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CHAPTER 47

PSYCHOLINGUISTIC PERSPECTIVES ON LANGUAGE AND ITS ACQUISITION

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ABSTRACT

Knowing, using and learning a language are forms of what is often called cognition. Ideally, theories of cognition account for its representation, processing, and acquisition. Linguists in the generative school and connectionists give radically different accounts of these three dimensions of cognition, and therefore hold different views on the acquisition of speaking, listening, reading, and writing skills in a second language. Recent developments in cognitive science also result in new definitions of implicit and explicit learning, different from Krashen's notions of acquisition and learning that have influenced L2 pedagogy for more than 20 years. The chapter focuses on fluency, emphasizing the importance for L2 learners to automatize their word recognition skills in listening and reading and their word retrieval skills in speaking and writing. With regard to explicit grammar instruction, it is argued that although explicit knowledge cannot be transformed into implicit knowledge neurophysiologically, explicit grammar instruction may indirectly be beneficial to the establishment of implicit knowledge.

INTRODUCTION

Most people around the world, whether they are attending school or whether they are functioning as professionals or entertaining themselves as tourists, live with the desire to know one or more foreign languages. However, most people think that, whereas learning their mother tongue takes place naturally, incidentally, and without much effort, learning a foreign language is a long, laborious, and even boring enterprise, not unlike the learning of mathematics or physics—believed to require a high IQ. That is why, when foreign language learning is obligatory, students often begin to hate it, and, when it is voluntary, students soon drop out of classes. How realistic is the popular belief that L1 learning is easy and L2 learning is difficult? In this chapter, we look at this question from a psycholinguistic perspective. In the first part of the chapter, language acquisition is placed in a general framework of human cognition. Recent developments in cognitive science are described, leading to a conceptualization of *implicit* and *explicit learning*. These two notions are different in some essential respects from the well-known notions of *acquisition* and *learning*, proposed by Krashen (1981). The next few sections of the chapter give a brief description of the components of the processes involved in fluent speaking, listening, reading, and writing. The chapter ends with conclusions and implications for L2 instruction, focusing on fluency building.

A LINGUISTIC VIEW ON LANGUAGE ACQUISITION

Knowing, using, and learning a language are forms of what is often called *cognition*. Ideally, theories of cognition account for its *representation*, the *processing,* and the *acquisition*, three essential aspects to which we will return several times in this chapter. As we will see in the present and next section, linguists in the generative school and connectionists give different accounts of these three dimensions of cognition.

The big question, which has kept psychologists, linguists, biologists, neuroscientists, and philosophers busy for a long time, is, to what extent do we have to regard cognition as consisting of several modules, specialized in processing and storing specific kinds of information; to what extent do such modules depend on each other; and to what extent do they do their work independently of each other as if they were encapsulated or isolated (Elman et al. 1996; Fodor, 1983; Pinker, 1997)?

A major breakthrough in the discussion of this fundamental issue was produced some 50 years ago by Chomsky, the founder of generative linguistics. According to Chomsky (1986), one of the most remarkable characteristics of human languages is that they allow the generation of an infinite number of grammatical sentences. Every day, we hear and produce new sentences that we have never heard or produced before. For instance, we can, in principle, make sentences which have no end, such as "Yesterday I met the doctor's sister, who is married to a carpenter, who is the son of a teacher, who teaches in the school where ...." Chomsky also pointed out that, with elements such as words, one can generate a class of grammatical, well-formed sentences (such as *Did you order already?*), as well as a class of ungrammatical, ill-formed sentences (such as **Ordered you already?*), and that adult native speakers have intuitions concerning the grammaticality of sentences. To account for the infiniteness of language, Chomsky proposed recursive rules, operating on categories, which function as slots for items that are members of these categories. For instance, a grammar may (a) contain categories such as Sentence, Verb, and Noun Phrase (NP); (b) contain a rule stipulating that a sentence may contain a verb accompanied by one or several NPs; and (c) contain the rule that NPs can be expanded as sentences (such as the NP, *a carpenter,* expanded with the sentence, *who is the son of a teacher*). Generative linguistics, the school that grew out of Chomsky's epoch-making ideas, concerns itself with designing grammars, with which all and only the infinite set of grammatical sentences of a language can be generated. Although most linguists claim that grammars reflect the knowledge that native speakers have of their mother tongue (called *competence*), it is *not* their principal aim to account for the way language knowledge is actually (a) stored in the brain, (b) processed online, e.g., during speaking, or (c) acquired. However, they do claim that any serious theory addressing these three issues must be capable of accounting for the infiniteness of language. Chomsky, and many generative linguists with him, makes the following claims concerning language and cognition: language is a relatively encapsulated component of cognition, separate from other components (*modularity issue*); children can learn the language of their environment by virtue of an inborn Universal Grammar (*nativism*) that restricts the power of their grammars (*learnability*); and knowledge of language must be represented with *symbolic architectures*, i.e., systems of principles and rules operating on abstract categories (*symbolism*—a notion to which we will return in a later section). Most theories of L2

acquisition are based on Chomsky's school of thought. They regard L2 acquisition as a movement through successive grammars (*interlanguages*). There is, however, no consensus on the issues of whether Universal Grammar is still operative during L2 acquisition and how L1 knowledge affects L2 knowledge (Gass & Selinker, 2001, chap. 3-7).

COGNITIVE VIEWS ON LANGUAGE ACQUISITION

A view on language acquisition, in many ways radically different from that of generative linguistics, has been developed over the last 20 years by a school of thought commonly referred to as *connectionism*. A connectionist architecture or system is a network of interrelated units or nodes, representing knowledge. The connection between any two nodes is said to have a certain activation weight, reflecting the strength with which the two nodes are associated. When the system is exposed to new information (in the form of input nodes), the connection between some of its nodes may increase or decrease somewhat (acquisition or loss of knowledge). When asked to perform (use of knowledge), the system produces output nodes that reflect its current internode activation patterns (Dijkstra & de Smedt, 1996; McLeod, Plunkett, & Rolls, 1998). In most architectures, activation does spread upwards and downwards. For instance, in a simple network for the recognition of written words, if the system has recognized the word's first letter as being the letter *B*, it will activate all words beginning with a *B* while simultaneously deactivating all words not beginning with a *B*. There are many words whose first two letters are *BA,* but there are no words beginning with *BN*. The recognition of the second letter *A*, therefore, takes place not only upward but is also facilitated in a downward fashion. At the same time, the expectation that *N* will be the word's second letter is decreased.

One of the ambitions of connectionism is to tackle the representation, processing, and acquisition of cognition with a single model. Knowledge representation is the connection pattern of a network at a given moment; knowledge processing is the flowing of activation through the network when it receives new information; and knowledge acquisition is the changes in internode connection strengths, as the result of processing. After exposure to a large number of inputs, certain groups of nodes will eventually settle on more or less permanent connection weights (e.g., the group of nodes that together recognize the word *BALL*).

The notion of *frequency* is of crucial importance for an appreciation of the connectionist approach to learning. The more frequently the system is exposed to the letter string *BALL*, the more readily this string will form a strong bond, in contrast to strings which will never or seldom occur, such as *BLAL, LABL,* etc. Thus, in connectionist models, there is no absolute borderline between grammatical and ungrammatical strings. In a network representing the knowledge of a native speaker of English, the string *Ordered you already?* will not be categorically ruled out—although it will evoke an extremely low activation—whereas the sentence *Did you order already?* will have a high activation level.

Pinker (1997, 1999) and many other critics of the connectionist approach have argued that connectionist architectures may be good models of those areas of cognition that can be considered as finite, e.g., knowledge of a finite number of words and knowledge of relatively idiosyncratic phenomena such as "irregular" plurals (*mice, men*) and past tenses (*saw, took*), but that they are insufficient to

account for phenomena of regularity and productivity (e.g., the fact that native speakers can easily understand new formations such as *ragas* as the plural of *raga*, and *flacked* as the past tense of *flack*, when heard for the first time). That is why so-called *hybrid models* have been proposed, consisting of connectionist architectures to handle finite forms of cognition and symbolic, rule-based architectures to handle phenomena of (infinite) regularity (e.g., Carpenter & Just, 1999; MacWhinney, 1999; Pinker, 1999). Perhaps children learn language, and other forms of cognition, first as a closed system, best represented by a connectionist architecture, and later develop open, productive forms of cognition, best represented by rule systems of the symbolic type. In a similar vein, it has been suggested that second language acquisition also proceeds in two stages. First, words and (frequent) word combinations are acquired, to be represented in architectures of the connectionist type. Later, prototype patterns of words and phrases are acquired. These patterns may first be represented in the form of connectionist networks but eventually take the form of rule-based networks, to account for their productivity (Ellis, 2002; Hulstijn, 2002).

WHAT IS THE FORM OF GRAMMATICAL KNOWLEDGE UNDERLYING FLUENT LANGUAGE USE?

It is not easy to assess the value of the arguments for and against symbolist and connectionist architectures in modern cognitive science, because it is often left implicit at which point of the so-called mind-brain continuum a certain architecture is proposed to have explanatory value. We must ask ourselves, is the architecture supposed to have a philosophical/mental, a psychological/behavioral, or a neurobiological/neurophysiological function? With this question in mind, let us look at three types of architectures.

1. A generative grammar can best be seen as an attempt to explain mental phenomena and must therefore be placed at the mind end of the continuum. Because of its serial nature (the generation of a sentence is a stepwise, serial, non-parallel procedure), such a grammar is not optimally suited to account for behavioral data, such as the speed with which we process linguistic information online during listening and speaking.

2. Connectionist architectures of the so-called *localist* type must be placed at the psychological/behavioral level of the mindbrain continuum. Such systems are networks of symbols (such as phonemes, letters, syllables, word stems, word endings, etc.). They have been mainly developed to account for the speed and accuracy of human language use. For instance, models of speaking (to which we will turn in a later section) aim to account not only for accurate speech but also for speech errors. If the model produces an error, the error should be a "human error." It may, for instance, allow for the production of the occasional human error *a pig bark* instead of the intended *a big park*, but not for the implausible error *a bag pirk*.

3. Proponents of connectionist models of the so-called *parallel distributed processing* (PDP) type have claimed both psychological and neurophysiological plausibility for these architectures. A PDP network does not have nodes that represent abstract, symbolic categories but consists, instead, of more elementary, subsymbolic units. For instance, in a

PDP network for reading, there is no single node representing the word *BALL*. *BALL* is represented in a distributed way over many nodes at levels lower than the word level (hence *subsymbolic*), as a constellation of four letters, each of which in turn consists of a number of letter features (straight-curved, long-short, horizontal-vertical, etc., lines). The neurophysiological plausibility of PDP networks rests on two claims. First, it has been claimed that there is a resemblance between PDP networks and the way neurons and their axons and synapses in brain tissue are interconnected. Second, the mechanics of activation spreading in PDP networks resembles the way in which electrochemical processes take place in the brain, involving the secretion and diffusion of neurotransmitters. However, these resemblances may only be superficial and without much significance. It is not certain, therefore, whether PDP networks have to be placed at the brain end of the continuum (Grainger & Jacobs, 1998; McLeod, Plunkett, & Rolls, 1998, p. 10).

Notwithstanding differences in view concerning the type of phenomena along the mind-brain continuum that different types of architectures purport to model, most scholars do agree on the following two claims:

Claim 1: There are some forms of cognition of which we can't have conscious, explicit, knowledge. We simply do not know how our brains and the dozens of muscles in our speech organs work together to allow us to articulate a word or a phrase. Similarly, in the realm of language reception, we are not consciously aware of how our brains and ears work together in parsing the acoustic signal into phonemes, syllables, and words. Thus, at what we may call the lower levels of cognition, explicit, conscious knowledge is hardly possible. Furthermore, it is a matter of debate whether architectures of some connectionist type (localist or PDP), are best suited to account for the representation and processing of information at this level.

Claim 2: There are forms of cognition from which we can form conscious, explicit, knowledge. Linguists and psycholinguists have uncovered, empirically investigated, and documented an impressive amount of regularities in the knowledge and online processing of language. At school, in mother tongue and foreign-language classes, many students learn some of these regularities, couched in the terms of pedagogic grammars (e.g., "Say *a* and *an* when the following word begins with a consonant or vowel, respectively"). However, adult native speakers do not consciously apply such rules when they speak or listen to others. For instance, there is evidence that to understand a passive negative sentence (e.g., *The boy wasn't hit by the car*) does not necessarily take more time than to understand the active affirmative sentence (*The car hit the boy*), although, in linguistic theories of the 1970s, the derivation of the passive negative sentence involved the application of more rules than the derivation of the active affirmative sentence (Clark & Clark, 1977, p. 143).

It is safe to conclude then that, although it remains an unresolved issue how grammatical knowledge can best be modeled in order to account for fluent speaking, listening, reading, and writing behavior, fluent language use does not involve the rapid, serial application of explicit rules. Fluency emanates from a form of implicit cognition that is not open to conscious inspection.

IMPLICIT AND EXPLICIT KNOWLEDGE AND LEARNING

On the basis of the previous discussion, we may now introduce and define the notions of implicit and explicit linguistic knowledge and learning (see Hulstijn, 2005, for a more elaborate exposition).

Implicit knowledge is knowledge that is represented in a way that allows for rapid, parallel processing. To date, connectionist networks might be the best candidates for the representation and processing of implicit knowledge. It is implicit knowledge that underlies the normal, fluent speaking, listening, reading, and writing behavior of skilled native speakers. At the phenomenological level, it can be observed that implicit knowledge is not open to conscious inspection; its processing components cannot be verbalized. Recent neurocognitive studies suggest that implicit knowledge resides not in a particular, restricted area of the brain but is spread out over various regions of the neocortex (Paradis, 1994; Reber, Allen, & Reber, 1999). *Implicit learning* is the forming of implicit knowledge. This is an autonomous, non-conscious process taking place whenever information is processed receptively (through hearing and seeing), be it intentionally and deliberately or unintentionally and incidentally. That is, once we have decided to listen, read, speak, or write, we cannot choose *not* to encode and store information, or, technically speaking, *not* to adjust the connection weights in our network.

Explicit knowledge is knowledge in the form of symbols (concepts, categories) and rules, specifying intersymbol relationships. Explicit knowledge, including many aspects of vocabulary knowledge, has been claimed to reside, or at least be processed, in a particular area of the brain (the medial temporal lobe, including the hippocampus), independent of the areas where implicit knowledge resides (Squire & Knowlton, 2000; Ullman, 2001). *Explicit learning* is the construction of explicit, verbalizable knowledge—a conscious, deliberative process of concept formation and concept linking. This process may either take place when learners are being taught concepts and rules by an instructor or textbook, or when they operate in a self-initiated searching mode, trying to develop concepts and rules on their own. Explicit learning, therefore, requires a certain cognitive development, and will generally not occur in early childhood. In most instructional settings around the world, explicit teaching and learning are the preferred modes of instruction and knowledge acquisition. This is true for many school subjects, including foreign languages.

THE INTERFACE ISSUE: CAN EXPLICIT KNOWLEDGE TRANSFORM INTO IMPLICIT KNOWLEDGE?

A burning question that is as old as the history of L2 instruction is whether the goal of establishing fluent L2 use, based on implicit L2 knowledge, can, or even must, be reached through the learning of explicit knowledge. According to Anderson and his associates, implicit knowledge can come into existence through the proceduralization of explicit knowledge (Anderson & Lebiere, 1998). According to

Logan (1988), learners may start off with a rule (e.g., "Use *a* and *an* when the following word begins with a consonant or vowel, respectively"), but each time they produce or perceive a phrase in which this rule is instantiated, they store that phrase as an *instance* in their memory. With increasing experience, these instances will become stronger in memory, raising their activation levels. Eventually, retrieval of a stored instance will be faster than rule application.

Empirical evidence, so far, does not unequivocally support either theory (for a discussion, see DeKeyser, 2001; Schmidt, 2001; Segalowitz, 2003; Segalowitz & Hulstijn, 2005). What is important in the present context, however, is that although there may be several routes of developing implicit knowledge (*automatization*), automatized processing eventually takes place in parallel and not under conscious control.

PROCESSES OF SPEAKING, LISTENING, READING, AND WRITING

What are the characteristics of skilled, fluent, implicit language behavior? This question has been studied by psycholinguists over the last 40 years with considerable success, as documented, for instance, by Gernsbacher (1994) and Miller and Eimas (1995). We will briefly review some of the robust findings of this research, relevant to SLA.

Speaking

According to the most prominent theory of speaking (Levelt, Roelofs, & Meyer, 1999), the transformation of thoughts into spoken utterances comprises a number of stages. First, there is the emergence of nonverbal thoughts. In the second stage, a search is undertaken in the mental lexicon for so-called *lexemes* that match some of the key elements of these thoughts. A lexeme is a word without information concerning its phonological form; the latter information is carried by the *lexical entry*. Lexemes and lexical entries form, as it were, two sides of the coin *word*. For instance, if a speaker wants to give a verbal expression to the thought that she visually perceived a road accident, the search in the mental lexicon may result in the activation of lexemes that correspond to the lexical entries *see, perceive, observe, view, witness*. If the speaker has opted for the lexeme *witness*, she has selected a conglomerate of semantic and grammatical features, such as the meaning *to hear or see something* and the fact that it is a verb that can take a grammatical subject and object with certain obligatory and optional features. The next stage involves the search for the lexical entry, i.e., the phonological form of the lexeme. It is not until this stage that the phoneme string /wItnəs/ is activated. One of the reasons to distinguish the lexeme from the lexical entry is the so-called *tip-of-the-tongue phenomenon*. The speaker may definitely know the word or name she wants to express but may momentarily be unable to retrieve its full form; for instance, she may be able to say, "It begins with a /w/ and it has two syllables."

The next stage in the speaking process involves the construction of an articulatory plan, which requires a phonetic specification of the lexical entries in terms of syllable structure, phonetic features, and the arrangement of the lexical entries in the right utterance order. The final stage consists of the implementation of the articulatory plan by the speech organs. The output of the articulatory plan is fed back into the language system, enabling speakers to monitor their speech plan,

detect any errors in the planned utterance, and plan the utterance once more (*covert error correction*). Speakers also listen to the utterance after it has been articulated and may then detect errors, which may motivate them to plan and produce the utterance once again (*overt correction*).

Note that the stages in the production of an utterance partially overlap each other. Thus, at some point in the process of producing an utterance, a speaker may be simultanesously doing three things: articulating the first phrase, formulating the second, and contemplating about the contents of the third.

In the context of L2 instruction, it is important to note two characteristics of speaking. The first one is the fact that speakers do not select an empty grammatical structure first, and subsequently fill its slots with lexical items. Speaking is primarily lexically driven. The key lexemes, which have been selected from the mental lexicon, are matched and arranged on the basis of their grammatical specification. In general, one could say that the lexicon comes first and grammar only second. (This is largely true as well for listening, reading, and writing.) The second characteristic to bear in mind is that the planning of utterances is a matter of *parallel processing,* running off automatically without the speaker's conscious awareness. Only the actual articulation itself is largely a matter of serial processing, as speech sounds are articulated consecutively, not simultaneously.

Listening

At first, one may be inclined to think that listening is basically the same thing as speaking but in reverse order. This, however, is not the case. Developing listening skills involves the construction of a cognitive system partly independent of the system that needs to be constructed for speaking. Speech perception is a complex process of abstraction, taking auditory data as its input and producing mental representations of abstract categories, such as phonological features, phonemes, and syllables, as its output (Boersma, 1999; Harrington, 2001). *Frequency* appears to be the main driving force in the construction of such categories, in both L1 and L2 acquisition (Ellis, 2002).

Understanding the meaning of utterances involves many stages (Rost, 2002). The most crucial one is the word-by-word understanding of what is being said. Only after one or more words have been identified can the higher order processes begin to operate. These processes involve sentence parsing, reorganization of the linear order of the incoming information into a nonlinear arrangement of grammatical and semantic information units, and finally the activation of nonverbal thoughts. Listening, like speaking, is largely a matter of automatic, parallel processing. The lower-order processes of word recognition play a crucial role in these automatic processes, as it is at the level of words (i.e., lexemes) that forms are matched with meanings.

Ontogenetically, listening comes before speaking. Infants acquire their mother tongue primarily by listening. During the first few months of their lives, they become tuned to the speech sounds that are characteristic of the language spoken in their environment (Eimas, 1985). There is even a brief period during which infants of up to 6 months old can discriminate between speech sounds that are present in languages other than the language of their parents (Jusczyk, 1997). The strengthening of features characteristic of the mother tongue may simultaneously imply the inhibition of features characteristic of other languages. Thus, L1

acquisition can, in and of itself, form an obstacle to L2 acquisition. The extent to which this may be so depends on the structural differences between L1 and L2.

This is illustrated in a remarkable study on syllable segmentation, conducted by Cutler, Mehler, Norris, and Segul (1989). Native speakers of French segment their language syllable-by-syllable, as French has relatively clear (phonetic) syllable boundaries. English, however, has relatively unclear syllable boundaries and uses, instead, stress-based timing. French-English bilinguals with French as their dominant language had no difficulty switching from the marked syllabic segmentation to the unmarked stress-based processing when listening to English. English-French bilinguals with English as their dominant language, however, were not able to develop the marked syllabic segmentation procedures when listening to French. According to the investigators, these results suggest that, at the level of speech segmentation, there appears to be a limit to bilingualism (see also Cutler, 2001).

The interfering role of L1, present in speaking, writing, listening, and reading, appears to be especially hard to overcome in the case of listening, because of the high degree of automaticity of speech segmentation processes in L1. Speech segmentation pertains to lower levels of cognition than morphological and syntactic processes. Whereas the latter lend themselves more to conscious monitoring (resulting in error correction in the case of speaking), the former can hardly be consciously monitored (allowing for the interference of highly automatic L1 processes, in the case of listening). Furthermore, because of its highly implicit nature, listening provides the listener with fewer opportunities to invoke time-consuming explicit knowledge than do the other skills, as listeners, in most communicative situations, cannot influence the speed with which they process incoming speech. L2 speakers with low to intermediate L2 knowledge, can, and often have to, slow down their speaking processes, allowing themselves more time to consciously pay attention to the formulation process. That is why the speech of low-proficiency L2 speakers exhibits more pausing than that of high-proficiency L2 speakers (Towell, Hawkins, & Bazergui, 1996). Listeners, on the other hand, are dependent on the speech to which they listen: they therefore have fewer possibilities to avail themselves of extra processing time.

Reading

Reading is similar to listening in many respects, but it is certainly not identical to it. The processing of acoustic and orthographic input requires different networks with different units to be constructed. Another difference is that literacy (reading and writing) requires a form of metalinguistic knowledge, which, in turn, requires a certain cognitive development. It is only at the age of 4 or 5 years that children develop a conscious awareness for literacy. It is at around that age that they acquire words such as *meaning*, *language*, *letter*, *sound*, and *word* itself. They then become consciously aware that the words that already belonged to their daily oral vocabulary can actually be *written down* and also be *read*. Word recognition is the most important factor in fluent reading (Perfetti, 1994). Most deficiencies in literary skills are caused by problems at the lowest cognitive levels, in particular in the coding of acoustic, phonetic, and phonemic information.

Writing

Due to its complex problem-solving nature, writing requires perhaps more attention to the highest levels of information than the other language skills. Writers, when writing a particular sentence, must be aware of where they are in the text, what has been written already, and what has and what has not already been planned (Bereiter & Scardamalia, 1994; Flower & Hayes, 1980; Grabe & Kaplan, 1996). This requirement normally exceeds the attentional capacity of the writer. That is why writers spend more time on pausing (for rereading and planning) than on the very act of producing strings of letters. However, to be able to devote pausing time to higher-order information, it is mandatory that word retrieval and spelling consume relatively little time. That is why writers with high verbal ability have been shown to spend more time on text coherence than low verbal-ability writers (Glynn, Britton, Muth, & Dogan, 1982).

THE NECESSITY OF AUTOMATICITY IN L2 LEARNING

Language use requires the processing of a large amount of information in a short time. Normal speech is produced with two to three words per second (Levelt, 1989, p. 22) and must hence be processed by listeners with the same speed. Normal *linear reading*, i.e., the reading of easy text that does not require backtracking, proceeds with the pace of five words per second (Carver, 1990, p. 20). If so much information has to be processed in such a limited time, it is mandatory that most of this information is processed automatically, in parallel, without conscious monitoring, as human beings possess a limited capacity to pay conscious attention to information. It is especially the recognition of words that must be automatized so as to free up attentional capacity for the processing of the meaning of the text that is being produced or perceived (Segalowitz & Hulstijn, 2005). L2 curricula often allow too little time to be devoted to the training of fluency skills. Moreover, fluency-promoting activities, when programmed at all, often do not meet the requirement that they must not pose lexical obstacles for their successful completion. If improving learners' listening and reading fluency is the aim of a task, texts should not contain (many) unfamiliar words, as the occurrence of an unfamiliar lexical item will bring the course of listening or reading to a halt. The fundamental requirement for fluency tasks can be stated in simple terms: words can only be "re-cognized" if they are already "cognized" (Coady, 1997; Hulstijn, 2001).

CONCLUSIONS

This chapter has placed the four language skills in a general framework of the representation, processing, and acquisition of cognition. It was shown that recent developments in cognitive science now allow us to give more precise definitions of implicit and explicit knowledge and learning of a second language than Krashen (1981) could provide for his influential notions of acquisition and learning, respectively. The following conclusions and implications emerge from the literature dealt with in this chapter:

1.   Humans have a limited attentional capacity for information processing. The more the processing of information at the lower levels is automatized, the

more attention language users are able to give to the higher levels of linguistic information, i.e., to meaning. Fluency-promoting activities, therefore, must have a prominent place in the L2 curriculum. (Nation, 2001, suggests spending 25% of learning time to fluency.)

2. An important element of fluent language use is automatic word recognition (in listening and reading) and automatic word retrieval (in speaking and writing). Words cannot be recognized if they are not known. The acquisition of a large vocabulary should therefore constitute a key element in any L2 curriculum (see Chapter 50 by Schmidt in this volume).

3. Acquiring a large vocabulary, however, is not enough. The recognition and retrieval of words needs to be automatized. Activities that aim to promote fluency in these skills need to meet the requirement that their linguistic demands must be at, but not beyond, the learner's current lexical knowledge (see Skehan's chapter in Volume 1 for a fuller discussion).

4. There are good reasons to regard listening as the most implicit and least explicit of the four language skills. Speech segmentation hardly lends itself to conscious monitoring. Listeners can seldom determine the speed at which they process the speech they listen to. Furthermore, speech segmentation processes in L1 play an interfering role in L2 speech segmentation because of their automatic and implicit nature. These facts call for special attention to listening tasks in the L2 curriculum.

5. Recent developments in cognitive science, with the advent of connectionism and the current debate between symbolism and connectionism, the call for hybrid systems, and recent findings in brain imaging research, have significantly increased our understanding of implicit and explicit knowledge and learning. Although the underlying, fundamental issues of human cognition (modularity, nativism) still remain to be solved, the debate has opened our eyes to the distinction between representation and processing of information: most linguistic theories appear to be poorly suited for a psychological account of the representation and processing of grammatical information, as they consist of rules that apply sequentially. Architectures are needed that allow parallel processing, the hallmark of automatic, fluent language use. Furthermore, better definitions of implicit and explicit knowledge can now be given than before (see the above, Implicit and Explicit Knowledge and Learning).

6. Explicit grammar instruction may be beneficial to the acquisition of implicit knowledge, although the actual neurocognitive mechanics are still poorly understood. However, as humans can handle only a limited amount of explicit knowledge at a time, explicit rules must be as short and simple as possible. Windy rules, although valid, must be broken down into, and replaced by, simple rules of thumb for the sake of explicit, serial, information-processing capacity. For example, for many learners of English a rule like "Use *much* with words like *money* and *many* with words like *dollars*" may be just simple enough to consciously apply during speaking, although a linguistically valid generalization would require a much longer and more complex expression, including various classes of determiners and quantifiers and a formal distinction between count and mass nouns. However, although explicit grammar instruction may have a useful place in L2 acquisition, it is important to bear in mind that implicit knowledge

comes into existence *not* through the conscious use of explicit rules itself, but only by the frequency with which a to-be-acquired linguistic construction occurs in receptive and productive language use.

In the introduction to this chapter, a question was raised: How realistic is the popular belief that L1 acquisition is easy and L2 acquisition difficult? The thrust of argument in this concluding section is that L2 acquisition can be a lot easier, and a lot more fun, than many learners (and teachers) believe, when language courses provide ample opportunities to develop fluency in word-by-word understanding, for which high levels of IQ are not required.

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