Applied Psycholinguistics **27** (2006), 43–105
Printed in the United States of America

Commentaries

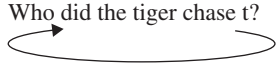
DOI: 10.1017.S0142716406060036

The usability of syntax

Clahsen and Felser's article (CF) is an important contribution to the field of psycholinguistics in several respects. First, it draws attention to the importance of a better understanding of the processing mechanisms utilized by child and adult language learners. Differences in these mechanisms may be responsible for the final outcome of the acquisition process. Second, the article provides an excellent summary of current first language (L1) and second language (L2) research on processing. A variety of studies, ranging from morphological off-line investigations to on-line research on syntactic development, are reviewed in a concise and accurate manner; the cross-linguistic dimension of the article makes both the review and the argument even more comprehensive and convincing. Third, based on their own experimental results, and the results from other studies, the authors propose a novel account of L2 processing, the so-called shallow syntax hypothesis (SSH).

In this short commentary, I would like to focus on a particular line of research that is relevant specifically for L1 development and that does not receive close attention in CF. I take as a starting point the authors' claim that ". . . the results on children's sentence processing indicate that the child parser is essentially the same as the adult one. Although children's sentence processing tends to be slower overall than adults', there is no reason to believe that their processing system is fundamentally different from adult native speakers' processing system . . ." Although I agree that the child system is not qualitatively different from that of adults, the question is what happens when interpretation of a particular structure can be obtained, in principle, by two different systems, for example, on the basis of structural ("narrow syntax") or discourse information. Consider Examples 1 and 2.

1. Who did the tiger chase t?



2. Which lion did the tiger chase t?



The difference between these two types of *wh*- questions is well known. Example 2 represents the so-called D-linked *wh*- question, shown to exhibit different properties from non-D-linked *wh*- questions such as Example 1 (Cinque, 1990; Pesetsky, 1987; Rizzi, 1990). Moreover, there is a difference in processing of these questions: De Vincenzi (1991) and Shapiro (2000) demonstrated experimentally with native adult speakers that establishing a dependency between the trace, and

© 2006 Cambridge University Press 0142-7164/06 $12.00

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

the *wh-* phrase takes more processing resources for D-linked than for non-D-linked *wh-* phrases. Avrutin (2000) also showed that 4- to 6-year-old children are, overall, at chance in interpreting sentences of type Example 2. When presented with a picture where a tiger is chasing a lion while being chased, at the same time, by another lion, children chose the correct lion only 48% of the time, pointing to the lion chasing the tiger 52% of the time. No such problem was observed in sentences with non-D-linked *wh-* questions as in Example 1 (results for the same children were above chance: 86% of the time correct). In line with CF's claim, that ". . . children have more difficulty than adults accessing different knowledge sources and evaluating different types of information in parallel . . ." Avrutin (2000) suggests that coordination of syntactic and discourse information overloads child processing capacity, which results in a chance performance.[1]

In fact, recent research on dependencies in natural languages allows us to make more precise claims about the source of errors. Basing his research mostly on pronominal anaphora, Reuland (2001) developed a theory where dependencies can be established at different levels (e.g., lexical, syntactic, semantic, discourse), and that these levels form a hierarchy in such a way that the possibility of a "cheaper" dependency blocks the application of a more "expensive" one. Whenever a lexical dependency is, in principle, an option, it will prevent establishing a syntactic one; the possibility to establish dependency relation in "narrow syntax" will block semantic and discourse dependencies, and so forth. Considering *wh-* traces to be pronominal elements, and extending Reuland's approach to *wh-* questions, we can conclude that there is an important difference in how a trace can be interpreted in Examples 1 and 2. Non-D-linked *wh-* phrases can be linked to their traces only via syntactic dependencies, while D-linked ones can, in principle, enter a discourse dependency. For adult speakers the syntactic dependency is the chosen one in both cases: in Example 1 because there is no other option available, and in Example 2 because it occupies a more economical place in Reuland's hierarchy. Suppose, however, that the syntactic dependency is not the cheapest option available to children, at least at a younger age. In this case, the interpretation of D-linked *wh-* questions in Example 2 may involve a competition of two equally possible sources of interpretation: narrow syntax and discourse, the former involving establishing a syntactic chain, and the latter involving linking the trace (a pronominal element) to the referent introduced into discourse as part of the D-linked *wh-* phrase. As a result of such competition, children will demonstrate an overall chance performance, as reported in Avrutin (2000).

Similar claims have been made with regard to children's interpretation of pronouns in exceptional case marking (ECM) clauses. In a number of cross-linguistic experiments, Ruigendijk et al. (2006; see more in Ruigendijk, Avrutin, & Vasic, 2005) present evidence that Dutch-, Russian-, and Spanish-speaking children often interpret the pronoun in the ECM clause as coreferent with the matrix subject (the translation of the relevant experimental condition is given in Example 3).

3. First the man and the boy ate, and then the boy saw him skating.

Children interpreted the pronoun equivalent to "him" as coreferent with "the boy" approximately 50% of the time, significantly more often than the equivalent

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

pronoun in a simple transitive clause, or a reflexive pronoun (equivalent to English "himself") in the ECM sentence. The authors provide analyses consistent with Reuland's economy hierarchy: in adult language the pronoun cannot be dependent on the matrix subject because semantic- and discourse-level (extrasyntactic) dependencies are blocked due to the potential availability of the syntactic dependency, which in adult hierarchy occupies a more privileged, more economical position. The syntactic dependency, although structurally possible, is disallowed due to the feature specification of the pronoun. The authors argue, however, that the syntactic dependency is not the cheapest one for children at the relevant age (4 years, 0 months [4;0]–6;0), and that their errors are due to the competition between the (unacceptable) syntax-based interpretation and the (acceptable) semantic one.

The weak, unreliable nature of the "narrow syntax" in children is argued to be the source of the optional omission of such functional categories as articles and tense.[2] Avrutin (2006) provides analyses of these omissions in terms of a competition between two systems, syntax and discourse, each of which is, in principle, capable of encoding information about temporal relations and specificity. Indeed, omission of determiners and tense is possible in certain adult registers as well, provided contextual information is strong enough to take over the syntactic encoding (typical examples include the so-called Diary style, Haegeman, 1990; headlines, Avrutin, 1999; Stowell, 1999; Mad Magazine register, Akmajan, 1984).

It is important that, and in full agreement with CF's claim, the nature of the child processing system does not seem to differ from adults'; however, the ability to fully rely on "narrow syntax" as a source of interpretation may develop in time. Narrow syntax becomes fully operational only when it becomes fully efficient, which is related, among other things, to the maturation of the child's processing capacity. In this sense, it would be interesting to see whether L2 adult learners, whose biological development is not different from adult native speakers, will demonstrate different performance in a *wh*- question experiment (reported by CF) when non-D-linked *wh*- questions are replaced with D-linked ones.

To summarize, as important as it is to distinguish between the learner's knowledge of the target language, and his/her ability to use this knowledge, it is also important to realize that the use of a specific processing mechanism requires the availability of sufficient resources. When resources are not sufficient, for example, due to the incomplete maturation of relevant brain structures, the output of the processing system may be different from that of a normal adult native speaker because of reliance on other, competing sources of interpretation or encoding information. This appears to be the case for structures that rely crucially on the use of narrow syntax. By itself, this is not really surprising; after all, syntax is a very useful thing to have, but only when it is fully usable.

NOTES

1. Interestingly, Hickok and Avrutin (1995) report similar findings for agrammatic Broca's aphasics. The authors suggested a knowledge-based account arguing for the selective deficit of binding versus government chains, an account that I no longer consider tenable.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

2. In case of production, of course, children are significantly younger, approximately between 2;0 and 2;8.

REFERENCES

Akmajan, A. (1984). Sentence type and form-function fit. *Natural Language and Linguistic Theory, 2*, 1–23.
Avrutin, S. (1999). *Development of the syntax–discourse interface*. Dordrecht: Kluwer Academic.
Avrutin, S. (2000). Comprehension of D-linked and non-D-linked *wh*-questions by children and Broca's aphasics. In Y. Grodzinsky, L. Shapiro, & D. Swinney, (Eds.), *Language and the brain* (pp. 295–313). San Diego, CA: Academic Press.
Avrutin, S. (2006). Weak syntax. In Y. Grodzinsky & K. Amunts (Eds.), *Broca's region*. New York: Oxford University Press.
Cinque, G. (1990). *Types of A-bar dependencies*. Cambridge, MA: MIT Press.
De Vincenzi, M. (1991). *Syntactic parsing strategies in Italian*. Boston, MA: Kluwer Academic Publishers.
Haegeman, L. (1990). Understood subjects in English diaries: On the relevance of theoretical syntax for the study of register variation. *Multilingua, 9*, 157–199.
Hickok, G., & Avrutin, S. (1995). Representation, referentiality, and processing in agrammatic comprehension: Two case studies. *Brain and Language, 50*, 10–26.
Pesetsky, D. (1987). Wh-in-situ: Movement and unselective binding. In E. Reuland & A. ter Meulen (Eds.), *The representation of (in)definiteness*. Cambridge, MA: MIT Press.
Reuland, E. (2001). Primitives of binding. *Linguistic Inquiry, 32*, 439–492.
Rizzi, L. (1990). *Relativized minimality*. Cambridge, MA: MIT Press.
Ruigendijk, E., Avrutin, S., & Vasic, S. (2005). *Reference assignment: Using language breakdown to choose between theoretical approaches*. Manuscript submitted for publication.
Ruigendijk, E., Baauw, S., Zuckerman, S., Vasic, N., de Lange, M. J., & Avrutin, S. (2006). *A cross-linguistic study on the interpretation of pronouns by children and agrammatic speakers: Evidence from Dutch, Spanish and Italian*. Manuscript submitted for publication.
Shapiro, L. (2000). *Some recent investigations of gap filling in normal listeners: Implications for normal and disordered language processing*. In Y. Grodzinsky, L. Shapiro, & D. Swinney (Eds.), *Language and the brain* (pp. 357–376). San Diego, CA: Academic Press.
Stowell, T. (1999). *C-command effects in newspaper headlines*. Unpublished manuscript, University of California, Los Angeles.

Sergey Avrutin
Utrecht University

DOI: 10.1017.S0142716406060048

Dominance, proficiency, and second language grammatical processing

Clahsen and Felser (CF) deserve praise for their superlative synthesis of literature relating to grammatical processing, as well as for their original contributions to this area of research. CF "explore the idea that there might be fundamental differences between child L1 and adult L2 processing." The researchers present evidence that adult second language (L2) processing is often less automatic and less efficient than first language (L1) processing. Qualitative differences are suggested as well. Adult L2 processing may be restricted to shallow computations, whereas L1 processing typically involves detailed representations. These conclusions are reached

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

in large part by comparing highly proficient L2 learners with natives on various neurological and behavioral dimensions of processing. I propose that additional comparisons might be carried out that involve an understudied population: learners whose L2 is their dominant language.

Although dominance has been operationalized in terms of the relative personal benefits of L1 versus L2 use (Cutler, Mehler, Norris, & Segui, 1989), more germane to the present discussion, and less controversial, are psycholinguistic metrics of dominance. Psycholinguistically, an individual's L2 is dominant if, compared to this person's L1, performance on a battery of language tasks is characterized by greater speed, fluency, automaticity, or efficiency (accuracy) in processing. These tasks include reading aloud, speeded picture and number naming, and recognition and recall of words under noise (see Flege, MacKay, & Piske, 2002; Golato, 1998; Grosjean, 1998, for discussion of various operationalizations of dominance). Dominance is understood in relative and continuous terms. That is, L2 dominants differ across individuals in the degree to which their L2 is superior to their L1 along the behavioral dimensions just mentioned.

Operationalized psycholinguistically, dominance reflects quantitative differences between processing in the L1 and processing in the L2. Importantly, CF suggest that quantitative differences in processing are not associated with qualitative differences in processing behaviors, a point to which we will return shortly.

Proficiency and dominance are overlapping and confusable constructs, as levels of proficiency and degrees of dominance tend to correlate. However, it is important to maintain logical and functional distinctions between L2 dominance and L2 proficiency. As we have seen, the former is defined in processing terms, whereas the latter is typically viewed in terms of attainment in areas of grammar, lexis, pronunciation, and so forth. One can imagine, for example, an L2-dominant individual whose L2 performance is peppered with "fossilized" nonnativelike morphosyntax, or who scores one SD below the mean of native controls on a given L2 attainment measure. By the same token, one does not have to be L2 dominant to be a highly proficient speaker or writer in the L2.

The incomplete convergence of proficiency and dominance highlights a key methodological concern. To determine the upper limits of L2 processing, we should take a look at L2 learners who do well on processing measures, not just those who do well on proficiency measures. It would therefore be reasonable to target L2 dominants, who have greater speed, accuracy, and automaticity in their L2 than in their L1, and who might be found to outstrip high-L2 proficients in these respects. One could further envision comparing the L2 grammatical processing of L2 dominants and L2-high proficients who are matched for age of acquisition.

As previously noted, CF and others have found both quantitative and qualitative processing differences between high-L2 proficients and natives. Will quantitative differences (e.g., in reading aloud and word recall tasks) be found between L2 dominants and natives? Will qualitative differences be found? For example, will L2 dominants display nonnativelikeness in ambiguity resolution, processing filler-gap dependencies, and ERP negativities in sentence processing? Will CF's shallow-structure hypothesis be a good fit for data from L2 dominants?

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

These are open questions, but they are not idle questions. Recent studies suggest that data from high-L2 proficients do not tell the whole story about what L2 learners are capable of. For example, Flege et al.'s (2002) study of Italian L1/English L2 bilinguals showed that the pronunciation of L2-dominant bilinguals was indistinguishable from that of natives, whereas both L1-dominant and balanced bilinguals (i.e., individuals who were highly proficient in both languages) displayed detectable accents. This finding led the authors to suggest that interlingual interference effects in pronunciation may be absent among L2 dominants.

A more relevant example comes from Golato's studies (1998, 2002) of word processing among late-learning French–English bilinguals who were proficient in both languages. Golato found that word parsing routines for French and English words varied as a function of the participants' dominant language. English-dominant subjects were able to switch between segmentation strategies and parse both French and English words in the manner typical of monolingual speakers of these languages. French dominants, on the other hand, were not flexible in their routines, applying French-based open-syllable parsing biases to both English and French words. (The study by Cutler et al., 1989, of French–English bilinguals from birth found French dominants, but not English dominants, to be flexible in this respect.) In Golato (1998), processing patterns were shown to be independent of the participants' native language. That is, no matter what their L1, the performance of English dominants differed from that of French dominants. Late L2 learners can become L2 dominant, although as both Golato (1998) and Flege et al. (2002) point out, this outcome is not typical. Late age of acquisition notwithstanding, the results of Golato's research suggest that bilinguals' processing performance in both the L1 and the L2 depends on which of their languages is dominant.

If L2 dominants were included in the study of grammatical processing, what kinds of results might we expect? By the psycholinguistic definition of L2 dominance, we know that processing in the L1 is relatively slow and less efficient than in the L2 across a range of tasks. It would not be surprising if L2 dominants' processing of their L1 also turns out to be slower and less efficient than that of monolingual speakers of that language. In qualitative terms, can we expect L2 dominants' processing of the L2 to resemble that of monolingual native speakers of that language? Given the asymmetries found by Cutler et al. (1989) and Golato (1998, 2002), the answer would appear to be: in some cases, yes; and in some cases, no.

As long as the L1 is actively used, it is reasonable to hypothesize at least some degree or some type of non-monolingual-likeness in grammatical processing among L2 dominants. It is in the nature of bilingualism to find L1 effects in the L2, and indeed to find L2 effects in the L1 (Cook, 2003; Flege, 2002; Grosjean, 1998). However, in the case of L2 dominants where the L1 is unused or infrequently used, one could conjecture that their L2 grammatical processing might turn out to be indistinguishable from that of L1 monolinguals. Monolingual-like processing of the L2 might be more likely still in those extraordinary instances where the L1 is completely forgotten, as suggested by behavioral and imaging data from Korean adoptees moved to Paris and deprived of contact with the Korean language (Pallier et al., 2003). For these individuals, the L2 is not merely dominant, it has effectively supplanted the L1.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Because there are degrees of L1 and L2 dominance, in all the comparisons suggested it would be important to look at data from individuals as well as from groups. Finally, it goes without saying that future work with L2 dominants should involve not only behavioral measures of processing, but should include results from neurofunctional imaging and electrophysiological techniques as well.

ACKNOWLEDGMENTS

This response was written under a Faculty Research Assignment from the University of Texas. I am grateful for this support, as well as for the comments of Peter Golato, Marianne Gullberg, and Leah Roberts on an earlier version.

REFERENCES

Cook, V. (2003). *Effects of the second language on the first*. Clevedon: Multilingual Matters.

Cutler, A., Mehler, J., Norris, D., & Segui, J. (1989). Limits on bilingualism. *Nature, 340*, 229–230.

Flege, J. E. (2002). No perfect bilinguals. In A. James & J. Leather (Eds.), *New Sounds 2000: Proceedings of the Fourth International Symposium on the Acquisition of Second-Language Speech* (pp. 132–141). Klagenfurt, Germany: University of Klagenfurt.

Flege, J. E., MacKay, I. R. A., & Piske, T. (2002). Assessing bilingual dominance. *Applied Psycholinguistics, 23*, 567–598.

Golato, P. (1998). *Syllabification processes among French–English bilinguals: A further study of the limits of bilingualism*. Unpublished doctoral dissertation, University of Texas–Austin.

Golato, P. (2002). Word parsing by late-learning French–English bilinguals. *Applied Psycholinguistics, 23*, 417–446.

Grosjean, F. (1998). Studying bilinguals: Methodological and conceptual issues. *Bilingualism: Language and Cognition, 1*, 117–130.

Pallier, C., Poline, J.-B., LeBihan, D., Argenti, A.-M., Dupoux, E., & Mehler, J. (2003). Brain imaging of language plasticity in adopted adults: Can a second language replace the first? *Cerebral Cortex, 13*, 155–161.

David Birdsong
University of Texas

DOI: 10.1017.S014271640606005X

The shallow structure hypothesis of second language sentence processing: What is restricted and why?

Clahsen and Felser (CF) analyze the performance of monolingual children and adult second language (L2) learners in off-line and on-line tasks and compare their performance with that of adult monolinguals. They conclude that child first language (L1) processing is basically the same as adult L1 processing (the contiguity assumption), with differences in performance being due to cognitive developmental limitations. They argue that differences in L2 performance, however, are more qualitative and not explained by shortage of working memory (WM) resources, differences in processing speed, transfer of L1 processing routines, or incomplete acquisition of the target grammar. They propose a shallow structure hypothesis (SSH) to explain the differences reported in sentence processing. According to

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

this, the syntactic representations computed by L2 learners during comprehension are shallower and less detailed than those computed by native speakers and involve more direct form-function mappings.

The main question they are addressing, whether L2 processing is fundamentally different from L1 processing, has been repeatedly asked from different perspectives (e.g., Dehaene et al., 1997; Hahne, 2001; Hahne & Friederici, 2001; Hasegawa, Carpenter, & Just, 2002; Kim, Relkin, Lee, & Hirsch, 1997; Perani et al., 1998; Sebastian-Gallés, Echeverría, & Bosh, 2005; Weber-Fox & Neville, 1996), and several hypotheses have been formulated to account for the differences (e.g., Ullman, 2001). What is new in this interesting contribution is the attempt to clarify specific aspects of L1 and L2 morphological and syntactic processing and to account for them. Their proposal of the SSH is intriguing, timely, and should lead to further research. However, it needs a further degree of specification and clearly more empirical data.

Although the comparison of child L1 processing with that of L2 adults is interesting and illustrative, perhaps it should not be pushed too far, because there are a number of important differences other than language learning to consider. In that sense, the comparison of early and late bilinguals of the same age, matched in proficiency, would be a good approach to consider. Early bilinguals are not actually discussed in the paper, despite the relevance of this group to completing the picture the authors are trying to build of L1/L2 processing differences. Do proficient early bilinguals use "superficial" or "deep" syntactic strategies for both their languages, or structure-driven strategies for the (temporarily?) dominant language and lexical–semantic strategies for the other? What would the SSH predict in the case of these "balanced" bilinguals? To answer that question it is maybe necessary to know why the sentence parsing options available in the L2 are "restricted" to shallow strategies and under what circumstances. What would prevent adult L2 learners from eventually achieving nativelike parsing strategies? Why are they able to use every other type of information, including morphosyntactic information, and yet not syntactic structural cues? If the authors believe that this is due to developmental factors (critical periods/age of acquisition effects), can they account for why there is a critical period for (some aspects of) sentence parsing and not for morphosyntactic processing, without being as "vague" as the Ullman model?

Another concern is that, because the results from the different studies on ambiguity resolution in relative clause attachment (in relation to L1 transfer, etc.) are, as they admit, inconclusive, the authors are really basing their conclusions about the "striking" differences in L2 processing strategies, on very little data. This is not to say, of course, that their hypothesis is incorrect. As the authors state, this kind of shallow processing strategy or "good enough" representation is probably part of the L1 repertoire, "an option available to the human language comprehension system in principle" (see Sanford & Sturt, 2002).

Thus, it seems intuitively logical that for L2 adults, even after long periods of exposure, if a "shallow" strategy is available, less costly but effective, then this is what will be used, given the higher cognitive demands of processing in the L2. It could, then, be an early interlanguage feature of L2 sentence processing that continues to be effective, and so employed, even at advanced learner stages. It could even be that

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

reliance on this type of processing routine interferes with or impedes acquisition of more structure-driven parsing strategies. However, more data is needed from L2 learners from different backgrounds (e.g., immersion vs. academic learning) and different levels of proficiency, as well as different comprehension modalities (auditory as well as visual) before it can be claimed that adult L2 learners are "restricted" to this type of sentence-processing strategy. In addition, are the authors suggesting that all syntactic representations computed are less detailed? Perhaps there are characteristics of the particular structures studied that lend themselves to this type of strategy. Again, more data from other experiments with different structures is necessary before claims can be made about "restrictions." Because only a very small number of structures in the three domains (morphosyntax, ambiguity resolution, and syntactic dependencies) were tested, it remains to be seen in which domains L2 performance is qualitatively worse than native performance and how general is the decrease in performance across the domain.

It is interesting that the authors appear to be taking it for granted that their highly proficient L2 adult participants have reached a fixed, immutable stage of L2 competence beyond which they cannot progress and that whatever processing strategies the participants were using in these studies will remain unchanged, presumably because, as seen from the low number of errors, these strategies are effective for successful L2 comprehension. However, this need not necessarily be the case. Even when L2 late learners demonstrate high levels of L2 knowledge and competence in some measures (particularly off-line measures) there could still be room for "improvement" or change in terms of greater processing automaticity, or perhaps even changes in the parsing options, as a result of longer exposure to the L2, or more intensive experience of the particular language structures in question. One example of this is that some of our recent data seem to suggest that very proficient adult late bilinguals who have spent around 20 years immersed in the L2 environment, process agreement of certain morphosyntactic features (e.g., number agreement) in a similar way to natives (Gillon-Dowens, Barber-Friend, Vergara, & Carreiras, 2004).

As to the question of the "confounding factors" that might account for the differences in adult L2 syntactic processing, again more research is needed before these factors of WM limitations, differences of processing speed and "incomplete" acquisition (whether due to L1 transfer or lack of L2 automaticity) can be dismissed as not significantly contributing to L2 processing differences. Although each of these factors might not be individually responsible for these differences, the interaction and combined effects of these limitations will surely account for at least part of the differences found. For example, looking at the question of the higher cognitive demands and the limitations of WM resources in the L2, if the SSH is correct, and describes the kind of processing strategy adult L2 learners use, WM limitations may be one of the reasons adult L2 learners fall back on this type of "good enough" or shallow representation. Obviously, WM resources will be more taxed in the L2, especially in the case of these long-distance syntactic dependencies. According to the authors, however, if WM limitations were a main problem then "we would expect L2 learners to prioritize on grammatical information in the same way as children do." This does not necessarily have to be the case, however, as L2 acquisition does not have to mirror child L1 acquisition. Adults,

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

among other differences, already have well-developed, complex lexical–semantic networks before learning the L2 so there is no reason why their processing strategies should initially be of the "structure-based, least-effort" type, as is the case of children, as reported here. Adult L2 learners, through increased exposure to the L2, may develop more nativelike, structure-based parsing heuristics, as WM resources are released by faster lexical access and greater automaticity at a morphosyntactic processing level.

A final point is that the authors argue against the Ullman proposal because of its vagueness. We may agree with that, but the proposal they put forward—shallower L2 sentence processing (but not morpohological processing)—is not very well specified either. Specifically, which components are processed in this way? Does the processor carry out a general shallow processing and so some components are not processed properly? Do some language components reach automaticity easier and are therefore less prone to be processed in a shallow way? It may be the case that there is still not enough empirical evidence to present a more detailed proposal, but presumably the authors have predictions about future studies.

In sum, the SSH is an interesting proposal that hopefully will be refined by future data from the research in this field that it will undoubtedly promote.

REFERENCES

Dehaene, S., Dupoux, E., Mehler, J., Coher, L., Pauksu, E., Perani, D., et al. (1997). Anatomical variability in the cortical representation of first and second language. *NeuroReport, 8*, 3809–3815.

Gillon-Dowens, M., Barber-Friend, H., Vergara, M., & Carreiras, M. (2004). *Does practice make perfect? An ERP study of morphosyntactic processing in highly proficient English–Spanish late bilinguals*. Presented at the 10th Meeting of AMLAP, Aix-en Provence, France.

Hahne, A. (2001). What's different in second language processing? Evidence from event-related brain potentials. *Journal of Psycholinguistic Research, 30*, 251–266.

Hahne, A., & Friederici, A. (2001). Processing a second language: Late learners' comprehension mechanisms as revealed by event-related brain potentials. *Bilingualism: Language and Cognition, 4*, 123–141.

Hasegawa, M., Carpenter, P. A., & Just, M. A. (2002). An fMRI study of bilingual sentence comprehension and workload. *NeuroImage, 15*, 647–660.

Kim, K. H. S., Relkin, N. R., Lee, K., & Hirsch, J. (1997). Distinct cortical areas associated with native and second languages. *Nature, 338*, 171–174.

Perani, D., Paulesu, E., Galles, N. S., Dupoux, E., Dehaene, S., Bettinardi, V., et al. (1998). The bilingual brain: Proficiency and age of acquisition of the second language. *Brain, 121*, 1841–1852.

Sanford, A., & Sturt, P. (2002). Depth of processing in language comprehension: Not noticing the evidence. *Trends in Cognitive Science, 6*, 382–386.

Sebastian-Gallés. N., Echeverría, S., & Bosh, L. (2005). The influence of initial exposure on lexical representation: Comparing early and simultaneous bilinguals. *Journal of Memory and Language, 52*, 240–255.

Ullman, M. (2001). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition, 4*, 105–122.

Weber-Fox, C., & Neville, H. (1996). Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of Cognitive Neuroscience, 8*, 231–256.

Margaret Gillon Dowens
Manuel Carreiras
Universidad de La Laguna

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

DOI: 10.1017.S0142716406060061

Shallow processing: a consequence of bilingualism or second language learning?

Clahsen and Felser (CF) review ground-breaking work comparing selected types of language processing in monolingual children and adults, on the one hand, and in monolingual first language (L1) adults and adult second language (L2) learners, on the other. They argue that children behave essentially like adults, but that adult L2 learners, even high-proficiency ones, do not. Thus, there is a principled difference to be made among types of learners; there is continuity of mechanism and process to be observed in monolingual development but L2 acquisition exhibits certain fundamental differences. In particular, L2 learners construct shallow syntactic structures (essentially failing to compute trace chains) when processing long-distance filler-gap dependencies. According to the shallow structure hypothesis (SSH), learners immediately interpret incoming words in a minimal semantic representation by assigning thematic roles to argument expressions and associating modifiers to their hosts. They are not mapping detailed and complete syntactic representations onto semantic representations.

Although I view these studies as an essential adjunct to standard L2 acquisition (SLA) research and applaud CF for undertaking in a systematic way the study of sentence processing, I see a fundamental methodological weakness in that the populations from which samples have been selected have not been carefully defined. Psycholinguists need to provide basic comparative data on bilinguals and monolinguals before the consequences of their results to L2 *learning* can be properly assessed. It is commonplace in SLA research, it is true, to compare learner behavior to that of monolinguals, but this practice is questionable in language processing research where the effects of bilingualism itself on parsing must be researched. We must not assume, prior to investigation, that the population of high-proficiency steady-state bilinguals can be equated with that of monolinguals simply because particular competence tests reveal them to be indistinguishable (Grosjean, 1989). Having two languages in one's head will mean, at least in certain circumstances, that both languages are activated and accessed during language processing because there is no other way to explain unique properties of bilingual language behavior such as nonce borrowings and code switching, or the ability to identify the source language of a given string (Grosjean, 1997). At the same time, we must not assume, prior to investigation, that the population of steady-state "fossilized" *L2 users* (to use a handy term of Vivian Cook's), whatever their linguistic competence might be, can be equated with that of balanced bilinguals, defined here as those whose acquisition is simultaneous rather than sequential, who have reached levels of proficiency and language use that make them indistinguishable from monolinguals (except for the kinds of bilingual behavior just mentioned) and who use each of their languages on a daily basis (cf. Meisel, 2001, pp. 12–14). Such individuals will serve to provide necessary comparison points for the larger group of other sorts of L2 user.[1]

At the very least, the problem of establishing criteria for identifying and labeling language learners (those whose systems are unstable and changing), steady-state

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

L2 users and bilinguals must be addressed. There is no consensus currently even on appropriate terminology and one man's "learner" is another man's "bilingual," something that makes interpreting results of individual studies difficult. Once a clear picture is obtained of the consequences of bilingualism for language processing of the phenomena discussed here, we will be better able to interpret the significance of the results obtained with groups of high- or low-proficiency learners.

The authors apparently see a direct link between the results of their research and SLA because they attempt to motivate their studies by mentioning an apparent acquisition paradox, namely, that comprehending sentences of a language presupposes prior knowledge of the grammar of that language, whereas building a grammar presupposes the existence of mechanisms for processing linguistic input. The paradox is indeed only apparent because language acquisition is, even in monolinguals, a long-term affair. The hypothesis that lexical and grammatical acquisition is incremental is well documented. It is no news that learners first build mental representations of some things, representations that then permit them to process or parse additional representations of the *same things*. At some subsequent point in time, in ways that are entirely unclear, the established grammatical and conceptual representations, which are also subserving existing processing procedures, permit learners to build novel representations of *different things*, which then, in turn, permit them to parse those things. Consider in this regard the well-known facts about the early interpretation of passives, or bound anaphora in English-speaking children. The challenge for theories of acquisition is, precisely, to discover and describe what comes first and what comes after, and to try to make precise how, in the absence of explicit representations of some bit of knowledge, a learner can come to represent it. How parsing and learning interact in specific cases is thus anything but clear (see Carroll, 2001, for discussion) and this paper does nothing to elucidate the matter, whatever its merits in shedding light on parsing.

If the SSH is borne out in further studies, much will depend on giving it substance. CF readily acknowledge that others have proposed comparable ideas, and there is considerable variation among the proposals identified as to mechanics and functional architecture. It is striking, therefore, that one of the most worked out versions of this claim—the late assignment of syntax theory (LAST) of Townsend and Bever (2001)—is not cited or discussed. The LAST proposal is especially interesting for the current discussion because it proposes that all syntactic processing proceeds along two lines in parallel: a shallow analysis and a deeper analysis by synthesis of a complete and fully specified syntactic representation. The shallow analysis consists of an analysis of canonical patterns and semantic roles, including moving *wh-* expressions back to their source position, the resulting "pseudosyntactic" representation being immediately linked to semantic representations. The pseudosyntax is associatively acquired based on relevant input and is sensitive to the input's frequency. The deeper analysis by synthesis takes place independently of the semantics up to the end of the clause, computing a derivation on a cyclical basis. At that point, a comparison of the synthesized syntactic representation and the input string occurs. When there is a match, the computed meaning is stored and the syntactic details can fade from working memory.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Townsend and Bever (2001) suggest that shallow processing might be impaired in aphasias. The CF studies suggest that their subjects may not be accessing the full information in rule-based derivations. The time course of the two types of analysis is different, and this is where an investigation of bilinguals versus L2 users, and L2 users versus L2 learners might prove to be especially enlightening. For if it is generally acknowledged that L2 learners process their L2 more slowly, the exact cause of this delay is not known. It may be that learners are slower precisely because they, as learners, are constructing processing procedures in real time. Conversely, it may be that L2 users process the L2 more slowly because the L1 processing procedures or lexicon are activated and compete with L2 processing procedures, competition serving in all L2 users to slow down processing. Conversely, it might be the case that certain L1-based procedures "win-out" in an initial competition, because they are more automated and harder to suppress, but an L2-based reparsing has to occur if the syntax and the semantics are to match. This is what we might suspect occurs with L2 users with highly differentiated capacities (highly proficient readers but not highly proficient listeners). Comparing well-defined groups should help us sort out these possibilities. Moreover, they should tell us if a slowed capacity creates *qualitative* differences in processing because an alternative representation from which a semantic representation can be built "wins out."

The SSH is an interesting one and should lead not only to much-needed replications of the same phenomena with different groups whose learning profiles and linguistic knowledge are thoroughly investigated and properly documented, but also to studies of novel phenomena. Because if L2 learners are restricted to shallow structure processing, there should be profound differences in their abilities to comprehend those subtle semantic distinctions (such as scope ambiguities) that hinge on the fine detail of hierarchical representations. Research studies on the syntax–semantics interface in SLA have been rather limited to date in number, in the phenomena examined, and in the language pairs involved. The Essex research will hopefully inspire more interest in this area while providing an explicit processing framework within which to couch results.

Such individuals will serve to provide necessary comparison points for the larger group of other sorts of L2 user.

NOTE

1. These individuals are those whose input is severely constrained because they have acquired their L2 in the classroom (meaning that they may have little understanding of how to interpret certain linguistic registers and genre, cannot draw appropriate inferences from indirect speech acts, and otherwise lack relevant sociocultural knowledge necessary to linguistic performance); those whose performance is lopsided in that they read extensively but have little exposure to spoken language and hardly ever speak the L2 (meaning that they have never developed appropriate processing procedures specific to these modalities); those who use the L2 on a daily basis but in highly stereotyped and ritualized circumstances such as service encounters in banks, restaurants, and shops (meaning that they have little exposure to complex language and infrequent vocabulary); and so forth.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

REFERENCES

Carroll, S. (2001). *Input and evidence: The raw material of second language acquisition*. Amsterdam: Benjamins.

Grosjean, F. (1989). Neurolinguists beware! The bilingual is not two monolinguals in one person. *Brain & Language, 36*, 3–15.

Grosjean, F. (1997). Processing mixed language: Issues, findings and models. In A. M. B. de Groot & J. F. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 225–254). Mahwah, NJ: Erlbaum.

Meisel, J. M. (2001). The simultaneous acquisition of two first languages: Early differentiation and subsequent development of grammars. In J. Cenoz & F. Genesee (Eds.), *Trends in bilingual acquisition* (pp. 11–41). Amsterdam: Benjamins.

Townsend, D. J., & Bever, T. G. (2001). *Sentence comprehension. The integration of habits and rules*. Cambridge, MA: MIT Press/Bradford Books.

Susanne E. Carroll
Universität Potsdam

DOI: 10.1017.S0142716406060073

How do you like your doughnuts?

Ever since the derivational theory of complexity (DTC) apparently bit the dust in the late 1960s, experimental psycholinguistics have been afflicted by a dualism at least as troublesome as the mind/brain dichotomy, namely, the grammar/parser distinction.[1] The idea that mentally represented grammar[2] is something fully dissociated from the human language processor is less than compelling, yet it has implicitly informed much of the last half century's psycholinguistics practice on both sides of the formalist–functionalist divide.

On the one hand, those who interpreted the apparent failure of the DTC to mean that generative grammar was not "psychologically real" proceeded to develop models of language processing that have typically neglected the fact that language users come to know highly abstruse, often dysfunctional, constraints on grammatical analysis, such as those on ellipsis, parasitic gaps, *wh*- movement, and so forth. In other words, notwithstanding their many virtues, these models neglected complex grammar. (Exemplary psycholinguistic work of this sort includes Marslen-Wilson & Tyler, 1980; Seidenberg & MacDonald, 1999; and Tyler, 1992.)

On the other hand, there are those who placed formal syntactic grammatical knowledge at the very center of their theory, and then proceeded to develop parsing theories to address just those behavioral contrasts about which the grammar itself had nothing to say, in particular, various instances of (grammatical) structural ambiguity. Here, the work of Janet Fodor, Lyn Frazier, and their respective colleagues is obviously central (see Frazier, 1987, for an overview). In this scheme of things, grammatical information served to exclude ungrammatical analyses whereas parsing theories were developed to pick out the preferred analyses from the remaining set (the "grammar proposes, parser disposes" doctrine). Ironically, this branch of psycholinguistics also often came to neglect grammar in developing parsing theories: it was so central as to be ignored.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

At the risk of flippancy, the last 40 years of psycholinguistics has witnessed two competing "doughnut theories": the JAM DOUGHNUT theory, with grammar the jam hidden inside, and the RING DOUGHNUT theory, with grammar the hole in the middle.[3]

CF's paper is a highly commendable example of work within the latter theory, where the boundary between grammar and parser is taken to be as self-evident as it is well-delineated. Were this not the case, it would be impossible as a matter of principle to infer that differences between native-speakers' and second language (L2) learners' performance in experimental tasks are due to differences in their processing systems rather than to differences in their grammatical competence, which I take to be CF's central claim. That CF have little difficulty in drawing the line between processing capacity and grammatical competence is especially evident in the following quotes:

> . . . The L2 learners performed at native-speaker levels in the judgment task, and also achieved high proficiency scores. The differences between native-speakers and L2 learners in the on-line task cannot *therefore* be attributed to incomplete acquisition of the Greek grammar . . .
> . . . [T]he fact that adult L2 learners already possess a full-fledged competence grammar and processing system for their L1 raises the possibility of L1 interference or processing transfer . . . [italics added]

The clear implication of these quotes is that the competence grammar and the processing system are distinct entities; moreover, that data from judgment tasks and proficiency tests provide a direct channel to (L2) competence, which allows one to infer complete or incomplete acquisition of grammar, *and which is unmediated by the processing system*. Neither of these implications is acceptable when spelled out, I think.

Notice that what is at stake here is *not* the issue of the autonomy of syntax (within the language processing system), nor the question of whether aspects of the language processing may be modality specific, nor whether on-line and off-line tasks engage different processing capacities, and certainly not the validity of the competence/performance distinction.[4] These are all matters where I suspect CF and I would find broad agreement.

What *is* disputed is whether one can say that a particular piece of linguistic performance—whether it comes from traditional behavioral methods such as response latencies, or from more modern techniques such as event related potentials—is uniquely due to the grammar or to the processing system. Surely one cannot: grammatical competence is always mediated by the processing system (in virtue of being part of it); the ghost, if one exists, is *in* the machine, not somewhere else.

In conclusion, this perspective on the relationship between syntactic theory and language processing[5] prevents me from sharing CF's main theoretical conclusions, even while applauding the empirical research presented here. The paper offers thorough and, to my mind, convincing arguments that adult L2 learners really "do (theoretically interesting) things differently," and hopefully will inspire further work in this crucial area of comparative first language and L2 studies. However,

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

the question of *why* native speakers and L2 learners do what they do will have to await a better theoretical doughnut recipe.

NOTES

1. Whether (every form of) the DTC actually failed in theoretical or empirical terms is open to debate: for a range of views, see Prideaux (1985), Tanenhaus (1986), and Townsend and Bever (2001). What is generally agreed is that the *perceived* failure of the DTC divided the field of psycholinguistics and heavily determined future psycholinguistic practice.
2. Although I restrict attention to syntactic aspects of grammar, similar remarks apply to phonology.
3. Apologies to those who prefer jelly in their donuts (sic). It should also be clear that for the purposes of the argument, I am ignoring the important contribution of various forms of principle-based parsing associated with Berwick (1991), Pritchett (1988), and Crocker (1994), among others, where some serious attempts have been made to synthesize grammatical and processing theories; I think it is fair to say that the bulk of psycholinguistic work on syntactic processing has not been of this kind.
4. In some form or other: for a discussion, see Duffield (2003, 2005).
5. This perspective owes a considerable intellectual debt to recent work by Peter Culicover (especially Culicover, 1998, 2000).

REFERENCES

Berwick, R. C. (1991). Principles of principle-based parsing. In R. C. Berwick, S. P. Abney, & C. Tenny (Eds.), *Principle-based parsing: Computation and psycholinguistics* (pp. 1–38). Dordrecht: Kluwer Academic.

Crocker, M. (1994). On the nature of the principle-based language processor. In C. Clifton, L. Frazier, & K. Raynor (Eds.), *Perspectives on language processing* (pp. 245–266). Hillsdale, NJ: Erlbaum.

Culicover, P. (1998). The minimalist impulse. In P. W. Culicover & L. McNally (Eds.), *The limits of syntax* (pp. 44–77). New York: Academic Press.

Culicover, P. (2000). Minimalist architectures [review of Jackendoff 1997]. *Journal of Linguistics, 35*, 137–150.

Duffield, N. (2003). Measures of competent gradience. In R. van Hout, A. Hulk, F. Kuiken, & R. Towell (Eds.), *The Lexicon–syntax interface in second language acquisition* (pp. 97–127). Amsterdam: John Benjamins.

Duffield, N. (2005). Implications of competent gradience. *Moderne Sprachen, 45*, 95–117.

Frazier, L. (1987). Sentence processing: A tutorial review. In M. Coltheart (Ed.), *Attention and performance: Vol. XII*. Hillsdale, NJ: Erlbaum.

Marslen-Wilson, W., & Tyler, L. K. (1980). The temporal structure of spoken language understanding. *Cognition, 8*, 1–71.

Prideaux, G. (1985). *Psycholinguistics: The experimental study of language*. New York: Guilford Press.

Pritchett, B. (1988). Garden Path phenomena and the grammatical basis of language processing. *Language, 64*, 539–576.

Seidenberg, M. S., & MacDonald, M.-E. C. (1999). A probabilistic constraints approach to language acquisition and processing. *Cognitive Science, 23*, 569–588.

Tanenhaus, M. (1986). Psycholinguistics: An overview I. In F. Newmeyer (Ed.), *The Cambridge survey of linguistics: Vol. IV*. Cambridge: Cambridge University Press.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Townsend, D. J., & Bever, T. G. (2001). *Sentence comprehension*. Cambridge, MA: MIT Press.
Tyler, L. K. (1992). *Spoken language comprehension: An experimental approach to disordered and normal comprehension*. Cambridge, MA: MIT Press.

Nigel Duffield
University of Sheffield

DOI: 10.1017.S0142716406060085

How do second language learners build syntactic structure?

Understanding the mechanisms learners use to process target language input is crucial to developing a complete model of both first language (L1) and second language (L2) acquisition. If adult L2 learners are found to process the target language with mechanisms that differ from those used by child L1 learners and adult native speakers, what implications might this have for the developing grammar? Clahsen and Felser review evidence that appears to point to such differences, generalizing their findings under a shallow structure hypothesis about how adult learners process input in L2.

The claim is that adult learners project a "shallower" structure than do child L1 learners or adult native speakers. Such structure contains less detail about certain types of dependencies (e.g., filler-gap chains), and may not fully resolve certain types of ambiguities (e.g., relative clause attachments), although adult L2 learners can nevertheless exploit nonstructural information to determine meaning. The shallow structure hypothesis thus seems to claim that a person who has learned an L2 in adulthood (after the onset of puberty, presumably) uses one type of processing mechanism for input in L1, a different type of mechanism for input in L2. (I have described this as *language-dependent* processing; Fernández, 1998, 2003.)

Let us consider the issue of L2 processing within a larger theoretical framework. In a perfect world, L1 and L2 acquisition would be fundamentally similar (see VanPatten, 2005). Likewise, any type of linguistic input, in L1 or L2, would be processed in fundamentally similar ways, with one mechanism that follows the same operating principles. These are traditionally described as principles of minimal effort, motivated by the inherent limitations of human cognition (e.g., Frazier, 1978). However, the world may not be all that perfect; the human language processor might be found to have different operational properties, depending on whether the stimulus language is an L1 learned in childhood or an L2 learned in adulthood, as the shallow structure hypothesis seems to claim. If so, we face having to explain not only how and when the processing mechanism arrives at such a change as the individual matures, but also what consequences such a change will have for the acquisition of the target language grammar. If the shallow structure hypothesis makes accurate predictions about adult behavior with L2 input, *shallow performance* could be one source for the difficulties adults encounter when learning an L2 (e.g., Johnson & Newport, 1989), an interesting possibility that has not accrued much empirical support (but that has certainly been contemplated before; see, e.g., Dussias, 2003; Fernández, 1999).

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

We now turn to one phenomenon Clahsen and Felser investigate to examine L2 processing: the relative clause (RC) attachment ambiguity. In this construction, a restrictive RC may modify one of two nouns in the complex noun phrase (NP) that precedes it, for example:

1. The dean liked the secretary of the professor who was reading a letter.

The RC attachment ambiguity has been the focus of many studies of L2 processing for at least one important reason: monolingual speakers of different languages have been found to differ in how they prefer to interpret the ambiguous string, and such cross-linguistic differences permit asking whether the system used to process L1 might differ from the system used to process L2.

Since the first report of the phenomenon (Cuetos & Mitchell, 1988), many studies have shown that monolingual speakers of some languages (English, most notably) prefer to interpret sentences like Example 1 with the RC modifying the second noun, *actress* (a "low attachment" interpretation), while monolingual speakers of other languages (German, Greek, Russian, Spanish, to name a few) prefer for the RC to modify the first noun, *maid* (a "high attachment" interpretation). The mechanism responsible for building syntactic structure, the *parser*, likes to build minimal trees (e.g., Frazier, 1978): it prefers attachments that involve fewer nodes (minimal attachment), that create shorter filler-gap chains (minimal chains), and that are made locally (late closure). (Minimal structure should not be confused with the notion of shallow, "less detailed" structure developed by Clahsen and Felser.) The simpler tree for Example 1 would be one where the RC is attached low to the local noun, *actress*, following the principle of late closure (Frazier, 1978). Attaching to the higher and farther noun, *maid*, means violating this preference for local attachments. Why would speakers of some languages exhibit such behavior?

Of the many proposals designed to answer this question, those with the most solid empirical support assume that the parser operates the same way in all languages. Such proposals claim that some languages prefer the (theoretically) more difficult high attachments because of extrasyntactic factors. The catalyst promoting high attachment could be a grammatical property of the language, for example, prosody (Fodor, 2002), or the language-specific consequences of the application of discourse principles (Frazier & Clifton, 1996). Details about their differences aside, these two accounts (prosody, discourse) agree in that the cross-linguistic differences are not sourced in first-pass syntax-only structure-building processes, but rather have to do with considerations outside of the parser proper. In support of this idea, robust cross-linguistic differences have been reported in studies employing untimed, or "off-line," methods (see, e.g., Fernández, 2003, and references there), methods that allow for such extrasyntactic factors to be taken into consideration. Indeed, "on-line" studies have yielded a rather mixed set of findings (some of the controversies are discussed in Fernández, 2003), plausibly because there is no guarantee that a given "on-line" method effectively prevents the system from considering extrasyntactic information. (The RC attachment ambiguity may therefore not be of theoretical or practical interest, if the goal is to examine early processing routines in L2. Nonetheless, studying how final interpretations are

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

arrived at might be of use for developing an understanding how different types of learners use different types of information to determine meaning, regardless of how early or late this information might be used.)

If the source of the cross-linguistic differences lies outside of the parser, possible outcomes, in studies of RC attachment in L2, are restricted to those where a learner will have similar preferences in L2 and L1, unless knowledge of the critical component (prosody, discourse) is nativelike in both languages. (Note: when L1 coexists with an L2, there is no a priori reason to assume the system remains intact and is not affected either by L2's grammar or by the cognitive load of having two grammars and lexicons in place. That an L1 speaker of a high attaching language will continue attaching high in L1, regardless of attachment preference for stimuli in L2, is an assumption that requires empirical confirmation.) Thus, we expect to find *language-independent* processing (Fernández, 1998, 2003), absent nativelike knowledge in L2 of whatever property guides the language's attachment preferences. Crucially, we need to compare directly L2 and L1 RC attachment preferences.

The RC attachment data offered by Clahsen and Felser in support of the shallow structure hypothesis come from separate experiments carried out in low-attaching English (Felser, Roberts, Gross, & Marinis, 2003) and high-attaching Greek (Papadopoulou & Clahsen, 2003). In both studies, the behavior of native speakers is contrasted to that of learners whose L1 is a language that either differs in preference from L2 (German or Greek L1 speakers learning English; Felser et al. 2003) or not (German, Russian, and Spanish L2 speakers learning Greek; Papadopoulou & Clahsen, 2003). All experiments tested target materials like Example 1, above, and Example 2:

2. The dean liked the professor with the secretary who was reading a letter.

The contrast between Examples 1 and 2 has to do with the nature of the preposition in the complex NP: nonthematic *of* in Example 1 (and its equivalent in the genitive construction used in the Greek studies) versus thematic *with* in Example 2 (and its equivalent in Greek). The preposition in Example 2 is more likely to block high attachment than the preposition in Example 1.[1]

The general findings of these experiments are straightforward (see also Clahsen & Felser's table 4). In both untimed (off-line) questionnaires and grammaticality judgment tasks, and timed (on-line) self-paced reading tasks, Clahsen, Felser, and colleagues find that speakers of all language history profiles attach low with materials like Example 2, all being similarly influenced by the presence of a preposition like *with*, whatever the source for this may be (see note 1). The interesting findings come from responses to materials like Example 1, for which these experiments replicate the standard cross-linguistic difference with monolinguals (even in the on-line tasks): Greek monolinguals attach high, English monolinguals attach low. However, with sentences like Example 1, the L2 learners, across the board, apparently fail to exhibit a preference for either site, regardless of native language, and regardless of stimulus language. Where we would expect similarity between how we assume these learners process their L1s and how they process their L2s, we find instead that L1 speakers of high attachment languages

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

fail to show a preference to attach high in L2, whether L2 is high-attaching Greek (Papadopoulou & Clahsen, 2003), or low-attaching English (Felser et al., 2003).

To support the shallow structure hypothesis, we are forced to stipulate that the L2 learners would perform, in the same task and with fully comparable materials, in their respective L1s as do the monolingual controls. Such a stipulation becomes problematic in light of evidence from a number of studies that have compared directly how speakers of two languages process ambiguous RCs in both languages. These have systematically found similarity in attachment preference within speakers across languages (Dussias, 2003; Fernández, 2003; Frenck-Mestre, 2002; Maia & Maia, 2005).

Clahsen and Felser argue that methodology is not to blame for the apparent discrepancies in the empirical database, pointing to the similar outcomes of their on-line and off-line tasks. Taking into consideration that cross-linguistic differences in monolinguals are only robust when the task is off-line, we could very well be suspect of Clahsen and Felser's on-line data, but we should accept their off-line data. Yet, the L2 Greek off-line data come from a task that differs considerably from those used elsewhere: it requires participants to rate the acceptability of sentences where number agreement forces the RC to attach high or low. We have no way of telling if L2 learners make acceptability judgments with the same confidence as do native speakers (see discussion and references in Altenberg & Vago, 2004), or if L2 learners use agreement features such as number with the same efficacy as do native speakers. Thus, the only data we can safely evaluate against existing studies comes from the English questionnaire reported by Felser et al. (2003), where participants read fully ambiguous stimuli and selected one of two possible interpretations for the RC (as in other studies). Here, the only statistical tests performed on the quantified data, number of N2 responses, were one-sample t tests, which show that for materials like Example 2 performance was above chance, for all three groups (L1 English, German, and Greek), while for materials like Example 1 performance was above chance for the native speakers, at chance for the two groups of L2 learners. A more appropriate treatment for these data (somewhat problematic, given the uneven number of participants, $N = 45$ for L1 English, $N = 28$ for L1 German, $N = 39$ for L1 Greek) would be a two-factor analysis of variance (Speaker Group $\times$ Preposition). Given the means reported, we would expect reliable main effects of both speaker groups (N2 responses average at 77% for L1 English, 70% for L1 German, 67% for L1 Greek) and preposition (55% for nonthematic *of*, 87% for thematic *with*). The shallow structure hypothesis would predict an interaction of the two factors, with similar preferences for all groups for materials like Example 2, but differences between learners and native speakers for materials like Example 1. The means reported do not suggest the presence of such an interaction: overall, the native speakers chose N2 interpretations more frequently (9%, on average), in both conditions, an effect that remains without explanation. Notice also that the analyses performed by Felser et al. (2003) make the assumption that *chance* (50% N2 responses) equals *no preference*. With data collected using unnormed materials, this is by no means guaranteed: a given materials set might be intrinsically biased toward one or the other attachment site (Scheepers, 2003).

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Clahsen and Felser point out that their experiments have an important mechanism in place to ensure that the L2 learners had knowledge of the target language grammar (they were administered a general proficiency test) and of the grammatical principles that generate RCs in L2 (they were also administered a grammaticality judgment task probing relevant constructions). Yet, these tests may not be sensitive to the language-specific factor responsible for the cross-linguistic differences of interest here. Two factors to consider are prosody and discourse principles, neither of which is typically tapped by general proficiency tests or by grammaticality judgment tasks. The reported "random" behavior of the learners might have been guided by the misapplication by some, and adequate application by others, of L2 nativelike prosodic or pragmatic principles. It is not at all farfetched to imagine that these components of language (prosody, discourse) are not fully learned until very late in the acquisition process, and are subject to high between-speaker variability. How to test for L2 knowledge of such elusive components is unclear; what is clear is that we urgently need to develop such tests, if the goal is to understand the source for the behavior of L2 learners in experiments such as these.

The L2 RC attachment data offered by Clahsen and Felser thus fail to convince me that L2 processing differs fundamentally from L1 processing. At the same time, I acknowledge the powerful implications of the shallow structure hypothesis, in its claim that the mechanism for processing input in a language being learned changes as the individual matures. We would need to determine how, and when, this change takes place, and what effect such a change would have for the acquisition of the target language. Shallow performance might turn out to be the source for the variable success rates in L2 acquisition, under a model in which the development of competence is guided by universal grammar, but in which the shallow processing of input in L2 induces a departure from the natural acquisition process. It is a hypothesis that merits further empirical testing, precisely the type of enterprise that advances science.

NOTE

1. Under the construal hypothesis (Frazier & Clifton, 1996), RCs are interpreted within the current thematic processing domain. This thematic domain includes N1 and N2 in Example 1, but only N2 in Example 2. An alternative explanation, not yet subjected to empirical test (although see Papadopoulou, Marinis, & Roberts, 2003), might claim that some prepositions are more likely than others to attract a prosodic phrasing break between N1 and N2; this phrasing has been demonstrated to strongly induce low attachment interpretations (e.g., Igoa & Teira, 2004).

REFERENCES

Altenberg, E. P., & Vago, R. M. (2004). The role of grammaticality judgments in investigating first language attrition: A cross-disciplinary perspective. In M. S. Schmid, B. Köpke, M. Keijzer, & L. Weilemar (Eds.), *First language attrition: Interdisciplinary perspectives on methodological issues* (pp. 105–129). Amsterdam: John Benjamins.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Cuetos, F., & Mitchell, D. C. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the late closure strategy in Spanish. *Cognition, 30*, 73–105.
Dussias, P. E. (2003). Syntactic ambiguity resolution in second language learners: Some effects of bilinguality on L1 and L2 processing strategies. *Studies in Second Language Acquisition, 25*, 529–557.
Felser, C., Roberts, L., Gross, R., & Marinis, T. (2003). The processing of ambiguous sentences by first and second language learners of English. *Applied Psycholinguistics, 24*, 453–489.
Fernández, E. M. (1998). Language dependency in parsing: Evidence from monolingual and bilingual processing. *Psychologica Belgica, 38*, 197–230.
Fernández, E. M. (1999). Processing strategies in second language acquisition: Some preliminary results. In E. C. Klein & G. Martohardjono (Eds.), *The development of second language grammars: A generative approach* (pp. 217–239). Amsterdam: John Benjamins.
Fernández, E. M. (2003). *Bilingual sentence processing: Relative clause attachment in English and Spanish*. Amsterdam: John Benjamins.
Fodor, J. D. (2002). Psycholinguistics cannot escape prosody. *Speech Prosody 2002 electronic proceedings* [on-line]. Retrieved from http://www.lpl.univ-aix.fr/sp2002/pdf/fodor.pdf
Frazier, L. (1978). *On comprehending sentences: Syntactic parsing strategies*. Unpublished doctoral dissertation, University of Connecticut.
Frazier, L., & Clifton, C. (1996). *Construal*. Cambridge, MA: MIT Press.
Frenck-Mestre, C. (2002). An on-line look at sentence processing in the second language. In R. R. Heredia & J. Altarriba (Eds.), *Bilingual sentence processing* (pp. 217–236). Amsterdam: Elsevier.
Igoa, J. M., & Teira, C. (2004). *Prosody and relative clause attachment in Spanish: Evidence for early but asymmetric effects*. Poster presented at Architectures and Mechanisms of Language Processing (AMLaP) 2004, September 16–18, Aix-en-Provence, France. Abstract [on-line]. Retrieved from http://www.lpl.univ-aix.fr/∼AMLaP2004/Final_Abstracts_pdf/igoa.pdf
Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology,* 21, 60–99.
Maia, M., & Maia, J. (2005). A compreensão de orações relativas por falantes monolíngües e bilíngües de Português e de Inglês. In M. Maia & I. Finger (Eds.), *Processamento da linguagem* (pp. 163–178). Pelotas, Brazil: Editora Educat.
Papadopoulou, D., & Clahsen, H. (2003). Parsing strategies in L1 and L2 sentence processing: A study of relative clause attachment in Greek. *Studies in Second Language Acquisition, 24*, 501–528.
Papadopoulou, D., Marinis, T., & Roberts, L. (2003). *Lexical effects in sentence processing: evidence from modifier attachment in Greek and English*. Paper presented at Architectures and Mechanisms for Language Processing (AMLaP) 2003, August 25–27, Glasgow, Scotland.
Scheepers, C. (2003). Syntactic priming of relative clause attachments: Persistence of structural configuration in sentence production. *Cognition, 89*, 179–205.
VanPatten, B. (2005). *The fundamental similarities and fundamental differences in first and second language acquisition*. Manuscript submitted for publication.

Eva M. Fernández
Queens College and Graduate Center, CUNY

DOI: 10.1017.S0142716406060097

Commentary on Clahsen and Felser

Clahsen and Felser (CF) have written a fairly comprehensive review of the current literature on on-line second language (L2) processing, presenting data from eye movement, self-paced reading, and event-related potential (ERP) studies with the aim of evidencing possible differences between native language (L1) and

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

L2 processing. The thrust of the article, in regard to adult L2 processing, is apparently an attempt to gather evidence to bolster their argument about "shallow processing" in adult L2 learners. Although the authors provide the reader with a generally good overview of the current literature, their argumentation seems to be flawed at times. Consider, first, the authors' presentation of recent ERP evidence. The authors claim that L2 adult learners may lack automaticity in comparison to native speakers in regard to syntactic processing. This is based upon a delayed N400 response, often found in L2 learners compared to native speakers, as well as by the pattern of anterior negativities to morphosyntactic violations. Later, however, this line of argumentation is seemingly undermined. First, as CF rightly underline, the range of variability in anterior negativities found in L2 learners falls within the range of variation observed in native speakers. As such, variability in this response cannot be taken as a marker of differential processing specific to (shallow) syntactic processing in the second language (see also Frenck-Mestre, 2005; Osterhout et al., 2004). Second, as CF later note, the N400 (as well as P600) is systematically observed in adult L2 learners, and is often highly similar to that found for native speakers. Consider, next, the behavioral evidence cited by CF on adult L2 syntactic processing. The authors cite work on various structures, notably relative clause attachment (which has received a great deal of attention in both monolingual and L2 studies). Concerning this structure, although CF cite studies, which show both clear L1 influence on L2 processing and differential effects as a result of experience with the L1, they favor studies that fail to show such effects and reject Mitchell et al.'s (2000) tuning hypothesis as an explanatory model. (Note Mitchell and colleagues have indeed produced evidence of their own showing limitations of their model.) It is also noteworthy that CF's argumentation about the sensitivity of the measure they used to test for immediate preferences for this structure is not as strong as it could be. Indeed, where they report L2 preferences (for low attachment following thematic prepositions), the literature shows the same systematic preference independent of the language tested (cf. Mitchell et al., 2000). As such, the sensitivity of their measure may not be adequately demonstrated. In sum, although CF provide the reader with an impressive collection of current L2 studies, the viewpoint that they espouse does not seem to be as substantiated as they wish to claim.

REFERENCES

Frenck-Mestre, C. (2005). Eye-movement recording as a tool for studying syntactic processing in a second language: A review of methodologies and experimental findings. *Second Language Research, 21*, 175–198.

Mitchell, D., Brysbaert, M., Grondelaers, S., & Swanepoel, P. (2000). Modifier attachment in Dutch: Testing aspects of construal theory. In A. Kennedy, R. Radadh, D. Heller, & J. Pynte (Eds.), *Reading as a perceptual process*. Amsterdam: Elsevier.

Osterhout, L., McLaughlin, J., Kim, A., & Inoue, K. (2004). Sentences in the brain: Event-related potentials as real-time reflections of sentence comprehension and language learning. In M. Carreiras & C. Clifton, Jr. (Eds.), *The on-line study of sentence comprehension: Eyetracking, ERP, and beyond*. New York: Psychology Press.

Cheryl Frenck-Mestre
Université de Provence

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

DOI: 10.1017.S0142716406060103

It is time to work toward explicit processing models for native and second language speakers

In their target article, Clahsen and Felser (CF) review studies that they and others have conducted in recent years to confirm the dual mechanism hypothesis and to extend its application to first and second language (L1 and L2) learners. They interpret the findings as supporting both the dual mechanism hypothesis and the claim that the sentence-level processing of L2 but not L1 learners shows "striking" differences compared to adult native speakers. I argue that an exclusive focus on the *representation* of linguistic knowledge is insufficient for understanding the real-time *processes* in morphological production and sentence comprehension.

HOW TO BLOCK A FASTER PROCESS?

In the first part of the target article CF report data from Clahsen, Hadler, and Weyerts (2004) that show a frequency effect for irregular past tense production and a reversed frequency effect for regular past tense production; that is, high-frequency regular past tense forms were produced slower than low-frequency forms. CF interpret the frequency effect as evidence for the dual mechanism model of inflectional morphology. For the reversed frequency effect in regular production CF adopt an explanation from Pinker (1999). This explanation assumes that high-frequency regulars are lexically stored, low-frequency regulars are not. Pinker suggests that regular production is delayed for high-frequency verbs because it is blocked by their lexical entry. Because there is no lexical entry for low-frequency regular verbs, production of their regular past tense form is not blocked and thus faster.

This explanation demonstrates a weakness of the dual mechanism hypothesis as a processing model. The assumed blocking mechanism clearly lacks serious consideration of the timing of the processes involved. If unblocked regular past tense production is faster than the retrieval of lexically stored past tense forms (which both CF and Pinker seem to assume), then it is hard to see how the retrieval of a stored past tense form can ever block regular production. Retrieval should always be too late, and irregulars should always be regularized. On the other hand, if retrieval were faster than regular production the blocking mechanism could work. However, in that case stored high-frequency regular past tense forms should be produced faster than low-frequency forms synthesized by a rule mechanism. Hence, there could be no reversed frequency effect. A simple way out of this paradox might be a modified dual mechanism model in which it is not the retrieval of the stored past tense forms as such that blocks regular production but some "pointer" to a stored past tense form that is already available as soon as the verb stem is retrieved.

Note, furthermore, that according to Pinker (1999, p. 303), who refers to Beck (1997), the suggested explanation only holds when there are so many irregulars in the stimulus set that participants adopt a special strategy: they always search for a

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

lexical past tense entry. Surprisingly, this means that looking up a past tense entry is not the normal procedure, which again raises the question how the blocking mechanism actually works outside of experimental stimulus sets.

Clearly, what is needed to achieve some progress in our understanding of morphological production is a model that is explicit in terms of the timing of lexical retrieval and regular production and can explain (a) the main effect of regular past tense production being on the whole faster than irregular past tense production that is found in most studies (Beck, 1997; Jaeger et al., 1996; Prasada, Pinker, & Snyder, 1990; Sach, Seitz, & Indefrey, 2004), (b) how overregularization is avoided, and (c) the conditions under which (reversed) frequency effects occur. For the time being I do not see that any of the suggested models satisfactorily deals with all three points.

ARE LOW-SPAN NATIVE SPEAKERS STRIKINGLY DIFFERENT FROM HIGH-SPAN NATIVE SPEAKERS?

In the second part of their target article CF turn to syntactic processing. They provide evidence suggesting that during sentence parsing L2 learners unlike native speakers do not build up structural representations but semantic ("shallow") representations. In an experiment by Marinis, Roberts, Felser, and Clahsen (2005), for example, native speakers but not advanced L2 speakers of English showed sensitivity to the intermediate gap in sentences like *The nurse who the doctor argued _____ that the rude patient had angered _____ is refusing to work late.* Based on this finding, CF conclude a "striking" difference between L2 and native speakers. Again, if the main interest is to provide evidence for a dichotomous view of language processing, this result may be considered satisfactory. If we want to understand what listeners in general do when processing sentences it is not. Note that we learn from another experiment (Roberts, Marinis, Felser, & Clahsen, 2004) that low memory-span native speakers did not show sensitivity to the gap in sentences like *John saw the peacock to which the small penguin gave the nice birthday present _____ in the garden last weekend.* It seems that an unbiased interpretation of the two studies would have to conclude that L2 speakers behave at least like some native speakers. Thus, if we were to classify types of listeners it would be high working-memory span native speakers on one side and low-span native speakers together with L2 speakers on the other. Obviously, what the latter groups have in common is not their language background but much more likely some limitation of their processing resources. CF attempt to argue against such an explanation for L2 speakers by pointing out (a) that reading time differences do not seem to affect sentence processing, and (b) that L1 learners show "overreliance on structural information due to their relatively limited working-memory resources." Both arguments are hardly convincing. If L2 processing as such imposes a high load on processing resources, then a resulting preference for semantic rather than structural sentence processing should already be found in even the fastest L2 reader, and in this respect no differences to slower readers are to be expected. The second argument transfers findings from children's inflectional behavior to the domain of sentence processing. However, CF themselves suggest that the processing in these two domains may differ when they conclude that

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

advanced L2 speakers seem to employ the same mechanisms as L1 speakers in inflectional processing but not in sentence parsing. The second argument, furthermore, ignores the much more relevant findings of the Roberts et al. (2004) study on sentence processing showing that the memory-span effect in L1 learners was just like in adult speakers, that is, low-span children did *not* rely on structural information.

In sum, the studies reviewed by CF do not provide evidence that L2 sentence processing is, in principle, different from L1 sentence processing. Nonstructural sentence processing observed in L2 speakers is an option that is also used by native speakers when they have limited processing resources, be it a low working-memory span or more severe limitations in aphasia (Hagoort, Wassenaar, & Brown, 2003). Furthermore, to the extent that structural sentence processing relies on Broca's area, neuroimaging data suggest that the degree of structural processing varies as a function of task demands and complexity of the sentence material (Dapretto & Bookheimer, 1999; Friederici, 2002; Indefrey, Hellwig, Herzog, Seitz, & Hagoort, 2004). To put it simply, native speakers seem to employ their structural sentence processing resources to the degree that is necessary to perform a task at hand or to understand a particular type of sentence. Quite possibly this means that structural processing is not simply on or off, but there are varying types of "shallow" representations with different amounts of syntactic information being represented. What we need to know is for which types of sentences speakers with a given amount of processing resources process which types of morphosyntactic or structural information.

REFERENCES

Beck, M.-L. (1997). Regular verbs, past tense and frequency: Tracking down a potential source of NS/NNS competence differences. *Second Language Research, 13*, 93–115.

Clahsen, H., Hadler, M., & Weyerts, H. (2004). Speeded production of inflected words in children and adults. *Journal of Child Language, 31,* 683–712.

Dapretto, M., & Bookheimer, S. Y. (1999). Form and content: Dissociating syntax and semantics in sentence comprehension. *Neuron, 24*, 427–432.

Friederici, A. D. (2002). Towards a neural basis of auditory sentence processing. *Trends in Cognitive Sciences, 6*, 78–84.

Hagoort, P., Brown, C. M., & Wassenaar, M. (2003). Real-time semantic compensation in patients with agrammatic comprehension: Electrophysiological evidence for multiple-route plasticity. *Proceedings of the National Academy of Sciences of the United States of America, 100*, 4340–4345.

Indefrey, P., Hellwig, F., Herzog, H., Seitz, R. J., & Hagoort, P. (2004). Neural responses to the production and comprehension of syntax in identical utterances. *Brain and Language, 89*, 312–319.

Jaeger, J. J., Lockwood, A. H., Kemmerer, D. L., Van Valin, R. D., Murphy, B. W., & Khalak, H. G. (1996). A positron emission tomographic study of regular and irregular morphology in English. *Language, 72*, 451–497.

Marinis, T., Roberts, L., Felser, C., & Clahsen, H. (2005). Gaps in second language sentence processing. *Studies in Second Language Acquisition, 27*, 53–78.

Pinker, S. (1999). *Words and rules. The ingredients of language*. New York: Basic Books.

Prasada, S., Pinker, S., & Snyder, W. (1990). *Some evidence that irregular forms are retrieved from memory but regular forms are rule-generated*. Paper presented at the 31st Annual Meeting of the Psychonomic Society, New Orleans, LA.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Roberts, L., Marinis, T., Felser, C., & Clahsen, H. (2004). *Antecedent priming at trace positions in children's sentence processing*. Unpublished manuscript, University of Essex.
Sach, M., Seitz, R. J., & Indefrey, P. (2004). Unified inflectional processing of regular and irregular verbs: A PET study. *NeuroReport, 15*, 533–537.

Peter Indefrey
Max Planck Institute for Psycholinguistics
and
F.C. Donders Centre for Cognitive Neuroimaging, Nijmegen

DOI: 10.1017.S0142716406060115

Grammar and parsing and a transition theory

The article by Clahsen and Felser (CF) on grammatical processing in language learning is a timely and much-needed synthesis of research on this topic. It correctly identifies both morphological processing and syntactic processing as key areas that require attention. This commentary raises two issues: the relationship between the grammar and the parser, and the need for a transition theory in adult second language (L2) learning.

CF advance a viewpoint, one long been held by Clahsen and colleagues, that adult L2 acquisition and representation is fundamentally different from first language (L1) acquisition and adult native speaker competence (Bley-Vroman, 1989; Clahsen & Muysken, 1986). The article proposes further evidence that this is the case: first, CF point to evidence that young children focus primarily on structure during processing, to the exclusion of plausibility constraints; second, children are less able to revise an analysis, and resort to bottom-up processing in contexts of high processing demand. In contrast, adult learners make primary use of lexical information to resolve ambiguities, but seem unable to make use of structural gaps (Marinis, Roberts, Felser, & Clahsen, 2005).

The question that arises is whether the data discussed by CF constitute evidence that L2 processing is just different, or *fundamentally* different. In this context, a clarification about the relationship between the grammar and parser is necessary. CF are implicit about their assumptions, and it would be helpful if their characterization of this relationship were clearer. It is accepted that syntactic processing involves both bottom-up and top-down information. However, the concern is what system drives the bottom-up portion. If one adopts the somewhat controversial position (in some quarters anyway) that the relationship between the grammar and parser is one of local application of global principles (Pritchett, 1992; Weinberg, 1999), then a claim that L2 parsing is *fundamentally* different becomes problematic. If we assume that a formal grammar is one that describes operations on a set of symbols, then one has to decide which set of symbols one will pick to describe processing behavior. If the choice is a Principles and Parameters grammar, or its current Minimalist incarnation (Chomsky, 1995), then one is dealing with parser that is involved in feature checking. CF's use of gaps and empty categories puts them squarely in this camp. (Note that this is not

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

necessarily true of a theory that would be based on head-driven phrase structure grammar, for example, because it is a theory that does not posit empty categories; Borsley, 1998). Under current minimalist assumptions, feature checking is required even for lexical integration, which CF concede that L2 learners do well. Given this assumption, L2 learners do not face difficulties with the formal feature checking mechanism; rather, one must assume that a specific subset of features are affected, for example, [±*wh*] and perhaps other functional features.

In this context, CF propose the "shallow processing" hypothesis. This hypothesis is that thematic and pragmatic information are used in processing but not structural gaps involving [±*wh*] features. However, their characterization of this shallow processing will need some further formalization before it can be empirically tested. Specifically, why is it that some uninterpretable features that need to be checked can be checked successfully, for example, Case and argument features, but others cannot. Moreover, in CF's sentence, which is used to illustrate shallow processing, an object relative clause that modifies a Subject is presented. In this context, we have two verbs next to one another. As Juffs (2005) suggests, this problem may cause L2 learners problems, as it seems to for adult native speakers (e.g., King & Just, 1991). It is unclear whether object relatives that modify an object cause similar problems: the prediction is that a sentence such as "the tiger chased the lion that the hunter tracked _____ in the forest" should cause the same difficulty as "the lion that the hunter tracked _____ chased the tiger in the forest." If shallow processing is correct, will L2 learners find both these structures difficult because the mechanism is "impaired," or will the objects that are modified be easier because the features of the object and the relative pronoun are the same?

The second issue that CF's review of the literature raises, indeed, the first words of their abstract zeroes in on this issue, is the theoretical claim that processing is a part of a transition or acquisition theory (Fodor, 1998; Gregg, 1996). The data from children are suggestive in that children appear to pay attention to structural cues to the exclusion of pragmatics, a behavior that suggests that parsing failure might drive changes in the grammar as suggested by Fodor (1998) and by Johnson and Newport's (1989) "less is more" hypothesis. However, it is not clear from the literature that CF review that parsing is, in fact, as deeply involved in acquisition as theory proposes. Crucially, no empirical studies are reviewed that specifically test the hypothesis that that parsing breakdown is, in fact, a trigger for restructuring of the grammar in children. This is not something that CF are responsible for, but given current formal approaches to language learning, one might have expected some experimental evidence to show how the focus on structure among children leads to restructuring of the grammar. In a sense, this is another gap in the research, and not a critique of CF's review. However, in L2 acquisition, there does seem to be some evidence that targeted processing can assist in acquisition (VanPatten, 1996, 2002; but cf. DeKeyse, Salaberry, Robinson, & Harrington, 2002).

On a more practical note, CF's characterization of L2 learners' processing has a pedagogical implication. If it is true that the L2 learners' deficit is that they process only "shallowly," then the data CF present are further evidence that teaching techniques that emphasize communicative competence (Canale & Swain,

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

1980; Paulston, 1974; i.e., approaches that encourage integration of grammatical, pragmatic, sociolinguistic, and strategic competence), *to the exclusion of attention to form* may not be appropriate for successful L2 acquisition. This is to say that it may not be surprising that learners have not been able to home in on some narrow structural properties of their second language for processing, if instruction encourages use of pragmatics for successful comprehension. If shallow processing is available in the L1, and can be transferred to the L2, then a least effort principle may permit them to process the L2 without the necessary structural analysis. Methods that require processing and comprehension, drawing attention to processing errors (e.g., VanPatten, 1996) will be helpful in this regard.

In their conclusion, CF note that their conclusions are preliminary. It remains true that there are very few studies that use psycholinguistic techniques to investigate L2 processing. This article should be seminal in promoting further research.

REFERENCES

Bley-Vroman, R. (1989). What is the logical problem of foreign language learning? In S. Gass & J. Schachter (Eds.), *Linguistic perspectives on second language acquisition* (pp. 41–68). Cambridge: Cambridge University Press.

Borsley, R. (1998). *Syntactic theory*. Oxford: Arnold.

Canale, M., & Swain, M. (1980). Theoretical bases of communicative approaches to second language teaching and testing. *Applied Linguistics, 1*, 1–17.

Chomsky, N. (1995). *The minimalist program*. Cambridge, MA: MIT Press.

Clahsen, H., & Muysken, P. (1986). The availability of UG to adult and child learners: A study of the acquisition of German word order. *Second Language Research, 2*, 93–119.

DeKeyser, R. M., Salaberry, R., Robinson, P., & Harrington, M. W. (2002). What gets processed in processing instuction? A commentary on Bill VanPatten's "Processing instruction: An update." *Language Learning, 52*, 805–823.

Fodor, J. D. (1998). Unambiguous triggers. *Linguistic Inquiry, 29*, 1–36.

Gregg, K. (1996). The logical and developmental problems of second language acquisition. In W. C. Ritchie & T. K. Bhatia (Eds.), *Handbook of second language acquisition* (pp. 50–84). New York: Academic Press.

Johnson, J., & Newport, E. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology, 21*, 60–99.

Juffs, A. (2005). The influence of first language on the processing of *wh*-movement in English as a second language. *Second Language Research, 21*, 121–151.

King, J., & Just, M. A. (1991). Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language, 30*, 580–602.

Marinis, T., Roberts, L., Felser, C., & Clahsen, H. (2005). *Gaps in second language sentence processing*. Manuscript submitted for publication.

Paulston, C. B. (1974). Linguistics and communicative competence. *TESOL Quarterly, 8*, 347–362.

Pritchett, B. L. (1992). *Grammatical competence and parsing performance*. Chicago: Chicago University Press.

VanPatten, B. (1996). *Input processing and grammar instruction in second language acquisition*. Norwood, NJ: Ablex.

VanPatten, B. (2002). Processing instruction: An update. *Language Learning, 52*, 755–803.

Weinberg, A. (1999). A minimalist theory of human sentence processing. In S. Epstein & N. Hornstein (Eds.), *Working minimalism* (pp. 287–315). Cambridge, MA: MIT Press.

Alan Juffs
University of Pittsburgh

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

DOI: 10.1017.S0142716406060127

How language learners comprehend and produce language in real time

This paper does a fine job of advancing discussion concerning a question that is indeed quite underrepresented in the literature, that is, how language learners comprehend and produce language in real time. The paper is firmly rooted in the dual mechanism approach to language processing and takes as its starting point the assumption that normal adult processing is characterized by two systems, one that is lexically based and one that is essentially combinatorial. The authors cite evidence that both first language (L1) learners and adult native speakers show evidence of dual mechanism processing and that, in particular, children's sentence processing shows early reliance on structure-based interpretation and less ability to employ lexical/pragmatic information in the resolution of language ambiguity. One way to view this preference is that L1 learners might know, broadly speaking, considerably more about their language than they do about the world in which they live. Adult second language (L2) learners might be said to be in exactly the opposite situation. It is therefore hardly surprising that adult L2 speakers rely strongly on lexical/pragmatic cues in sentence processing. In the early stages of adult L2 acquisition, the demands of real-time processing make use of such nonsyntactic inference crucial. The question that strikes me as key is whether, as L2 speakers become more proficient, they are weaned from this reliance such that their processing reflects the interaction between syntactic and lexical processing that is characteristic of adult native speakers. When and if they do, we could say that their L2 processing is, both internally and externally, nativelike.

We might represent this characterization in simplified form as follows:

1. a. L1 learners: syntax first, lexical/world knowledge second
   b. L2 learners: lexical/world knowledge first, syntax second
   c. Native speakers: lexical/world knowledge and syntax interact

We know, by definition, that Example 1a becomes Example 1c, and Clahsen and Felser (CF) argue that this transition involves quantitative rather than qualitative changes along the way within fundamentally the same dual mechanism architecture. The mystery at hand is why, even at very high levels of L2 proficiency, Example 1b does not become Example 1c.

CF present two possible reasons for this: the first is the Paradis/Ullman perspective (Paradis, 1994, 1997, 2004; Ullman, 2001), which states that L1 language is characterized by the dominance of procedural knowledge and that L2 language is characterized by the dominance of declarative knowledge. The second is the shallow structure hypothesis (SSH), which they propose.

Although I am sympathetic to the authors' view that characterizing L1/L2 differences solely in terms of procedural versus declarative knowledge may be too simplistic, I am not entirely convinced that their arguments warrant its dismissal. The model is indeed underspecified, but it must be admitted that their alternative account is, at present, also a sketch. They argue that the Paradis/Ullman (Paradis,

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

1994, 1997, 2004; Ullman, 2001) position could not account for the observed distinction between L2 learners' morphological and syntactic abilities, and that we are left wondering what exactly concepts such as "*reduced* availability of procedural knowledge" might mean. It seems to me at least possible that, in this context, "reduced availability" might mean exactly that procedural knowledge is insufficiently available to deal with the computational complexity posed by sentences as compared to relatively simple inflected forms.

Even if the arguments for rejecting the Paradis/Ullman (Paradis, 1994, 1997, 2004; Ullman, 2001) position are less than overwhelming, the authors' alternative SSH does seem to have substantial merit. The hypothesis provides a very plausible account for why Example 1b does not become Example 1c, namely, because the requisite structural complexity required to scaffold syntactic processing is not available to the L2 learner. In this way, their hypothesis is reminiscent of Caplan and Hildebrandt's (1988) account of sentence comprehension disorders in aphasia, positing a flat rather than hierarchical syntactic representation upon which sentence interpretation can be based.

This may be simply another way of saying that procedural knowledge is less available. However, even if it is, I find it to be one that is more useful in that it casts the phenomenon in terms that are likely to lead to further refinement of our understanding. I am struck, for example, by the possibility that the authors have set up a false dichotomy between morphological and sentence processing. As the authors note, the observed differences between morphological processing and sentence processing may be related to the fact that the morphological structures studied so far in this domain "involve the simple concatenation of two adjacent elements (stems and affixes) and thus have a much shallower internal structure than sentences." Perhaps, then, the differences that the authors note between morphological and sentence processing are not differences that are intrinsic to these domains, but simply ones that fall out as artifacts of the stimulus materials chosen among studies. Indeed, it seems to me that German, the language in which the authors have done so much work, offers fertile ground for investigating the interaction of lexical/pragmatic knowledge and hierarchical syntactic knowledge within the morphological domain. Unlike English, German allows for hierarchically structured triconstituent compounds to be written as single words, so that a word such as *Lederhandschuh* (leather + hand + shoe [leather glove]) clearly has a right-branching structure, whereas *Handschuhleder* (hand + shoe + leather [glove leather]) clearly has a left-branching structure.

Krott et al. (2004) have presented evidence that, all things being equal, native speakers of German show a preference for left-branching analyses of triconstituent compounds. Against this background, lexical/pragmatic constraints could be manipulated to yield contrasts in the morphological domain that might be comparable to those that have been used to investigate the interaction of structural and lexical/pragmatic preferences in the sentence domain.

As an example of this, consider the four novel compound structures in Example 2. The compound in Example 2a is ambiguous in that it could plausibly have both a left- and right-branching structure. Structure 2b is also balanced, but in a manner such that neither reading corresponds to our real-world knowledge of the materials typically used to manufacture either carpets or brooms. Finally, in

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Structures 2c and 2d, the choice of the initial constituent pragmatically biases toward either a left-branching or right-branching reading.

2. a.	left-good, right-good	kinderteppichbesen	(child('s)-carpet-broom)
b.	left-bad, right-bad	glasteppichbesen	(glass-carpet-broom)
c.	left-good, right-bad	wollteppichbesen	(wool-carpet-broom)
d.	left-bad, right-good	holzteppichbesen	(wood-carpet-broom)

My expectation is that stimuli such as these in the morphological domain would yield very much the same pattern of data that has been reported in sentence processing for adult native speakers of German, L1 learners, and adult L2 learners. L1 learners should show a left-branching (structural) bias, which is relatively insensitive to pragmatic constraints, whereas L2 learners should show a reliance on pragmatic cues and less of a structurally based left-branching preference. If this prediction is correct, it would suggest no underlying morphological/sentence processing difference and the need for a unified account across the domains.

Finally, I would like to note that I was very pleased by the authors' comment at the end of the paper concerning the need to investigate L2 processing in real time across different levels of L2 proficiency. This will be a critical step in the development of our understanding of whether structural depth follows a developmental pattern in L2, or whether, as the authors seem to suggest, shallow structure is tied to the fundamental nature of L2 processing.

REFERENCES

Caplan, D., & Hildebrandt, N. (1988). *Disorders of syntactic comprehension*. Cambridge, MA: MIT Press.

Krott, A., Libben, G., Jarema, G., Dressler, W., Schreuder, R., & Baayen, H. (2004). Probability in the grammar of German and Dutch: Interfixation in triconstituent compounds. *Language and Speech, 47*, 83–106.

Paradis, M. (1994). Neurolinguistic aspects of implicit and explicit memory: Implications for bilingualism and SLA. In N. Ellis (Ed.), *Implicit and explicit language learning* (pp. 393–419). London: Academic Press.

Paradis, M. (1997). The cognitive neuropsychology of bilingualism. In A. De Groot & J. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 331–354). Mahwah, NJ: Erlbaum.

Paradis, M. (2004). *A neurolinguistic theory of bilingualism*. Amsterdam: John Benjamins.

Ullman, M. (2001). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition, 4*, 105–122.

Gary Libben
University of Alberta

DOI: 10.1017.S0142716406060139

How do children become adult sentence producers?

We join other responders in thanking Clahsen and Felser (CF) for pulling together these observations about the development of language processing. We

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

are especially impressed by the generality and inclusiveness of CF's treatment of development in L1 and L2. Because most of their specifics concerned comprehension processes, our contribution will emphasize the added value of an appeal to production processes. In particular, we will articulate the value of applying existing production models to developmental phenomena. Language development can be interpreted in revealing ways through the lens of adult sentence production models. These models specify how lexical, syntactic, morphological, and phonological knowledge are integrated in real time as we produce sentences. They are performance models, but they go well beyond general measures of working memory and general notions of limited capacity and resources.

PRODUCTION MODEL PERSPECTIVES ON DEVELOPMENTAL PROCESSES

In the past 40 years, research in adult language production and in child language acquisition has evolved along divergent paths despite being subdisciplines of psycholinguistics. Research on adult production uses systematic error to deduce the architecture and timing of processes like message formation, lexical access, sentence planning, and phonological encoding. This research has given rise to elaborate and revealing models of real-time sentence production (e.g., Bock & Levelt, 1994; Dell, 1986; Fromkin, 1971; Garrett, 1984). In contrast, systematic error in children's utterances is usually assumed to reflect limitations in their linguistic competence (e.g., Radford, 1990; Rice, Wexler, Marquis, & Herschberger, 2000; Wexler, 1996). Essentially, research on adult production has studied performance and real-time processes, whereas research on child production has studied linguistic competence.

Distinguishing between competence and performance in children seems more challenging than it is in adults, in part for methodological reasons. This difficulty may have led some to avoid children's performance limitations as an essential aspect of development or even to think that such limitations are not potentially informative or worthy of research (e.g., Crain & Thornton, 1998). CF clearly show the value of studying the development of parsing in child and adult language learners. As they note, little research addresses these issues. Even fewer studies concern the developing production system. This is striking, given the large body of production data in the field. Although obviously relevant, it is rarely used to explore the production system itself. Wijnen (1990, p. 651), echoing Marshall (1979), made this point 14 years ago: "Although most child language research is based on spontaneously produced speech, the predominant approach is competence-oriented." The irony here is that production data are arguably poorly suited to studying adult grammar (for all the reasons that account for its motivated exclusion by syntacticians working on adult language). Both the adult and child language data represent competence through a production filter. By and large, we know how to exclude adult error from our data base. For early child language, the matter of "error" is intrinsic, so a satisfactory analysis must provide principled ways to evaluate the effects of that filter. For such analysis, we need a theory of the real-time production system.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

The few existing studies of the developing production system emphasize phonological and lexical speech errors in spontaneous utterances (e.g., *bolar pears* for *polar bears*; *easy* for *hard;* Stemberger, 1989; see also Jaeger, 1992; Wijnen, 1992). Children's speech errors *are* revealing. Indeed these small *n* studies show that some aspects of adultlike speech errors are present in early childhood. Interestingly, these aspects appear developmental in nature. Still, Bock (1991, p. 156) points out that "the linguistic and extralinguistic contexts of natural errors may vary freely in ways that bear both on the occurrence of error and on the validity of different explanations, making some form of experimental control essential." However, the experimental paradigms and large *n* studies that are needed to understand the *developing* system are largely lacking.

Some developmental psycholinguists, including CF, do consider children as both acquiring new knowledge *and* learning to use this knowledge in the split-second operations of sentence production. We would like to note a few additional studies in this vein. Some components of sentence production, such as self-monitoring, clearly develop (Rispoli, 2003). The vocabulary spurt observed in young children may be due to a restructuring of the lexical retrieval part of the production process rather than to an actual increase in vocabulary size (Dapretto & Bjork, 2000). Young children appear to have capacity limits that may initially restrict the length and complexity of their utterances (Rispoli & Hadley, 2001). The classic phenomenon of subject omission may also involve capacity limitations (Bloom, 1990; Valian, Hoeffner, & Aubrey, 1996). Morphosyntactic elements that are inserted during later stages of sentence production may initially be difficult to generate (McKee & Iwasaki, 2001). Cross-linguistic variation in omission patterns suggests that the way a language packages lexical information also affects these processes (McKee & Emiliani, 1992). Children's difficulties with some relative clause constructions may be due to the developing formulator's adherence to strategies that aid the sentence planning process rather than to strategies that aid the parser (McDaniel & Lech, 2003). Children's pauses in complex sentences occur in the same positions as those of adults, indicating a similar planning process (McDaniel, McKee, & Garrett, 2005). Such studies are just the beginning. Much more warrants study.

CF discuss at some length the production study by Clahsen, Hadler, and Weyerts (2004), which addressed the linkage of knowledge and processing during development. Clahsen et al. (2004) found that, although children's participle forms were essentially the same as in adult's production, children were generally slower. Children also showed an antifrequency effect in response latency for regular participles. That is, high-frequency regular participles took longer to produce than low-frequency regular participles. This effect disappeared in adulthood. Pinker (1999) suggests an explanation for these findings via the competition between two mechanisms for the production of morphologically complex forms, one based on the retrieval of a word form and the other on the use of a morphological rule. This competition appears most prominently for forms in which high-frequency representations of regularly inflected words are stored independently of the rule route and can inhibit the application of the rule route.

Clahsen et al. (2004) is a case that exemplifies the need to "developmentalize" production models. Now let us situate affix production into a particular model

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

of real-time sentence production. This history of the model begins in the 1970s (Fromkin, 1971; Garrett, 1975) and has evolved over a 30-year period (Bock & Levelt, 1994; Dell, 1986; Garrett, 1984; Levelt, 1989). In this model, sentence production and sentence comprehension are codependent but separate systems. Of central importance is a division in the word processing system between *lemma* level semantic and syntactic information and *lexeme* level phonological information. The model is, in important respects, *lemma driven*. This means that the information contained in the lemma for a word mandates syntactic frames.

Critical features of the model are motivated by speech errors, including lexical exchanges. Lexical exchange errors may strand affixes, and this reveals important details of the production process. For example, a speaker who intends to say "bless Dr. Schwartz's heart" may say instead "bless Dr. Heart's Schwartz" (Pamela Hadley, personal communication). This observation motivates the hypothesis that inflectional affixes are part of the grammatical encoding, and not inserted lexically. That stranded affixes typically adjust to the environment of the incorrectly inserted lexical stem buttresses this hypothesis (Garrett, 1975). Such errors show that affix production has two stages. The early stage uses the syntactic/semantic information in the lemma, whereas the later stage uses the phonological information in the lexeme (Levelt, 1989). This model also posits a process called *indirect election*, by which lemma information mandates the incorporation of inflectional affixes into a syntactic frame (Bock & Levelt, 1994).

As a concrete example involving affixation, we can now ask how children's antifrequency effect of regular forms might play out in a model of sentence production (Clahsen et al., 2004). It is likely that some lemmas, even for high-frequency regular words, are incomplete during development. Whole word forms for both irregulars and regulars might initially be stored unanalyzed. Those representations would compete with a rule-driven system as the latter develops (in our terms, by the elaboration of a lemma system that either calls up the appropriate affixation process for regular forms or blocks it for irregular forms). The competition between whole form representations and rules must be maintained for the irregular forms. The entries in that system must continue to inhibit the rule-based system. If high-frequency items are initially stored as unanalyzed wholes and that set includes both irregulars and regulars, then the regular high-frequency forms will (counterproductively) inhibit the rule-based system. Which lemmas will have to undergo restructuring must somehow get sorted out: the learner must eventually know which whole form entries should win the competition (the irregulars) and which can run by either output route (the regulars). Although incomplete in many details, this story about a decision conflict could explain the (surprising) antifrequency effect. (Note, though, that the architecture described above accommodates but is not necessary to this explanation.)

Theories of adult sentence production were designed to account for adult language use. Although they have been usefully applied to the study of language breakdown (e.g., aphasia, Alzheimer disease), they are rarely applied to learners who are building up both language knowledge and speaking proficiency. The problem we see is that the models generally do not articulate developmental hypotheses. Do lemma-driven models of (adult) sentence production predict what children do, if indeed the lemma must be taken into account to understand development? What

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

does the proceduralization of morphosyntax imply for lexical storage? Adult sentence production models have evolved by encompassing a range of phenomena exhibited in aphasic syndromes (Foygel & Dell, 2000; Garrett, 1982; Lapointe, 1985). Application of these models to aphasia has tested the models and necessitated their revision. In other words, these models have been seriously advanced by the study of aphasia. Developmentalizing them should have similar positive effects. Indeed, one might argue that accounting for language development is even more important than accounting for language breakdown, because the production system *must* develop, but it may or may not break down later on.

Sentence production models

Here are some research issues for which model-theoretical details might be informed by developmental considerations. Models of language production have developed along similar lines in some areas but show sharp contrasts in others. Future research should find the leverage points in production modeling that can be convincingly tied to developmental data and find ways to assimilate existing developmental claims with one or another approach to production modeling.

Some obvious areas for exploration involve the diverse relations between conceptual structure, lexical representations, and sentence integration processes. For example, some models of lexical retrieval map directly from the conceptual level to word form (e.g., Caramazza, 1997), while most others assume an indirect mapping that links abstract word representations with conceptual structure and sharply separates this from phonological and articulatory stages of representation and process. Within this latter group, there are differences in the extent to which interactive processes hold between semantic, syntactic, and phonological representation (e.g., Dell, 1986; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997; Ferreira, 2003; Levelt, Roelofs, & Meyer, 1999; Vousden, Brown, & Harley, 2000). Closely related questions arise in debates about the relation between conceptual representation and aspects of morphosyntax such as number agreement, gender marking, and pronominal expression (e.g., Bock, Eberhard, & Cutting, 2004; Bock & Miller, 1991; Vigliocco & Hartsuiker, 2002). More general issues of conceptual effects on lexical retrieval for sentence integration have been explored in several works by Bock and colleagues (e.g., Bock, 1987; Bock, Loebell, & Morey, 1992). How, precisely, do the competing adult accounts accommodate child language based claims for relations among lexical, syntactic, and semantic processes?

Another area that warrants exploration involves relations between comprehension and production systems. Most production models assume systems with distinct comprehension and production mechanisms, along the lines sketched by Levelt (1989). However, variation in the interaction of the systems is played out in theories of production monitoring (e.g., Postma, 2000). This leads to different views about the extent of overlap in the lexical and syntactic systems that serve production and comprehension. One of the strongest claims in this area is Kempen's (2004) proposal that the same mental machinery is responsible for syntactic integration in both production and comprehension. How, precisely, do the competing adult models accommodate the relative emergence of production and comprehension capacities in child language?

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Developmental phenomena and performance-based explanations

Here are some complementary ways that patterns in children's phonology, lexicon, syntax, and discourse might be informed by consideration of production models. Again, future research should tie the production models to developmental data and see how developmental phenomena affect one or another approach to production modeling.

Some areas for exploration involve continuity questions. For example, does the architecture of the production system change radically over time or can changes in children's production patterns be explained by increasing processing resources alone? Most of the research that CF review suggests that increasing resources affects comprehension. In a case study, Wijnen (1990) found that a child's dysfluencies were initially randomly distributed but later concentrated on function words and sentence-initial words. This may indicate that as learners master a grammar, their errors reflect the planning frames supported by that grammar. Such an interpretation is suggested by the child's dysfluencies across structures: some structures hosted more dysfluencies than others.

Such patterns suggest that an examination of frequency issues would also be useful. Wijnen (1992) reported a higher overall frequency of speech errors in children compared to adults but a lower incidence of phonologically similar lexical substitutions. He also found that children, *un*like adults, make sound errors in the high frequency functional elements. Children's production of certain syntactic structures can also be studied from this perspective. Learners' utterances reflect frequency patterns in their input, patterns that are less clear in their grammaticality judgments (McDaniel & Lech, 2003; McKee & McDaniel, 1998). We might ask to what extent frequency-based representations characterize the competence grammar and whether those representations are fundamentally the same (or continuous) over the course of language development.

Relations between comprehension and production systems are of great interest in child language, and the potential links to adult processing systems are intriguing. It is a truism that children's comprehension capacity outstrips the structure shown in their spontaneous production. The apparent dissociation is robust, but theoretical accounts of it are not. Moreover, the empirically supported range of structural contrasts between production and comprehension in child language is still rather limited. Thus, this is an area that also needs exploration. Explaining such differences provides a clear challenge for assumptions about relations between processing models and competence models in child language.

REFERENCES

Bloom, P. (1990). Subjectless sentences in child language. *Linguistic Inquiry, 21*, 491–504.

Bock, K. (1987). Coordinating words and syntax in speech plans. In A. Ellis (Ed.), *Progress in the psychology of language* (Vol. 3, pp. 337–390). London: LEA.

Bock, K. (1991). A sketchbook of production problems. *Journal of Psycholinguistic Research, 20*, 141–160.

Bock, K., Eberhard, K. M., & Cutting, J. C. (2004). Producing pronoun number. *Journal of Memory and Language, 51*, 251–278.

Bock, K., & Levelt, W. (1994). Language production: Grammatical encoding. In M. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 945–984). San Diego, CA: Academic Press.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Bock, K., Loebell, H., & Morey, R. (1992). From conceptual roles to structural relations: Bridging the syntactic cleft. *Psychological Review, 99*, 150–171.
Bock, K., & Miller, C. (1991). Broken agreement. *Cognitive Psychology, 23*, 45–93.
Caramazza, A. (1997). How many levels of processing are there in lexical access? *Cognitive Neuropsychology, 14*, 177–208.
Clahsen, H., Hadler, M., & Weyerts, H. (2004). Speeded production of inflected words in children and adults. *Journal of Child Language, 31*, 683–712.
Crain, S., & Thornton, R. (1998). *Investigations in universal grammar: A guide to experiments on the acquisition of syntax and semantics*. Cambridge, MA: MIT Press.
Dapretto, M., & Bjork, E. (2000). The development of word retrieval abilities in the second year and its relation to early vocabulary growth. *Child Development, 71*, 635–648.
Dell, G. (1986). A spreading activation theory of retrieval in sentence production. *Psychological Review, 93*, 283–321.
Dell, G., Schwartz, M., Martin, N., Saffran, E. M., & Gagnon, D. A. (1997). Lexical access in aphasic and non-aphasic speakers. *Psychological Review, 104*, 801–838.
Ferreira, V. (2003). The persistence of optional complementizer production: Why saying "that" is not saying "that" at all. *Journal of Memory and Language, 48*, 379–398.
Foygel, D., & Dell, G. (2000). Models of impaired lexical access in speech production. *Journal of Memory and Language, 43*, 182–216.
Fromkin, V. (1971). The non-anomalous nature of anomalous utterances. *Language, 47*, 27–52.
Garrett, M. F. (1975). The analysis of sentence production. In G. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (pp. 133–177). New York: Academic Press.
Garrett, M. F. (1982). Production of speech: Observations from normal and pathological language use. In A. Ellis (Ed.), *Normality and pathology in cognitive functions* (pp. 19–76). London: Academic Press.
Garrett, M. F. (1984). The organization of processing structure for language production: Applications to aphasic speech. In D. Caplan, A. R. Lecours, & A. Smith (Eds.), *Biological perspectives on language* (pp. 172–193). Cambridge, MA: MIT Press.
Jaeger, J. J. (1992). Not by the hair of my hinny hin hin: Some general properties of slips of the tongue in young children. *Journal of Child Language, 19*, 335–366.
Kempen, G. (2004). *Human grammatical coding: Shared structure formation resources for grammatical encoding and decoding*. Paper presented at the Seventeenth Annual CUNY Conference on Sentence Processing.
LaPointe, S. (1985). A theory of verb form use in the speech of agrammatic aphasics. *Brain and Language, 24*, 100–155.
Levelt, W. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.
Levelt, W., Roelofs, A., & Meyer, A. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22*, 1–75.
Marshall, J. C. (1979). Language acquisition in a biological frame of reference. In P. Fletcher & M. Garman (Eds.), *Language acquisition* (pp. 437–453). Cambridge: Cambridge University Press.
McDaniel, D., & Lech, D. (2003). The production system's formulation of relative clause structures: Evidence from Polish. *Language Acquisition, 11*, 63–97.
McDaniel, D., McKee, C., & Garrett, M. F. (2005). *Children's planning of complex sentences*. Manuscript submitted for publication.
McKee, C., & Emiliani, M. (1992). Il clitico: C'é ma non si vede [The clitic: It's there but it's not seen]. *Natural Language and Linguistic Theory, 10*, 415–437.
McKee, C., & Iwasaki, N. (2001). Lemma structure in language learning: Comments on representation and realization. In J. Weissenborn & B. Hoehle (Eds.), *Approaches to bootstrapping: Phonological, syntactic, and neurophysiological aspects of early language acquisition* (Vol. 1, pp. 125–144). Amsterdam: John Benjamins.
McKee, C., & McDaniel, D. (1998). *Bound to speak: Universal grammar in first language acquisition*. Paper presented at the Annual Meeting of the American Association for the Advancement of Sciences.
Pinker, S. (1999). *Words and rules: The ingredients of language*. New York: Basic Books.
Postma, A. (2000). Detection of errors during speech production: A review of speech monitoring models. *Cognition, 77*, 97–131.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Radford, A. (1990). *Syntactic theory and the acquisition of English syntax: The nature of early child grammars of English*. Oxford: Blackwell.
Rice, M., Wexler, K., Marquis, J., & Herschberger, S. (2000). Acquisition of irregular past tense by children with specific language impairment. *Journal of Speech, Language and Hearing Research, 43,* 1126–1145.
Rispoli, M. (2003). *Components of sentence production during the development of grammar*. Paper presented at the Biennial Meeting of the Society for Research in Child Development.
Rispoli, M., & Hadley, P. (2001). The leading-edge: The significance of sentence disruptions in the development of grammar. *Journal of Speech, Language and Hearing Research, 44*, 1131–1143.
Stemberger, J. P. (1989). Speech errors in early child language production. *Journal of Memory and Language, 28*, 164–188.
Valian, V., Hoeffner, J., & Aubrey, S. (1996). Young children's imitation of sentence subjects: Evidence of processing limitations. *Developmental Psychology, 32*, 153–164.
Vigliocco, G., & Hartsuiker, R. (2002). The interplay of meaning, sound, and syntax in sentence production. *Psychological Bulletin, 128*, 442–472.
Vousden, J. I., Brown, G. D. A., & Harley, T. (2000). Serial control of phonology in speech production: A hierarchical model. *Cognitive Psychology, 41*, 101–175.
Wexler, K. (1996). The development of inflection in a biologically based theory of language acquisition. In M. Rice (Ed.), *Toward a genetics of language* (pp. 113–144). Mahwah, NJ: Erlbaum.
Wijnen, F. (1990). The development of sentence planning. *Journal of Child Language, 17*, 651–676.
Wijnen, F. (1992). Incidental word and sound errors in young speakers. *Journal of Memory and Language, 31*, 734–755.

Cecile McKee
University of Arizona

Matt Rispoli
Northern Illinois University

Dana McDaniel
University of Southern Maine

Merrill Garrett
University of Arizona

DOI: 10.1017.S0142716406060140

Does the shallow structures proposal account for qualitative differences in first and second language processing?

In their Keynote Article, Clahsen and Felser (CF) provide a detailed summary and comparison of grammatical processing in adult first language (L1) speakers, child L1 speakers, and second language (L2) speakers. CF conclude that child and adult L1 processing makes use of a continuous parsing mechanism, and that any differences found in processing can be explained by factors such as limited working memory capacity and incomplete lexical knowledge. The authors then suggest that the existing differences between L1 (both adult and child) and L2 processing provide evidence that parsing mechanisms are qualitatively different between these groups. They posit that this qualitative difference between L1 and L2 is due to L2 speakers having shallower and less detailed syntactic representations

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

than L1 speakers. This commentary focuses on discussing this shallow structures account and considers what this means for L2 processing.

CF discuss three possible explanations for the differences between L1 and L2 processing. The three possibilities explored are whether the differences found can be accounted for by an incomplete target grammar, cognitive limitations, or interference from the L1. Data presented do not fully support any of these accounts, although it is generally accepted that all these factors do have an effect at some level of L2 processing. The authors then discuss the procedural/declarative and implicit/explicit memory distinction to explain L1 and L2 processing differences proposed by Ullman (2001) and Paradis (1994, 1997, 2004). To deal with the inadequacies seen in Ullman's and Paradis' proposal, CF then put forward their shallow structures account. This account is an alternative idea to those already proposed in the literature. It is proposed to account for the qualitative differences found between L1 and L2 sentence processing on the one hand, and the lack of such qualitative differences in the domain of morphology. Although this idea seems at first to provide a full explanation of the L1 and L2 differences as well as similarities, there do seem to be some issues that are inconsistent with both the hypothesis and the data. The questions that arise from these inconsistencies are: does the shallow structures account allow for real qualitative differences? and what other data are needed before we can determine precisely how L1 and L2 processing are different.

QUALITATIVE DIFFERENCES AND THE SHALLOW STRUCTURES ACCOUNT

The shallow structures proposal put forth by CF accounts for the finding that L1 and L2 processing differences in the domain of morphology were less dramatic than the differences in the syntactic domain. CF summarize previous L2 processing studies and compare these to findings from L1 processing, and are able to conclude that differences in morphological processing could be attributed to factors such as incomplete knowledge of the target language. Differences in syntactic processing, on the other hand, are claimed to be due to these shallower and less detailed representations (which are defined as representations without hierarchical syntactic organization). CF claim that the L2 speakers are able to acquire a nativelike lexical–semantic representation but their syntactic representations lack this hierarchical detail and their representations do not contain any abstract information. This shallow structures account does help to explain why L2 speakers' processing differs from that of native speakers. However, it then seems that the authors weaken their own interpretation by going on to claim that these same shallow representations also affect native-speaker processing under certain circumstances. This to me suggests that differences between L1 and L2 processing are considered by CF to be due purely to quantitative effects. If what the L2 speakers are doing is sometimes seen in L1 processing, then this seems to be alluding to the presence of some continuity between the L1 and L2 processing, similar to what was proposed to account for the differences between child and adult L1. If an L2 speaker could reach native-speaker level proficiency then they should also be able to add depth and detail to their representations.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

This contradicts what seemed to be CF's initial reason for proposing a shallow structures account, which is that L2 processing seemed to be qualitatively different from L1 processing at least at the level of sentence processing. How then can we resolve this inconsistency between the presence of qualitative differences and a proposed account that can also be used to explain some aspects of L1 processing?

WHAT OTHER DATA ARE STILL NEEDED?

The nature of any qualitative differences between L1 and L2 processing still needs to be addressed. CF do note that further research needs to be done, and they provide some direction for this. However, I would like to add that before any firm conclusions and hypotheses can be made concerning differences in the L1 and L2 we need to evaluate the effects of proficiency, transfer, and age of acquisition. It does not seem that any one of these can fully predict when native versus nonnative processing will occur.

Neuroimaging studies of early bilinguals (who are highly proficient in both their languages) still show differences in how they process each of their languages. Perani et al. (2003) looked at early (L2 learned at age 3) Spanish–Catalan bilinguals in a verbal fluency functional magnetic resonance imaging task. Functional comparisons indicated that there was less extensive areas of activation in the brain for the language acquired first. This finding indicates that even with a very early age of acquisition for the L2, functional differences can be found. This study also found that amount of exposure (even with very early L2 acquisition) to the L2 can affect the pattern of brain activation. The L1 Catalan participants in this study had less exposure to their L2 and showed a greater activation to Spanish than the Spanish participants showed to Catalan.

The effect of language transfer and interference also still needs to be investigated in more detail before its precise effects on L2 processing are understood. In a study looking at L2 grammatical gender and the effect of L1 it was found that having gender in the L1 does help the acquisition of an L2 grammatical gender system (Sabourin, 2003; Sabourin, Stowe, & de Haan, in press). On the other hand, an ERP study demonstrated that this effect of transfer was further complicated depending on whether the L1 and L2 grammatical gender systems were similar (Sabourin, 2003; Sabourin & Stowe, 2005). Just having grammatical gender in the L1 helped L2 learners acquire the necessary knowledge of the L2 system (in terms of scores on a behavioral task), but in terms of nativelike processing there was an added requirement not only of having an L1 gender system but that the system must be similar.

These findings, as well as those discussed by CF, suggest that L2 processing is very complex. Further research investigating many other types of linguistic structures and levels as well as looking at a greater number of types of L1s and L2s is still necessary before any firm conclusions can be made. In addition, a fuller understanding of how proficiency levels, age of acquisition, and transfer affects L2 acquisition and processing must be attained before we can begin to propose what it is that is different between L1 and L2 processing.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

REFERENCES

Paradis, M. (1994). Neurolinguistic aspects of implicit and explicit memory: Implications for bilingualism and SLA. In N. Ellis (Ed.), *Implicit and explicit language learning* (pp. 393–419). London: Academic Press.

Paradis, M. (1997). The cognitive neuropsychology of bilingualism. In A. de Groot & J. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 331–354). Mahwah, NJ: Erlbaum.

Paradis, M. (2004). *A neurolinguistic theory of bilingualism*. Amsterdam: John Benjamins.

Perani, D., Abutalebi, J., Paulesu, E., Brambati, S., Scifo, P. Cappa, S. F., et al. (2003). The role of age of acquisition and language usage in early, high-proficient bilinguals: An fMRI study during verbal fluency. *Human Brain Mapping, 19*, 170–182.

Sabourin, L. (2003). *Grammatical gender and second language processing: An ERP study*. University of Groningen (Groningen Dissertation in Linguistics 42).

Sabourin, L., & Stowe, L. A. (2005). *Second language processing: Circumstances under which the P600 effect is present*. Manuscript in preparation.

Sabourin, L., Stowe, L. A., & de Haan, G. J. (in press). Transfer effects in learning an L2 grammatical gender system. *Second Language Research*.

Ullman, M. (2001). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition, 4*, 105–122.

Laura Sabourin
University of Oregon

DOI: 10.1017.S0142716406060152

Pervasiveness of shallow processing

Clahsen and Felser (CF) offer a novel explanation for the qualitative differences in language processing often observed between adult first language (L1) speakers and second language (L2) learners. They argue that, although L2 learners are successful in drawing on lexical, morphological, and pragmatic sources of information, they underutilize syntactic structure, which results in shallower and less detailed processing than that of native speakers.

We concur with CF on the role of shallow representations in syntactic processing and, further suggest that shallow processing is much more pervasive in both monolingual and bilingual adult speakers than previously assumed. As shown by Ferriera and others (e.g., Ferreira, Bailey, & Ferraro, 2002; Sanford & Sturt, 2002), even native speakers are not immune to shallow processing of unambiguous passive constructions, garden-path sentences, and quantifier scope ambiguity. Additional evidence comes from our laboratories. We present the results of two new studies, one investigating the processing of universal quantifiers by adult native English speakers and the other prepositional phrase (PP)-attachment ambiguity resolution by bilingual heritage speakers of Russian. These studies show that shallow processing is not restricted to L2 processing, nor is it limited to syntax.

PROCESSING OF UNIVERSAL QUANTIFIERS IN ADULT NATIVE SPEAKERS OF ENGLISH

Evidence that shallow syntactic processing is not limited to L2 learners comes from a recent study (Brooks & Sekerina, in press) of the interpretation of universally

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

quantified sentences, such as *Every car is in a garage,* in native English-speaking college students. Previous studies of children (e.g., Donaldson & Lloyd, 1974) indicated that in situations where cars and garages were arranged in partial one to one correspondence (e.g., three cars each in a garage, along with an extra garage), children up to age 9 often answered "no" to the question *Are all the cars in garages?* Geurts (2003) interpreted these so-called "quantifier spreading" errors as indicative of the use of a simpler processing strategy in mapping syntactic structures to semantic representations. In particular, strong universal quantifiers, such as *all* or *every*, require relational representations that indicate whether the set of entities modified by the universal quantifier exhausts its domain of quantification (e.g., the set of cars). In contrast to strong quantifiers, weak quantifiers such as numbers (e.g., two) do not have intrinsically relational meanings, and therefore, only require instantiation for their interpretation. Geurts argued that children treat universal quantifiers as if they were weak quantifiers, and assign semantic interpretations that fail to properly identify the quantifier's domain. Given such an underspecified semantic representation, they resort to pragmatic mechanisms in responding to experimental questions. Consistent with the pragmatic account of children's reasoning with universal quantification, are results (e.g., Freeman, 1985) showing that the distribution of error types (i.e., so-called underexhaustive versus overexhaustive variants of quantifier spreading) is highly malleable and influenced by context.

It has been widely assumed that improvements in working memory and/or attention allocation eliminate children's mapping errors with universal quantification (Geurts, 2003), such that adults are essentially error free. We tested this belief using a timed picture-selection task (Brooks & Sekerina, in press): 21 monolingual English-speaking undergraduates were shown pictures structured to be comparable to the "garage" problem used in child studies. (See Figure 1 for an example picture set of mice on tables.) Across trials, adults were instructed to identify the picture whether either *Every mouse is on a table* or *Every table has a mouse on it*. Rather astonishingly, our college students averaged only 75% correct for both sentence types, with errors restricted to selecting the opposite picture showing, for example, mice on tables (i.e., adults successfully avoided the "distractors" showing, e.g., mice on bikes). For the 12 critical trials, given a choice of two "most relevant" pictures, above-chance performance required 10/12 correct (binomial distribution). By this criterion, only 38% of the adults were above chance. Thus, use of shallow processing strategies in comprehending universal quantifiers appears to be pervasive in adults, as well as children.

PROCESSING OF PP-ATTACHMENT AMBIGUITY

CF (2005) describe the results of a number of eye-tracking studies on ambiguity resolution in children using sentences containing reduced relative clauses, such as *Put the frog on the napkin in the box* (Trueswell, Sekerina, Hill, & Logrip, 1999). The temporary ambiguity concerned the interpretation of the PP1 *on the napkin* that is initially interpreted as destination for the verb *put*. In the visual context with one frog biasing the destination interpretation of the PP1, native English-speaking adults showed signs of misinterpretation in their eye movements;

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

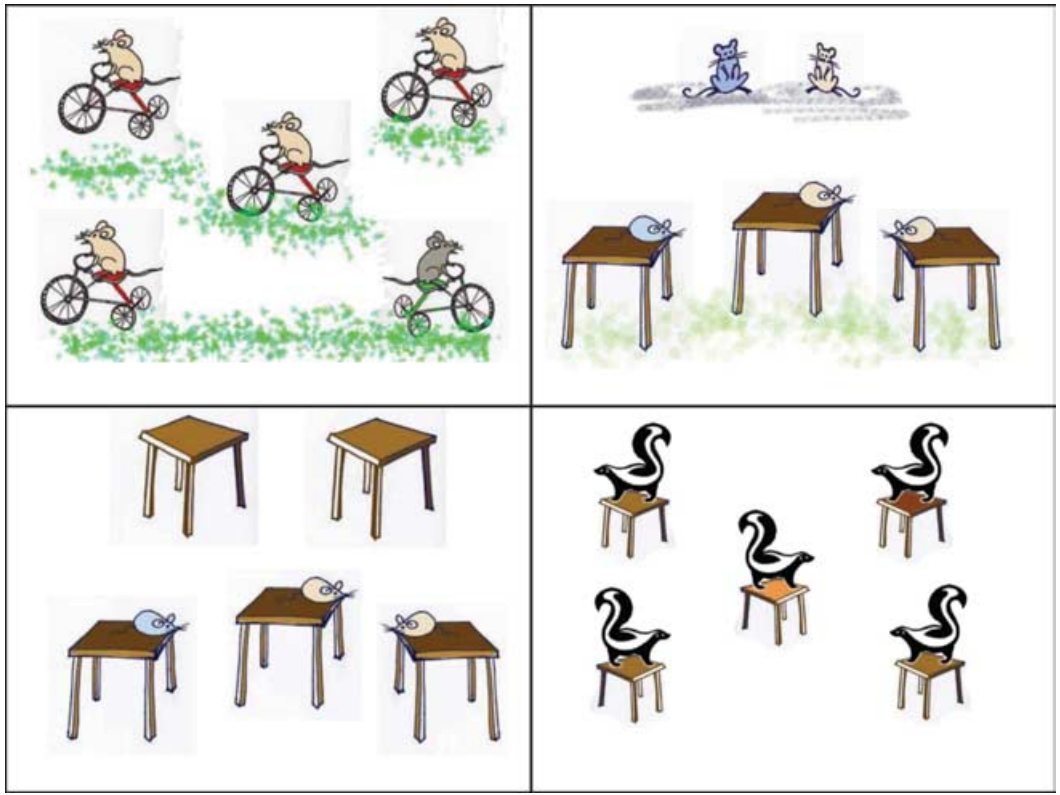


Figure 1. A sample array of pictures from the experiment with quantifiers. Adapted form Brooks and Sekerina (in press).

however, they successfully recovered from it and performed the correct action. Children's eye movements and action data revealed deterministic processing, such that they misinterpreted the PP1 as a destination and showed an inability to revise their interpretations in the face of disambiguating information.

We recently tested early Russian–English bilingual adults to determine the extent to which their on-line processing of a Russian PP-attachment ambiguity is comparable to native speakers (Sekerina, 2004). Our participants were Russian heritage speakers (i.e., young adults who emigrated to the United States when they were elementary school-age children). These individuals spoke Russian exclusively from birth until emigration for 11 years on average. With few exceptions, they were literate in Russian having spent several years in Russian schools.

We introduced a somewhat different type of disambiguation, involving the presence or absence of *and* in sentences like *Put the frog on the towel/napkin [and] in the box*. To create a second source of ambiguity, we took advantage of the fact that Russian neuter nouns have identical vowel endings for locative and accusative cases, whereas feminine nouns have distinct endings for these two cases. In a 2 × 2 design we crossed the presence/absence of *and* with case ambiguity. In the case ambiguous condition, the PP1 *na polotenc-e*$_{\text{NEUT}}$ (on the towel$_{\text{ACC/LOC}}$) is ambiguous between modification and destination while in the case unambiguous condition, the PP1 *na salfetk-u*/*-e*$_{\text{FEM}}$ (on the napkin$_{\text{ACC/LOC}}$) is not. The bilingual heritage Russian speakers' action and eye movement data were compared to those of monolingual Russian adults, who made less than 10% errors across conditions. Surprisingly, bilinguals showed an unusually high error rate (43%) in processing syntactically unambiguous sentences with ambiguous case marking. This error was explained by proposing that the bilinguals were unable to process the Russian word *and* (i.e., *i*) when it was adjacent to a case marker that was phonologically similar (i.e., *-e*). These results indicate underspecified morphophonological processing in L1 of "balanced" bilinguals.

Under what circumstances does shallow processing predominate?

There remains the question of precisely why shallow processing is widespread. CF (2005) provide no explanation saying that "the exact circumstances under which native speakers rely on such 'good enough' representations are not entirely clear." Our view is that part of the answer resides in individual differences in verbal working memory and allocation of attention that apply to all language learners alike (Nation, Marshall, & Altmann, 2003). Language processing is not either input or learner driven; it is a continuum of possibilities ranging from perfect fully articulated representations and exact mapping to just "good enough" representations.

REFERENCES

Brooks, P. J., & Sekerina, I. A. (in press). Shortcuts to quantifier interpretation in children and adults. *Language Acquisition*.

Donaldson, M., & Lloyd, P. (1974). Sentences and situations: Children's judgements of match and mismatch. In F. Bresson (Ed.), *Problème actuels en psycholinguistique* (pp. 73–86). Paris: Presses Universitaires de France.

Ferreira, F., Bailey, K., & Ferraro, V. (2002). Good enough representations in language comprehension. *Current Directions in Psychological Science, 11*, 11–15.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Freeman, N. H. (1985). Reasonable errors in basic reasoning. *Educational Psychology, 5*, 239–249.
Geurts, B. (2003). Quantifying kids. *Language Acquisition, 11*, 197–218.
Nation, K., Marshall, C. M., & Altmann, G. T. M. (2003). Investigating individual differences in children's real-time sentence comprehension using language-mediated eye movements. *Journal of Experimental Child Psychology, 86*, 314–329.
Sanford, A. J., & Sturt, P. (2002). Depth of processing in language comprehension: Not noticing the evidence. *Trends in Cognitive Sciences, 6*, 382–386.
Sekerina, I. A. (2004). *Misinterpretation and heuristics in bilingual processing.* Poster presented at the 17th Annual CUNY Conference on Human Sentence Processing, University of Maryland, College Park, MD.
Trueswell, J. C., Sekerina, I. A., Hill, N. M., & Logrip, M. L. (1999). The kindergarten-path effect: Studying on-line sentence processing in young children. *Cognition, 73*, 89–134.

Irina A. Sekerina
Patricia J. Brooks
College of Staten Island
and
Graduate Center of the City University of New York

DOI: 10.1017.S0142716406060164

Possible manifestations of shallow processing in advanced second language speakers

The proposal by Clahsen and Felser (CF) has the potential of marking a turning point in second language (L2) acquisition research. Contrary to much L2 research to date, it suggests that some of the differences between native and (advanced) nonnative speakers may be at the level of grammatical processing, rather than grammatical representations. Accounting for L2 speakers' divergent behavior does therefore not necessarily involve positing "representational deficits": L2 speakers can, and indeed do, attain target representations of the L2, but may compute incomplete ("shallow") syntactic parses in comprehension. Such shallow processing is often accompanied by reliance (or overreliance) on lexical, semantic, and pragmatic information, which can lead to seemingly trouble-free comprehension in ordinary communication. It is only when speakers are faced with sentence ambiguities, which impose a greater than normal processing load, that the differences between adult L2 language acquirers and child first language (L1) acquirers become apparent: both child and adult language learners have difficulty in integrating structural and nonstructural information in on-line comprehension, but although children prioritize structural information, adult learners privilege nonstructural lexical–semantic information. CF's proposal opens up new perspectives on the nature of ultimate attainment in adult L2 acquisition; at the same time it raises some questions that, in my view, are of crucial importance for future research.

First, is shallow processing a strategy that L2 speakers employ only in particular circumstances, or do they have the ability for deep processing too? CF seem to believe that L2 speakers are restricted to shallow processing, that is, have no choice.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

It is possible that developmental data might show a decreasing reliance on shallow processing over time, and perhaps a discontinuous change marking the difference between advanced and nearly native L2 speakers. Second, is shallow processing more likely to occur in particular domains that favor this strategy because of their greater complexity? If computational overload is what induces L2 learners into shallow processing, this may be more visible with respect to constructions that are computationally more complex, and/or in on-line situations of language use that stretch L2 speakers processing abilities to their limits.

Third, does shallow processing take different forms? CF argue that it does not normally result in transfer of L1 parsing procedures, because these need a certain (minimum) amount of structural detail to be applied. However, it is not implausible to assume that shallow processing may at least occasionally result in the use of L1 syntactic representations if these are more "economical" than the corresponding target L2 ones.

Fourth, does shallow processing apply to production as well as comprehension? CF's arguments are based on behavioral and electrophysiological data from comprehension experiments, but to the extent that production involves syntactic analysis and encoding (Levelt, 1989), it may exhibit similar strategies and be amenable to similar explanations.

I now briefly illustrate the relevance of these questions to an area in which CF's proposal might shed new light. Recent research (e.g., Belletti, Bennati, & Sorace, 2005; Sorace, 2003; Tsimpli, Sorace, Heycock, & Filiaci, 2004) has shown that residual divergence and optionality in L2 nearly native grammars are largely restricted to the interface(s) between syntax and other cognitive domains. Furthermore, the same interfaces are vulnerable to instability/incompleteness in other populations of adult bilingual speakers, such as L1 speakers experiencing attrition from prolonged exposure to an L2. For example, L1 English nearly native speakers of L2 Italian have been found to overuse overt pronouns in contexts in which native Italian speakers would use a null pronoun, as in Example 1, where the overt pronoun is coreferential with a topic antecedent. The same speakers may also overuse preverbal subjects (often stressed) in contexts in which it would be more natural to use a postverbal subject because the determiner phrase (DP) is in narrow focus, as in Example 2.

1. Maria è andata via perchè lei era stanca.
   Maria is gone away because she was tired.
2. Chi è partito? Un mio amico è partito.
   Who has left? A friend of mine has left.

Not only the production but also the interpretation of overt pronouns and preverbal subjects is affected by optionality in these speakers. For example, they may interpret the overt pronoun *lei* in the biclausal forward anaphora sentence in Example 3 as coreferential with the subject of the matrix clause (*la mamma*); they may also interpret the preverbal subject in Example 4 as conveying new information (i.e., as referring to a different ship), instead of a partitive reading in which the sunk ship is one of the three already mentioned in the previous sentence (Pinto, 1997).

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

3. La mamma dà un bacio alla figlia mentre lei si mette il cappotto.
   The mother gives a kiss to the daughter while she puts on the coat.
4. Il governo ha mandato tre navi nel Golfo. E' affondata una portaerea.
   The government has sent three ships to the Gulf. Has sunk an aircraft carrier.

These speakers can use null subjects and postverbal subjects in a targetlike way: they have acquired a null subject grammar by setting the null subject parameter to the required positive value. However, this is clearly not sufficient to ensure consistently nativelike production and interpretation of pronominal subjects and subject placement in constructions at the syntax–pragmatics interface.

Do interface constructions pose residual problems at the representational or at the processing level? Consider the overuse of preverbal subjects in Example 2. One possibility (see Belletti, 2005; Belletti et al., 2005, for details) is that L2 speakers of Italian whose L1 is English fail to activate the verb phrase (VP) internal focus position required by focalization in Italian, as shown in a simplified form in Example 5.

5. [CP . . . [TP *pro* . . . è . . . partito . . . [TopP [FocP . . . un mio amico [TopP [VP . . .]]]]]

The result is the use of focus in situ, namely, an L1-based strategy that is more economical because it involves an "activated" DP internal focus position as the one overtly manifested in a sentence like "John himself came."

It is worth noticing that L1 French speakers of L2 Italian often use clefting in the same context (Belletti & Leonini, 2004), which is an alternative way of activating the VP periphery (as shown in Example 6) and is widely available in French.

6. Ce . . . [Top [Foc [Top [VP être [sc Jean [CP qui est parti]]]]]]

Suppose, then, that this is a case of shallow processing: speakers do not always activate the VP periphery in producing narrow focus sentences, and instead of using postverbal subjects they resort to either an L1-based form of activation of the VP periphery (as in the case of French speakers), or an entirely different, but still L1-based, focalization strategy, such as DP internal focus in situ (as in the case of English speakers). Interpreting these phenomena in the light of CF's hypothesis allows us to identify their source in the persistence of an L1-based discourse "prominent" strategy, employed to compensate for the failure to compute the required L2 syntactic representation, despite the potential "grammatical" availability of the latter. In comprehension, shallow processing may also involve the optional lack of activation of the VP periphery, which is necessary to the reading of the postverbal subject as carrying focus on new information. The result is a partitive interpretation of an indefinite postverbal DP.

What about the different distribution of overt subject pronouns in nearly native Italian? The production and interpretation of overt subject pronouns in Example 1 and Example 3 may stem from shallow processing of the interface conditions

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

governing the use of overt subjects (e.g., the obligatory presence of the feature "topic shift"; see Tsimpli et al., 2004) and consequent assimilation of strong Italian pronouns to the corresponding weak English pronouns, which, unlike Italian overt pronouns, can refer to topic antecedents. The strategy used in these circumstances would be different from the use of overt pronouns a default form to relieve processing overload due, for example, to insufficient knowledge of (or access to) agreement inflection (Bini, 1993; Liceras & Diaz, 1998; Sorace, 2005).

Both the phenomena just described involve optionality of shallow processing, that is, the L2 speakers' ability to perform full processing, at least at the nearly native level. Shallow processing, in this sense, would be a relief strategy that is available to all speakers but is relied on especially by bilingual speakers. Arguably, the coordination of syntax and pragmatics may be more likely to exceed bilingual speakers' capacity and to force them to resort to shallow computations. Neither access of pragmatics information nor access to syntactic knowledge is problematic, as CF point out. What remains inconsistent is the targetlike integration of this information within the syntactic representations that are computed in online production and comprehension. More behavioral and neurological data are needed to support this interpretation of near-native optionality; meanwhile, CF's contribution has paved the way to new explorations of these phenomena.

REFERENCES

Belletti, A. (2005). *Answering with a cleft: The role of the null subject parameter and the VP periphery*. Unpublished manuscript, University of Siena.

Belletti, A., Bennati, E., & Sorace, A. (2005, February). *Revisiting the null subject parameter from an L2 developmental perspective: Pronominal subjects and postverbal subjects in adult L2 near native Italian*. Paper presented at the XXXI Generative Grammar Meeting, Rome.

Belletti, A., & Leonini, C. (2004). Subject inversion in L2 Italian. In S. Foster-Cohen, M. Sharwood Smith, A. Sorace, & M. Ota (Eds.), *Eurosla yearbook* (pp. 95–118). Amsterdam: John Benjamins.

Bini, M. (1993). La adquisicíon del Italiano: Mas allá de las propiedades sintácticas del parámetro *Pro-Drop*. In J. Liceras (Ed.), *La linguistica y el analisis de los sistemas no nativos* (pp. 126–139). Ottawa, Canada: Doverhouse.

Levelt, W. (1989). *Speaking from intention to articulation*. Cambridge, MA: MIT Press.

Liceras, J., & Diaz, L. (1999). Topic-drop versus pro-drop: Null subjects and pronominal subjects in the Spanish L2 of Chinese, English, French, German and Japanese speakers. *Second Language Research, 15*, 1–40.

Pinto, M. (1997). *Licensing and interpretation of inverted subjects in Italian*. PhD dissertation, University of Utrecht.

Sorace, A. (2003). Near-nativeness. In M. Long & C. Doughty (Eds.), *Handbook of second language acquisition* (pp. 130–152). Oxford: Blackwell.

Sorace, A. (2005). Selective optionality in language development. In L. Cornips & K. Corrigan (Eds.), *Syntax and variation: Reconciling the biological and the social* (pp. 55–80). Amsterdam: John Benjamins.

Tsimpli, T., Sorace, A., Heycock, C., & Filiaci, F. (2004). First language attrition and syntactic subjects: A study of Greek and Italian near-native speakers of English. *International Journal of Bilingualism, 8*, 255–277.

Antonella Sorace
University of Edinburgh

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

DOI: 10.1017.S0142716406060176

How dynamic is second language acquisition?

Clahsen and Felser (CF) present a thought-provoking article that is likely to have a strong impact on the field, in particular, on developmental psycholinguistics and second language (L2) acquisition research. Unlike the majority of previous work on language acquisition that focused on "competence," that is, the knowledge basis underlying grammar, CF emphasize the need to approach language acquisition with psycholinguistic measures of processing. Based primarily on behavioral and electrophysiological on-line data, they argue that language acquisition in early first language (L1) and late L2 follows different patterns.

Some of the main issues CF address are as follows:

1. Whereas children use basically the same "syntax first" mechanisms in processing grammar as adult native speakers ("continuity hypothesis"), late (adult) language learners "underuse" syntactic information and instead rely on lexical–semantic and pragmatic information ("shallow syntax" hypothesis).
2. However, in contrast to what others apparently claim (e.g., Ullman, 2001), the rule-based computational system (procedural system) is assumed to be available to late L2 learners at least to some extent, in addition to the mental lexicon (stored knowledge, declarative system).
3. CF distinguish between morphological processing, which may be similar in early and late learners and involve the rule system, and syntactic processing, which is subject to the above mentioned differences.
4. The authors do not see evidence for transfer between L1 and L2, so it should not matter which L1 is available during the initial state of late L2 learning.
5. Future research should focus particularly on the largely neglected processing mechanisms of language learners at early stages.

I am in agreement with many of these points, although some appear incomplete and may require modifications. In some cases, even the evidence referred to in their article does not necessarily support their claims.

First, I find that Lück, Hahne, Friederici, and Clahsen's (2001) plural production data showing much worse performance accuracy for regular (51.8%) than irregular (98%) nouns is counterintuitive if one assumes that the children have acquired at least some rule knowledge, as suggested by the frontal negativities in event-related potentials (ERPs; found in 8- to 12-year-olds), that are taken to reflect "rule-based morphological processing" (see CF's Table 2). The authors tentatively attribute the poor performance to the potentially lesser degree of familiarity with loan words. However, CF's Table 1 suggests that familiarity (measured as frequency) of regulars should not have an impact at all. In fact, the rule-computed plural -s should be the default by definition, even for entirely novel words, and should therefore result in better than chance level performance in any case. Moreover, this finding is in apparent contrast to the high overregularization rates reported for children's production of past participles.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Second, one of CF's claims is that L1 should not have an impact on the late acquisition of L2. However, apart from considerable evidence from behavioral data, some recent ERP data seem to support L1–L2 transfer as well. (a) The cited ERP study on grammatical gender processing in Dutch by Sabourin (2003) reported that only German learners displayed a "nativelike" ERP response to gender violations, whereas Romance and English learners whose L1 gender system is more different from Dutch did not. In addition to this supportive transfer, negative transfer was found as well in cases where German and Dutch differ. (b) A recent ERP study by Tokowicz and MacWhinney (2005) demonstrates further support for negative transfer: English learners of Spanish displayed P600 effects for violations of features that either similarly exist in their L1 (subject–verb number agreement) or are not represented in L1 at all (gender agreement), but not for features that follow different distributions in L1 and L2 (determiner number agreement). (c) Even one of the authors' own ERP studies seems to support transfer effects. Hahne, Müller, and Clahsen (2003) found that adult Russian learners of German displayed a nativelike LAN-P600 pattern for overregularizations of German past participles (which are similar to Russian participles), but not of German noun plurals (which strongly differ from Russian plurals).

Third, a main point, particularly in apparent contrast to Ullman's declarative/procedural (DP) model, is that CF posit at least partial accessibility of the (procedural) rule system in late L2 learners; however, only for "local" morphology and not (or much less so) for phrase structural rules in syntax. I believe it is premature to draw such a clear distinction. Morphology can be viewed as local, perhaps, even as intralexical, only in the domain of morpho*phonology*, on which most of the authors' work has focused. In this domain, rule application is, in fact, limited to the local composition or decomposition of polymorphemic words. According to CF, this is the limited level at which rule-based processing in late L2 learners may still be functional, whereas the "ability to compute grammatical representations at the sentence level is reduced." However, the regular/irregular distinction in morphophonology is just one aspect of inflectional morphology, whose main function (i.e., the morphosyntactic marking of tense, number, case, or grammatical gender, etc.) crucially depends on structural relations among sentence constituents. Thus, in the case of morpho*syntactic* agreement violations (e.g., subject–verb agreement), inflectional morphology cannot be processed locally at the word level but crucially involves phrase structural representation. As the studies cited above demonstrate (Sabourin, 2003; Tokowicz & MacWhinney, 2005), this is also a domain in which nativelike processing in late L2 learners may be possible and in which transfer from L1 may occur. Similarly, the domain of syntax also comprises a number of principles and parameters that may cause distinct patterns of difficulty in language learners. In contrast to the behavioral data presented by CF, there is at least some evidence that late L2 learners can achieve nativelike competence and performance levels (e.g., White & Genesee, 1996, for subjacency and the empty category principle in late French-speaking learners of English).[1] Intriguingly, one of the ERP studies CF referred to found nativelike ERP patterns including the early anterior negativity in proficient late L2 learners of an artificial language when they were presented with *phrase structural violations* (Friederici, Steinhauer, & Pfeifer, 2001). Thus, proficiency appears to

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

influence the neurocognition of late-acquired L2 beyond morphophonology and may indeed lead to nativelike processing even in subdomains of syntax. Unlike for morphophonology, these proficiency-dependent changes may occur only late, and at very high levels of proficiency. They may be observable only in nativelike end states of exceptionally successful L2 learners. That is, even the "high end of the proficiency scale" on which most previous L2 studies have focused according to CF may not usually be sufficient to capture these changes, unless a subject screening for nativelike proficiency has been performed (White & Genesee, 1996). Even after several decades of exposure to the target L2, the actual level of ultimate attainment conceivably depends on many factors. Among these, the age of first exposure, but also the structure of L1, the relative use of L2 compared to L1 (see also Birdsong, this issue), and a variety of sociocultural factors may play a role. CF's article presents a valuable account for the vast majority of averagely successful late L2 learners near or at end state. I completely agree with the authors that one area of future research should focus on the largely neglected earlier stages of language acquisition. In addition, however, it might be worthwhile to also look at the top end of nativelike attainment in late L2 learners. Only data from this population will shed light on the critical period hypothesis, that is, on the question of whether maturational constraints ultimately prevent late language learners from involving the same neurocognitive mechanisms as native speakers. Friederici et al.'s (2002) data suggest that changes in syntactic processing during L2 acquisition may turn out to be as dynamic as those observed for morphological processing. The combined employment of behavioral and physiological on-line measures is likely to answer some of these questions.

NOTE

1. Hyltenstam and Abrahamsson (2003) suggest that the L2 learners' success in this study may be due to the similarities between L1 and L2, which, however, would imply transfer from L1 and also contradict CF's position.

REFERENCES

Friederici, A., Steinhauer, K., & Pfeifer, E. (2002). Brain signatures of artificial language processing: Evidence challenging the critical period hypothesis. *Proceedings of the National Academy of Science of the United States of America, 99*, 529–534.

Hahne, A., Müller, J., & Clahsen, H. (2003). Second language learners' processing of inflected words: Behavioral and ERP evidence for storage and decomposition. *Essex Research Reports in Linguistics, 45*, 1–42.

Hyltenstam, K., & Abrahamsson, N. (2003). Maturational constraints in SLA. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 539–588). Oxford: Blackwell.

Lück, M., Hahne, A., Friederici, A., & Clahsen, H. (2001, November). *Developing brain potentials in children: An ERP study of German noun plurals*. Paper presented at 26th Boston University Conference on Language Development.

Sabourin, L. (2003). *Grammatical gender and second language processing: An ERP study*. Unpublished PhD Dissertation, University of Groningen.

Tokowicz, N., & MacWhinney, B. (2005). Implicit and explicit measures of sensitivity to violations in second language grammar: An event-related potential investigation. *Studies in Second Language Acquisition, 27*, 173–204.

Ullman, M. (2001). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition, 4*, 105–122.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

White, L., & Genesee, F. (1996). How native is near-native? The issue of ultimate attainment in adult second language acquisition. *Second Language Research, 12,* 233–265.

Karsten Steinhauer
McGill University

DOI: 10.1017.S0142716406060188

Commentary on Clahsen and Felser

In this article, the authors lay out an impressive body of evidence that supports two main claims. First, they favor the continuity hypothesis, according to which children's parsing mechanisms are essentially the same as adults'. Parsing strategies change little over time, and those changes that occur are attributed to differences in lexical processing efficiency and working memory capacity. Second, they suggest that there are substantial differences in the parsing strategies adopted by native speakers and adult learners of second languages.

Although I do not have extensive experience investigating child language processing, the one study I have conducted on children (8–12 years old; Traxler, 2002) suggested that they, like adults, did not make use of subcategory preferences to make initial parsing decisions in subject–object ambiguities (as in *When Mary tripped the table fell over/the policeman stopped to help her up*). Whether the subordinate clause verb preferred a direct object or was incompatible with a direct object, children's self-paced reading times showed evidence of processing difficulty at and following the point of syntactic disambiguation (the main-clause verb, in this case). However, the verbs' subcategorization preferences predicted overall difficulty resolving the ambiguity for both children and adults (Traxler, in press). Both of these findings are compatible with the authors' proposal that the first language (L1) parsing mechanism is stable over time.

One claim that may require further justification is that differences in language processing performance are based on the way working memory differences affect parsing per se, rather than other aspects of processing and interpretation (Caplan, Hildebrandt, & Waters, 1994; Caplan & Waters, 1990, 1995, 1999; Traxler, Morris, & Seely, 2002; Traxler, Williams, Blozis, & Morris; 2005; Waters & Caplan, 1992, 1996a, 1996b; Waters, Caplan, & Rochon, 1995). There are a number of reasons to be cautious about the relationship between working memory and parsing performance. First, studies of stroke and Alzheimer disease patients show that people with very low scores (1 or 0) on the *sentence span* test are able to parse and interpret sentences containing long-distance dependencies, which require readers to hold information in a working memory buffer while inputting and structuring subsequent text (Rochon, Waters, & Caplan, 1994; Waters & Caplan, 1997). Second, the working memory task that has been most widely used in sentence processing research (sentence span; Daneman & Carpenter, 1980) has fairly low test–retest reliability, and instability in classifying participants' working memory capacity makes it more difficult to replicate findings (Waters & Caplan, 2003). Third, many of the studies in which a connection between working memory capacity and some aspect of comprehension performance have been found

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

(including the original Wanner & Maratsos, 1978, study) have relied on dual- or triple-task paradigms, where the ability to maintain task instructions or switch attention between the primary and secondary task are at least as important in determining performance as the actual language processing task. Fourth, studies where a single-task paradigm (e.g., eye-movement monitoring) is used often employ quasiexperimental designs in which a conceptually continuous variable (working memory capacity) is treated as a categorical variable, or use extreme-group designs (e.g., King & Just, 1991; MacDonald, Just, & Carpenter, 1992), which can artificially exaggerate possible between-group differences. Fifth, associations between working memory capacity and processing time are sometimes found in sentences that can be interpreted incrementally, and that should not impose substantial working memory demands (e.g., Pearlmutter & MacDonald, 1995), and are sometimes not found in studies involving sentences, such as object relatives, that are thought to impose substantial working memory load (Traxler et al., 2005). Sixth, working memory capacity covaries with a number of other potentially important variables such as lexical decoding skill, print exposure, and ability to shift attention (Engle, 2002; La Pointe & Engle, 1990). Thus, working memory capacity may be serving as a proxy for unassessed variables in studies where a significant association is found between working memory and comprehension performance. Unless these other potentially important variables are measured, and unless their contribution to performance is evaluated simultaneously with working memory capacity, it is not entirely safe to conclude that working memory differences are the source of observed differences in performance.

There is also a great deal of work that needs to be done to elevate minimalist parsing strategies, such as *good enough* heuristics (Ferreira, Bailey, & Ferraro, 2002) or Townsend and Bever's (1999) *pseudosyntax* approach, to the status of fully articulated accounts of grammatical representation and processing. It is not clear, for example, when processing difficulty or failure to assign a correct standard interpretation reflect the workings of a system that does not take the time to generate fully specified syntactic representations for complex constructions because it is relying on sketchy or partial syntactic trees, or a system that is merely subject to random error. It is clear, however, that comprehenders can fall back on more rudimentary interpretive strategies, such as assigning prototypical theta roles to entities named in a complex sentence, rather than making syntactically driven assignments. What we need are better accounts of precisely when minimalist strategies will be applied (i.e., whether they apply widely across a broad range of sentence types, or whether they serve as a backup system when the syntax is too complex or when the standard interpretation is deficient) and whether individual differences in lexical knowledge and cognitive resources (such as working memory, sensitivity to semantic cues, tendency to perseverate, or the ability to manage attention flexibly) affect the degree to which people employ minimalist parsing strategies.

REFERENCES

Caplan, D., Hildebrandt, N., & Waters, G. S. (1994). Interaction of verb selectional restrictions, noun animacy, and syntactic form in sentence processing. *Language and Cognitive Processes, 9*, 549–585.

Caplan, D., & Waters, G. S. (1990). Short term memory and language comprehension: A critical review of the neuropsychological literature. In G. Vallar & T. Shallice (Eds.), *Neuropsychological impairments of short-term memory*. Cambridge: Cambridge University Press.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Caplan, D., & Waters, G. S. (1995). Aphasic disorders of syntactic comprehension and working memory capacity. *Cognitive Neuropsychology, 12*, 637–649.
Caplan, D., & Waters, G. S. (1999). Verbal working memory and sentence comprehension. *Behavioral and Brain Sciences, 22*, 77–126.
Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11*, 19–23.
Ferreira, F., Bailey, K., & Ferraro, V. (2002). Good enough representations in language comprehension. *Current Directions in Psychological Science, 11*, 11–15.
King, J., & Just, M. A. (1991). Individual differences in syntactic parsing: The role of working memory. *Journal of Memory and Language, 30*, 580–602.
La Pointe, L. B., & Engle, R. W. (1990). Simple and complex word spans as measures of working memory capacity. *Journal of Experimental Psychology: Learning, Memory, Cognition, 16*, 1118–1133.
MacDonald, M. C., Just, M. A., & Carpenter, P. A. (1992). Working memory constraints on the processing of syntactic ambiguity. *Cognitive Psychology, 24*, 56–98.
Pearlmutter, N. J., & MacDonald, M. E. (1995). Individual differences and probabilistic constraints in syntactic ambiguity resolution. *Journal of Memory and Language, 34*, 521–542.
Rochon, E., Waters, G. S., & Caplan, D. (1994). Sentence comprehension in patients with Alzheimer's disease. *Brain and Language, 46*, 329–349.
Townsend, D. J., & Bever, T. G. (1999). *Sentence comprehension*. Cambridge, MA: MIT Press.
Traxler, M. J. (2002). Plausibility and subcategorization preference in children's processing of temporarily ambiguous sentences: Evidence from self-paced reading. *Quarterly Journal of Experimental Psychology, 55A*, 75–96.
Traxler, M. J. (in press). Plausibility and verb subcategorization preference in temporarily ambiguous sentences. *Journal of Psycholinguistic Research*.
Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: Evidence from eye-movements. *Journal of Memory and Language, 47*, 69–90.
Traxler, M. J., Williams, R. S., Blozis, S. A., & Morris, R. K. (2005). *Working memory, animacy, and verb class in the processing of relative clauses*. Manuscript submitted for publication.
Wanner, E., & Maratsos, M. (1978). An ATN approach to comprehension. In M. Halle, J. Bresnan, & G. A. Miller (Eds.), *Linguistic theory and psychological reality*. Cambridge, MA: MIT Press.
Waters, G. S., & Caplan, D. (1992). The capacity theory of sentence comprehension: Critique of Just and Carpenter. *Psychological Review, 103*, 761–772.
Waters, G. S., & Caplan, D. (1996a). The measurement of verbal working memory capacity and its relation to reading comprehension. *Quarterly Journal of Experimental Psychology, 49*, 51–79.
Waters, G. S., & Caplan, D. (1996b). Processing resource capacity and the comprehension of garden path sentences. *Memory and Cognition, 24*, 342–355.
Waters, G. S., & Caplan, D. (1997). Working memory and on-line sentence comprehension in patients with Alzheimer's disease. *Journal of Psycholinguistic Research, 26*, 377–400.
Waters, G. S., & Caplan, D. (2003). The reliability and stability of verbal working memory measures *Behavior Research Methods, Instruments and Computers, 35*, 550–564.
Waters, G. S., Caplan, D., & Rochon, E. (1995). Processing capacity and sentence comprehension in patients with Alzheimer's disease. *Cognitive Neuropsychology, 12*, 1–308.

Matthew J. Traxler
University of California at Davis

DOI: 10.1017.S014271640606019X

The declarative/procedural model and the shallow structure hypothesis

Clahsen and Felser (CF) have written a beautiful and important paper. I applaud their integrative empirical approach, and believe that their theoretical account is largely correct, if not in some of its specific claims, at least in its broader

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

assumptions. CF directly compare their shallow structure hypothesis (SSH) with a model that my colleagues and I have proposed for aspects of the neurocognition of first and second language: the "declarative/procedural" (DP) model. Although some of CF's discussion accurately depicts the DP model and its relation to the data, they also make a few critical errors. Here, I first summarize the DP model in both first language (L1) and adult-learned second language (L2), in order to be able to contrast it with the SSH, and then address the relevant problems in CF. For further details on the DP model and L1, see Ullman (2001a, 2001c, 2004) and Ullman et al. (1997). For the model as it applies to L2, see Ullman (2001b, 2005).

THE DP MODEL

The basic premise of the DP model is that language depends on two well-studied brain memory systems that have been implicated in nonlanguage functions in animals and humans. The *declarative memory* system subserves the learning, representation, and use of knowledge about facts and events (Eichenbaum & Cohen, 2001; Mishkin, Malamut, & Bachevalier, 1984; Squire & Knowlton, 2000). The knowledge learned in this system is at least partly (but *not* completely; Chun, 2000) explicit, that is, available to conscious awareness. Medial temporal structures consolidate new memories, which eventually depend largely on neocortical regions, particularly in the temporal lobes (Eichenbaum & Cohen, 2001; Hodges & Patterson, 1997; Martin, Ungerleider, & Haxby, 2000; Squire & Knowlton, 2000). Other brain structures play a role in declarative memory as well, including ventrolateral prefrontal cortex, which underlies the selection or retrieval of declarative memories (Buckner & Wheeler, 2001). The molecular bases of declarative memory have also been studied. For example, declarative memory function can be enhanced by estrogen (Sherwin, 1988), perhaps via the modulation of the neurotransmitter acetylcholine (Packard, 1998). The *procedural memory* system underlies the implicit (nonconscious) learning of new, and the control of long-established, motor and cognitive "skills" and "habits," especially those involving sequences (Mishkin et al., 1984; Squire & Knowlton, 2000; Willingham, 1998). (Note that the term procedural memory is used here to refer *only* to one type of implicit, nondeclarative, memory system, Squire & Zola, 1996, *not* to all such systems.) The system is composed of a network of interconnected brain structures, and is rooted in frontal/basal ganglia structures, including premotor regions and Brodmann area 44 (BA44; Ullman, 2004, in press). The neurotransmitter dopamine plays a particularly important role in aspects of procedural learning (Harrington, Haaland, Yeo, & Marder, 1990; Nakahara, Doya, & Hikosaka, 2001). The two memory systems interact, yielding both cooperative and competitive learning and processing (Packard & Knowlton, 2002; Poldrack & Packard, 2003; Ullman, 2004). First, the two systems can complement each other in acquiring the same or analogous knowledge, including knowledge of sequences. Thus, declarative memory may acquire knowledge initially, thanks to its rapid acquisition abilities, whereas the procedural system gradually learns analogous knowledge. Second, animal and human studies suggest that the two systems also interact competitively. This leads to a "see-saw effect" (Ullman, 2004), such that a dysfunction of one system results in enhanced learning in the other, or that learning in one system depresses the function of the other.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

According to the DP model, each of the two memory systems plays analogous roles in its nonlinguistic and linguistic functions. In *L1* the distinction between declarative and procedural memory largely parallels the distinction between the mental lexicon and the mental grammar. Declarative memory underlies the lexicon, which contains (at least) all idiosyncratic word-specific knowledge, including the sounds and meanings of words, and whether a word takes a morphologically irregular form, although the lexicon can *also* contain other information, including memorized complex forms. The procedural memory system subserves aspects of the mental grammar, which underlies the rule-governed sequential and hierarchical computation of complex linguistic structures. The procedural system plays computationally analogous roles across grammatical subdomains, including morphology and syntax, and may be especially important in grammatical structure building. The two systems are predicted to interact both cooperatively and competitively in the acquisition and use of language. For example, young children should initially learn both idiosyncratic and complex forms in declarative memory, while the procedural system gradually acquires the grammatical knowledge underlying rule-governed combination.

The DP model makes a somewhat different set of claims and predictions for *late-learned L2*. In L2, the acquisition of grammatical/procedural knowledge is expected to be relatively more problematic than the acquisition of lexical/declarative knowledge, compared to language learning in young children. This can be explained by one or more factors that directly or indirectly affect one or both brain systems, including the attenuation of procedural memory and the enhancement of declarative memory. Whereas motor skill learning associated with the procedural system may be subject to early critical period effects, declarative memory improves during childhood, with a possible plateau in adolescence (Di Giulio, Seidenberg, O'Leary, & Raz, 1994; Fredriksson, 2000; Siegler, 1978; Wolansky, Cabrera, Ibarra, Mongiat, & Azcurra, 1999). The changes in both procedural and declarative memory may be at least partly explained by the increasing levels of estrogen that occur during childhood/adolescence in both genders (Calabresi, Centonze, Gubellini, Pisani, & Bernardi, 2000; Sherwin, 1988; Ullman, 2004, 2005). Finally, competitive interaction between the two memory systems (see above) suggests that the improvements in declarative memory during childhood may be accompanied by an attenuation of procedural learning abilities.

Thanks to their relative facility at declarative compared to procedural learning, L2 learners should tend to rely heavily on declarative memory, even for functions that depend upon the procedural system in the L1. Thus, L2 learners should tend to memorize, as chunks, complex linguistic forms (e.g., *walked; the cat*) that are generally computed compositionally by L1 speakers (e.g., *walk* + *-ed; the* + *cat*). They may also depend heavily on stored schemas or constructions (e.g., of the sort proposed by construction grammar; Fillmore, Kay, & O'Connor, 1988), and may memorize transition probabilities between words, particularly when adjacent words co-occur frequently in the same syntactic frame. Productivity in the L2 may involve associative generalization over similar forms or structures stored in lexical memory, the computation of conceptual–semantic relations among items, or the use of "rules" learned in declarative memory.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

These strategies should lead to a fairly high degree of proficiency, the level of which should vary according to a number of factors, including the amount and type of L2 exposure, and individual subject differences regarding declarative memory abilities. However, not all types of "grammatical" knowledge should be equally learnable in declarative memory. For example, complex forms that are shorter or more frequent should be particularly easy to remember. Constructions that cannot be easily memorized, such as those that involve long-distance dependencies, should cause particular difficulties. The limitations of lexical/declarative memory lead to the expectation that this system cannot supply all functions subserved by the grammatical/procedural system in L1, and thus cannot provide nativelike proficiency in all aspects of grammar. Crucially, however, the complete dysfunction of the grammatical system in L2 is *not* expected. Rather, in accordance with multiple studies of the adult acquisition of nonlinguistic skills by procedural memory (Schacter & Tulving, 1994; Squire & Zola, 1996), practice should lead to procedural learning and improved performance. Thus, with sufficient experience with L2, the language should become L1-like in its grammatical dependence on the procedural system, with the potential for a high degree of proficiency. Whether or not a given individual acquires a given set of grammatical knowledge in the procedural system will depend on factors such as the type of grammatical knowledge being learned, the nature of the L2 exposure, and characteristics of the learner, such as intrinsic procedural learning abilities.

THE DP MODEL AS DISCUSSED BY CF

The DP model differs from Paradis' perspective

CF seem to suggest substantial equivalence between the DP model and the view espoused by Paradis (1994, 1995, 1999, 2004). Like the DP model, Paradis suggests a greater dependence on declarative than procedural memory in L2 compared to L1, and in low-proficiency L2 compared to high-proficiency L2. However, *unlike* the DP model, which emphasizes the parallels between the lexicon/grammar distinction and the dichotomy between the declarative and procedural brain memory systems, Paradis seems to assume a direct correspondence between explicit knowledge (available to conscious awareness) and declarative memory, and between implicit knowledge (not available to conscious awareness) and procedural memory. That is, for Paradis, all that is conscious is declarative, and all that is nonconscious is procedural. Thus, the two models focus on very different distinctions and parallels. Indeed, Paradis discusses the increased reliance on procedural memory, in *both* L1 and high-proficiency L2, largely in terms of greater automatization and implicitness *across* various domains of language, including both lexicon and grammar. Paradis also diverges somewhat from the DP model with respect to neuroanatomy. Paradis focuses only on medial temporal lobe structures for declarative memory, and on the basal ganglia, cerebellum, and neocortex for procedural memory; particular neocortical regions do not appear to be implicated, other than left "perisylvian areas" (Paradis, 1999, 2004). Finally, unlike the DP model, Paradis does not seem to make further predictions based on independent knowledge of the two memory systems, such as modulation by sex hormones. In

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

sum, the DP model makes a different set of predictions from Paradis, allowing the two perspectives to be empirically distinguished.

A comparison of the DP model and the SSH

The SSH and the DP model both posit a lack of L1-like grammatical processing in L2 speakers, who instead rely on other mechanisms, in particular, those that involve lexical and semantic knowledge and processes. However, the two perspectives differ crucially in at least three ways. First, whereas the DP model posits that experience with the L2 eventually leads to proceduralization of grammar, resulting in L1-like grammatical processing, the SSH denies such a qualitative change over time. Unfortunately, CF do not seem to acknowledge the fact that such a shift is expected by the DP model. Second, whereas the DP model posits that low-experience (but not high-experience) L2 speakers differ from native speakers both in syntax *and* morphology, the SSH argues that only syntax differs between L1 and L2, and that, in fact, L2 morphology is processed in much the same ways as in L1. Third, whereas the SSH limits its purview to processing, and indeed is relatively specific in this respect, the DP model makes claims and predictions at numerous neurocognitive levels, from the molecular level on up through brain structures to acquisition, representation, and processing. Such a level of detail is possible because the DP model's assertions about language are derived from and constrained by not only language studies, but also our *independent* knowledge of the two well-studied memory systems. In contrast, the SSH is apparently motivated only by psycholinguistic evidence, and thus is limited in the nature of its claims. It is certainly not the case, as CF suggest, that the DP model suffers from a "vagueness of notions such as 'less available' and 'more dependent.'" In fact, the DP model specifies both *why* and *how* language may depend less on procedural memory and more on declarative memory in low-experience L2 speakers, compared to both L1 and high-experience L2 speakers. Ironically, although CF critique the DP model as being vague in defining the notion of less available, they themselves provide virtually no detail as to why or in what way L1-like grammatical processing is absent in L2. Moreover, it should be pointed out that CF's shallow structure account appears to rely largely on formulations that have either previously been incorporated into the DP model (e.g., chunking), or are entirely compatible with the basic premises of the model (e.g., L2 learners compute representations that "capture thematic roles and other aspects of lexical–semantic structure").

The neurocognitive data

Although CF accurately present a wide range of data, they mischaracterize or omit certain important findings. A comprehensive examination of the neurological, neuroimaging, and event-related potential (ERP) data, as well as of psycholinguistic findings on morphology, paints quite a different picture than that depicted by CF, and in fact, supports the DP model and is inconsistent with aspects of the claims of both CF and Paradis. (For further details and discussion, see Ullman, 2001b, 2005.)

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Neurological studies. Patients with left frontal/basal ganglia lesions show greater grammatical impairments in L1 than L2, *as well as* in more proficient L2 compared to less proficient L2. However, these lesions do *not* appear to lead to differences in *lexical* performance between L1 and L2, or between high- and low-proficiency L2s (Fabbro, 1999; Fabbro & Paradis, 1995; Ullman, 2001b). This pattern is predicted by DP and is at least partly problematic for both Paradis and the SSH.

Neuroimaging studies (positron emission tomography and functional magnetic resonance imaging). Tasks that involve only *lexical/conceptual processing* have not elicited more activation in the L2 than the L1 (Chee, Tan, & Thiel, 1999; Illes et al., 1999; Klein, Milner, Zatorre, Zhao, & Nikelski, 1999; Pillai et al., 2003), suggesting a common neurocognitive basis, or have elicited more activation in the L2 than the L1 in regions that may reflect the greater demands of the less well-learned L2 on articulation, working memory, or lexical retrieval/selection (Chee, Hon, Lee, & Soon, 2001; De Bleser et al., 2003; Klein, Milner, Zatorre, Meyer, & Evans, 1995; Klein, Zatorre, Milner, Meyer, & Evans, 1994). In contrast, *sentence comprehension* tasks generally elicit greater activation in the L2 than the L1 in temporal lobe regions, especially in medial temporal structures, suggesting a greater dependence on declarative memory in the L2 than the L1 (Dehaene et al., 1997; Perani et al., 1996; Perani et al., 1998). High experience and proficiency with the L2 seems to diminish or eliminate this L2/L1 difference (Chee et al., 1999; Perani et al., 1998), although confounds between age and length of exposure complicate these findings. Finally, syntactic processing of an adult-learned artificial language elicited medial and neocortical temporal lobe activity at low proficiency, whereas by the time subjects had reached high proficiency this activation had decreased while activation increased in BA44 (Opitz & Friederici, 2003). This finding directly supports the DP model's prediction of a shift from the declarative to the procedural system in grammatical processing during late L2 learning, and is not consistent with the SSH.

ERP studies. Lexical/semantic processing in the L2 as well as the L1 consistently elicits N400s (Hahne, 2001; Hahne & Friederici, 2001; McLaughlin, Osterhout, & Kim, 2004; Weber-Fox & Neville, 1996), which have been linked to the declarative memory system (Ullman, 2001b). In contrast, most studies of syntactic or morphological violations in L2 speakers have failed to find left anterior negativities (LANs; Hahne, 2001; Hahne & Friederici, 2001; Hahne, Muller, & Clahsen, 2003; Weber-Fox & Neville, 1996), which have been linked to the grammatical/procedural system (Ullman, 2001b). Instead, one finds no negativities at all, or even an N400-like component, consistent with a reliance on declarative memory for grammatical processing in L2 (Osterhout & McLaughlin, 2000; Ullman, 2001b; Weber-Fox & Neville, 1996). LANs have been found in only two experiments of later learned language: in a study of *syntactic* violations in adults acquiring an artificial language to high proficiency (Friederici, Steinhauer, & Pfeifer, 2002) and in a finding cited by CF as problematic for the DP model, in which a LAN was elicited by the inappropriate addition of a regular past-participle affix to an irregular verb (Hahne et al., 2003). Importantly, the subjects in this study were also highly proficient, as expected by the DP model.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Psycholinguistic studies of morphology. Contrary to the expectations of the SSH, Brovetto and Ullman (2001) found past tense frequency effects for regular past tense forms in lower experience L2 speakers but not in native speakers, suggesting that the former but not the latter retrieve these forms from memory; both groups showed frequency effects for irregulars. In contrast, Birdsong and Flege (2001) reported an L1-like pattern in high-experience L2 subjects, with frequency effects for irregular but not regular inflected forms.

SUMMARY AND CONCLUSION

The DP model constitutes a well-specified theory of the neurocognitive bases of both L1 and L2. It gives an account of both the whys and hows of the differences and commonalities of L1 and low- and high-experience L2, at various neurocognitive levels. The model is similar in certain respects to both Paradis' perspective and the SSH, although it also differs from both in crucial and testable ways. The extant neurocognitive data are largely compatible with the DP model, and are at least partly problematic for Paradis' proposal as well as for the SSH claims that L2 sentence processing is never L1-like, whereas morphological processing in the L2 and L1 do not differ.

ACKNOWLEDGMENTS

The author is currently supported by NSF SBR-9905273, NIH R01 HD049347, and research grants from the National Alliance for Autism Research, and Pfizer, Inc. Matthew Moffa and Matthew Walenski provided helpful comments.

REFERENCES

Birdsong, D., & Flege, J. E. (2001). Regular-irregular dissociations in the acquisition of English as a second language. In *BUCLD 25: Proceedings of the 25th Annual Boston University Conference on Language Development* (pp. 123–132). Boston: Cascadilla Press.

Brovetto, C., & Ullman, M. T. (2001, March). *First vs. second language: A differential reliance on grammatical computations and lexical memory.* Paper presented at the CUNY 2001 Conference on Sentence Processing, Philadelphia, PA.

Buckner, R. L., & Wheeler, M. E. (2001). The cognitive neuroscience of remembering. *Nature Review Neuroscience, 2*, 624–634.

Calabresi, P., Centonze, D., Gubellini, P., Pisani, A., & Bernardi, G. (2000). Acetylcholine-mediated modulation of striatal function. *Trends in Neurosciences, 23*, 120–126.

Chee, M. W., Caplan, D., Soon, C. S., Sriram, N., Tan, E. W., Thiel, T., et al. (1999). Processing of visually presented sentences in Mandarin and English studied with fMRI. *Neuron, 23*, 127–137.

Chee, M. W., Hon, N., Lee, H. L., & Soon, C. S. (2001). Relative language proficiency modulates BOLD signal change when bilinguals perform semantic judgments. *Neuroimage, 13*, 1155–1163.

Chee, M. W., Tan, E. W., & Thiel, T. (1999). Mandarin and English single word processing studied with functional magnetic resonance imaging. *Journal of Neuroscience, 19*, 3050–3056.

Chun, M. M. (2000). Contextual cueing of visual attention. *Trends in Cognitive Science, 4*, 170–178.

De Bleser, R., Dupont, P., Postler, J., Bormans, G., Spellman, D., Mortelmans, L., et al. (2003). The organization of the bilingual lexicon: A PET study. *Journal of Neurolinguistics, 16*, 439–456.

Dehaene, S., Dupoux, E., Mehler, J., Cohen, L., Paulesu, E., Perani, D., et al. (1997). Anatomical variability in the cortical representation of first and second language. *NeuroReport, 8*, 3809–3815.

Di Giulio, D. V., Seidenberg, M., O'Leary, D. S., & Raz, N. (1994). Procedural and declarative memory: A developmental study. *Brain and Cognition, 25*, 79–91.

Eichenbaum, H., & Cohen, N. J. (2001). *From conditioning to conscious recollection: Memory systems of the brain*. New York: Oxford University Press.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Fabbro, F. (1999). *The neurolinguistics of bilingualism*. Hove: Psychology Press.
Fabbro, F., & Paradis, M. (1995). Differential impairments in four multilingual patients with subcortical lesions. In M. Paradis (Ed.), *Aspects of bilingual aphasia* (Vol. 3, pp. 139–176). Oxford: Pergamon Press.
Fillmore, C., J., Kay, P., & O'Connor, C. (1988). Regularity and idiomaticity in grammatical constructions: The case of *Let Alone*. *Language, 64*, 501–538.
Fredriksson, A. (2000). Maze learning and motor activity deficits in adult mice induced by iron exposure during a critical postnatal period. *Developmental Brain Research, 119*, 65–74.
Friederici, A. D., Steinhauer, K., & Pfeifer, E. (2002). Brain signatures of artificial language processing: Evidence challenging the critical period hypothesis. *Proceedings of the National Academy of Sciences of the United States of America, 99*, 529–534.
Hahne, A. (2001). What's different in second-language processing? Evidence from event-related brain potentials. *Journal of Psycholinguistic Research, 30*, 251–266.
Hahne, A., & Friederici, A. D. (2001). Processing a second language: Late learners' comprehension strategies as revealed by event-related brain potentials. *Bilingualism: Language and Cognition, 4*, 123–141.
Hahne, A., Muller, J., & Clahsen, H. (2003). Second language learners' processing of inflected words: Behavioral and ERP evidence for storage and decomposition. *Essex Research Reports in Linguistics, 45*, 1–42.
Harrington, D. L., Haaland, K. Y., Yeo, R. A., & Marder, E. (1990). Procedural memory in Parkinson's disease: Impaired motor but not visuoperceptual learning. *Journal of Clinical and Experimental Neuropsychology, 12*, 323–339.
Hodges, J. R., & Patterson, K. (1997). Semantic memory disorders. *Trends in Cognitive Sciences, 1*, 68–72.
Illes, J., Francis, W. S., Desmond, J. E., Gabrieli, J. D., Glover, G. H., Poldrack, R., et al. (1999). Convergent cortical representation of semantic processing in bilinguals. *Brain and Language, 70*, 347–363.
Klein, D., Milner, B., Zatorre, R. J., Meyer, E., & Evans, A. C. (1995). The neural substrates underlying word generation: A bilingual functional-imaging study. *Proceedings of the National Academy of Sciences of the United States of America, 92*, 2899–2903.
Klein, D., Milner, B., Zatorre, R. J., Zhao, V., & Nikelski, J. (1999). Cerebral organization in bilinguals: A PET study of Chinese–English verb generation. *NeuroReport, 10*, 2841–2846.
Klein, D., Zatorre, R. J., Milner, B., Meyer, E., & Evans, A. C. (1994). Left putaminal activation when speaking a second language: Evidence from PET. *NeuroReport, 5*, 2295–2297.
Martin, A., Ungerleider, L. G., & Haxby, J. V. (2000). Category specificity and the brain: the sensory/motor model of semantic representations of objects. In M. S. Gazzaniga (Ed.), *The cognitive neurosciences* (pp. 1023–1036). Cambridge, MA: MIT Press.
McLaughlin, J., Osterhout, L., & Kim, A. (2004). Neural correlates of second-language word learning: Minimal instruction produces rapid change. *Nature Neuroscience, 7,* 703–704.
Mishkin, M., Malamut, B., & Bachevalier, J. (1984). Memories and habits: Two neural systems. In G. Lynch, J. L. McGaugh, & N. W. Weinburger (Eds.), *Neurobiology of learning and memory* (pp. 65–77). New York: Guilford Press.
Nakahara, H., Doya, K., & Hikosaka, O. (2001). Parallel cortico-basal ganglia mechanisms for acquisition and execution of visuomotor sequences—A computational approach. *Journal of Cognitive Neuroscience, 13*, 626–647.
Opitz, B., & Friederici, A. D. (2003). Interactions of the hippocampal system and the prefrontal cortex in learning language-like rules. *NeuroImage, 19*, 1730–1737.
Osterhout, L., & McLaughlin, J. (2000). *What brain activity can tell us about second-language learning.* Paper presented at the 13th Annual CUNY Conference on Human Sentence Processing.
Packard, M. G. (1998). Posttraining estrogen and memory modulation. *Hormones and Behavior, 34*, 126–139.
Packard, M. G., & Knowlton, B. J. (2002). Learning and memory functions of the basal ganglia. *Annual Review of Neuroscience, 25*, 563–593.
Paradis, M. (1994). Neurolinguistic aspects of implicit and explicit memory: Implications for bilingualism and SLA. In N. C. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 393–419). London: Academic Press.

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press

Paradis, M. (1995). Introduction: The need for distinctions. In M. Paradis (Ed.), *Aspects of bilingual aphasia* (Vol. 3, pp. 1–9). Oxford: Pergamon Press.
Paradis, M. (1999, August 4). *Neuroimaging studies of the bilingual brain: Some words of caution*. Paper presented at the 25th Lacus Forum, University of Alberta, Edmonton.
Paradis, M. (2004). *A neurolinguistic theory of bilingualism*. Amsterdam: John Benjamins.
Perani, D., Dehaene, S., Grassi, F., Cohen, L., Cappa, S. F., Dupoux, E., et al. (1996). Brain processing of native and foreign languages. *NeuroReport, 7*, 2439–2444.
Perani, D., Paulesu, E., Galles, N. S., Dupoux, E., Dehaene, S., Bettinardi, V., et al. (1998). The bilingual brain. Proficiency and age of acquisition of the second language. *Brain, 121*, 1841–1852.
Pillai, J. J., Araque, J. M., Allison, J. D., Suthuraman, S., Loring, D. W., Thiruvaiy, D., et al. (2003). Functional MRI study of semantic and phonological language processing in bilingual subjects preliminary findings. *NeuroImage, 19*, 565–576.
Poldrack, R., & Packard, M. G. (2003). Competition among multiple memory systems: Converging evidence from animal and human brain studies.*Neuropsychologia, 41*, 245–251.
Schacter, D. L., & Tulving, E. (Eds.). (1994). *Memory systems 1994*. Cambridge, MA: MIT Press.
Sherwin, B. B. (1988). Estrogen and/or androgen replacement therapy and cognitive functioning in surgically menopausal women. *Psychoneuroendocrinology, 13*, 345–357.
Siegler, R. S. (Ed.). (1978). *Children's thinking: What develops?* Hillsdale, NJ: Erlbaum.
Squire, L. R., & Knowlton, B. J. (2000). The medial temporal lobe, the hippocampus, and the memory systems of the brain. In M. S. Gazzaniga (Ed.), *The new cognitive neurosciences* (pp. 765–780). Cambridge, MA: MIT Press.
Squire, L. R., & Zola, S. M. (1996). Structure and function of declarative and nondeclarative memory systems. *Proceedings of the National Academy of Science of the United States of America, 93*, 13515–13522.
Ullman, M. T. (2001a). The declarative/procedural model of lexicon and grammar. *Journal of Psycholinguistic Research, 30*, 37–69.
Ullman, M. T. (2001b). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition, 4*, 105–122.
Ullman, M. T. (2001c). A neurocognitive perspective on language: The declarative/procedural model. *Nature Reviews Neuroscience, 2*, 717–726.
Ullman, M. T. (2004). Contributions of memory circuits to language: The declarative/procedural model. *Cognition, 92*, 231–270.
Ullman, M. T. (2005). A cognitive neuroscience perspective on second language acquisition: The declarative/procedural model. In C. Sanz (Ed.), *Mind and context in adult second language acquisition* (pp. 141–178). Washington, DC: Georgetown University Press.
Ullman, M. T. (in press). Is Broca's area part of a basal ganglia thalamocortical circuit? *Cortex*.
Ullman, M. T., Corkin, S., Coppola, M., Hickok, G., Growdon, J. H., Koroshetz, W. J., et al. (1997). A neural dissociation within language: Evidence that the mental dictionary is part of declarative memory, and that grammatical rules are processed by the procedural system. *Journal of Cognitive Neuroscience, 9*, 266–276.
Weber-Fox, C. M., & Neville, H. J. (1996). Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of Cognitive Neuroscience, 8*, 231–256.
Willingham, D. B. (1998). A neuropsychological theory of motor skill learning. *Psychological Review, 105*, 558–584.
Wolansky, M. J., Cabrera, R. J., Ibarra, G. R., Mongiat, L., & Azcurra, J. M. (1999). Exogenous NGF alters a critical motor period in rat striatum. *NeuroReport, 10*, 2705–2709.

Michael T. Ullman
Georgetown University

https://doi.org/10.1017/S0142716406060176 Published online by Cambridge University Press