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PSYCHOLINGUISTICS IN APPLIED LINGUISTICS: TRENDS AND PERSPECTIVES

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INTRODUCTION

This article addresses the relationship between two major terms, psycholinguistics and applied linguistics, and in the process, explores key issues in multilingual processing. A straightforward definition of psycholinguistics is provided by Kess (1991:1): "The field of study concerned with psychological aspects of language studies." In the last decade, the definition has become more restricted, leaving out more social-psychological aspects like the study of attitudes in language use. Here, psycholinguistics will be further restricted to the study of processes of language production and perception (as opposed to acquisition and attrition).

Defining what applied linguistics (AL) is at the moment is less straightforward,[1] particularly when the simple interpretation of the application of linguistic theory is abandoned. In Europe, AL as a label for a whole field, is now gradually losing ground to the more general label 'Applied Language Studies.' This change of emphasis reflects a distancing from structural linguistics and an awareness that there is more to be known about language that is applied than just linguistics. Looking at the role of linguistics itself in studies on cognitive processing, there is a clear preference for Lexical Functional Grammar over other models (e.g., Levelt 1989, Pienemann 1998). In particular, the more recent minimalist approach in generative grammar seems to have lost contact with the study of language acquisition and language use, while earlier L2 research based on the principles and parameters model has lost contact with more recent theoretical developments (Cook 1997).

RELATING PSYCHOLINGUISTICS AND APPLIED LINGUISTICS

If we want to clarify the role psycholinguistics can or should play in AL, we need to narrow down the definition of the latter, or rather look at only a part of

that vast field. *The acquisition and use of a second language* seem to be the appropriate chunk of AL in this context. This sub-area relates to many other parts of our field, but its core is, in my view at any rate, essentially psycholinguistic in nature. The psycholinguistic interest would be in the processing mechanisms involved in using more than one language and the acquisition of additional languages. The AL interest would be in understanding why language learners behave the way they do, or in other words, what the mechanisms are for L2 use and acquisition. Ultimately, interest also lies in interventions that change and improve those mechanisms. This interpretation means that multilingual processing can be defined as the intersection or shared interest across psycholinguistics and AL. In this intersection, there are many questions to be answered: How are different languages processed? What are the processing mechanisms of cross-linguistic influence? What is the impact of level of proficiency? Is there a limit to the number of languages the system can deal with before breaking down? Are there processing differences between different types of languages? To what extent do socio-psychological factors influence processing mechanisms?

In the last two decades, psycholinguistics, as a sub-field of cognitive science, has seen an enormous growth that cannot be captured in a few pages. Therefore, a selection of topics will be discussed here to show the potential of connecting theories and models from other fields to the psycholinguistic study of multilingual processing. In what follows, I want to concentrate on a few issues that I expect to be high on the psycholinguistic research agenda for the coming decade, including the following: cognitive processes and SLA, socio-psychological factors in language processing, language processing and language testing, sign language and multilingual processing, and the neuro-imaging of multilingual processing. Before addressing each topic in turn, three central issues from the current literature on bilingual processing are noted briefly in order to set the stage.

KEY ISSUES IN THE MULTILINGUAL PROCESSING

1. The structure of the bilingual lexicon

Of all the issues that have been addressed, the structure of the bilingual lexicon is no doubt the main issue in recent years. As surveys of this literature show (cf. Kroll and de Groot 1997), early proposals based on single/dual storage models are too simple and inadequate to explain experimental findings. There now seems to be agreement that a functional view of the lexicon—that is, models that clarify how lexical information can be accessed—is to be preferred. Following proposals by Paradis (1987), the now dominant model assumes that the words from different languages are organized as subsets in lexical memory. These subsets are formed through the co-occurrence of word relations as these words are used together. This process leads to networks of interrelated words. Since the words of specific languages quite naturally tend to be used together, language-specific subsets develop. This concept of the bilingual lexicon clearly is a dynamic one: New words will be added and, through non-use, connections between words will

weaken to the point that the network falls apart. (See Meara 1999 for a mathematical approach to structural changes of the lexicon.)

In most models of the (bilingual) lexicon, three levels are distinguished: a conceptual level, a lexical level, and a phonological level. How languages come into play at these three levels raises other major issues: 1) Are there language specific representations on the conceptual level? 2) Are words organized on the basis of language? 3) Are there different sets of phonemes or syllables? None of these issues have really been resolved.

2. Language choice in production and perception

In both production and perception, there must be language specific processing, though the two processes will differ. In perception, characteristics of the input (e.g., sounds that are language specific) will trigger the system to 'expect' input in a given language. (See Grosjean 1997 for an overview of the literature.) Of course, there will also be information in the communicative setting that suggests the use of a particular language. So in perception, language choice is typically both a top-down (setting) and a bottom-up (language characteristics) process. In language production, language choice is essentially a top-down process: The speaker has to include in his/her communicative intention the language in which an utterance has to be encoded. In many situations, it is clear that one specific language has to be selected exclusively for production. In situations in which multilingual speakers are interacting, the use of more than one language is possible and may even be the preferred choice. Language switching can be a communicative tool to highlight specific information or express an attitude towards a topic of conversation. De Bot and Schreuder (1993) propose a 'language cue' to explain the wide variation in code switching that has been reported in the literature. (See also Milroy and Muysken 1995 for a collection of papers on code-switching.) They argue that for many individual switches, no linguistic or socio-psychological explanation can be given and indeed is needed because speakers set the cues for the languages to be used to a certain value, leading to the right mix of language in a given situation. The exact locus of the language cue is still a matter of debate (cf. Poulisse 1997 and Green 1998 for a model in which inhibition plays a crucial role).

3. The language mode

In several publications, Grosjean has developed the idea of a language mode to explain the various ways multilinguals use their languages. The language mode is defined as follows: "The state of activation of the bilingual's languages and language processing mechanisms, at a given point in time." The language mode is a continuum, ranging from a monolingual mode to a bilingual speech mode (Grosjean to appear). In the monolingual mode only one language is activated and the other languages in a multilingual are deactivated. The notion of a language mode is related to the issues of the language cue discussed above: The language mode is defined by the setting and the communicative intentions of a speaker. This

is not to say that there is fully conscious control of the position on the mode. Several experimental studies have shown that even in a supposedly monolingual setting, the other language continues to play a role (e.g., in experiments with monolingual and bilingual presentation of stimuli). Results from such studies have shown that, with monolingual presentation of stimuli, there was interference from the other language because the subjects could not completely 'switch off' that language (Dijkstra, van Jaarsveld and ten Brinke 1998). Hermans, Bongaerts, de Bot and Schreuder (1998), carried out an experiment in which they tested the interference of the L1 in L2 experimental tasks. Using a picture word interference task, they assessed the activation over time of form and meaning characteristics. They showed that in the initial stages of activation of an English word, the Dutch name of the picture to be named is also activated. Their data show that bilingual speakers cannot suppress activation of their first language while naming pictures in a foreign language.

The notion of the language mode clearly needs to be developed further. In several descriptions, it seems that language mode is a metaphor for the levels of activation of language-specific subsets in different processing components. It is not clear whether languages as a whole should be activated more, or less, or whether only parts can be active; in other words, can a bilingual operate in a more bilingual mode in the phonological processing unit and in a more monolingual mode for the syntactic unit? Or should they all be on the same place of the continuum? It seems likely that these components are interrelated and activate each other through back-propagation, and the components are probably 'in tune' most of the time, possibly with some delay, depending on the part of the system that makes a request for more information.

In general, the idea that the language mode is a one-dimension continuum is problematic: Mode is a momentary position of an individual speaker in a multi-dimensional space. For all languages, there is a given level of activation, in some situations zero, or close to that; in other situations, much higher, and every position in this multidimensional space is possible, though maybe for very high levels of activity, an as-yet-undefined level of proficiency is called for.

FUTURE DEVELOPMENTS AND NEEDS

1. Cognitive processes and SLA

In the last decade, several researchers have tried to relate cognitive processing to SLA. Richard Towell and his colleagues (Towell and Hawkins 1994, Towell, Hawkins and Bazergui 1996) have been looking at learners of French from the perspective of the Levelt model for quite some time, trying to relate the Chomskyan approach to SLA. Pienemann's (1998) book is a further development of his earlier work on learnability, but it now includes a processing component. His approach is heavily based on Lexical Functional Grammar and, again, on the

Levelt model. His main argument is that processing components and mechanisms put constraints on what can be processed at a specific stage of acquisition. In a recent paper, Doughty (in press) discusses various steps in the processing system and storage systems in language production and perception. Her main interest is to find ways to impact the processing mechanisms through interventions in order to improve language processing in language learners. One of the real issues here is how input is used to change the knowledge in the system. It has been suggested that recasts, corrected versions of learners utterances, may be the best way to change that information because a direct comparison can be made between output and input. This hypothesis opens up a whole discussion that goes beyond the present article. My reading of the psycholinguistic literature on processing leads me to believe that there is never a direct comparison between input and output because the input information is immediately processed and not stored in memory in that form. In language production, words, rules, and elements are drawn from memory at a considerable speed. Therefore, availability of information is an important factor. If we assume that the same storage systems are used for production and perception (as the findings of cross-modal experiments on picture naming with interfering written stimuli seem to suggest), the activation of an element in memory through the perceptual system will be slightly higher for some time, then it decays again. This enhanced level of activation of an element increases the chances of that element being selected again. Selection is always a trade-off between accuracy and speed, and in many situations, a word that may not be the perfect match, but comes very close, may be preferred over the best match, because it is easier to access.

With respect to Doughty's main concern (whether it is possible to have an impact on processing), I take the position that we cannot interfere with the ongoing process, but what we can do is manipulate the selection process. A crucial point is that we cannot erase information from our memory. What we can do, though, is add competing information that for various reasons wins in the rat-race. Thus, to influence processing, another option needs to be made a more attractive candidate in the selection procedure. If a learner systematically matches the wrong word with a concept that he/she wants to express (like 'mourir' rather than 'tuer' in Swain and Lapkin 1995), we need to make another word the better candidate. We cannot do that 'on-line' during the immediate retrieval process, but various lexical tasks in which relevant conceptual and functional aspects of that verb are activated may give this word a 'push,' making it a better match for later processing and, more importantly, one that is accessed more easily. Once we succeed in having this candidate win the competition—every time a successful match is made—the connection between the concept and the related lemma is strengthened, making a correct choice more likely the next time.

If we can manage to turn our understanding of the processes of production and perception into interventions that provide learners with the right information at the exact time they need it, this would represent a real step forward. Given the

possibilities of information technology, it is easier now to develop materials and techniques to make such well-timed interventions than it was in the past.

2. Language processing and language testing

While language testers are generally never slow nor reticent to tell the applied linguistic community what their moral standards and research methods should be, the major part of their work on testing language proficiency is basically built on the black box approach prevalent in the behaviorist era. While there now is quite some information on the various subprocesses of language production and language perception, most language testing is still geared towards the outcomes of the whole process. For real diagnostic testing, instruments have to be developed that are specifically aimed at assessing the workings of various subprocesses. In production, things can go wrong in many stages of the process. For example, in phonological encoding, segmental and suprasegmental information have to be combined to develop the phonetic plan. It is more or less known how this takes place, and accordingly, what can go wrong. Testing procedures are needed that will allow us to get specific information about problems in these substages of language production.

3. Socio-psychological factors in language processing

One of the big issues for future research is to determine the extent and the manner in which socio-psychological factors related to the minority status of a language may have an impact on language processing. It is in a way attractive to view our language production system purely as a language producing machine, but this is evidently too simple a picture: lexical access, grammatical complexity, and phonological encoding do not take place in a socio-psychological vacuum. Factors like status, self-esteem, and self consciousness are critical factors in all stages of the production and perception process. To give an example, when, in speaking, a specific word is needed, there will be a process of matching the meaning components of a lexical item and the communicative intention it is supposed to express. In that matching process, there is an evaluative moment in which many factors will come into play. (For example, is this word appropriate or good enough for this communicative situation? Am I using the right level of politeness? If I cannot use this word, should I continue or stop?) There is no absolute or mechanistic device that can make that decision for all words. Of course, not every single word is weighed in such a way in speaking, since that would lead to too much loss of speed. How such social-psychologically motivated mechanisms operate is far from clear, but, in particular for our understanding of language use in language learners, a better understanding of such mechanisms is vital.

4. Sign language and multilingual processing

There is very little research specifically aimed at the study of the bilinguality of sign language. As Padden (1999) points out, very few sign users use that code only. Many language-signers either mouth or even vocalize spoken language and combine sign language with other communicative means, such as additional gestures or facial expressions. Dufour's (1997) overview of the research on sign language and bilingualism shows that some of the research that has been done on the processing of sign language can be reinterpreted in terms of bilingual processing. An example is the study by Siple, Caccamise and Brewer (1982) on the encoding of signs. In this study, deaf and hearing signers with different levels of fluency in signing had to encode signs that differed in formational properties, meaning, and translation in English. Formational properties appeared to play a more important role than the influence of (spoken) English, which suggests an independent storage of signs.

On the basis of the literature available, Dufour (1997) proposes a model of processing in which three levels are distinguished, a conceptual level, a lexical level, and a third level for both (vocal) articulation and signing. One of the problems in Dufour's model is that there is no account of the processing of sign words and finger spelled words. This is not a trivial matter for a processing model. The decision either to use a sign or to finger spell has to be made at a fairly early stage of the production process because different mechanisms are involved. In sign language, there is vocabulary that alternates between finger spelled and signed forms. For example the signed LOVE and the finger spelled LOVE are different in grammatical class: the signed form is a verb and the finger spelled, a noun (Padden, personal communication). This distinction means that in the early stages of encoding, the decision either to sign or finger spell has to be taken. So far, no research seems to have been done on the relation between signing or fingerspelling on the one hand and the other languages (signed or other) of the signing-language user on the other.

Another element that is missing in Dufour's model is the fact that most signers support their signing with mouthing. What aspects of processing exactly are expressed in mouthing is unclear; the impression is that content words are more likely candidates than function words and that new information is highlighted through mouthing more than old information. In addition, some parts of the communicative intention are expressed in a non-verbal way (e.g., through nodding to add negation to a message). Messing (1994) adds a sociolinguistic perspective in her study on bimodal communication, examining the introduction of individual signs into spoken language or individual words into a signed conversation. Her data showed that there are register variations in the mix of spoken and signed language.

The many options signers have, such as switching across sign languages, or between vocal language and sign language, or combining signing and mouthing,

present a real challenge for the psycholinguistics of bilingualism. It is obvious that present models of language processing cannot deal with the complexities of signing and bilingualism. An extensive research program will be needed to come closer to an understanding of what our language processing system can do. As Dufour (1997) concludes, "The difference in modalities between signed and spoken languages may have important and critical consequences for our understanding of language representation and processing in the bilingual mind" (p. 327).

5. Neuro-imaging of language processing

In the last two decades, our understanding of the functional organization of the human language capacity has increased enormously. At the same time, various new techniques have been developed to register neuro-physiological processes in the brain. There is a rapidly expanding field of research that aims at relating the cognitive architecture of language and those neurophysiological processes.

> Although the relation between the cognitive architecture and the neural architecture of higher cognitive functions is by no means a simple and direct one, there is a growing awareness among cognitive scientists that they should construct models of cognitive functions in which neurobiological constraints are taken seriously…. The rapidly developing field of cognitive neuroscience is therefore based on the conviction that findings at the neurobiological level of analysis should have real consequences for the psychological analysis, and, similarly, that the results at the psychological level should have substantial implications for our understanding of the neurobiological system (MPI-Booklet for Psycholinguistics 1998).

Different techniques to support this agenda include measures of in-vivo brain activity, including nuclear magnetic resonance imaging (MRI), positron emission tomography (PET-scans) and magnetoencephalography (MEG). These techniques provide information about brain structures and the time course of language-processing events with a high resolution in terms of milliseconds.

Neuro-imaging of bilingual processing is still in its infancy, and even for 'big questions,' such as the neural substrates of individual languages, the more refined techniques have not yet led to real conclusions.[2] While some studies (Klein, *et al*. 1994 and Yetkin, *et al*. 1996) report that the same areas of the brain are used to process L1 and L2, other studies (Dehaene 1997, Kim, *et al*. 1997) report a dissociation of the areas used by the two languages. Here we should refer to Paradis (1997) who warns against simplified over-generalizations with respect to neural substrates of languages. He points out that differences in proficiency may lead to the use of different strategies (e.g., pragmatic vs. lexical) which have been shown to be located in different parts of the brain. In addition, there is evidence that type of bilingualism (early vs. late) has an effect on cognitive processing, even for near native speakers of the second language (Neville, Mills and Lawson 1992). In the future, neuro-imaging may become a useful tool to understand changes in

processing that are associated with learning or forgetting, and it may even help us determine whether what we present is actually processed, which brings us close to the input-intake discussion in SLA.

One of the main problems is going to be that, in order to make a real contribution to our understanding of the human-language-processing mechanism, applied linguists have to keep in touch with researchers from other fields, while at the same time these fields are becoming more complex and technically advanced, as experimental techniques and measurement procedures develop further. Bilingualism and SLA are not the prime interest of researchers working in cognitive science and neuro-imaging. If we want to maintain that the study of multilingual processing is at the heart of the study of the human language capacity, we need to become discussion partners informed about new developments and techniques. This requirement means staying current with pretty much a complete field of research apart from one's own.

CONCLUDING REMARKS

From the above, it is obvious that a thorough introduction in psycholinguistics should be part of the training of future applied linguists. Without denying the importance of sociolinguistic and pedagogical issues in SLA, we need to teach and understand foremost the processing mechanisms that play a role in acquisition and use.

There is no simple answer to the question of whether we should develop programs in applied linguistics that take into account developments in cognitive science. There seems to be little point in having programs focused solely on multilingual processing. A set-up in which a major in applied linguistics, with a substantial part of the program devoted to psycholinguistic aspects of bilingualism, combined with a specially tailored minor in cognitive science, may be a solution here, but that will take the applied linguistics program quite far from what for many people working in this field consider to be the core of our field.

One final point is that while psycholinguistics as a field is highly international, it is remarkable that so much of the work on multilingual processing is done in Europe. This pattern probably reflects two tendencies: One is that monolingual researchers will in general be less interested in studying multilingualism than researchers who speak more than one language. The other tendency is that, for the kind of research reported on here, fairly large numbers of multilingual subjects are needed, preferably partly second language learners, and partly foreign language learners. Since the European scene is more multilingual, maybe not so much in numbers as in attitudes and interests, it is likely to carry on more research on multilingualism. Such a trend will, in all likelihood, increase with the current internationalization trends in Europe for at least the next decade.

NOTES

1. At the 1999 Tokyo world congress of AILA (*Association Internationale de Linguistique Appliquée*), several sessions were devoted to somewhat *fin-de-siècle* discussions of what constitutes the field of applied linguistics.

2. The author is indebted to Laura Sabourin for providing him with information about this topic.

ANNOTATED BIBLIOGRAPHY

de Groot, A. and J. Kroll (eds.) 1997. *Tutorials in bilingualism: Psycholinguistic perspectives*. Mahwah, NJ: L. Erlbaum.

This edited volume is the most comprehensive set of papers on bilingual processing that is currently available. In particular, the papers by Poulisse, Paradis, Cook, Dufour, and Grosjean are relevant in this context. The introduction by De Groot and Kroll provides a very useful overview of current trends.

Doughty, C. In press. Cognitive underpinnings of focus on form. In P. Robinson (ed.) *Cognition and second language instruction*. Cambridge: Cambridge University Press.

This paper is one of the first to integrate processing mechanisms and SLA with the aim to develop interventions for language learners. The paper covers a wide range of issues related to processing and storage in memory, and usefully relates this information to what we know about SLA.

Green, D. 1998. Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*. 1.2.67–82.

This provocative paper builds on Green's long ranging interest in bilingual processing. It proposes an inhibitory control model to explain how bilinguals control their two languages systems. The paper is followed by eight peer comments and the author's reaction to these comments.

Grosjean, F. To appear. The bilingual's language modes. In J. Nicol (ed.) *One mind, two languages: Bilingual language processing*. Oxford, Blackwell.

This paper contains the fullest description of Grosjean's ideas about the Bilingual Language Mode available. Though the concepts used and the

mechanics of how the language mode works in actual processing are not always clear, the idea of a language mode is very compelling, and researchers working on multilingual processing have to at least take a position on this issue.

Levelt, W. J. M. 1989. *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

While now 10 years old, this book still is as relevant as it was when it came out. It is the only full description of the language production system, integrating information ranging from concept formation to articulation. Its relevance for multilingual processing has been evidenced in many recent articles on multilingualism.

Levelt, W. J. M., *et al*. 1999. A theory of lexical access in speech production. *Behavioral and Brain Sciences*. 22.1.1–75.

This article contains the most recent version of the Levelt model for language production. It is clearly the state of the art in lexical access. This very rich paper is followed by peer commentaries in the BBS-tradition.

Padden, C. 1995. Early bilingual lives of deaf children. In I. Parasnis (ed.) *Cultural and language diversity and the deaf experience*. Cambridge: Cambridge University Press. 99–116.

This is a very useful overview of what makes sign users bilinguals or multilinguals. Based on her own extensive experience in sign language research, Padden describes how the various languages of signers grow and interact.

Pienemann, M. 1998. *Language processing and second language development. Processability Theory*. Amsterdam: J. Benjamins.

In this book, Pienemann describes his Processability Theory, which is based on the idea that constraints of the processing system determine what can be acquired in SLA. This view is in marked contrast with the idea that linguistic aspects, as proposed in formal linguistic theories, determine the order of acquisition in a second language.

Schreuder, R. and B. Weltens (eds.) 1993. *The bilingual lexicon*. Amsterdam: J. Benjamins.

Though the field is moving so fast that some of the papers in this volume are becoming outdated, this edited volume is still one of the few in which various aspects (teaching, testing, acquisition, attrition, and storage) of the

bilingual lexicon are brought together, and most of the contributions have not lost much of their relevance.

Towell, R. and R. Hawkins. 1994. *Approaches to second language acquisition*. Clevedon, UK: Multilingual Matters.

In contrast to Pienemann, Towell and Hawkins firmly believe in the relevance of Chomsky's Principles and Parameters model to explain language acquisition. In this book, an interesting attempt is made to combine the ideas of the P&P model with processing mechanisms as proposed in the Levelt model.

UNANNOTATED BIBLIOGRAPHY

Beauvillain, C. and J. Grainger. 1987. Accessing interlexical homographs: Some limitations of a language-selective access. *Journal of Memory and Language*. 26.658–672.

Bierwisch, M. and R. Schreuder. 1992. From concepts to lexical items. *Cognition*. 41.23–60.

Cook, V. 1997. The consequences of bilingualism for cognitive processing. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah NJ: L. Erlbaum. 279–300.

de Bot, K. 1992. A bilingual production model: Levelt's Speaking model adapted. *Applied Linguistics*. 13.1–24.

_____ and R. Schreuder. 1993. Word production and the bilingual lexicon. In R. Schreuder and B. Weltens (eds.) *The bilingual lexicon*. Amsterdam: J. Benjamins. 191–214.

de Groot, A. and G. Nas. 1991. Lexical representation of cognates and non-cognates in compound bilinguals. *Journal of Memory and Language*. 30.90–123.

Dehaene, S., *et al*. 1997. Anatomical variability in the cortical representation of first and second language. *NeuroReport*. 8.3809–3815.

Dijkstra, T., H. van Jaarsveld and S. ten Brinke. 1998. Interlingual homograph recognition: Effects of task demands and language intermixing. *Bilingualism, Language and Cognition*. 1.51–66.

Dufour, R. 1997. Sign language and bilingualism: Modality implications for bilingual language representation. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 301–330.

Grainger, J. 1993. Visual word recognition in bilinguals. In R. Schreuder and B. Weltens (eds.) *The bilingual lexicon*. Amsterdam: J. Benjamins. 11–26.

Grosjean, F. 1997. Processing mixed language: Issues, findings and models. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Hillsdale, NJ: L. Erlbaum. 225–254.

Hermans, D., T. Bongaerts, K. de Bot and R. Schreuder. 1998. Producing words in a foreign language: Can speakers prevent interference from their first language. *Bilingualism: Language and Cognition*. 1.213–229.
Kess, J. 1991. *Psycholinguistics: Psychology, linguistics and the study of natural language*. Amsterdam: J. Benjamins.
Kim, K., *et al*. 1997. Distinct cortical areas associated with native and second language. *Nature*. 388.9938.171–174.
Klein, D., *et al*. 1994. Left putaminal activation when speaking a second language. *NeuroReport*. 5.2295–2297.
Kroll, J. and A. de Groot. 1997. Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 169–200.
Meara, P. 1999. Simulating recovery from bilingual aphasia. *International Journal of Bilingualism*. 3.1.45–54.
Messing, L. 1994. Bimodel communication, signing skill and tenseness. *Sign Language Studies*. 84.209–220.
Milroy, L. and P. Muysken (eds.) 1995. *One speaker, two languages: Cross-disciplinary perspectives on code-switching*. Cambridge: Cambridge University Press.
MPI. 1998. Booklet for Psycholinguistics: Neurocognition of language processing. http://www.mpi.nl/world/groups/neuro/neuro_intro.html
Neville, H., D. Mills and D. Lawson. 1992. Fractionating language: Different neural subsystems with different sensitive periods. *Cerebral Cortex*. 2.244–258.
Padden, C. 1999. Practical applications of sign language research. Keynote address, AILA World Congress. Tokyo, August 1999.
Paivio, A. and A. Desrochers. 1980. A Dual-Coding approach to bilingual memory. *Canadian Journal of Psychology*. 34.388–399.
Paradis, M. 1987. *The assessment of bilingual aphasia*. Hillsdale, NJ: L. Erlbaum.
_____ 1997. The cognitive neuropsychology of bilingualism. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 331–354.
Poulisse, N. 1997. Language production in bilinguals. In A. de Groot and J. Kroll (eds.) *Tutorials in bilingualism*. Mahwah, NJ: L. Erlbaum. 201–224.
_____ and T. Bongaerts. 1994. First language use in second language production. *Applied Linguistics*. 15.36–57.
Siple, P., F. Caccamise and L. Brewer. 1982. Signs as pictures and signs as words: The effects of language knowledge on memory for new vocabulary. *Journal of Experimental Psychology: Learning Memory and Cognition*. 8.619–625.
Swain, M. 1995. Three functions of output in second language learning. In G. Cook and B. Seidlhofer (eds.) *For H. G. Widdowson: Principles and practices in the study of language. A festschrift on the occasion of his 60th birthday*. Oxford: Oxford University Press. 125–144.

Swain, M. and S. Lapkin. 1995. Problems in output and the cognitive processes they generate: A step towards second language learning. *Applied Linguistics*. 16.371–391.
Towell, R., R. Hawkins and N. Bazergui. 1996. The development of fluency in advanced learners of French. *Applied Linguistics*. 17.84–119.
Woutersen, M. 1997. The organization of the bilectal lexicon. Nijmegen: University of Nijmegen. Ph.D. diss.
Yetkin, O., *et al*. 1996. Use of functional MR to map language in multilingual volunteers. *American Journal of NeuroRadiology*. 17.473–477.