

Abstract

The mechanisms underlying language production are often assumed to be universal, and hence not contingent on a speaker's language. This assumption is problematic for at least two reasons. Given the typological diversity of the world's languages, only a small subset of languages has actually been studied psycholinguistically. And, in some cases, these investigations have returned results that at least superficially raise doubt about the assumption of universal production mechanisms. The goal of this paper is to illustrate the need for more psycholinguistic work on a typologically more diverse set of languages. We summarize cross-linguistic work on sentence production (specifically: grammatical encoding), focusing on examples where such work has improved our theoretical understanding beyond what studies on English alone could have achieved. But cross-linguistic research has much to offer beyond the testing of *existing* hypotheses: it can guide the development of theories by revealing the full extent of the human ability to produce language structures. We discuss the potential for interdisciplinary collaborations, and close with a remark on the impact of language endangerment on psycholinguistic research on understudied languages.

Key phrases

sentence production; grammatical encoding; cross-linguistic; field-based psycholinguistics

The Cross-linguistic Study of Sentence Production

1 Introduction

In order to communicate, speakers need to encode the messages they intend to convey into an acoustic signal. Speakers need to select the words necessary to convey the intended message, determine the functional dependencies between them, arrange them in an acceptable order, and retrieve the phonological information necessary to initiate articulation. Despite the obvious complexity of this task, speakers usually master it in real time, while (more or less) obeying language-specific grammatical constraints, and while maintaining a high degree of fluency. Psycholinguistic research on sentence production seeks to understand the linguistic processes, representations, and interfaces involved in the encoding of pre-linguistic messages into linguistic form and, ultimately, into articulation. In this paper, we describe how evidence from the cross-linguistic study of language production (work on different languages) –albeit still rare- has advanced our theoretical understanding of this area of psycholinguistics. We discuss some of the challenges of cross-linguistic work and suggest future directions for this research program.

We limit ourselves to what is commonly referred to as *grammatical encoding*, the first “steps” in the process from thought to articulation. Grammatical encoding is the process of selecting the lexical entries and syntactic frames necessary to encode the intended pre-linguistic message. This process is commonly assumed to involve two stages (Bock & Levelt, 1994; Garrett, 1980; Kempen & Hoenkamp, 1989; Levelt, 1989; but see Branigan, Pickering, and Tanaka, 2008; Kempen & Harbusch, 2004), *functional processing* and *positional processing*, as illustrated in Figure 1 (reprinted from Bock & Levelt, 1994).

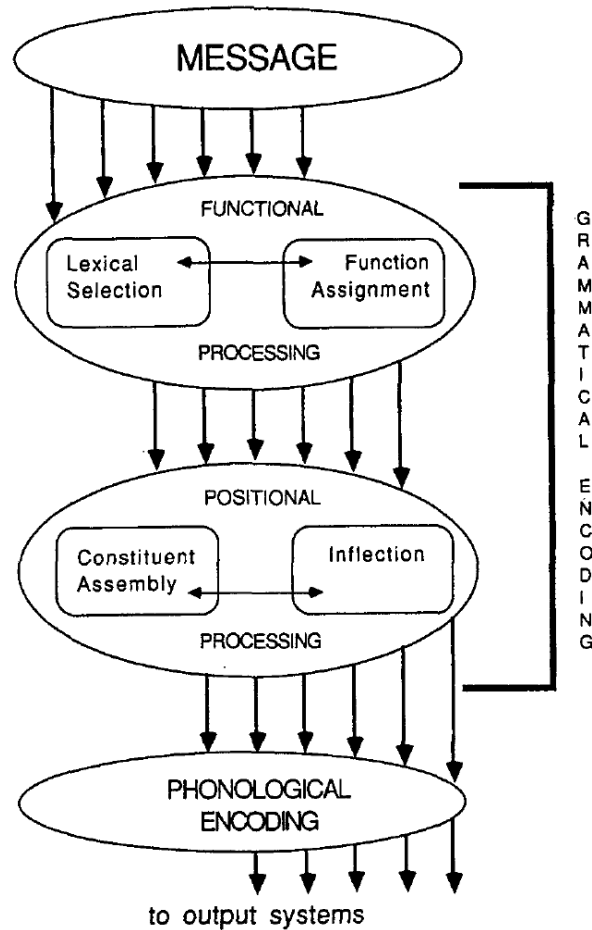


FIGURE 1 Model of sentence production (reprinted from Bock & Levelt, 1994)

During functional processing, speakers are assumed to select lexical entries, retrieve their syntactosemantic information, and assign grammatical functions (i.e. determine which referent bears the subject function, etc.). During positional processing, the retrieved lexical items are then inflected (e.g. subject-verb agreement), assembled into constituents, and linearized.

Most psycholinguistic research assumes that the architecture of the language production system is universal and hence does not depend on speakers' native languages (e.g. Bock et al., 2006; Bock, Eberhard, Cutting, Meyer, & Schriefers, 2001, but see discussions in Bates & Devescovi, 1989; Bates & MacWhinney, 1982; MacWhinney & Bates, 1989; and references below). Indeed, at least at a very general level, accounts originally based on evidence mostly from English, Dutch, and German (Bock &

Levelt, 1994; Garrett, 1980; Kempen & Hoenkamp, 1989; Levelt, 1989) seem to be compatible with evidence from other languages. Several production phenomena, including accessibility-sensitive and complexity-sensitive sentence production, syntactic persistence (discussed below), have been attested in all languages investigated so far.

However, the set of languages that have been studied psycholinguistically is small. Out of more than 5,000 languages spoken across the world, less than 30 have been subjected to controlled psycholinguistic investigation on sentence production, most of which resemble each other typologically. Even for this typologically rather homogeneous sample, there is evidence that language-specific properties affect language processing and that not all aspects of language production are fully universal (cf. evidence from agreement processing, discussed below). But cross-linguistic work can do more than just check whether our fundamental assumptions about language production are justified. We give examples from work on grammatical encoding where cross-linguistic evidence has distinguished between competing psycholinguistic accounts.

We believe that the value of cross-linguistic work goes even further, beyond the direct comparison of *existing* psycholinguistic theories. Cross-linguistic work on sentence production and, more generally, psycholinguistics drives progress by broadening the empirical base in need of explanation. In addition, we argue, cross-linguistic work provides a great opportunity (and need) for interdisciplinary collaborations between linguists and cognitive scientists.

2 Current Findings in Cross-linguistic Research on Sentence Production

We summarize three widely studied research themes on grammatical encoding, focusing in particular on the impact that cross-linguistic work has had on theoretical development. First, we summarize research on how the relative accessibility of referents involved in a message affects sentence production and what this reveals about the extent to which sentence production is incremental. Second, we summarize research on agreement (e.g. subject-verb agreement), which aims to answer to whether conceptual information, which is generally considered pre-linguistic, is available during grammatical encoding. Finally, we summarize

research on how the complexity of constituents affects constituent order. We conclude this section by briefly mentioning other areas of cross-linguistic research on sentence production.

2.1 Accessibility and grammatical encoding

Much cross-linguistic work on sentence production has focused on so called *conceptual accessibility* effects (Bock & Warren, 1985) and implications about the time course of incremental sentence production. In its most general sense, conceptual accessibility refers to the ease of retrieval of a referent and the corresponding expression from memory. Conceptual accessibility has been linked to both inherent properties of referents (accessibility increases with *imageability*, Bock & Warren, 1985; *prototypicality*, Kelly, Bock, & Keil, 1986; Onishi, Murphy, & Bock, 2008; *animacy/humanness*, Bock, Loebell, & Morey, 1992; Bresnan, Cueni, Nikitina, & Baayen, 2007; Byrne & Davidson, 1985; Dennison, 2008; F. Ferreira, 1994; Kempen & Harbusch, 2004; McDonald, Bock, & Kelly, 1993; Prat-Sala & Branigan, 2000; Rosenbach, 2005; van Nice & Dietrich, 2003) and contextually conditioned properties (accessibility increases with *previous mention* of the same referent, Bock & Irwin, 1980; Bresnan et al., 2007; V. S. Ferreira & Yoshita, 2003; MacWhinney & Bates, 1978; Prat-Sala & Branigan, 2000; *semantic similarity* to recently mentioned words, Bock, 1986b; Igoa, 1996; *visual salience*, Gleitman, January, Nappa, & Trueswell, 2007; Myachykov, 2007; Myachykov, Garrod, & Scheepers, forthcoming; Myachykov, Posner, & Tomlin, 2007). Production researchers have been interested in conceptual accessibility, because it affects speakers' word order choices, for example, in active vs. passive voice (*Lightning struck the church* vs. *The church was struck by lightning*) or the ditransitive alternation (*John handed a book to Mary* vs. *John handed Mary a book*). Early findings suggested that more accessible material is generally produced earlier in such environments (Bock & Warren, 1985), which has been taken to suggest what Ferreira and Dell (2000:289) call the Principle of Immediate Mention: "Production proceeds more efficiently if syntactic structures are used that permit quickly selected lemmas to be mentioned as soon as possible." Production is assumed to be radically incremental, greedily proceeding with whatever material is available first, wherever speakers have the choice to do so (i.e. where grammar permits it). In this view,

conceptual accessibility affects word order *directly* (i.e. during positional processing; see also Branigan & Feleki, 1999; V. S. Ferreira & Yoshita, 2003; Kempen & Harbusch, 2004; Prat-Sala & Branigan, 2000). According to an alternative proposal, conceptual accessibility affects word order *indirectly* by affecting grammatical function assignment to referents (during functional processing, Bock & Warren, 1985; F. Ferreira, 1994). According to indirect accounts of conceptual accessibility effects, a passive becomes more likely when the patient (the entity being acted on) is more accessible than the agent (e.g. *The boy was struck by lightning* vs. *The church was struck by lightning*) because speakers prefer to assign the subject function to the most accessible referent (Bock & Warren, 1985). Unfortunately, direct and indirect accounts are hard to distinguish based on English data alone, because “structures separating grammatical function from string prominence are rare in English” (Christianson & Ferreira, 2005: 109; see also Branigan, Pickering, & Tanaka, 2008; Prat-Sala & Branigan, 2000). For example, English passivization not only assigns the subject function to the patient, the patient is also mentioned earlier than in the active.

Prior to cross-linguistic work on conceptual accessibility, the distinction between the two accounts rested on one piece of data: the fact that animacy affects word order variations involving different mappings between referents and grammatical function (such as the voice and ditransitive alternations), while apparently not affecting word order in NP coordination, where the two word orders do not correspond to difference in grammatical function assignment (*The lost hiker fought time and winter* vs. *The lost hiker fought winter and time*; Bock & Warren, 1985; McDonald et al., 1993; Osgood & Bock, 1977). Other studies have found conflicting evidence (Gleitman et al., 2007; Kelly et al., 1986; Onishi et al., 2008). Yet others have pointed out that NP coordination is a syntactically unusual structure for independent reasons (Branigan et al., 2008), making it all the more desirable to have additional evidence distinguishing direct and indirect accessibility accounts.

This evidence has come from the cross-linguistic study of accessibility effects (already called for in Osgood & Bock, 1977: 133), including work on Fijian (Byrne & Davidson, 1985), German (Kempen & Harbusch, 2004; van Nice & Dietrich, 2003), Greek (Branigan & Feleki, 1999), Hungarian and Italian (MacWhinney & Bates, 1978), Japanese (V. S. Ferreira & Yoshita, 2003; Tanaka, Branigan, & Pickering,

forthcoming), Korean (Dennison, 2008), Odawa (Christianson & Ferreira, 2005), Russian (Myachykov, 2007), Spanish (Prat-Sala & Branigan, 2000), and other languages (Sridhar, 1988 presents evidence from Cantonese, Hebrew, Finnish, Slovenian, English, Spanish, Hungarian, Japanese, Kannada, Turkish; see also Chang, Lieven, & Tomasello, 2008). For example, while grammatical function and word order are fairly highly correlated in English, languages with case-marking tend to have more flexible word order (presumably because they do not need to rely on word order as a cue to grammatical function):

(1a) Sta dimokratika politevmata, ton politiki sevete to sindagma (Greek)
 in democratic regimes the citizen_{ACC} respects the law_{NOM}
'In democratic regimes, the law respects the citizen.'

(1b) Sta dimokratika politevmata, to sindagma sevete ton politiki
 in democratic regimes the law_{NOM} respects the citizen_{ACC}
'In democratic regimes, the law respects the citizen.' (Branigan & Feleki, 1999:4-5)

Studies on such languages in which word order can vary more freely without changes in grammatical function assignment have found that animacy affects word order even after grammatical function assignment is controlled for (see Kempen & Harbusch, 2004 for German; Branigan & Feleki, 1999 for Greek; Tanaka et al., forthcoming for Japanese). Similar effects have been observed for givenness (MacWhinney & Bates, 1978 for Italian and Hungarian; V. S. Ferreira & Yoshita, 2003 for Japanese). This provides evidence for a direct effect of accessibility on word order. However, independent effects of accessibility on grammatical function assignment have also been observed.

Consider Japanese, a case-marking verb-final language, that allows both subject-object-verb (SOV) and object-subject-verb (OSV) sentences and does so in both the active and the passive voice (distinguished on the verb).

(2a) Active SOV sentence (Japanese)

booto-ga gonin no hito-o hakonda.
boat-NOM five people-ACC carry-PAST
'A boat carried five people.'

(2b) Active OSV sentence

gonin no hito-o booto-ga hakonda.
five people-ACC boat-NOM carry-PAST
'Five people, a boat carried.'

(2c) Passive SOV sentence

gonin no hito-ga booto-niyotte hakobareta.
five people-NOM boat-OBL carry-PAS-PAST
'Five people were carried by the boat.'

(2d) Passive OSV sentence

booto-niyotte gonin no hito-ga hakobareta.
boat-OBL five people-NOM carry-PAS-PAST
'By the boat, five people were carried.'

(Tanaka et al., in prep)

These properties make it possible to study both indirect and direct accessibility effects on the same language. As expected by direct accounts, Japanese speakers prefer to realize animate referents earlier in the sentence, independent of whether they carry the subject or object function (Tanaka et al., forthcoming, Experiment 1). However, as expected by indirect accounts, Japanese speakers also prefer to assign the subject function to animate referents (independent of word order, Tanaka et al., forthcoming, Experiment 2; see also Christianson & Ferreira, 2005 on Odawa).

In sum, cross-linguistic work provides strong evidence that conceptual accessibility affects word order both indirectly during functional processing and directly during positional processing, which has led some researchers to reject the assumption that these two 'stages' of grammatical encoding are independent (Branigan et al., 2008; Kempen & Harbusch, 2004; Tanaka et al., forthcoming) – a conclusion that would be hard or impossible to arrive at without cross-linguistic data on sentence

production.

2.2 Incrementality

Cross-linguistic investigation has also contributed significantly to another area of research that is tightly linked to the question of whether accessibility affects production directly or indirectly (e.g. Dutch and French: Brysbaert, Fias, & Noel, 1998; German: van Nice & Dietrich, 2003; Odawa: Christianson & Ferreira, 2005; Spanish: Brown-Schmidt & Konopka, 2008). The presence of direct accessibility effects has been taken to indicate that grammatical encoding is a strongly incremental process: presumably to maintain fluency, speakers continue with whatever material becomes available first whenever grammar permits it (cf. Ferreira and Dell 2000:289; see also V. S. Ferreira, 1996; Kempen & Harbusch, 2003; Kempen & Hoenkamp, 1989; Levelt, 1989; Roelofs, 1998; Wheeldon & Lahiri, 1997; but see Bock, 1986a: 359). But just how incremental is grammatical encoding (Christianson & Ferreira, 2005; F. Ferreira & Swets, 2002)?

Brown-Schmidt and Konopka (2008) take advantage of an asymmetry between Spanish and English to demonstrate that speakers initiate pronunciation of a noun phrase before all its parts are retrieved. While adjectives precede the noun they modify in English (*the small butterfly*), they follow the noun in Spanish (*la mariposa pequeña*). Brown-Schmidt and Konopka show that Spanish speakers retrieved the adjective later in Spanish than in English, consistent with the hypothesis that sentence production is highly incremental (see also Brysbaert et al., 1998 on Dutch and French; van Nice & Dietrich, 2003 on German; but see Christianson & Ferreira, 2005; F. Ferreira & Swets, 2002). Results like these demonstrate the power of cross-linguistic psycholinguistic investigations, but further work is necessary to see whether the finding extends beyond the planning and production of noun phrases. Some studies on English suggest that speakers need to plan the subject and verb of a sentence before they initiate articulation, arguing for a special status of the sentence subject and predicate and against radical incrementality (Lindsay, 1975; also Smith & Wheeldon, 1999). It is an open question how this finding would extend to verb-final languages or languages where the subject usually follows the verb. For

example, do Japanese speakers initiate articulation only after the sentence-final verb is planned? Some evidence that previous studies (Lindsley, 1975; also Smith & Wheeldon, 1999) have underestimated incrementality comes from studies showing that utterances can be initiated when as little as one word has been fully planned (Griffin, 2003; Wheeldon & Lahiri, 1997; also Brysbaert et al., 1998). One possible reason for the conflicting data may be that incrementality is to some extent under speakers' strategic control: under time pressure, speakers initiate articulation earlier (F. Ferreira & Swets, 2002 on English; van Nice & Dietrich, 2003 on German). This area will most likely benefit from further cross-linguistic work on languages with different base word orders than most German languages.

2.3 Conceptual vs. grammatical influences during agreement processing

Psycholinguists have studied what information is available at different processing stages. While, for example, modularist accounts assume restrictive interfaces between the different stages of production such as conceptual processing, functional and positional processing, and phonological encoding (Garrett, 1976, 2000; Levelt, 1989), others take the view that information can spread more freely between levels (Vigliocco & Franck, 2001; also cascading activation and connectionist accounts of lexical access and grammatical encoding, Caramazza, 1997; Chang, Dell, & Bock, 2006; Dell, 1986; Dell, Chang, & Griffin, 1999; Stemberger, 1985). One phenomenon that has been studied extensively with regard to this question is *agreement* (e.g. subject-verb agreement, as in *The road is wet* vs. *The roads are wet*). Agreement provides a window into what information is available during positional processing (the hypothesized second stage of grammatical encoding, during which agreement/inflection takes place, see Figure 1). In particular, psycholinguists have investigated what role conceptual (a.k.a. notional) information plays in agreement processing, and whether the availability of this information might vary across languages (Bock, Carreiras, & Meseguer, forthcoming; Bock et al., 2001; Eberhard, Cutting, & Bock, 2005; Lorimor, Bock, Zalkind, Sheyman, & Beard, 2008; Vigliocco & Franck, 1999, 2001; Vigliocco & Hartsuiker, 2002).

Consider the word *cats*. At the conceptual level, speakers begin with a notion of the numerosity of the referent, in this case, a multitude of cats. At the grammatical level, this preverbal notion undergoes linguistic encoding as a word bearing grammatical number features. *Grammatical* number refers to the linguistic agreement properties of a word. For example, we know that *cats* is grammatically plural because words that agree with it, e.g. finite verbs, must themselves be plural. Typically, grammatical number and notional number converge, though not always. *Scissors* for example, is grammatically plural, but notionally singular, that is, it is conceived of as a single object (Bock et al., 2001). Conversely, *clothing* can denote a multitude, yet is grammatically singular. Mismatches between grammatical and notional number extend to noun phrases as well. For example, although the phrase the picture on the postcards is grammatically singular, it has a distributive interpretation (multiple postcards bearing the identical picture), which can favor notional plurality in a speaker's mental model (Eberhard, 1999; R. J. Hartsuiker, Kolk, & Huinck, 1999; Vigliocco, Butterworth, & Garrett, 1996; Vigliocco, Butterworth, & Semenza, 1995).

Experimental investigations of conflicts between notional and grammatical number provide evidence for the existence of two separate components of number information in agreement resolution. This has been observed most often for distributive construals of noun phrases. For example, Humphreys and Bock (2005) found that English speakers were more likely to use plural verbs after subject noun phrases like the gang on the motorcycles, which have a distributive construal, than after minimally different phrases like the gang near the motorcycles, which don't. Distributivity has been shown to affect subject-verb agreement in a number of languages, including English, Dutch, French, Spanish and Russian (Eberhard, 1999; Lorimor et al., 2008; Vigliocco, Butterworth et al., 1996; Vigliocco, Hartsuiker, Jarema, & Kolk, 1996).

This research has raised questions about the universality of the agreement mechanism: is agreement processing in all languages affected by the same types of information (Bock et al., 2006; Bock et al., 2001; Lorimor et al., 2008) or do language-specific properties mediate processing (Vigliocco, Butterworth et al., 1996; Vigliocco, Hartsuiker et al., 1996)? In particular, some studies have suggested

that the morphological richness of a language affects to what extent conceptual information affects agreement processing. While some early studies have suggested that languages with rich verb-number morphology (e.g. Italian or French compared to English) exhibit stronger effects of notional number (Vigliocco, Butterworth et al., 1996; Vigliocco, Hartsuiker et al., 1996), more recent evidence suggests, if anything, the opposite (Berg, 1998 on German and English; Lorimor et al., 2008 on Russian; for a possible account, see also Bock et al., forthcoming). In either case, this research suggests that language-specific properties can interact with production mechanisms to lead to cross-linguistic differences with regard to information flow during sentence production (Vigliocco, Butterworth et al., 1996; Vigliocco, Hartsuiker et al., 1996), a conclusion which receives independent support from cross-linguistic research on other aspects of noun phrase production (e.g. determiner selection, Schiller & Caramazza, 2003; Schriefers, 1993 on Dutch; Schiller & Caramazza, 2003; Schriefers & Teruel, 2000 on German; Miozzo & Caramazza, 1999 on Italian; Costa, Sebastian-Galles, Miozzo, & Caramazza, 1999 on Catalan and Spanish; for an overview, see Caramazza, Miozzo, Costa, Schiller, & Alario, 2001).

Another tempting possibility is that what appear to be language-specific differences actually point to deeper cross-linguistic generalizations. For example, there is evidence that within a language, too, reduction of morphological complexity (e.g. the elision of pronouns) correlates with increased availability of conceptual information during agreement processing (Foote, 2006; Lorimor et al., 2008), suggesting “an unexpected and scientifically interesting consistency in language processes across different languages” (Lorimor et al. 2008:791). While it remains to be seen, whether this generalization holds for a typologically more varied set of languages than studied so far, cross-linguistic research has already contributed significantly to our understanding of agreement processing.

2.4 Complexity

It has been widely documented, and experimentally demonstrated, that English speakers exhibit a strong preference to order lighter constituents before heavier ones, grammar permitting. In the dative alternation, for example, in which speakers have a choice between the double object construction (*I gave [Tom] [the*

book) and the prepositional dative construction (*I gave [the book] [to Tom]*), heavy constituents tend to be produced later (*I gave the book to the man riding the bicycle*; Arnold, Wasow, Losongco, & Ginstrom, 2000; Bresnan et al., 2007; Hawkins, 1994; Wasow, 2002).¹ Such tendencies have also been observed in English for PP ordering (*I saw him [TEMP yesterday] [LOC in the park]* vs. *I saw him [LOC there] [TEMP just a couple of days ago]*, Hawkins, 1999), verb particle shift (*Give [OBJ me] up* vs. *Give up [OBJ any hope]*, Lohse, Hawkins, & Wasow, 2004) and heavy NP shift (*Put [OBJ the apple] [LOC in the basket]* vs. *Put [LOC in the basket] [OBJ the apple that's lying on the napkin]*, Arnold et al., 2000; Wasow, 1997). Short-before-long preferences have also been widely documented for other (Germanic) languages, including Dutch (Haeseryn, 1997) and German (Uszkoreit, 1987), which has contributed to the assumption that it may be a universal feature of the production mechanism. One prominent account for the asymmetry is framed in terms of the Levelt (1989; see Bock & Levelt, 1994) model of sentence production: the ordering of constituents is determined by the processing time required to actually produce them. Short constituents can be formulated faster, and hence are selected earlier for production (de Smedt, 1994; Wasow, 1997, 2002; cf. the Principle of Immediate Mention, Ferreira and Dell 2000:289, discussed above).

However, investigations of other languages have undermined the postulated universality of these preferences. For example, in Japanese (Dryer, 1980; Hawkins, 1994; Yamashita & Chang, 2001) and Korean (Choi 2007) speakers seem to prefer to produce long phrases *before* short phrases (see also Matthews & Yeung, 2001 for comprehension evidence for a similar preference in Cantonese Chinese).

(3a) Long-before-short

Kunye-ka kkoli-lul huntunun kay-eykey ppye-lul cwu-ess-ta. (Korean)
 she tail wagging dog-to bone-ACC gave

¹ What exactly is meant by “heavy” can be variously interpreted, e.g. as syntactic complexity (e.g. phrasal nodes), or as simple length. Wasow (2002) and Szmrecsányi (2004) report that structural complexity has no greater effect on ordering phenomena than simple phrasal length. Wasow & Arnold (2005) summarize further efforts to tease apart length and complexity as influences on ordering. In most research on the subject it is simple length that tends to be used as a measure of grammatical weight (Choi, 2007).

'She gave a dog wagging his tail a bone.'

(3b) Short-before-long

Kunye-ka ppye-lul kkoli-lul huntunun kay-eykey cwu-ess-ta.

she bone-ACC tail wagging dog-to gave

'She gave a bone to a dog wagging his tail.'

(Choi 2007:209)

These language-specific ordering preferences have been linked to an interaction between general principles of efficient processing and differences in the headedness of the languages (Hawkins, 1994, 2004, 2007). While the languages investigated thus far that exhibit a tendency to order short before long are head-initial (i.e. they order heads of syntactic constituents canonically before their complements), those that exhibit the opposite tendency (Japanese, Korean, Cantonese prenominal relative clauses) are head-final. According to Hawkins (2004), this correlation is due to the preference for choosing constituent orders that allow comprehenders to recognize immediate constituents as quickly as possible. In a head-initial language like English, shifting a heavy theme to follow the recipient in a sentence like *I introduced [RECIPIENT to Mary] [THEME some friends that John had brought to the party]* (Hawkins, 1994) allows the two constituents of the VP to be recognized more quickly than in the reverse ordering, *I introduced some friends that John had brought to the party [to Mary]*, in which all words in the long theme NP must be processed before the verb's recipient can be identified. In the case of head-final structures, the mirror image of this is predicted to be preferred, because this similarly will keep the distance between the heads of the two constituents short. This type of theory allows for a mediating role of language-specific structure in determining the outcome of universal processing preferences.

Production-oriented accounts that acknowledge the need for language-specific differences have also been proposed: it is possible that Japanese speakers are more sensitive to conveying meaning (putting enriched material earlier), while English speakers prefer to sequence forms (putting easier to produce, e.g. shorter, words earlier, Yamashita & Chang, 2001, 2006, based on Bock, 1982). This of course leaves the

question open as to what might account for these cross-linguistic differences in early accessing of form vs. meaning in incremental processing.

Regardless of which of these accounts turns out to be correct, data from non-Germanic languages challenges production accounts that attribute constituent order preferences to availability-based production, because these accounts predict a universal preference for short-before-long ordering (de Smedt, 1994; Wasow, 1997; see also references in Section 2.1). Thus, the relation between constituent complexity and constituent ordering is yet another example demonstrating the crucial role of cross-linguistic evidence both in ruling out postulated processing universals and in advancing our understanding of the mechanisms underlying language production.

2.5 Other cross-linguistic research on grammatical encoding

In addition to the research themes discussed above, several other topics have been studied cross-linguistically, although they have received considerably less attention. For example, the tendency for speakers to reuse recently processed syntactic structures (syntactic priming, Bock, 1986c; Pickering & Branigan, 1998) has been replicated for a variety of syntactic structures in several languages (e.g. R. J. Hartsuiker & Westenberg, 2000 on auxiliary-past participle ordering in Dutch; R. J. Hartsuiker & Kolk, 1998 on Dutch passives and ditransitives; Scheepers, 2003 on German RC attachment). This supports the view that syntactic processing of different languages shares at least some general, language-independent mechanisms, although it is important to keep in mind that the languages investigated so far are typologically very similar (we return to this point in the next section).

Syntactic priming has also been used to investigate the organization of linguistic knowledge in speakers that are proficient in two languages (bilinguals). Several studies have shown syntactic priming for bilinguals from one language to another (e.g. Dutch-English: Salamoura & Williams, 2006; Dutch-German: Bernolet, Hartsuiker, & Pickering, 2007; German-English: Loebell & Bock, 2003; Greek-English: Salamoura & Williams, 2007; Spanish-English: R. J. Hartsuiker, Pickering, & Veltkamp, 2004; Hernandez, Bates, & Avila, 1996; Meijer & Fox Tree, 2003; for an overview, see Robert J. Hartsuiker &

Pickering, 2008). This research has accumulated evidence that bilinguals' representations of syntactic structures that are present in both languages are shared between the two languages (for recent overviews, see Desmet & Duyck, 2007; Salamoura & Williams, 2007).

Beyond experimental psycholinguistic research, rich traditions in sociolinguistic, variationist, and comparative work have yielded evidence relevant to psycholinguistic theories of language production. An adequate discussion of the literature in these areas is beyond the scope of this paper (for examples, see Bresnan & Hay, 2007; Strunk, 2005; Tagliamonte & Smith, 2005; Tagliamonte, Smith, & Lawrence, 2005).

3 Expanding the empirical base

To get an estimate of how much work has been conducted on languages other than English, we elicited references from two international language news lists, read all suggested papers, and followed all references to work on other languages in them. While this survey is admittedly itself biased (being posted in English on lists *we* were aware of), it may suffice to make our point: We found psycholinguistically controlled production research on fewer than thirty of the world's 5,000 to 10,000 languages. A sizable literature on sentence production (more than five papers) seems to exist for only seven languages: English, Dutch, German, French, Spanish, Italian, and Japanese, of which six fall into two language families (Germanic and Romance), both of which have developed from Indo-European and have been spoken in close geo-cultural proximity for many centuries.² This focus on a few genetically and areally related languages has resulted in a striking lack of typological diversity in the empirical base against which theories of sentence production are evaluated. By far most of the world's 200 language families have not been investigated psycholinguistically, leaving entire continents close to unexplored (including almost all native American, African, and Austronesian language families; see below for exceptions).

² The situation looks even more dire once dialects are considered. Languages usually consist of many dialects, which can show considerable structural variation. Yet hardly any psycholinguistic production studies have compared dialects (but see Bock et al., 2006).

In the first part of this paper, we have given examples of production research where cross-linguistic differences provided crucial theoretical insights. But there are further reasons why psycholinguistic research will benefit from a typologically more diverse empirical base. We briefly elaborate on a few of them.

Different languages come with different structures and structural choices. For example, languages may differ in terms of word order and word order flexibility (e.g. English with rather fixed word order vs. Warlpiri, which allows many different constituent orders and even discontinuous constituents):

- (4a) Ngarrka-ngku ka wawirri panti-rni (Warlpiri)
 man-ERG PRES.IMPF kangaroo spear-NONPAST
'The man is spearing the kangaroo'
- (4b) Wawirri ka pantirni ngarrkangku
 Pantirni ka ngarrkangku wawirri
 Ngarrkangku ka pantirni wawirri
 Pantirni ka wawirri ngarrkangku
 Wawirri ka ngarrkangku pantirni (Hale, 1983:3)

Languages may have little inflectional morphology (e.g. English) or have complex morphological processes (e.g. Yup'ik Inuit, a polysynthetic language):

- (5) tuntussuqatarniksaitengqiggtuq (Yup'ik Inuit)
 tuntu -ssur -qatar -ni -ksaite -ngqiggte -uq
 reindeer -hunt -FUT -say -NEG -again -3SG:IND
'He had not yet said again that he was going to hunt reindeer.' (Eliza Orr, cited by Payne, 1997: 27–28)

They may signal argument functions via dependent-marking (e.g. case-marking on arguments as in, e.g. German) or via head-marking (e.g. clitics or pronominal inflection on the verb as in, e.g. Bulgarian or

Yucatec Mayan). They may differ in terms of morphosyntactic alignment (e.g. ergative languages mark subjects of intransitive verbs like objects of transitive verbs, and distinctly from subjects of transitive verbs, while accusative languages treat subjects of both transitive and intransitive verbs alike); they may differ in the size of the lexicon; and so on. In other words, speakers of different languages are faced with different choices when encoding their message into an utterance, and the work of encoding is distributed differently across different levels of linguistic processing. This raises the question as to what extent speakers of different languages may employ different strategies in formulating their utterances.

A typologically narrow empirical base comes with the risk that mechanisms observed in all languages studied so far -- and hence assumed to be universal-- are in actuality due to typological features shared by all those languages. Crucially, there is evidence that even similar constructions may be processed differently in different languages, as seen, for example, in the discussion of agreement processing. Another example comes from animacy effects on grammatical encoding. Prat-Sala and Branigan (2000) found that Spanish speakers are more likely to left-dislocate animate patients compared to inanimate patients as in *The boy, the swing hit (him)*. Snider and Zaenen (2006) find the opposite, an anti-animacy effect, for English. Similar observations have been made by others. Myachykov (2007) summarizes: “[accessibility]-driven choices of word order are realized differently in different syntactic structures and in languages with different grammatical systems” (see also Bates & Devescovi, 1989; Branigan et al., 2008; Chang et al., 2008; V. S. Ferreira & Yoshita, 2003; MacWhinney & Bates, 1978; Rosenbach, 2008; Sridhar, 1988).

Just as linguistic theories have been transformed by cross-linguistic evidence, psycholinguistic theories are shaped by the empirical basis against which they are evaluated. By studying languages that differ typologically from those psycholinguistic researchers are familiar with, not only are we able to compare already well-explored phenomena across a broader range of language *types*, but we are bound to discover new *phenomena* themselves in need of explanation, data points that existing theories do not make predictions about. Consider, for example, a type of variation peculiar to dependent marking languages, so called differential object marking (e.g. in Hindi, Aissen, 2003b; de Hoop & Narasimhan,

2005), where speakers have a choice between explicitly marking a direct object with case morphology or omitting that morphology (underlining of the t indicates a retroflex).

(7a) Ravii-ne kaccaa kelaa kaataa (Hindi)
Ravi-ERG unripe banana cut.PERF
'Ravi cut the/an unripe banana.'

(7b) Ravii-ne kacce kele-ko kaataa
Ravi-ERG unripe banana-ACC cut.PERF
'Ravi cut the unripe banana.' (Mohan, 1994: 87-88)

In the linguistics literature, whether an object is marked or not has been argued to be affected by a range of factors including its animacy, definiteness, topicality and person (e.g. Aissen, 2003b; de Hoop & Narasimhan, 2005; Morimoto, 2002). We have already seen how these factors figure prominently in psycholinguistic theories of accessibility, but it remains unclear what predictions (if any) these theories would make for differential object marking, given that the variation involves neither the subject function (Bock & Warren, 1985) nor linear ordering (V. S. Ferreira & Dell, 2000). Psycholinguistic research must draw from a wider typological base. We argue in the next section that this can be best achieved through collaboration between psycholinguistics and linguists.

4 Cross-linguistic psycholinguistics as an interdisciplinary program

Adequate cross-linguistic research on sentence production is impossible without detailed typological knowledge of the range of cross-linguistic variation that exists. It is also impossible without a detailed knowledge of the structural choices available in the particular language(s) under study. The 'same' word or structure translated into another language may come with different connotations, subtle different meanings, different subcategorization biases, and so on. For example, there is reason to believe that some apparent cross-linguistic differences found in early work on agreement processing (Vigliocco, Butterworth et al., 1996) vanish or change direction once translation equivalence of the stimuli is

achieved (Bock et al., forthcoming; see also Section 2.3 above). While this does not invalidate cross-linguistic psycholinguistics, it supports our argument that cross-linguistic psycholinguistics requires collaboration between researchers familiar with psycholinguistic theory and methodology and researchers familiar with the target languages.

Also, while much linguistic work has not provided quantitative data (at least in the past), it has provided introspective evidence as to what factors influence speakers' choices, as shown above with the example of differential object marking. Indeed, the harmonic alignment accounts proposed for differential object marking in the linguistic literature (Aissen, 2003a, 2003b; see also linguistic alignment accounts for voice or word order variations, e.g. Bresnan, Dingare, & Manning, 2001; Bresnan & Hay, 2007) correspond closely to the indirect accessibility account of how conceptual accessibility affects word order (Bock & Warren, 1985; Christianson & Ferreira, 2005; F. Ferreira, 1994) if one assumes not necessarily alignment to the subject function, but rather to particular unmarked/prototypical/frequent structural types.

An equally important benefit psycholinguistic researchers could receive from collaborations with linguists is methodological in nature. Since the vast majority of the world's languages (especially those typologically different from previously studied languages) are not spoken in the vicinity of psycholinguistic labs, it will be necessary to collect quantitative data in the field. Field-based psycholinguistics comes with a set of social and methodological challenges that, while not insurmountable, require expertise that is not commonly part of psycholinguistic training (Jaeger, Norcliffe, Bohnemeyer, & Nikitina, 2008).

Psycholinguistics, too, brings much into the collaborative effort of cross-linguistic psycholinguistics. In addition to the obvious methodological advances that have been made in collecting quantitative data, psycholinguistic theory links linguistic phenomena to cognitive mechanisms, thereby (at least potentially) providing cognitive plausibility to linguistic theory.

Hawkins (2007) provides probably the most compelling argument for collaboration between psycholinguistics and typologists (see also Hawkins, 1994, 2004; see Bender, 2009 for a similar argument for collaborations between researchers in natural language processing and typologists). Hawkins

summarizes evidence that many of the typological patterns observed across the world's languages reflect the processing preferences observed within speakers of one language. For example, Hawkins derives the typologically observed preference for SVO languages from the same principles of efficient processing that predict the short-before-long preference in head-initial languages like English (Arnold et al., 2000; Bresnan & Hay, 2007; Hawkins, 1999) and the long-before-short preference in head-final languages like Japanese (Yamashita & Chang, 2001) and Korean (Choi, 2007). This means that typological work can inform psycholinguistic theory and conversely, psycholinguistic findings about processing mechanisms can provide explanations for cross-linguistically observed typological patterns (Hawkins, 2004, 2007, in press; Newmeyer, 2005).

5 The dwindling sample

Cross-linguistic psycholinguistic research assumes an increased importance as much of the data on which theorizing can be based is disappearing. It is estimated that 90% of the world's languages will be extinct or moribund by the end of the 21st century (Hale, Krauss, & Watahomijie, 1992; for a recent overview, see Romaine, 2007). While many of these language communities realistically are already too small to conduct standard psycholinguistic research on them (Chung, 2008), the majority still have enough speakers (70% of all languages are still spoken by more than 1,000 speakers, about 40% by more than 10,000 speakers, Romaine 2007:121). The alarming rate of language death lends additional urgency to the psycholinguistic study of these language communities while we still can.

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