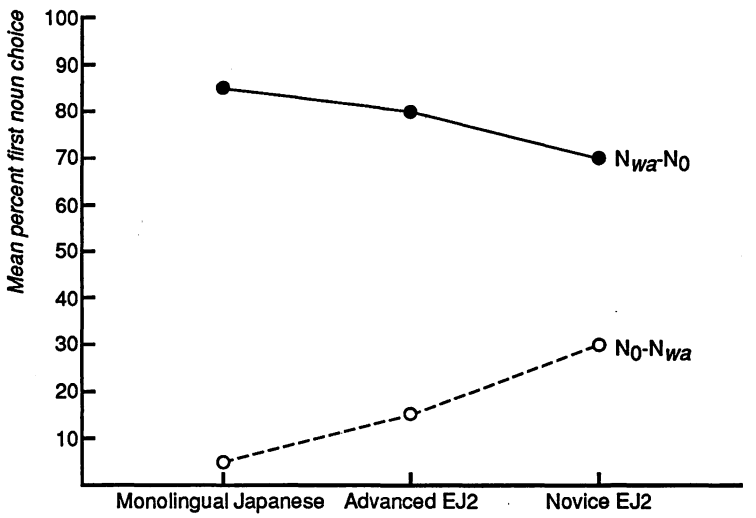

Figure 8.12. Group × sentence type ($N_{wa} - N_0$ vs. $N_0 - N_{wa}$) interaction.

over *wa* even when the two markers were in competition, regardless of order, choosing *ga* 87% of the time in *wa*/*ga* orders, and 78% of the time in *ga*/*wa* orders. Advanced EJ2 subjects also chose the *ga*-marked noun at higher than chance levels, 67% of the time in *ga*/*wa* orders and 69% of the time in *wa*/*ga* orders. However, novice EJ2 speakers preferred *wa*-marked nouns as agents in

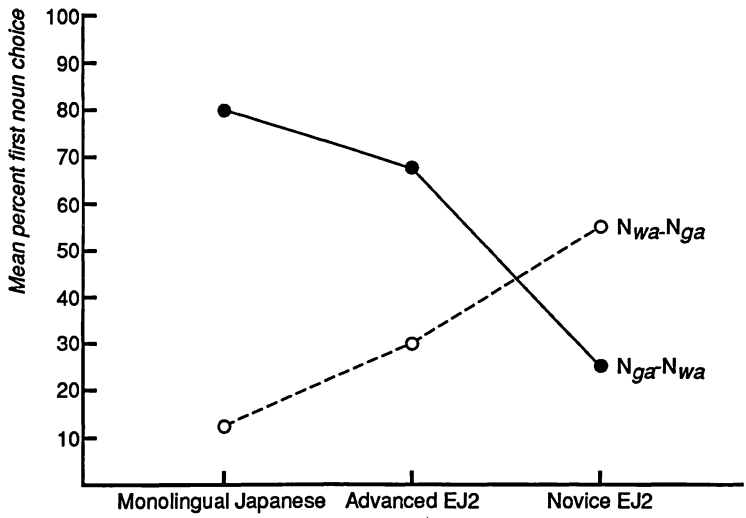

Figure 8.13. Group × sentence type ($N_{ga} - N_{wa}$ vs. $N_{wa} - N_{ga}$) interaction.

ga/*wa* orders (75% chose *wa*), but exhibited no preference in the opposite order (44% chose *ga*). To summarize, native Japanese and advanced EJ2 speakers preferred the noun with the subject marker *ga* as agent over the noun with the topic marker *wa*, whereas the novice EJ2 speakers preferred the topic-marked noun.

A subsidiary analysis showed a group × word order × particle interaction as well. Summarizing this interaction, the Japanese monolinguals overwhelmingly ignored word order, attending instead to the morphological case particle contrasts. The advanced EJ2 group, though less consistent in their dependence on this cue, showed a similar pattern. In contrast, the novice EJ2 group was largely unaffected by the presence or absence of particles of any kind in NVN and VNN orders. Rather, the word order cue appeared to "win" over competing morphological cues in these subjects. This finding is consistent with the observation made earlier that English-speaking subjects, perhaps due to their habitual tendency to utilize word order cues in their native language, may place unusually heavy emphasis on word order as a cue in Japanese as L2. What is interesting in this regard is that EJ2 novices gravitate toward SOV, a word order that is not valid in their native language. They seem to have elected a short cut to sentence interpretation, based on the "metaprinciple" that word order is important.

Discussion

The Competition Model, a functional performance model of language processing, has served as the foundation for a variety of empirical investigations into

the nature of adult processing (Bates et al., 1982; MacWhinney et al., 1984), language acquisition (Bates et al., 1984), and language breakdown in aphasia (Bates et al., 1985; Wulfeck et al., 1986). One of the foremost strengths of the Competition Model is its applicability across many language types, an aspect which distinguishes it from the majority of other models of language processing, which are based largely on work in English. This same crosslinguistic utility affords one other obvious application of this approach: the exploration of second language acquisition. The studies reported in this chapter represent the "first generation" of second language acquisition research based on the Competition Model. These experiments were carried out by various researchers, in different settings, in different languages, with slightly varying methodologies, and they were generated independently, taking off from the promise offered by one very tentative pilot study (i.e., Bates & MacWhinney, 1981). In a sense, however, their differences provide a strong test of the universality of the concepts proposed by the Competition Model to explain the real-time processing characteristics of individuals who speak more than one language.

One goal shared by all of the studies discussed here is to identify the conditions under which a second language speaker's two language systems may interact. This interaction may take various forms; in the context of these studies, we have observed different kinds of transfer reflected in the strategic variations adopted by bilinguals in the sentence interpretation tasks. It is in this context that we can identify whether and to what extent (1) strategies appropriate to first language processing are applied to the second language; (2) a "switchover" to L2 strategies occurs; (3) appropriate L1 strategies are adopted for each language; or (4) an amalgam of L1 and L2 processing strategies leading to an "in-between" stage in interpreting L1 sentence cues exists.

Understanding a "Partial" Language System

The Competition Model has offered one way to define what it means to be between languages, without necessary reference to rules. An important aspect of this approach is that it allows us to characterize the partial language system of the learner as the result of a general learning mechanism and its sensitivity to the cue distribution that defines the target grammar. This is accomplished via an account of how various cues to assigning formal surface devices to underlying functions can operate. The notion that cues can vary in strength suggests a straightforward way to acount for many of the findings reported here; in conjunction with this, the competition or convergence of cues helps explain how different strategies may be adopted at different times in the course of acquisition. Cues may be "tuned" according to various factors, some under learner control (e.g., vocabulary size in L2, attention to particular elements in discourse, etc.), and some in the language/structural domain (e.g., absolute

frequency of lexical items, particular grammatical constructions, specific global constraints on WO, subject-topic cohesion, etc.). This has obvious implications for any situation in which languages come into contact. For example, a foreign language teaching program that emphasizes aspects of the language-to-be-learned, which are likely to encounter interference from the "linguistic underground" of the native language, may facilitate learning.

Bilingual Sentence Processing: Implications for the Competition Model

The studies of bilingual sentence processing based on the Competition Model have shown that three problems exist for a straightforward application of the notion of cue validity to second language acquisition. The first problem is the persistence of L1 strategies in L2 processing even after decades of exposure and practice in L2. Second, individual variation, both within and across languages, has consequences for the generality of the performance aspect of the model. Third, the model's account of transfer or intrusion from L1 into L2, based on a more or less direct invasion of L1 cues, is challenged by evidence for a "meta-strategic" level of transfer, which may involve conscious manipulation of rules. We will discuss each of these problems in turn.

1. Persistence. One of the central assumptions of the Competition Model is that processing is essentially cue-driven. A language processing system that takes full advantage of the cues provided by the language would certainly be sensitive to the often vast differences across languages, and thus we would expect to find that bilinguals are able to realign their own processing strategies to suit the available cues. As we have seen, however, the sometimes stubborn application of L1 strategies to L2, despite lengthy exposure to L2, shows incredible insensitivity to the very cues that are supposed to lie at the heart of the process.

There are two ways to reconcile the phenomenon of persistence with the underlying principles of the Competition Model. One way involves a property of the learning mechanism recruited in the service of language. Although it seems incredible on the surface that core L2 strategies are resisted despite years of exposure, it may be the case that this persistence results from the statistics of massive overlearning of L1. Once established, cue weights may be difficult to change; in other words, what appears to be extensive exposure to L2 may not begin to compare with the amount of exposure experienced by L1 learners (whose cues, incidentally, generally have no crosslanguage competition). This notion could be tested by simulations in which cue weights are adjusted according to relative amounts of exposure.

A second way out of the persistence problem is provided by the observation that natural languages contain a large degree of redundancy. This redundancy

may permit L2 speakers to "reconfirm" their old (L1) tunings often enough to stave off the rare disconfirmations. For example, not all NVN strings in German require an SVO interpretation, but each instance which does so would tend to "shore up" a native English speaker's already well-established bias in that direction.

The cue settings made in the course of L1 acquisition have been seen to persist far into L2 acquisition, perhaps indefinitely. Although it is possible that vastly different mechanisms are at work in L1 versus L2 acquisition, the Competition Model suggests another possibility. L1 and L2 acquisition may differ not as much in terms of their underlying properties as they do in the emphasis placed on the imperativeness of making complete and unambiguous form–function assignments. The strength, and later persistence, of L1 cues may derive from principles of optimality, which demand that the L1 learner establish the best, most complete form–function assignments possible, regardless of cognitive "cost." L2 acquisition, on the other hand, is more likely to reflect principles of economy, since the L2 learner is primarily motivated to learn to communicate efficiently and quickly, even if it means failing to achieve nativelike performance on some parameters.

2. *Individual Differences.* The issue of individual differences has arisen consistently in work with second language learners. As suggested earlier, it is possible that each of the four bilingual sentence processing possibilities suggested by the Competition Model (i.e., L1 strategies applied to L2, L2 strategies acquired correctly, L2 strategies come to supplant L1 strategies, and the acquisition of an amalgam of L1 and L2 strategies) are observable at some point. Indeed, they may be observable within a single individual, depending on a variety of factors. Both input conditions, such as formal language instruction versus naturalistic acquisition, and output conditions, such as code-switching or social register, may be factors in individual differences. In any case, it is not unreasonable to assume that individuals will differ in the particular path they take to fluency in a second language.

In several of the studies discussed here, researchers report finding individual differences among subjects of different language groups. Wulfeck et al. (1986) identified two subgroups among native Spanish speakers. One subgroup depended heavily on a word order strategy, whereas agreement and animacy cues dominated the processing strategy of a second subgroup. Interestingly, each subgroup applied their particular strategy to processing in both Spanish and English. Kilborn and Cooreman (1987) found essentially the same dichotomous strategy differences in native Dutch speakers. Again, it appears that subjects applied the strategy they settled on uniformly across their two languages.

Individual differences have also been observed in monolingual processing, albeit to a lesser extent. Bates et al. (1982) observed patterns of individual

differences within groups of monolingual native speakers of Italian and of English. The so-called least English group of E1 speakers showed unusually strong interest in animacy cues. The so-called least Italian group of Italians showed an unusual interest in SVO word order. Nevertheless, subsidiary analyses showed that the direction of other language-specific differences remained the same even within these extreme language groups. For example, "least Italians" were still more influenced by topicalization and contrastive stress cues than "least English." The outlaws retained recognizable signs of their native language.

Harrington (1987) observed that animacy was more pronounced in his monolingual English subjects than in previous studies. He attributed this finding to the presence of two subgroups within the English group, one which relied on word order, as expected, and one which relied on animacy, much in the same way as his Japanese subjects did. McDonald (this volume) identified individual differences in the way certain cues were applied by native speakers of German, Dutch and English. Although some subjects were quite consistent in their form–function mappings, others were much less so. For instance, case inflection may dominate all other cues for some subjects, whereas for others different cues may at times be the strongest.

Kail (this volume) found that some adult native speakers of French differed in their use of word order and animacy cues. On NVN strings, which are interpretable as SVO, the canonical word order in French, most F1 subjects relied on word order. But with noncanonical NNV and VNN orders, a syntactic strategy gave way to a semantic strategy in many F1 subjects. Kail suggests that subjects may in fact be sensitive to the competition between word order and animacy, and split their strategies accordingly. And, as we might expect, subjects differed to some degree in their tendency to treat canonical and noncanonical orders differently, underscoring the point that even "individual differences are a matter of degree."

Just as alternative sentence processing strategies may be open to individuals, there may be alternative segmentation routines available at the phonemic and syllabic levels. Cutler, Mehler, Norris, and Segui (1986) show that adult French speakers use syllabic speech segmentation regardless of whether the words heard were French, in which words are easy to syllabify, or English, in which words do not have clearly bounded syllables. English listeners, however, do syllabify in the same way, whether in English or in French. Cutler et al. propose that speakers have a range of segmentation procedures available to them; the one they typically use will tend to be the most efficient one for the language they speak. This may also involve mixing segmentation routines when necessary.

Returning to sentence processing, Bates et al. (1982) suggest several possible sources for such differences: an agreement versus animacy bias may have independent psychological status; or subjects may simply choose one of several possibilities and stick with that one. As noted earlier, Gass (1987) has suggested

that semantics may be a "universally" stronger force than syntax, and thus more prone to be the cue which carries over to L2 processing. But this suggestion runs directly counter to the stronger "meta-word-order" strategy observed in many EJ2 speakers. Faced with a limited number of cues to choose from, none of which is particularly overwhelming, individual preferences may determine what strategy will win.

McDonald (1986) points out two other potential causes for individual differences: First, because in most cases subjects are required or encouraged to respond within a very short time (typically 2 seconds or so), some subjects may not have enough time to completely resolve the conflict in a sentence. Second, the nature of the immediately preceding context may influence the mapping strength of cues in the current sentence, in turn influencing the interpretation of the sentence. The repeated finding of similar subgroup differentiation in the context of even typologically different languages suggests that this effect is not accidental or due to language-specific factors. Moreover, it sounds a cautionary note by indicating that individual differences may be an important factor in any language processing study, and especially in within-subject comparisons of bilingual language use.

3. Language Transfer: Strategies and Meta-Strategies. The studies discussed in this chapter provide extensive evidence for the invasion of L1 strategies into L2 processing. The Competition Model handles this direct transfer without problem: the L2 speaker continues to rely on cue weights assigned to various form–function mappings in L1. Although the Competition Model accounts in a straightforward way for basic transfer phenomena, other findings reported here provide a challenge. In particular, native English speakers interpreted NNV sentences in Japanese as SOV, which is the canonical word order in simple, declarative sentences in Japanese. Based on the Competition Model, two alternate strategies are predicted. First, L2 strategies may be adopted. If subjects had followed this course, they would have shown no preference for either noun in NNV strings, relying instead like native Japanese on semantic features of the nouns. This was clearly not the case. Second, transfer or intrusions from L1 into L2 processing ought to involve cues which are "imported" as directly as possible from L1. Though this does not mean that L1 cues cannot interact with L2 cues, it does mean that the cues which are incorporated into the L2 processing strategy should be drawn from the same level of processing. For example, the model would predict that if an English word order-based strategy invades into Japanese processing, native English speakers ought to treat Japanese NNV strings as if they were English NNV strings, that is, as OSV. However, contrary to the Competition Model notion of transfer, these subjects preferred the SOV reading, at a much higher level than evidenced by native Japanese.

We are led to a different kind of explanation, one which may require some

modification of the crosslanguage transfer component of the model. Recall that the canonical word order in Japanese is SOV, which was precisely the interpretation of NNV strings made by novice Japanese L2 speakers. Clearly, simple transfer of a particular word order bias cannot account for this result. What transfer may consist of in this case is the *top-down* application of a strategy from L1, producing an almost rulelike effect: Word order is still at the core of the native English speakers' L2 processing strategy, just as it is in L1. However, rather than an English-specific SVO bias, what invades is a higher level strategic bias to pay attention to word order as a cue to sentence meaning. Note that this involves a very different level of processing than the one assumed by the Competition Model.

The course of a meta-strategy would go something like this: English speakers may notice that the least complex sentences are most often of the SOV form in Japanese. This S-first property may then be extrapolated to aid in the interpretation of subsequent input, on the assumption that word order properties ought to be relatively invariant. More complex constructions, however, may include many instances in which this assumption would be incorrect. Japanese speakers, and fluent L2 speakers, are able to depend on other types of information, such as case and topic marking morphology, which present problems for the on-line interpretation of Japanese by less fluent speakers. Of course, the phenomenon may be much more general: When all else fails, or input is hard to separate out, the learner may adopt the strategy of attending to global, robust features of the grammar. The issue remains the same, however, since the L2 features which appear robust to a beginning learner are likely to be the ones which are near the core of L1.

The meta-word-order strategy was observed only in novice L2 learners, but not in more advanced learners. This is not surprising, since if such a meta-word-order strategy exists, then we would not expect it to persist for long. For one thing, increasing familiarity with appropriate L2 cues and their clear advantages in a real-time processing system ought to lead to a gradual fading of initially useful but slower rule- or monitor-driven approaches. This view is consistent with the Monitor Theory of second language learning proposed by Krashen (1978, 1982). According to Krashen, the early stages of second language learning are characterized by the more or less conscious monitoring of L2 input and output, based on the learner's knowledge of the rules of the target language. Eventually, these rules are internalized, and though they form the basis for efficient, rapid L2 processing, the monitor itself no longer plays an active role in comprehension or production.

Without further evidence we cannot know whether such meta-level strategies actually constitute some level of processing, and lead to transfer, or whether they are merely epiphenomena, perhaps specific to the narrowly defined tasks used in these studies. Two kinds of data would have a bearing on this issue.

First, assuming that such rulelike transfer does occur, we ought to find similar meta-strategies involving other cues, such as agreement or animacy, in native speakers of languages in which those cues play a more central role than they do in English. Indeed, what we have taken to be a more or less direct transfer, as in the application of agreement cues by native speakers of German to English as L2, may also involve higher level strategies. One way to distinguish between simple transfer and a purported meta-strategy is to set up a processing task so that the L2 speaker has the opportunity to use a rule that native speakers of that language generally do not use, as we observed in the novice L2 learners of Japanese.

The second kind of evidence that would be relevant here involves performing machine-based simulations of L2 acquisition. Simulation studies of L1 acquisition have shown that complex, apparently rule-driven behavior can "fall out" of a system that includes no explicit rules, a general learning function based on analogy, and fairly minimal input. Rumelhart and McClelland (1986) used such a system to show that English past tense rules, including many instances of irregular verbs, could be simulated in great detail, including the characteristic U-shaped function corresponding to an initial rote period during which children simply copy the correct verb forms, followed by an error-prone period, during which the past tense "rule" is overgeneralized, followed by the gradual settling in of both regular and irregular forms. Rumelhart and McClelland suggest that this is one instance in which apparently rule-governed acquisition may not involve rules at all, but is instead a solution which emerges from a limited set of nodes with changeable interconnections.

Likewise, a meta-strategy in L2 processing may be the result of preset cue mappings in L1 which interact with incoming information about new cue mappings in L2; the apparently rule-governed behavior in this case, as in the case of past tense acquisition in English, may be another instance of an emergent solution in the context of acquiring a complex communication system. In this view, the rule which appears to underlie the processing behavior is not necessarily a component of the processing system itself, but is rather an emergent property of a system which is subject to a wide range of constraints. These may include restrictions on short-term memory, on the ability to process competing information sources (e.g., cues) in parallel, and especially in the case of novice L2 learners, a lack of automatic access to a variety of processing factors (e.g., lexical meanings may initially require some sort of look-up function which may interfere with other levels of processing simply because it takes time).

It is clear now that, at the very least, L2 learning offers a qualitatively different perspective on the general questions of representation and learning of language. We believe that this perspective can be broadened by further work, guided by a functional view, in the area of L2 acquisition.