AUTOMATIZATION, SKILL ACQUISITION, AND PRACTICE IN SECOND LANGUAGE ACQUISITION

Robert DeKeyser

University of Maryland

(rdk@umd.edu)

&

Raquel Criado

Universidad de Murcia

(rcriado@um.es)

AUTOMATIZATION, SKILL ACQUISITION, AND PRACTICE IN SECOND LANGUAGE ACQUISITION

1. Skill acquisition (declarative, procedural, automatized knowledge)

In the last few decades, the study of second language acquisition has been dominated by perspectives from linguistics, in particular syntactic theory, psycholinguistics, and socio-linguistics. Cognitive-psychological perspectives are increasingly common in the study of the mental lexicon and online processing. Given, however, that second/foreign language proficiency implies a set of skills that enable speakers to comprehend and produce messages quickly and efficiently, cognitive psychology in general and skill acquisition theory in particular are also unquestionably relevant to second language acquisition, assuming that one is interested in what students can do with the language at various stages of learning, and not just what the underlying abstract competence is.

The roots of skill acquisition theory are to be found in different schools of psychology, ranging from behaviorism to cognitivism and connectionism. The basic claim of skill acquisition theory is, as stated by DeKeyser (2007a, p. 97), that there exists a series of sequenced stages, from initial representation of knowledge to highly skilled behavior, and a common set of "basic principles" underlying the acquisition of skills. Such "basic principles" must necessarily take into account two aspects: (a) the three types of knowledge involved in the learning of a skill, i.e., declarative, procedural, and automatized; and (b) the actual stages required for attaining full command of a skill—initial acquisition, gradual development, and final consolidation.

Declarative knowledge is "knowing that," that is, knowledge or information about things and facts, which in the case of language is the knowledge of morphosyntactic and phonological rules and word meanings. In declarative processing,

the relevant information to perform a linguistic operation is recruited from long-term memory and transferred into working memory, which holds the rule or word meaning while the operation is being executed. Consequently, the latter process "can place a heavy burden on working memory capacity" (Anderson, 1982, p. 381).

Procedural knowledge is "knowing how." It is related to knowledge about how to perform various processes or behaviors, e.g., "our ability to understand language or to apply our knowledge of rules to solve a problem" (O'Malley, Chamot, & Walker, 1987, p. 294). Procedural knowledge is represented in our memory as a set of "productions" (Anderson, 1982), that is a set of if-X-then-do-Y rules, and is associated with implicit, unconscious knowledge. For example, in the formation of the past of the verb "talk," a specific "program" (following a computer simile) leads the student to the past of "talk" via a rule that requires adding the ending -ed to the stem of the verb.

Automatized knowledge is the result of restructuring and fine-tuning of procedural knowledge so that the relevant (linguistic) behavior is displayed correctly and rapidly. This restructuring and fine-tuning encompasses both qualitative changes such as putting various often co-occurring production rules together into one chunk, which is then retrieved from long-term memory as a whole, and mere quantitative changes such as speeding up retrieval and adjusting the probability that a rule is activated to minimize errors.

The role of declarative and procedural knowledge in skill acquisition is accounted for in the successive stages distinguished by researchers to explain skill development. Such stages have received different labels: cognitive, associative, and autonomous (Fitts & Posner, 1967); declarative, procedural, and automatic (Anderson, 1982, 1993; Anderson, Bothell, Byrne, Douglass, Lebiere, & Qin, 2004) or, as applied to language teaching, presentation, practice, and production—the three Ps or the

Presentation–Practice–Production pattern of activity sequencing (Byrne, 1986; Criado, 2010). This varying terminology does not affect the actual conceptualization of the three stages. First, learners develop a declarative encoding—factual information relevant to the skill—by themselves or, more often, by means of instruction or observation of an expert (e.g., a parent teaching a child how to ride a bicycle). Second comes the phase when declarative knowledge leads to procedural knowledge. Performance in this middle stage is still slower and more imperfect than in the final autonomous/automatic stage, whose outcome, automatized knowledge, does not require any conscious processing. As highlighted by DeKeyser (2007a, pp. 98–99), "A large amount of practice is needed to decrease the time required to execute the task (reaction time), the percentage of errors (error rate), and the amount of attention required (and hence interference with/from other tasks). This practice leads to gradual automatization of knowledge."

Correct proceduralization is vital for successful skill acquisition. For that purpose, two elements are essential. The first of these is a previous declarative base acting as the trigger for procedural knowledge acquisition. Although Anderson and Fincham (1994) acknowledge that not all learning is always supported by an initial declarative base, they also claim that "the research indicates that this is a major avenue for the acquisition of procedural knowledge" (p. 1323). The second essential element is that the specific task or target behavior should include a suitable arrangement of conditions for declarative knowledge to be drawn upon (see The Role of Practice in L2 Skill Acquisition, below).

2. Automatization

While different characteristics of automaticity have been stressed by different researchers (for overviews see DeKeyser, 2001; Segalowitz, 2003), there is general

agreement that the more automatized knowledge is, the less attention it requires and the less error-prone it is. Automaticity is now usually seen as the somewhat idealized end point of the process of automatization. Even highly automatized activities still require some degree of attention and can still interfere with (or be interfered with by) other activities, as driving accidents or arithmetic errors show.

Most researchers nowadays also see qualitative change as a characteristic of automatization, as opposed to mere speeding up. Segalowitz and Segalowitz (1993), in particular, argued that automatization implies elimination or at least reduction of some components of a cognitive process. The components being eliminated tend to be highly variable, so that automatization is characterized not only by a reduction in reaction time (RT), but also by reduced variability. As a result, the coefficient of variation (CV, the standard deviation divided by the mean) becomes smaller during automatization, while many studies have documented a strong correlation between the mean and the standard deviation for RT where cognitive processes merely speed up over time, resulting in a stable coefficient of variation (see especially Wagenmakers & Brown, 2007). Few researchers have adopted change in CV as a criterion for automatization, however, and Hulstijn, van Gelderen, and Schoonen (2009) argue that, while the proposal "that genuine automatization is characterized by a reduction or elimination of initially highly variable component processes remains a viable hypothesis," the coefficient of variation in itself is an imperfect operationalization, and more sophisticated experimental tasks are needed that are "capable of tapping component processes more directly" (p. 579). A step toward achieving this goal may be to isolate the different strategies that different individuals may use for a given task, because the power law of practice applies to these strategies rather than to tasks as a whole (Delaney, Reder, Staszewski, & Ritter, 1998; Jones, Ritter, & Wood, 2000; Rickard, 1997, 2004).

That qualitative changes of some kind take place is increasingly clear from neuroimaging research. For a variety of tasks, even over a relatively short time span, one sees reduction of activity in some brain areas, in particular the frontal and parietal cortex, showing the diminishing role of attention and domain-general processes. Once a very narrowly defined task is highly practiced, only very small areas show any substantial activation (see e.g., Hill & Schneider, 2006; Schneider & Chein, 2003). After very extensive long-term practice (e.g., spatial navigation in taxi drivers), however, even structural changes in the nervous system can be observed (Maguire et al., 2000).

For the sake of completeness it should be pointed out that a number of researchers hold radically different views of automatization and automaticity from those that see these processes as gradual quantitative and qualitative changes in the use of rules. For Logan (1988, 2002), for instance, automaticity, rather than efficient use of a rule, implies retrieval of an instance from memory that is very similar to the one currently being processed. Paradis (2009), on the other hand, does not accept the notion of various degrees of automatization: "A task component cannot be more or less automatized. It either is automatized or it is not" (p. xi). For him, knowledge originally acquired in declarative form can only be sped up, not automatized, and the only knowledge characterized by automaticity is implicit knowledge (in his view necessarily acquired implicitly).

Leaving some definitional and terminological issues aside, however, it is clear that a certain degree of automatization in a broad sense of the term is an important part of the language-learning process, in particular in the initial stages of instructed language learning (DeKeyser, 2007a). Therefore, an important part of curriculum planning is to figure out how language teaching can provide the kind of practice that is able to bring

about a certain degree of automatization. These issues are discussed further below: The Role of Practice in L2 Skill Acquisition provides a sketch of what this means for the concept of practice; and Practice in Context elaborates these notions for various teaching contexts.

3. The role of practice in L2 skill acquisition

Many scholars state that reaching automaticity requires massive, repetitive, and consistent practice (Shiffrin & Schneider, 1977; Schmidt, 1992; Segalowitz, 2003; DeKeyser, 2007b). The type of practice activities suitable for developing the three types of knowledge is summarized in the following quotation by DeKeyser (1998, p. 58), focused on grammar: "Explicit teaching of grammar, followed by FonF activities to develop declarative knowledge, and then gradually less focused communicative exercises to foster proceduralization and automatization." The well-known three Ps activity sequencing pattern in foreign-language instruction is implicitly distinguished here. For the relationship between the three Ps and declarative, procedural, and automatized knowledge, see Criado (2010, p. 84).

Declarative knowledge

The acquisition of declarative knowledge is launched through the initial phase of instruction, which consists of explicit teaching of rules to achieve complete understanding. Sheer understanding does not mean that declarative knowledge has been fully acquired and consolidated. This is achieved through quite controlled, discrete-item-based practice in the shape of form-focused exercises; for example, fill-in-the-blanks, sentence-combining, some forms of translation, etc. The purpose of this practice is (a) to develop, test, and refine declarative knowledge in long-term memory, and (b) to

ensure its correct anchoring in the student's mind so that it can be later drawn upon, helping in the process of proceduralization. Accordingly, learners should have enough time to attain declarative knowledge before engaging in linguistic production; in other words, they should not be pressured into rushed output.

Proceduralization

In instructed second language learning the basic condition for proceduralization is engaging in the target rule-governed behavior while relying on temporary declarative crutches kept in working memory. The repetition of these processes permits "the restructuring (see Cheng, 1985; McLaughlin, 1990) of declarative knowledge in ways that make it easier to proceduralize" and allows "the combination of co-occurring elements into larger chunks that reduce the working memory load" (DeKeyser, 1998, p. 49).

The suitable type of practice in this phase is communicative drills. As opposed to the previous type of practice exercises, communicative drills emphasize content without neglecting attention to form (see Littlewood's (1981) distinction between "precommunicative" and "communicative" activities). Thus, the establishment in long-term memory of form-meaning relationships will start and lead to proceduralization.

Automatization

Finally, in order to attain fluid and error-free automatic language use, the learner should undergo extensive practice of the procedures or target language behaviors in communicative activities that may promote "automaticity in the language learning situation in a manner that respects transfer-appropriate processing and other positive features of communicative practices" (Segalowitz, 2003, p. 402). These activities are

open-ended and fully focused on meaning, such as debates, extended role plays, and simulations, essays, etc.

4. Practice in context

Given the skill-specific nature of practice documented above (see Skill Acquisition), practice will differ depending on which of the four skills (reading, writing, listening, speaking) is the most immediate or most important goal. At the same time, the nature of practice differs considerably depending on the context. Traditional foreign-language teaching relies heavily on systematic practice in the P-P-P sense described above. Second language learning differs from foreign-language learning in various ways that have an impact on the frequency and usefulness of various forms of practice. On the one hand, the input available from the environment outside school may seem to make classroom practice in the receptive skills somewhat less necessary, but on the other hand, given that practice outside the classroom is easily available, it would be a shame if students could not make the most of it because they are ill-prepared to recognize elements in the input that are not very salient, but important for understanding. That is why systematic practice in the sense of processing instruction (see e.g., VanPatten, 2004) is so important in this context, especially for adults whose capacity for implicit learning is seriously limited (DeKeyser, 2003, 2009). Both input and output practice in a second language learning context should aim to prepare students to learn more from interaction with the out-of-class environment, not only for the psycholinguistic reason just mentioned, but also to have face validity and not give the impression that classroom practice is an artificial activity with no bearing on real-life communication.

Study abroad, in many ways, is a context that shares characteristics of both foreign-language learning and second language learning, because it is meant to make

students make the transition from the foreign-language classroom to the native-speaking environment. Just as for second language learning contexts, then, it is important that students be well prepared for practicing their language skills in interaction with native speakers. DeKeyser (2007c) shows how study abroad can lead to very disappointing results when students are not ready to benefit from this context because of insufficient declarative, let alone proceduralized, knowledge. Similar phenomena can be observed in bilingual education: in spite of the large amount of input and interaction available for years on end, students in bilingual programs often fail to learn certain structures in the absence of enough systematic practice (see e.g., Swain, 1985; Ranta & Lyster, 2007).

It is very important, of course, not to confuse systematic skill development with overly repetitive drills focused on individual forms. Practice, especially at more advanced stages, can take the form of real-world tasks, adapted to the communicative needs (see Long, 2005) and aptitudes for learning (see Robinson, 2007) of individual learners (Norris, 2009). Such tasks are both more motivating and better for transfer to use in the real world than decontextualized practicing of forms. Even at rather basic levels, teachers can play an important role in designing classroom tasks and choosing activities in a way that will help the students to draw on their declarative knowledge in the performance of a communicative task (e.g., Toth, 2006, 2008). In the case of children, special efforts need to be made to make practice age-appropriate and intrinsically motivating, e.g., through various forms of play (Cameron, 2001; Muñoz, 2007).

An important new development in the area of practice is the array of possibilities offered by information technology, from narrowly focused mechanical practice to free communication between learners and native or other non-native speakers. When computer-assisted language learning started out decades ago, it was mostly limited to

the very first stage of practice, repetitive drilling. During the 1980s and 1990s, researchers tried to develop very sophisticated forms of learner–computer interaction with the aid of artificial intelligence (AI) tools. While these had the advantage of involving meaning and being to some extent communicative, they still did not imply interaction with other human beings and at the same time were very expensive to design and very rigid to use. As a result, this approach has been overtaken by the boom in Internet technology, from e-mail to instantaneous messaging, which offers learners opportunities to practice L2 with each other or with native speakers under different degrees of time pressure, and with different degrees of attention to form (see e.g., Payne & Whitney, 2002; Fernández-García & Martínez-Arbelaiz, 2002, 2003; Chapelle, 2009). These forms of interaction are sometimes called computer-mediated communication (CMC). Meaning in this context comes from the human beings interacting, and the computer is simply a convenient way of putting them in touch and of putting some constraints on the interaction. Such constraints are often more helpful in the sense of taking some of the pressure off (the communication is not face-to-face, and there is less time pressure than in speaking) than they are artificial (as they coincide largely with many young people's preferred modes of peer interaction). The drawback of CMC is that there is usually no provision for feedback (which means "speakers" are not aware of their errors and "hearers" are exposed to faulty input), and that to the extent feedback can be given, it is very much delayed or incomplete. The ultimate practice of the future may involve CMC monitored by a computer with little AI, except in the area of natural language processing, used both to give feedback to the "speaker" and filtered input to the "hearer," but such technology will require many more years of research in natural language processing.

5. Summary and conclusions

While systematic practice is by no means the only mechanism for second language learning, there is no reason to doubt that skill acquisition applies to second language learning just as it does to other cognitive skills. This is especially the case for early stages of language learning and for instructed language learning. The fact that automatization takes a long time and that full automaticity of explicitly learned structures is probably never achieved is no reason to reject explicit learning and practice in favor of nonsystematic implicit learning through large amounts of exposure (especially as quantity and quality of exposure are usually limited for adult learners, and implicit learning does not lead to native-like competence even in the best circumstances). The nature of explicit teaching and practice, however, needs to be adapted to the context of learning and to the goals, aptitudes, and age of the learners. Most importantly of all, if practice is to be maximally effective for skill acquisition, it should try to stay as close as possible to the target skills. In the case of language learning, that means that linking forms and meanings should always be in focus.

CROSS REFERENCES

see Explicit Knowledge and Grammar Explanation in Second Language Instruction; Explicit Learning in Second Language Acquisition; Input-Based Instructional Approaches; Instructed Second Language Acquisition; Instructional Computer-Assisted Language Learning; Language Study Abroad; Practice in Second Language Instruction

REFERENCES

Anderson, J. R. (1982). Acquisition of cognitive skill. *Psychological Review, 89*(4), 369–406.

Anderson, J. R. (1993). *Rules of the mind.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C. & Qin, Y. (2004). An Integrated Theory of the Mind. *Psychological Review, 111,* 1036–1060.

Anderson, J. R., & Fincham, J. M. (1994). Acquisition of procedural skills from examples. *Journal of Experimental Psychology: Learning, Memory and Cognition, 20*(6), 1322–1340.

Byrne, D. (1986). *Teaching Oral English: New Edition.* Harlow, England: Pearson Education Limited.

Cameron, L. (2001). Teaching languages to young learners. Cambridge, UK: Cambridge University Press.

Chapelle, C. A. (2009). The relationship between second language acquisition theory and computer-assisted language learning. *The Modern Language Journal, 93* (Focus Issue), 741–753.

Chen, P. (1985). Restructuring vs. automaticity: Alternative accounts of skill acquisition. *Psychological Review, 92*(3), 414–423.

Criado, R. (2010). *Activity Sequencing in Foreign Language Teaching Textbooks. A Cognitive and Communicative Processes-Based Perspective.* Saarbrücken: LAP LAP.

DeKeyser, R. M. (1998). Beyond focus on form: Cognitive perspectives on learning and practicing second language grammar. In C. Doughty & J. Williams (Eds.), *Focus on form in classroom second language acquisition* (pp. 42–63). Cambridge, England: Cambridge University Press.

DeKeyser, R. M. (2001). Automaticity and automatization. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 125–151). NY: Cambridge University Press.

DeKeyser, R. M. (2003). Implicit and explicit learning. In C. Doughty & M. Long (Eds.), *Handbook of second language acquisition* (pp. 313–348). Oxford, England: Blackwell.

DeKeyser, R. M. (2007a). Skill acquisition theory. In B. VanPatten & J. Williams (Eds.), *Theories in second language acquisition: An introduction* (pp. 97–113). Mahwah, N.J.: Erlbaum.

DeKeyser, R. M. (Ed.). (2007b). *Practice in a second language: Perspectives from applied linguistics and cognitive psychology.* Cambridge, England: Cambridge University Press.

DeKeyser, R. M. (2007c). Study abroad as foreign language practice. In R. M. DeKeyser (Ed.), *Practice in a second language: Perspectives from applied linguistics and cognitive psychology* (pp. 208–226). Cambridge, England: Cambridge University Press.

DeKeyser, R. M. (2009). Cognitive-psychological processes in second language learning. In M. Long & C. Doughty (Eds.), *Handbook of Second Language Teaching* (pp. 119–138). Oxford, England: Wiley-Blackwell.

Delaney, P. F., Reder, L. M., Staszewski, J. J., & Ritter, F. E. (1998). The strategy-specific nature of improvement: The power law applies by strategy within task. *Psychological Science, 9*(1), 1–7.

Fernández-García, M., & Martínez-Arbelaiz, A. (2002). Negotiation of meaning in nonnative speaker-nonnative speaker synchronous discussions. *CALICO Journal, 19*, 279–294.

Fernández-García, M., & Martínez-Arbelaiz, A. (2003). Learners' interactions: A comparison of oral and computer-assisted written conversation. *ReCALL Journal, 15*, 113–136.

Fitts, P. M. & Posner, M. I. (1967). *Human performance*. Belmont, CA: Brooks/Cole.

Hill, N. M., & Schneider, W. (2006). Brain changes in the development of expertise: Neuroanatomical and neurophysiological evidence about skill-based adaptations. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 653–682). New York, NY: Cambridge University Press.

Hulstijn, J. H., van Gelderen, A., & Schoonen, R. (2009). Automatization in second language acquisition: What does the coefficient of variation tell us? *Applied Psycholinguistics, 30*(4), 555–582.

Jones, G., Ritter, F. E., & Wood, D. J. (2000). Using a cognitive architecture to examine what develops. *Psychological Science, 11*(2), 93–100.

Littlewood, W. (1981). *Communicative language teaching*. Cambridge, England: Cambridge University Press.

Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review, 95*(4), 492–527.

Logan, G. D. (2002). An instance theory of attention and memory. *Psychological Review, 109*(2), 376–400.

Long, M. (Ed.). (2005). *Second language needs analysis*. New York, NY: Cambridge University Press.

Maguire, E. A., Gadian, D. G., Johnsrude, I. S., Good, C. D., Ashburner, J., Frackowiak, R. S. J., & Frith, C. (2000). Navigation-related structural change in the hippocampi of taxi drivers. *Proceedings of the National Academy of Science of the United States of America, 97*(8), 4398–4403.

McLaughlin, B. (1990). Restructuring. *Applied Linguistics, 11*(2), 113–128.

Muñoz, C. (2007). Age differences and their implications for practice. In R. M.

DeKeyser (Ed.), *Practice in a second language: Perspectives from applied linguistics and cognitive psychology* (pp. 229–255). New York, NY: Cambridge University Press.

Norris, J. (2009). Task-based teaching and testing. In M. Long & C. Doughty (Eds.), *The handbook of language teaching* (pp. 578–594). Oxford, England: Wiley-Blackwell.

O'Malley, J. M., Chamot, A. U. & Walker, C. (1987). Some applications of cognitive theory to second language acquisition. *Studies in Second Language Acquisition, 9,* 287–306.

Paradis, M. (2009). *Declarative and procedural determinants of second languages*. Amsterdam, Netherlands: John Benjamins.

Payne, J. S., & Whitney, P. J. (2002). Developing L2 oral proficiency through synchronous CMC: Output, working memory, and interlanguage development. *CALICO Journal, 20*, 7–32.

Ranta, L., & Lyster, R. (2007). A cognitive approach to improving immersion students' oral language abilities: The Awareness-Practice-Feedback sequence. In R. M. DeKeyser (Ed.), *Practice in a second language: Perspectives from Applied Linguistics and Cognitive Psychology* (pp. 141–160). New York, NY: Cambridge University Press.

Rickard, T. C. (1997). Bending the power law: A CMPL theory of strategy shifts and the automatization of cognitive skills. *Journal of Experimental Psychology: General, 126*(3), 288–311.

Rickard, T. C. (2004). Strategy execution in cognitive skill learning: An item-level test of candidate models. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*(1), 65–82.

Robinson, P. (2007). Aptitudes, abilities, contexts, and practice. In R. M. DeKeyser (Ed.), *Practice in a second language: Perspectives from applied linguistics and cognitive psychology* (pp. 256–286). Cambridge, England: Cambridge University Press.

Schmidt, R. (1992). Psychological mechanisms underlying second language fluency. *Studies in Second Language Acquisition, 14,* 357–385.

Schneider, W., & Chein, J. (2003). Controlled and automatic processing: Behavior, theory, and biological mechanisms. *Cognitive Science, 27*, 525–559.

Segalowitz, N. S. (2003). Automaticity and second languages. In C. Doughty & M. Long (Eds.), *The handbook of second language acquisition* (pp. 382–409). Oxford, England: Blackwell.

Segalowitz, N. S., & Segalowitz, S. J. (1993). Skilled performance, practice, and the differentiation of speed-up from automatization effects: Evidence from second language word recognition. *Applied Psycholinguistics, 14*, 369–385.

Shiffrin, R. M. & Schneider, W. (1977). Controlled and automatic human information processing. *Psychological Review*, *84,* 127–190.

Swain, M. (1985). Communicative competence: Some roles of comprehensible input and comprehensible output in its development. In S. M. Gass & C. G. Madden (Eds.), *Input in second language acquisition* (pp. 235-253). Rowley, MA: Newbury House.

Swain, M. (2005). The output hypothesis: Theory and research. In E. Hinkel (Ed.), *Handbook of research in second language teaching and learning* (pp. 471-483). Mahwah, NJ: Lawrence Erlbaum.

Toth, P. (2006). Processing instruction and a role for output in second language acquisition. *Language Learning, 56*(2), 319-385.

Toth, P. D. (2008). Teacher- and learner-led discourse in Task-Based Grammar Instruction: Providing procedural assistance for L2 morphosyntactic development. *Language Learning, 58*(2), 237–283.

VanPatten, B. (Ed.). (2004). *Processing instruction. Theory, research, and commentary*. Mahwah, NJ: Erlbaum.

Wagenmakers, E.-J., & Brown, S. (2007). On the linear relation between the mean and the standard deviation of a response time distribution. *Psychological Review, 114*, 830–841.

SUGGESTED READINGS

Anderson, J. R. (2005). *Cognitive Psychology and its Implications* (6th ed.). New York, NY: Worth Publishers.

Anderson, J. R. & Lebiere, C. (1998). *The Atomic Components of Thought*. Mahwah, NJ: Erlbaum.

Criado, R. & Sánchez, A. (2009). The universal character of the *DEC−>PRO* Cognitive sequence in language learning and teaching materials. *RESLA, 22*, 89–106.

DeKeyser, R. M. (1997). Beyond explicit rule learning: Automatizing second language morphosyntax. *Studies in Second Language Acquisition, 19*(2), 195–221.

Dörnyei, Z. (2009). *The psychology of second language acquisition*. Oxford, England: Oxford University Press.

Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 683–703). New York, NY: Cambridge University Press.

Johnson, K. (1996). *Language Teaching and Skill Learning*. Oxford, England:

Blackwell.

Kroll, J. F., & Linck, J. A. (2007). Representation and skill in second language learners and proficient bilinguals. In I. Kecskes & L. Albertazzi (Eds.), *Grammatical gender in the bilingual lexicon: A psycholinguistic approach* (pp. 237–269). Dordrecht, Netherlands: Springer.

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

Segalowitz, N., & Hulstijn, J. (2005). Automaticity in bilingualism and second language

learning. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic perspectives* (pp. 371–388). Oxford, England: Oxford University Press.