CHAPTER THREE

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Individual Differences in Second Language Acquisition

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Why do individuals differ so much in second language (L2) attainment success? After all, every healthy human being in an intact social environment masters a first language to a degree of fluency that, in other skill domains, would be recognized as elite or near elite levels (we can exclude here the special accomplishments of outstanding writers, actors, orators, etc.). In terms of their high levels of accuracy, effortlessness, rapidity, situational flexibility, and creativity, virtually all first language speakers are elite performers; in fact, we all seem to be child prodigies when it comes to acquiring our first language. Yet, a comparable level of performance in L2 is usually considered exceptional and worthy of special note. This is because most L2 learners normally attain levels that are noticeably far below that of their first language. Certainly, if we use first language acquisition as a standard for comparison, then the range of individual differences we typically observe in L2 achievement stands in dramatic contrast. How then do we account for the interindividual variability specific to L2 acquisition?

A challenge facing anyone wishing to answer this question is that the literature on individual differences is uneven in its treatment and scattered across disciplines. For example, there is a large literature on field and laboratory studies by second language acquisition (SLA) researchers directly or indirectly involved in language teaching, the training of teachers, or the development of SLA theory. These authors make reference to the basic cognitive processes of memory, attention, pattern recognition, and learning processes presumed to underlie language development. Yet, there is relatively

little reference to original psychological sources in this literature. Correspondingly, there is relatively little to be found in the cognitive psychological literature itself dealing directly with individual differences in L2 acquisition.

Perhaps a reason for this is that scholars working from different disciplinary perspectives make different assumptions about how to explain individual differences in L2 development. For example, SLA researchers appear to see L2 development primarily as the acquisition of a linguistically defined competence whose success may be moderated by situational variables and personal characteristics; however, the linguistic competence itself is seldom addressed in terms of cognitive issues involving memory, attention, perception, etc. Cognitive psychologists, on the other hand, usually seek explanations for skill development (in language and other domains) in terms of human information processing. In the case of L2 skill development, this approach usually overlooks the social and communicative dimensions that necessarily affect the course of language development. Can these differences be bridged? The solution proposed here requires explicit recognition of the *complexity* of the perceptual, memory, attentional, and other demands made on the individual's cognitive resources, demands felt at every level, from the perception of basic linguistic units to the handling of communicative negotiations. The problem of how to account for individual differences specific to L2 development, then, can be formulated as: *What are the psychological complexities of communication that underlie L2 skill development, what cognitive resources are required to deal with these complexities, and why do individuals differ in the way they organize and manage these resources?*

Given the tutorial nature of this chapter, the following discussion is organized in this way: Three traditional frameworks for thinking about individual differences are reviewed—one from the SLA literature, one from a cognitive/information processing point of view, and a third from a neuropsychological perspective. The chapter concludes with a proposal for a new approach that bridges the issues raised by all three perspectives, one that addresses the question posed in the previous paragraph.

SLA RESEARCH AND INDIVIDUAL DIFFERENCES

The eclectic nature of the SLA literature makes it difficult to define a unique SLA perspective to the problem of individual differences. However, the literature does provide the most thorough and direct consideration of the issue. Important contributions here are provided by Altman (1980), Ellis (1994), Larsen-Freeman and Long (1991), and Skehan (1989) who have identified factors considered to be central to individual learner differences in L2 acquisition. Ellis provided a detailed overview of this literature that he organized in terms of a framework that draws on many different research

areas, including applied linguistics, cognitive psychology, and social psychology. The framework is formulated in rather general terms and points to large classes of variables that may be implicated in determining individual differences in L2 acquisition. Perhaps more important is that this literature identifies some of the basic phenomena of individual differences in L2 acquisition. The principal drawback of this literature is that it is relatively silent about the mechanisms responsible for these phenomena. Nevertheless, the framework provides a useful starting point for investigating possible sources of individual differences.

In his framework, Ellis (1994) identified three interacting sets of variables or dimensions along which individuals may differ with respect to L2 attainment, namely, *individual learner differences, learner strategies,* and *performance outcome.* Researchers working from this perspective have addressed questions about specific variables within each of these dimensions, but they have paid much less attention to potential interactions between them and to the mechanisms that explain their effects.

Individual Learner Differences

Ellis identified seven categories of individual learner differences. Three of these—age, aptitude, and motivation—have been the object of quite systematic research and theorizing. The other factors—learning style, beliefs, affective states, and personality—have received considerably less attention.

Age. One basic phenomenon of interindividual differences in L2 attainment is that learning appears to be more successful the younger one starts. Many reasons have been advanced for this (Ellis, 1994). First, the capacity to perceive and segment sounds may become progressively impaired as a function of age. Second, there may be a loss of neurological plasticity after some critical period that inhibits an adult's ability to acquire certain aspects of new linguistic skills (e.g., phonology, grammar). Third, the older one is, the less motivated one may become to communicate with native speakers of another language or integrate into their community. Also, the older one is, the more self-conscious and anxious one may be when communicating in the L2. Fourth, the older one is, and especially in adulthood, the more likely it is that learning proceeds according to different, less efficient, principles. For example, older individuals may learn by using explicit knowledge, and younger learners may rely more on implicit learning processes—what some linguists refer to as a language acquisition device. Fifth, younger learners may receive superior language input compared to what adults receive for language learning purposes. Finally, older learners already possess a more highly developed first language system, with the consequent need to co-ordinate memory storage between the two languages in a different man-

ner from younger learners, who acquire both at the same time. There may be costs associated with this.

Could age of onset of L2 learning really be a major source of individual differences in L2 development? The literature is inconclusive. The original hypothesis, formally articulated by Penfield and Roberts (1959) as a statement about a critical period of plasticity of brain function for language lateralization, has still not received unambiguous support, largely because of controversy about how to best define such a neurological critical period and how to measure pre- and postcritical period language learning differences (S. J. Segalowitz & Bryden, 1983; Vaid, 1983; Witelson, 1983; for discussion of evidence from the bilingual aphasia literature see Paradis, 1994, 1995, and references cited therein). Even the issue of whether younger learners are in fact superior to older learners is controversial (Birdsong, 1992; Flege, 1987; Harley, 1986; Harley & Wang, chapter 1, this volume; Johnson & Newport, 1989; Long, 1990; Neufeld, 1978; Patkowski, 1990; Snow & Hoefnagel-Höhle, 1978; Walsh & Diller, 1981).

The upshot of this literature is the following: On the one hand, young learners typically attain a higher level of success than do adults in learning an L2, especially with respect to pronunciation. Nevertheless, adults, under appropriate laboratory conditions, are typically superior to children in attaining high or even native-like skill in phonological and/or grammatical aspects of language learning. This suggests that older learners are in fact capable of high levels of attainment, especially in the short term, even if this is not what normally happens in less controlled situations. The problem here is that age is a very difficult factor to isolate from the multitude of social, affective, and other experiential factors confounded with it.

Aptitude. Language learning aptitude is another general learner characteristic frequently invoked to explain interindividual differences. Skehan (1991) pointed out that the idea of language aptitude implies the following: (a) there exists a talent for language learning independent of intelligence; (b) this talent is not simply a product of language learning experience; (c) this talent is relatively stable across the lifespan of an individual; and (d) this talent varies between individuals. Clearly, if such an aptitude or talent exists, it would have practical implications for language training and theoretical implications for understanding what underlies language learning.

Does such an aptitude exist? The first step in determining this is to devise a test of language learning aptitude. The most influential work on this issue is the research of Carroll and Sapon (1959) and Pimsleur (1966). Carroll (1981) suggested that four component abilities underlie language aptitude: phonemic coding ability (the ability to associate sounds and symbols), grammatical sensitivity (the ability to recognize the grammatical role played by words in a sentence), inductive language learning ability (the ability to reason and make inferences from language material), and rote learning

ability (the ability to remember associations between L1 and L2 words). He reports correlations of around .50 between his measure of aptitude and various formal performance criteria (grades, attainment in tests of foreign language skill, teachers' estimates of students' language learning potential). Others have found similar correlations between measures of aptitude and attainment. Indeed, in terms of the four criteria for isolating a specific language learning aptitude, there is general support for three of them, namely, for the idea that aptitude, as measured by Carroll's test, does not change as a function of language learning experience, that it is relatively stable for a given individual, and that there is variability between individuals.

There are problems, however, with this approach. As suggested earlier, if a general language learning aptitude exists, it should be independent of intelligence. Is this in fact true? Skehan (see his 1991 review) administered foreign language aptitude tests to children whose first language development had been investigated a decade earlier (by Wells, 1985). Skehan's goal was to see what connections there were between the rate of first language development (from children's performance from ages 3 to 5 years) and their performance on foreign language aptitude tests (same children at age 13). He found significant correlations as high as .50 and concluded that part of what is measured by tests of L2 learning aptitude reflects abilities common to first language learning, and part reflects abilities to handle decontextualized language material of the sort encountered on formal tests.

Is this general language learning ability independent of intelligence? Ellis (1994) suggested the answer is both yes and no. First, the underlying general language learning capacity identified by Skehan (1989) may relate to basic interpersonal communication skills (Cummins, 1983). This conclusion is based on the association Skehan found between aptitude and first language learning and on the fact that this first language acquisition took place during the period in which the children were developing interpersonal communication skills. This interpersonal communication skill factor is presumably not related to general intelligence, but to oral fluency and sociolinguistic skill. Skehan also found, however, that aptitude was related to the ability to handle decontextualized language that can be related to what Cummins has called cognitive academic language proficiency. Now, academic proficiency in L2 skills has been shown to be related to measures of intelligence, but not to measures of oral skill (Genesee, 1976). Thus, the answer to the question about the relation of language learning aptitude to intelligence is not straightforward; aptitude, as measured by Carroll's test (Carroll & Sapon, 1959), is related both to oral communicative fluency skills (which are not related to intelligence) and to abilities to handle decontextualized language as encountered in an academic setting (which are related to intelligence).

Thus, although it is clear that individuals do differ on language aptitude test performance and that these tests can be good predictors of L2 learning,

much more needs to be learned about the mechanisms involved. Skehan (1989) put forward a new agenda for aptitude research, suggesting that if aptitude tests are to reflect how language is actually used and processed, there needs to be a greater emphasis on factors related to interaction and production. He recommended that future research move beyond considerations of linguistic competence (capacity to handle grammar) to include communicative competence, that is, the capacity to handle the sociolinguistic and discourse aspects of communication (in the sense discussed by Hymes, 1972). Individuals may differ in the abilities that underlie these different facets of language, and these may have differential effects on the learning route taken by the individual (e.g., the strategies adopted) and on attainment success.

Motivation, Learning Style, Beliefs, Affective States, and Personality. Research on the remaining five factors focuses on what determines individual differences in the quantity, and, to some extent, the quality of the situations a learner is likely to experience. Socially determined *motivation* is the most thoroughly investigated area among these five remaining factors (see Ball, Giles, & Hewstone, 1984; R. Gardner, 1985; R. Gardner & Lambert, 1972; R. Gardner & MacIntyre, 1991; Gatbonton, 1975; Giles, Bourhis, & Taylor, 1977; Giles & Powesland, 1975; Hermann, 1980; Schumann, 1978, 1990; N. Segalowitz & Gatbonton, 1977). Thus, for example, some people may be motivated to learn a language in order to become closer to the target language community, whereas others learn the language for utilitarian purposes only. This may be expected to affect what learning situations they will seek out, how often, and what they will learn from them. *Learning style* differences may, in principle, also underlie individual differences in attainment (however, Ellis, 1994, suggests that support for this is poor; see also Chapelle, 1992; Griffiths & Sheen, 1992; Wesche, 1981). Beliefs about language learning or about the target language itself may affect learning success (see Bialystok, 1981; Birdsong, 1994; Horwitz, 1987; Wenden, 1987). *Affective states*, such as anxiety related to language learning situations, may play a significant role here, too (see R. Gardner & MacIntyre, 1991; MacIntyre & R. Gardner, 1991). Finally, some researchers have investigated the potential role of personality factors, such as extraversion/introversion and self-esteem, in L2 acquisition outcomes. Ellis (1994) however, concluded that there is little consistency in this literature (see MacIntyre, 1994, for an interesting study of *willingness-to-communicate* as a personality-based variable linked to L2 learning success).

Underlying the research on these five individual learner differences is a concern with predicting individual differences in seeking out, creating, or optimizing learning opportunities. This is, undoubtedly, important for any account of individual differences in L2 attainment. However, beyond the question of what is responsible for individual differences in the likelihood

of experiencing a given L2 learning opportunity lies the question of what happens cognitively during that experience, a question not normally addressed by research on these learner differences.

Learner Strategies

The next major element in Ellis' (1994) framework is learner strategy. Learners do appear to vary in terms of the ways they exploit their language learning environments, and any given environment is likely to favor certain approaches over others. Thus, the degree of match or mismatch between the learners' strategy and its appropriateness for a given environment may become a crucial factor in determining language learning success. Individual differences in success may, then, reflect differences in this degree of match.

What strategies do learners in fact use? This turns out not to be an easy question to answer. Authors are not consistent in their definitions about whether to include conscious decision making, to distinguish strategy from technique, or to differentiate language learning strategies from skill learning strategies. The choice of definition will, of course, influence the method of studying individual differences in learning strategies. There is great diversity in the way researchers have approached the study of strategy, and this has led to a proliferation of typologies and categories. For example, Chamot (1987), Oxford (1990), and Rubin (1987) have together proposed typologies comprising over two dozen possible learner strategies.

In terms of strategy use, is there such a thing as the *good language learner*? Naiman, Fröhlich, Stern, and Todesco (1978) reported a major study that looked into the characteristics distinguishing successful language learners. Although they suggest that successful learners can be identified, to some degree, by the strategies they use, there are, nevertheless, several challenges facing researchers in this area. One is that the association between strategy selection and success may sometimes be more apparent than real. For example, it may be that more capable students are better able to articulate and identify their strategies than are less capable students, giving the appearance that strategy selection is a determining factor here. This problem can be overcome, of course, by careful observation of the learners' behaviors and by not relying solely on interviews and introspective reports. Some researchers have found that strategy use varies according to which language is being studied. For example, Ellis (1994) cites studies by Chamot and her colleagues (Chamot, O'Malley, Kupper, & Impink-Hernandez, 1987) and Politzer (1983) that found that learners of Spanish used fewer strategies than learners of Russian, French, or German. While this finding may reflect language specific strategy selection, something else may be operating here. American students who select Russian, French, or German may be different (e.g., more capable, more prepared to take up particular challenges) from

those who select Spanish because the former languages are less commonly taught in the United States and provide fewer practice opportunities than does Spanish (Oxford, 1989, cited in Ellis, 1994). (For a different, more experimental approach to the question of the *good learner*, see Nation and McLaughlin, 1986.)

Does a definitive, good language learning strategy exist? There are reasons to doubt this. For example, Ellis (1994) pointed out that the language learning task can take several forms, and strategy selection may have to be tailored to specific task demands. One language task may focus on the development of linguistic competence, and another might focus on communicative skills. Each may demand its own specific strategies. Other contrasts in strategy demands are possible, too. For example, adults and children may require different strategies; naturalistic and classroom settings may place different demands on the learner. Ellis also questioned whether effective strategy use necessarily implies frequent strategy use. He thinks it is more likely that strategy timing and purpose are more important than frequency of use. Perhaps, as he suggested, some strategies work best when grouped with other strategies, but just what the best combinations are remains to be determined. Finally, Ellis noted that the majority of strategy related studies are cross-sectional in nature, and so we know little about how the ability to deploy strategies develops over time.

Language Learning Outcomes

Finally, we come to learning outcomes, the third principal element in Ellis' SLA framework. This variable has received little direct investigation, but, clearly, it can be expected to interact with the other two sets of variables—individual learner differences and strategies. Depending on how outcomes are perceived, different individuals may or may not experience encouragement or frustration that affects further progress. Perception of one's own performance might also cause one to adopt a new learning strategy or to change one's beliefs about learning. Research in this area should examine how people evaluate performance outcomes (What dimensions are they sensitive to?) and how they account for their success or failure. On the latter point, there is a well-established social psychological literature on causal attribution (Lipe, 1991; Weiner et al., 1972), but concepts from this area have not been systematically applied to individual differences in L2 learning.

An example of how (mis)perception of a communicative outcome may affect learner readiness to engage in further language contact is given in N. Segalowitz (1976). In that study, moderately skilled L2 speakers of French listened to and, in some cases, responded to messages in English and French. The context was designed to include an implicit sociolinguistic demand characteristic to switch from a formal to a casual speech register in the

course of communicating. Those participants who had to switch from a formal classroom-like register to an informal casual register that they had little mastery of tended later to downgrade themselves and their interlocutor in a questionnaire evaluation. Participants in a control condition who did not have to speak but who were otherwise exposed to identical input did not downgrade the interlocutor. These results suggested that the L2 speakers were aware, at some level, of their lack of sociolinguistic competence, were uncomfortable because of it, sought an after-the-fact explanation for it, and, hence, downgraded their interlocutor. Such negative reaction by a learner could well affect the course of future interactions.

General Discussion of the SLA Approach

The SLA framework does provide a way of organizing and documenting some of the basic phenomena concerning individual differences in L2 acquisition and the potentially important variables implicated in this. It provides, however, little theoretical direction concerning how these variables actually influence the language learning process. In fact, Ellis (1994) seemed to recognize this and included in his framework a fourth background component that underlies the contributions of the other three. This component deals with the learning mechanisms that mediate the impact of the variables discussed above. Unfortunately, SLA research rarely addresses these mediating variables in detail. What is needed is a theoretical framework regarding how such mechanisms operate and contribute to individual differences. Only then will we be able to make full sense of the complex interactions among the factors that SLA research has identified. We turn now, therefore, to a consideration of a human information processing approach that explicitly addresses the cognitive and learning factors that might determine individual differences in L2 acquisition.

A COGNITIVE INFORMATION PROCESSING FRAMEWORK

Ackerman (1986, 1987, 1988, 1989) has elaborated a cognitive/information processing framework to address individual differences in skill learning in general. The model is presented here in terms of how it relates to L2 learning.

His model posits three phases in the acquisition of skill. According to the model, complex tasks make demands on various kinds of knowledge and abilities. Initially, in Phase 1, speed of processing is not important, and task performance depends on access to factual knowledge. At this level, performance is based on declarative knowledge—knowledge that is conscious, potentially verbalizable, and under the user's control. Performance at this level

is seldom fluent or smooth; it is generally slow, error prone, and easily disturbed by competing demands. In this phase, knowledge is represented primarily as facts without readily available procedures for activating them. The particular cognitive demands made on the performer at this level will, therefore, relate to both general and domain specific content abilities, but not to abilities related to skill execution. An example of this, in terms of L2 development, would be the learner in an early phase of L2 acquisition who has conscious awareness of the composition of words but, nevertheless, is unable to use that knowledge correctly in actual conversation (see Ellis, 1994).

With practice, performance becomes faster and smoother as the individual becomes less reliant on explicit, controlled knowledge. At this stage, knowledge is said to become less cognitive and more associative. Knowledge related to task performance is *compiled* in the sense that the performer puts together sequences of processes, *chunked* sets of cognitive and motor processes necessary to task execution. These compiled production systems render performance faster and less error prone compared to Phase 1 performance, and the cognitive load on the individual is reduced. Performance now comes to reflect a greater mix of controlled and automatic processing. Demands on processing speed in this second phase will be greater than they were in the first because execution of the knowledge compilations or production systems will require rapid connecting of cognitive and motor processes on the basis of ever-changing incoming information and circumstances. The critical ability here, therefore, is perceptual speed—not knowledge—as smooth task performance requires selecting the appropriate production systems (cognitive and motor sequences) to be executed. An L2 example that illustrates this would be the case of a moderately experienced (Phase 2) learner who is able to engage in sentence construction during conversation by replacing declarative knowledge about words such as *drowned*, *saved*, *walked*, etc. with a production system (knowledge compilation) that employs the past tense formation rule (*X* in the past tense becomes *X* + *-ed*). Perceptual speed is required here to identify the components for building new production systems and to select the appropriate routines. Wong Fillmore (1979) described interesting examples of this phenomenon from a study of five children, native speakers of Spanish, learning English.

Finally, when the individual has achieved a very high level of skill, the psychomotor aspects of performance that do not require processing new information become autonomous. That is, major aspects of the task are now executed without attention and without conscious effort. In other words, what had previously been executed on the basis of declarative knowledge (Phase 1) or production systems (Phase 2) is now carried out on the basis of automatized, procedural knowledge (Phase 3). This knowledge is implicit, not available to conscious attention, and performance is said to be automatic. In the domain of L2 skills, word recognition, and grammatical and phonologi-

cal control would seem to be good candidates for the attainment of Phase 3 levels of performance fluency.

Ackerman (1989) pointed out some interesting implications that his model has for understanding individual differences. The model predicts that different abilities will be implicated in individual differences at each phase of development. This means that if we are to explain individual differences in L2 acquisition we must know, among other things, what phase of development the learners being compared have achieved. For example, in Phase 1, before performers have had a chance to practise the task at hand, individual differences will necessarily reflect differences in general ability and in broad content abilities appropriate to the task (e.g., verbal abilities for tasks involving the processing of semantic information). Initially, of course, there will be some particular overall relationship between these abilities and observed performance. However, as learners move on to Phase 2 with practice, various aspects of the tasks will become compiled as production systems, and, so, the relationship between general ability and performance will decrease.

As they approach Phase 2 level performance, learners become engaged in formulating and testing new production systems, systems that contribute to performance only to the extent that they can be readily selected and implemented. This requires the performer to make rapid selection of the components of the production system to be compiled and to make rapid selection of particular production systems to implement. Once the learner moves into Phase 2 by creating and implementing production systems as a replacement for declarative knowledge, there will be an increasing relationship between performance and perceptual speed. Thus, in Phase 2, differences between individuals will reflect perceptual speed differences, not differences in knowledge or broad content ability, as is the case in Phase 1.

With continued practice after Phase 2, individuals will, one by one, reach their maximal level of perceptual speed. Differences between individuals in perceptual speed will stabilize, and, consequently, the correlation between individual differences in performance and in perceptual speed ability will eventually decrease.

Finally, Phase 3 is characterized by a high level of automatization of skill components, especially with respect to noncognitive psychomotor abilities. Individual differences in automatization will enter into the picture quite late (in fact, perhaps some will never attain this level) and will do so only as performance approaches Phase 3. Thus, when performance has fully reached asymptote, and there is no significant improvement with additional practice, most individual differences will be due to differences in the degree to which the learners have automatized skill components. This should be seen most readily in the psychomotor aspects of the task. One might speculate here whether this helps to explain why L2 phonology, reflecting as it does extremely fine motor control, is the dimension of language that most charac-

terizes interindividual differences among otherwise skilled speakers and is, usually, the one dimension of language that is least often mastered. (See Walsh & Diller, 1981, for a different explanation in terms of neurological maturation.)

In summary, then, we have the following relationship between individual ability differences and performance: With novel tasks, those associated with Phase 1 skill level, performance will correlate highly with general and content abilities, including language aptitude, but not as highly with perceptual speed and psychomotor abilities. After moderate amounts of practice, the relationship between performance on the one hand and general and content abilities on the other will diminish, and the relationship between performance and individual differences in perceptual speed and psychomotor abilities will increase. Here the extent of language practice and exposure will play a role in determining individual differences. Eventually, individual differences in psychomotor abilities will be the primary determinant of performance differences.

McLaughlin (1987; McLaughlin, Rossman, & McLeod, 1983; McLeod & McLaughlin, 1986) is one of the few theorists to have proposed an information processing theory of L2 acquisition in terms that can be related to Ackerman's framework. In McLaughlin's view, learners operate under the constraint of limited information processing capacity. Because this restricts how much and what information they can attend to, they must, of necessity, routinize their skills to overcome processing limitations. Thus, skills that were initially carried out by means of controlled processes become routinized (automatized) with practice. Learning in this sense leads to quantitative changes, insofar as larger and greater numbers of chunks become available for processing.

In addition to this routinization of processes, learning can lead to restructuring or a qualitative change in the way the learner represents information. Thus, while routinization will involve the formation of larger and larger units, it is also possible for learning to result in the extraction of rule-based knowledge about the structure underlying recurrent patterns, and, thereby, enable the learner to avoid having to recall particular units or exemplars. This idea is developed in relation to L2 syntactic learning by Carr and Curran (1994). These authors pointed out how, under favorable conditions, when the learner devotes attentional resources to the patterned input, implicit learning of structure can take place, even if there is no conscious awareness of that structure. Thus, we can expect to see interindividual differences in achievement, where learners in the same learning environment allocate different amounts of attention to the linguistic input of that environment.

Other research compatible with Ackerman's framework has investigated the acquisition of automaticity in L2 word recognition. For example, Favreau and N. Segalowitz (1983) demonstrated that interindividual differences in reading rate between otherwise accomplished bilinguals can be attributed

to differences in automaticity of word recognition. That study employed a primed lexical decision task that varied the interval between the prime and the target. In the condition with only a short interval of time to process a stimulus word (the prime), it was found that skilled L2 readers could not override the association of that word with a semantically related target, whereas less skilled readers could (i.e., the association was less automatic). N. Segalowitz and S. Segalowitz (1993) showed how one can analyze response time variability to derive indicators of the degree of automaticity attained. Essentially, the method involves comparing the variability of response times relative to the mean response time in a word recognition task for skilled and unskilled participants. When word recognition is relatively unskilled, it will involve many components that are slow and highly variable. On the other hand, when word recognition is highly skilled, many of these processes will have become automatized—fast and stable in time of execution. In the first case, the blend of processing components underlying word recognition will tend more toward controlled processing, whereas, in the latter case, the blend will favor automatized components. This difference reveals itself in the coefficient of variation that becomes an index of the level of automaticity. This method of analysis opens up possibilities for studying individual differences as a function of practice, training, and general language learning history (N. Segalowitz, Watson, & S. Segalowitz, 1995).

Because the cognitive mechanisms discussed here necessarily depend on particular neurological structures for their functioning, it is natural to ask whether interindividual differences in achievement may not also reflect neuropsychological differences. We turn to this question in the next section.

A NEUROPSYCHOLOGICAL FRAMEWORK

Although researchers have long been interested in the neuropsychological foundations of bilingualism (Albert & Obler, 1978; see also Paradis, chapter 12, this volume), few have directly addressed the question of a neuropsychological basis for individual differences in L2 learning. Two questions need to be distinguished here. The first is whether individuals can differ in terms of nervous system structure and function. Clearly, the answer to this question is yes. Here we might consider differences in hemispheric lateralization, differences in the ratio of glial cells to neurons (that may affect speed of processing and decrease noisy cross-talk between neurons), and differences in the amount of dendritic growth (affecting learning and memory). Such differences are likely to affect overall performance across domains, but not L2 learning specifically.

The second question, more relevant to our concerns here, is whether there exists a neuropsychological basis for special abilities in language learn-

ing and whether there are interindividual differences in this. Waterhouse (1988), in a theoretical paper that addresses exceptional abilities in general, argued that, indeed, this is the case. Waterhouse proposed that exceptional ability, including language learning, is not simply a reflection of skill at the high end of a continuum of abilities. Rather, she hypothesized that special cognitive abilities involve exceptionally accurate and extensive representation of visual images and sounds, and the ability to rapidly recognize and manipulate patterns involving these representations.

Waterhouse (1988) contended, moreover, that the potential for such talents is essentially innate and due to special brain functions giving rise to these talents. In particular, the brain of exceptionally skilled individuals may be enhanced by the possession of distinctive and/or more extensive organization of visual and auditory sensory association cortex, or polymodal association cortex (e.g., the temporo-parieto-occipital junction). She distinguished this kind of neurological advantage from other forms of neurological differences between individuals that may account for differences in general intelligence, but not in the appearance of exceptional abilities. Waterhouse emphasized that special abilities, including exceptional language learning, are relatively domain-specific and, hence, reflect structural enhancement of particular sensory processing systems, not general enhancement of neural processing.

Although this view is necessarily highly speculative, Waterhouse (1988) did offer some interesting arguments to support it. This includes consideration of how components of abilities might be distributed in a population and how distributions of skilled abilities might look, given what we think about the distributions of the underlying components. These can be compared to how special abilities are actually distributed. Waterhouse claims that the distribution of special talents does not seem to be explainable as simply occurring at the extreme high end of the distribution of general talents. Rather, they appear to form a special distribution of their own, a bump, as it were, in the right-hand tail of the distribution of general skills. Waterhouse is not proposing that this special distribution reflects the presence of a domain specific intelligence (as does H. Gardner, 1983, for example). Instead, she focuses on the enhancement of specific sensory processing systems that then might give rise to special language learning abilities, but not to a language intelligence, as such.

There is no research I know of that has specifically addressed the implications of this point of view for L2 learning. In fact, most of the literature concerned with the neuropsychological bases of language development addresses either what is universal in terms of neuropsychological correlates of language development and representation, or it addresses the neuropsychological dimensions of differences between normal development and impaired development (see Huettner, 1994, and Willis & Aspel, 1994, for reviews with a concern for individual differences). We can, however, pose

certain questions. For example, if those special abilities responsible for superior language learning are to reflect special skills in sensory processing, then what might these skills be? It seems unlikely that they will be related to fine phonological discrimination because such skills are nearly always evident to a very high degree in the first language for all speakers. However, perhaps the difference is not so much in the ability to make basic or subtle phonological discriminations; the difference is in higher level processing. For example, as will be argued in the next section, it is logically possible for individuals to attain similar levels of skill in basic perceptual abilities but, nevertheless, to differ in their ability to shift attention from one phonological dimension to another. There may be a neuropsychological basis for interindividual differences at this level of processing.

Schneiderman and Desmarais (1988) proposed an idea that is compatible with this last suggestion. They speculated on what the neuropsychological basis for individual differences in language learning might be. They suggested that talented language learners have greater neurocognitive flexibility than do less talented individuals. They argued that, initially, we all possess what linguists refer to as Universal Grammar (White, 1990), which provides the basis for all human languages. Exposure to our native language environment causes us to set parameters in a manner relevant to our particular language. As we become more proficient in this language, and as we get older, it becomes more difficult for us to choose other parameter settings appropriate for other languages. Only the very neurocognitively flexible individual will be capable of switching focus to correctly access the settings relevant to the new input. The authors discuss this idea in terms of evidence related to hemispheric participation in language processing and evidence for cognitive flexibility in bilinguals.

The idea that neurocognitive flexibility underlies individual differences in language learning ability is attractive (although the link to Universal Grammar is more controversial; see Reber, 1987, for a discussion of the problem here). This idea is developed in the next section in terms of the management of general psychological resources—memory, attention, perception— during exposure to L2 input.

BRIDGING THE PERSPECTIVES

The three perspectives just reviewed approach the problem of individual differences in L2 acquisition quite differently. Even though they are not necessarily incompatible, they nevertheless are not cast within some larger, unifying framework. This section, therefore, proposes a framework that encompasses the issues raised by all of these. At the center of this proposal are three interconnected premises about the cognitive system that mediates L2 learning and performance.

These premises are derived from a consideration of the general nature of skill and expertise. For the most part, the literature on skill and expertise has said little about individual differences in L2 learning, although a few authors have described cases of exceptional language mastery (e.g., Lebrun, Van Endert, & Szliwowski, 1988; Novoa, Fein, & Obler, 1988; Smith, Tsimpli, & Ouhalla, 1993). Nevertheless, we can think of L2 acquisition as involving, to an important extent, the development of a particular expertise, leaving aside for the moment the question of whether there is an innate, domain-specific talent involved. The advantage of adopting a skills/expertise approach is that it enables us to place questions about L2 development into the much larger context of individual differences in complex human performance. The three premises underlying this proposed bridging perspective were originally formulated in relation to a framework for understanding musical virtuosity (N. Segalowitz, 1992). However, insofar as they are meant to apply to complex cognitive performance generally, they are appropriate here, too.

Premise 1: L2 Skill Is an Open Skill

Theorists have made a distinction between closed and open skills (Allard & Starkes, 1991; Poulton, 1957). Closed skills are those that take place in a relatively stable environment and primarily involve accurate repetition of particular physical or cognitive acts (e.g., weight lifting; mental calculation). Open skills, on the other hand, are those that take place in a relatively unpredictable environment and involve bringing about certain effects on that environment (e.g., playing hockey or chess). It should be evident from these definitions that the distinction need not be strictly dichotomous; a given skill may be more or less open in terms of the role environmental variability plays, and it may be more or less open in terms of the degree to which modifying the environment is a performance intention.

How, then, should we classify L2 communication skills? Certainly, in some contexts, L2 activities are carried out as though they were principally closed skills. In some classroom situations, for example, the linguistic and social environment might remain fairly constant and noninteractive. The student's goal is to reproduce linguistic utterances as accurately as possible every time. In this sense, L2 acquisition may be viewed by both teacher and student as a closed skill.

It is clear, however, that L2 acquisition is normally tested in real life under open skill conditions. In the real world, the linguistic and social environment changes from moment to moment. There are sociolinguistic demands to attend to, unpredictable turns in conversations, unexpected demands placed by other people, physical intrusion of noise, and other distractions. Moreover, the goal of communication is normally not to simply recite the L2 as perfectly

as possible, but to bring about a change in the interlocutor (e.g., enlighten, persuade, request, move to action or inaction). In this sense, L2 acquisition involves the acquisition of an open skill.

This distinction is important because it raises questions about the ways an individual organizes his or her cognitive resources. Open skills impose requirements different from those of closed skills. In performing a closed skill, the performer focuses primarily on himself or herself, and views the performance as relatively isolated from the surrounding environment, whereas the focus is the very opposite with open skills. In closed skills, performance accuracy and precision are defined primarily in terms of specific movements and actions, whereas, in open skills, they are defined in terms of a relationship to the environment. The performer of a closed skill does not need to be continuously alert for unexpected changes in the environment; the performer of an open skill, on the other hand, must always be prepared for surprises that might interfere with his or her performance intentions.

Concerning individual differences in L2, then, we may ask the following preliminary questions. Do some learners approach L2 acquisition with a closed skill mental set that is not appropriate for the natural language situations they will later encounter? Do some teaching methods actually foster a closed skill approach to language acquisition and others promote a more open skill approach (Gatbonton & N. Segalowitz, 1988)? Does exposure to situational and linguistic variability early on in the learning process hinder or enhance ultimate achievement? Does a predisposition toward a closed or open skill orientation in language learning change as a function of age-related changes in cognitive abilities or life experience?

Open skills, as just defined, involve the performer's intention to affect the environment in a specific way, where that environment is itself characterized by significant variability. To accomplish this, the performer needs to be perceptually sensitive to the relevant properties of the environment. Now, the standard way to view such perceptual sensitivity is in terms of the processing of arrays of sensory information. Thus, a listener perceptually analyzes incoming speech as a sequence of acoustic information that maps onto phonemic categories and, ultimately, onto semantic representations. Even though there is nothing wrong with this view, it is incomplete. In addition to the perceptual requirements just described, the skilled individual also has to negotiate through a changing communicative environment and to bring about an intended environmental change—here, the communicative goal. In this respect, listening to speech (apart from laboratory settings) presents a perceptual challenge quite different from that involved in passively viewing a static visual scene. This is because much more than the perception of basic sensory information is required. What is needed is perception of what Gibson (1977), in another context, has called environmental *affordances*. This brings us to the second premise.

Premise 2: L2 Performance Involves Sensitivity to Environmental Affordances

Gibson (1977) proposed that the environment in which a person or animal actively interacts presents more than a complex array of sensory stimulation. It also presents a range of possibilities and limitations for carrying out intentions to act upon this environment. Sensory cues, therefore, not only signal *what is out there* in the environment but also signal information about the opportunities and constraints available to the individual. For example, although a cup may be perceived in terms of the visual sensory information it provides, it will also be perceived (by humans) as graspable, capable of holding water for drinking, etc., and not useful for a range of other functions. In other words, the very perception of an object normally involves more than the registration of sensory information about it; it also involves a form of *ego-reception*, in which the functional relationship of the perceived object or event to the individual—its affordances—becomes an integral part of his or her perception of it (Gibson, 1977).

Neisser (1983) developed this idea further in relation to skills in general, pointing out that every skill is carried out in some particular medium which affords the performer certain possibilities, but not others. The idea is that a very skilled performer becomes highly adept at perceiving and making use of these affordances, adapting to circumstances while effectively pursuing a performance goal.

This idea can be further extended to include the communicative environment in which the L2 user has to operate. Words, sentences, speech registers, etc. need to be perceived not only as arrays of sounds but also as vehicles for carrying out speech acts (Halliday, 1973)—requesting, reporting, persuading, etc.—aimed at fulfilling communicative goals in a social/linguistic medium. A speaker's utterances place demands on the listener to respond in a certain way or to communicate certain ideas. The physical and sociolinguistic features of speech that carry this information signal possibilities (the interlocutor is friendly, accommodating, understanding) and constraints (the interlocutor is hostile, stubborn, uncomprehending) concerning the way the communication is likely to unfold. The perception of these features of the linguistic context shapes the listener's decisions about how to continue the communication. Normally, in first language communication, such perception occurs in real time, more or less effortlessly, without conscious awareness, even though it may require some degree of attention to many subtle linguistic and nonlinguistic cues. In L2, the situation may be different.

The idea that skilled communication involves the perception of affordances has the following important implication for individual differences in L2 attainment. In keeping an ear and eye out for information about affordances, and, in adjusting one's responses in real time to the changing linguistic

and nonlinguistic context, one is required to demonstrate both *fluency* and *flexibility* of processing. It is here that individuals may show important differences that lead to variability in L2 attainment. In this context, fluency refers to the ability to process information rapidly, in a maximally automatic fashion, as described earlier in relation to Phase 2 and Phase 3 processing in Ackerman's (1989) model. Flexibility refers to the ability to shift attention from one stimulus dimension to another, as the occasion requires, so as to remain sensitive to the pragmatic, social, semantic, syntactic, and phonological cues one is receiving and sending.

Fluency develops over time, primarily through extensive experience in a consistent environment (Ericsson & Charness, 1994; Ericsson, Krampe, & Tesch-Römer, 1993; Shiffrin & Schneider, 1977). What is gained by such extensive practice is the automatization of many of the components underlying the skill. This automatization reduces the burden on short-term memory and facilitates the chunking of information into higher level units, as discussed earlier. It is proposed here that, among the critical components that become automatized, are the processes involved in the fluent and flexible perception of speech and nonspeech features related to the sociolinguistic aspects of the environment.

Variation in L2 attainment may reflect differences in the extent to which such automatization and chunking have been achieved. Among the sources for such variation would be factors that affect the amount of practice opportunities individuals receive and the degree of consistency in the environment. Such factors may lie outside the control of the learner. For example, one learning context may be inherently incapable of providing the necessary amount and consistency of input required for fluency to develop (e.g., certain types of classroom situations). It is also possible, however, for an individual to fail to benefit from what would seem to be an otherwise appropriate environment. For example, a negative motivation or misguided attitude may lead the individual to reduce linguistic contact or to attend to the environment in such a way as to miss the consistency of the information it provides. In such cases, gains that could have been derived will not be felt.

Flexibility also develops over time and is required if the complexity of linguistic input is to be handled skilfully. Full processing of linguistic input requires the recognition of the interlocutor's intentions, based on the perception of sound sequences, the recognition of lexical items, the processing of syntactic patterns, the generation of semantic representations, the perception of social cues in the linguistic (e.g., phonological, syntactic, and semantic cues to speech register) and the nonlinguistic environment (e.g., facial expression, gesture), etc. It requires, as well, the coordination of one's own responses with the evolving communicative situation (e.g., efforts to control the direction of the conversation). This coordination may become very complex, given that communication will often involve subtexts, hidden agendas, etc. Thus, native-

like performance in L2 requires rapid shifting of attention from one communicative dimension to another, just as in the first language. The ability to do this presupposes a high degree of perceptual and production fluency, and the requisite neurocognitive flexibility to accomplish this.

Individuals may vary in terms of their neurocognitive flexibility, and it may be possible for an otherwise capable individual to fail to develop this type of flexibility because of poor training or because of a particular orientation to language learning. Whatever the cause, failure to develop the requisite flexibility will mean that, in natural language contexts, the learner will not process affordances fluently and, hence, not develop the skills needed for native-like language use.

Premise 3: Internal Sources of Interference Affect Performance Attainment

A primary distinction between successful and unsuccessful performers, in any skill domain, is the way psychological resources are organized and, in particular, how they are organized to overcome internal interference (Scheffler, 1985). Because the learning and execution of complex skills involves many different mechanisms operating on a very large knowledge base, there is the possibility of interfering cross-talk between processes (Hirst & Kalmar, 1987) or less than optimal information processing (Salthouse, 1991) during performance. Individuals will differ in the extent to which such factors impede performance and, thus, differ in their levels of attainment. It is important, therefore, to identify what these sources of internal interference may be and how individuals may overcome them.

It should be pointed out that this focus on internal sources of interference does not necessarily deny the possibility of differences in innate endowment regarding some of the sensory and motor components of language learning and performance. Because, however, the ability to use L2 involves the co-ordination of many highly complex skills, it is unlikely that L2 attainment can be reduced to the operation of simple sensory or motor systems. It is difficult, moreover, to see why such sensory-motor limitations would affect L2 acquisition selectively.

What might these sources of internal interference be, apart from the social, motivational, and attitudinal factors that may interfere with and, hence, restrict practice and learning opportunities? Here, we focus on the cognitive mechanisms directly implicated in the way performance suffers from internal, cognitive interference. There may be many such sources of interference; two general classes are identified here. They each reflect a failure to meet conditions required for successful learning to take place or for what has been learned to be expressed at the appropriate moment. The two classes are: failure to meet the requirements of transfer appropriate learning and failure to reduce resource competition and cognitive cross-talk.

Transfer Appropriate Learning. Learning always takes place in some particular context, in which the learner focuses on elements of the environment in a particular way for special purposes, engages in operations specific to the needs of the situation, as defined by its properties and by his or her intentions. Transfer appropriate learning refers to the idea that the expression of previous learning will be successful to the extent that the learner's psychological state (reflecting the nature of the context, the individual's orientation, intentions, etc.), existing at the time of learning, matches that required at the time of expression. When the match is strong, learning is said to be *transfer appropriate.* Support for the principle of transfer appropriate learning is widespread in the literature (for recent reviews, see Blaxton, 1989; Roediger, 1990). Failure to recall or recognize a stimulus can, therefore, reflect a failure to recreate the appropriate psychological context for retrieving the information. In this case, there is interference from other sources of information, sources related to the inappropriate retrieval strategies activated by the mismatch between learning and test contexts. Such effects of mismatch have been shown to extend beyond the conscious learning of factual information to include implicit learning of patterned sequences generated by an artificial grammar (Whittlesea & Dorkin, 1993).

Individual differences can arise here in the following way: Some learners may be exposed to contexts that do not promote transfer appropriate learning, and some learners may adopt strategies—ways of focusing on the to-be-learned material—that undermine transfer appropriate learning. In both cases, the result is that some learners will be more successful than others because of the absence or presence of interference that gets in the way of successful retrieval. Thus, here we will see differences in L2 attainment due not to the presence or absence of some specific linguistic knowledge, but to the efficiency of memory retrieval (see Ericsson & Kintsch, 1995, for an important discussion of this issue in relation to expertise).

Demands on Capacity and Information Cross-Talk. Internal interference can arise for another reason. A given communicative situation will tax one's resources, with the result that a demand placed on the individual may actually exceed the resources available. For example, understanding a spoken message in a noisy room or during an emotionally charged exchange will normally make greater demands on the listener than will a casual conversation. If the demands are too great, then the individual will not be able to engage in all the complex processing that the situation requires. A central resource in such complex processing is working memory, the temporary holding of information for further processing. Just and Carpenter (1992) explored the impact of individual differences in working memory capacity on the processing of complex (first language) material. They found that individuals with a high-working memory capacity will be more successful than people with low-working memory capacity at processing sentences that require the

interaction of different levels of processing (e.g., using syntactic information to resolve lexical ambiguities). Such *capacity constrained* performance, however, manifested itself only when the test materials were complex, that is, when overall capacity was heavily taxed. Performance did not vary as a function of working memory capacity when the task demands were simple. Just and Carpenter discussed a number of other examples leading to the same conclusion, namely, that individual differences in working memory capacity can lead to processing failures (see also Harrington & Sawyer, 1992). In the case of L2 acquisition, one can imagine how such failures might interfere with learning generally. L2 learning is demanding; individuals with low-working memory capacity may encounter processing failures more frequently than those with high capacity, with the effect that learning is diminished (and with it, perhaps, motivation and commitment).

In addition to the effects of demands on capacity, one can also speak about inefficient use of the resources available. In fact, there is some controversy about whether, in a given case, one is observing performance limitations due to excessive demands or to inefficient processing (see discussions in Hirst & Kalmar, 1987; Just & Carpenter, 1992; Salthouse, 1991). Hirst and Kalmar, for instance, argued that what may limit performance is not insufficient capacity but interfering cross-talk between processes. In this view, complex processing involves a large number of mechanisms operating in parallel; if there is insufficient segregation of the information that should be kept separate, then cross-talk occurs within the system of parallel processing, leading to interference and processing failures. Presumably, individual differences in learning may arise when the environment or the learner's strategy fails to create the appropriate segregation of information.

Salthouse (1991) referred to expertise as "the circumvention of normal human limitations" (p. 290) and pointed out that, in any given domain, one can identify a number of potential processing limitations that will prevent the nonexpert from achieving a high level of performance. He noted, for example, that, in the case of typing skills, there are perceptual motor constraints governing how fast a person should be able to type. These have been studied by looking at reaction times in typing isolated letters and in successive finger tappings where letter choice is not involved. Salthouse reported that, according to the limitations revealed by such studies, people should not be able to type more than 74 words per minute. Nevertheless, expert typists often exceed these limitations impressively. What appears to be happening is that the proficient typist is able to make use of many different sources of information simultaneously and, thereby, produce a smooth, rapid, and continuous performance, rather than one characterized by discrete, keystroke-by-keystroke sequences. In other words, the skilled typist is able to coordinate, simultaneously, a number of different events so as to prevent interference from arising among the diverse elements.

This principle can be generalized to other complex behaviors, including L2 performance. Whether in situations of production or reception, the organization of sentences and texts requires coordination among a range of different, simultaneously functioning, operating processes. Individuals may differ in how well they are able to engage in such coordinated action. A major source of such individual differences will be the amount and kind of language practice; these factors affect the degree of knowledge compilation and automatization, discussed earlier, that, in turn, would be expected to affect the quality of coordination among processes.

CONCLUSION

Together, these three premises provide the basis for a perspective that brings together the issues raised in the SLA, cognitive, and neuropsychological frameworks discussed earlier. It does so by viewing the learner as situated in a complex, dynamic, communicative environment that imposes many different kinds of cognitive demands. To achieve native-like ability, these demands require the learner to possess skills in recollecting linguistic information under difficult conditions and to have a high degree of attentional flexibility for handling the many different stimulus dimensions that carry significant communicative information. These demands flow naturally from two special facts about the L2 communicative situation: It is highly fluid and variable, and successful negotiation within this environment requires an ability to perceive and use its affordances. Individuals will differ in L2 mastery, therefore, as a function of how effectively their perceptual and cognitive processes can meet these demands.

Questions about the role of individual learner differences and strategies can be directly related to this framework. For example, we can see that the individual learner differences and strategies identified in the SLA literature will have an impact to the extent that they enhance or impede the development of the special perceptual and processing skills required by the communicative environment. The cognitive/information processing perspective focuses on how a learning environment becomes skill enhancing when it provides extensive practice and exposure to consistent input, conditions necessary for the learner to develop fast and accurate recognition of recurrent patterns and to automatize many of the components of linguistic functioning. The contribution, if any, of innate endowment—a *talent for language learning,* or neuropsychological predisposition—must now be seen in light of what it contributes to the development of these special skills.

This perspective shifts our focus away from the idea that there is one single, most important factor—some learner characteristic, some optimal strategy, learning environment, or innate endowment—that determines individual

differences in L2 attainment. It also suggests that what we perceive as language learning ability is not a fixed characteristic of a person but rather a complex reflection of the whole learning situation. High level achievement in language learning, as in other areas of complex human performance, is seen from this perspective as a matter of how one's perceptual and cognitive resources are organized. An interesting corollary is that, even though there will always continue to be great interindividual variability in L2 learning, everyone has the potential to attain a high level of mastery. The validity of this corollary will be tested as we learn more about the complex interactions between person and environment in the determination of ultimate attainment.

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