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AUTHOR MacWhinney, Brian
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ABSTRACT

Drawing on recent psychological and neurological research on how individual differences might interact with learning a particular language, the study examines how psycholinguistic research and theory can help in assigning military personnel to language training and to a given language. Using the Defense Language Institute's Defense Language Aptitude Battery (DLAB) for reference, five categories of language difficulty are described, based on degree of difference from English. Research on individual differences in language learning is reviewed to identify potential methods of improving the DLAB to measure individual traits allowing a student to excel at certain languages or language skills. Language learning presents difficulties in orthography, phonology, lexicon, morphosyntax, syntactic processing, language use, and language learning strategies. For each there is rich psycholinguistic literature that can be used as a basis for additional measures of learner abilities. In practice, it may be useful to increase emphasis on prediction of second language learning from first language skills. It may also be easier to measure skill at learning and processing certain aspects of language. It is concluded that more finely tuned psycholinguistic measures of language learning skills are needed to predict problems caused by individual differences. (Contains 111 references.) (MSE)

PSYCHOLINGUISTIC ISSUES IN THE ASSESSMENT OF THE SUB-COMPONENTS OF LANGUAGE ABILITIES[1]

Brian MacWhinney
Carnegie Mellon University

What are the roots of foreign language learning skills? Why are some students successful language learners and others not? Are some languages easier for a certain type of student and other languages easier for another? Answers to these questions could help us make better predictions regarding the outcomes of foreign–language instruction for different combinations of students and languages.

Let us consider a concrete example of how an understanding of individual differences can be used in a particular practical context—that of testing in the context of the instruction conducted at the Defense Language Institute Foreign Language Center (DLIFLC). The primary evaluation instrument used at the DLIFLC is the Defense Language Aptitude Battery or DLAB. The DLAB is a state–of–the–art language test used both for selection of individuals for foreign–language training and for assignment of students to languages. The various languages taught at DLI can be grouped into four categories, ranging in difficulty from easiest to most difficult. DLAB scores are used to ensure that only students with the highest measured language ability will be assigned to the most difficult languages. Assigning weaker students to the harder languages would be a mistake, since the dropout rate would become intolerably high.

This use of the DLAB treats language–learning ability as a unidimensional variable, which we can refer to as 'L'. The more 'L' as student has, the more confident we are that the student can succeed with even a difficult language. However, it makes more sense from a psycholinguistic viewpoint to think of the learner as having a range of abilities—L1, L2, L3, etc.—which share some common variance, but which are also partially dissociable. The other crucial variable determining the success of foreign–language learning is the relative complexity or difficulty of the language being learned. We can combine the psycholinguistic study of individual differences in language learning abilities with contrastive linguistic analyses to build a theory of skill–language interactions that would serve as the basis for successful language–specific prediction of the outcome of foreign language instruction. In building this theory, we need three things:

1. **Skill Analysis.** We would need to have good measures of the learner's strengths and weaknesses across a wide array of tasks. These measures should be based on a thorough psycholinguistic analysis of the basic cognitive, motivational, perceptual, and linguistic skills used in language learning.
2. **Task Descriptions.** We need good contrastive linguistic descriptions that outline the type of demands that particular phonological, morphosyntactic, and discourse structures can place on language learning skills.
3. **A Framework.** Finally, we need a theoretical framework that can allow us to predict and understand interactions between individual skills and target language structures.

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This type of information can be used to improve (1) the selection of students as candidates for the DLIFLC, and (2) assignment of students to languages.

The initial framework for understanding learner–language relations can be provided by the standard ANOVA model with its main effects and interactions. We begin by recognizing the fact that much of the variance in the outcome of language learning is the results of main effects for the learner and the language. One main effect is based on the overall language–learning abilities of the learner. For any two learners (Le1 and Le2), there can be a main effect for the difference:

$$Le1 > Le2$$

This is to say that if a particular learner Le1 is generally better at learning languages than another learner Le2, we would expect Le1 to surpass Le2 across a wide variety of language–learning experiences. Similarly, for any two languages (La1 and La2) there can be a main effect for the difference:

$$La1 > La2$$

In one such possible ordering, the easiest languages are the Group I languages of Western Europe which use the Roman alphabet, share many cognates with English, and use Indo–European grammatical categories and structures not too terribly different from those of English. Like English, most Group I languages have greatly simplified the original complex grammatical system of Indo–European. In Group II, we find more challenging Indo–European languages. These languages also use the Roman alphabet, but preserve much of the complex grammar of Indo–European. Languages like Lithuanian, German, Romanian, and Hindi are languages of this type. In Group III, at the next level of difficulty, we find those Indo–European languages which maintain both a complex grammar and a non–Roman writing system. These include Greek, Russian, Serbian, and Persian. In Group III, we can also include those 'easy' non–Indo–European languages, such as Hungarian, Tagalog, and Turkish that use Roman characters. In this group, we also find some of the isolating languages of Southeast Asia such as Thai or Vietnamese. In Group IV, we can place non–Indo–European languages with non–Roman orthographies and complex grammatical systems, including Arabic, Japanese, and Korean. Finally, in Group V, we find even more exotic languages like Eskimo (Fortescue, 1984), Warlpiri (Bavin, 1992), Navajo, or Georgian (Imedadze and Tuite, 1992) which present the learner with major challenges in lexicon, grammar, and underlying conceptual organization.

If all prediction of the outcomes of language instruction were the result of these main effects, we would expect to see patterns of this type:

Le1La1 > Le1La2 and Le2L1 > Le2La2 (because La1 > La2)
Le1La1 > Le2La1 and Le1La2 > Le2La2 (because Le1 > Le2)

However, if there are interactions between learners and languages, we would expect to see two types of reversal patterns:

1. Learner reversals which take the form: Le1La1 > Le2La1 but Le1La2 < Le2La2

Here the normal learner order is retained for La1, but reversed for La2 because Le1 has particular problems learning this type of language.

2. **Language reversals** which take the form: Le1La1 > Le1La2 but Le2La1 < Le2La2

Here the normal language order is retained for Le1, but reversed for learner Le2 who seems to do particularly well in learning the more difficult language La2.

In practice, language reversals probably tend to occur only between languages that are closely matched in difficulty level and only for learners who are also close in ability levels. For example, we might find that a somewhat stronger learner does better than a slightly weaker learner on Spanish, but not on French, where the somewhat weaker student has some unique affinity for the French sound system. However, we would be extremely surprised to find that a language learner who did an excellent job learning Korean but had no luck at all in learning Spanish.

Although marked language reversals or learner reversals may be rare, reversals in terms of finer levels of detail may be more common. These two additional types of reversals include:

3. **Stage reversals** which take the form: Le1 St1 > Le2St 1 but Le1 St2 < Le2St2

In this type of reversal, Le1 is generally better than Le2. This is true at stage 1 (St1) of language–learning, but at some later stage (St2), Le2 suddenly shows a learning advantage, at least for the material being learned at that stage.

4. **Skill reversals** which that the form: Le1Sk1 > Le2Sk2 but Le1Sk2 < Le2Sk2

In this type of reversal, Le1 is generally better than Le2. However, this is not true across all skills, since the advantage is reversed for skill 2 (Sk2).

It is likely that skill reversals are the underlying causes of stage reversals. For example, it could be that a learner who is good at picking up vocabulary items will do well at the beginning of language learning when vocabulary is so important, but less well at later stages of learning.

A standardized test like the DLAB will do a good job of picking up basic rank orderings among learners, and a thorough contrastive linguistic analysis of a group of languages can be used to establish main effects for languages. However, if we want to improve our ability to predict stage reversals and skill reversals, we will need more fine–grained psycholinguistic measures of language–learning skills as they are applied during the various stages of language instruction.

In the sections that follow, I will suggest some areas that need to be explored in order to better predict each of these four types of reversals.

Individual Differences in Language Processing

Language is the most complex of all human behaviors. At any given moment during language processing, we may be engaged simultaneously in speaking, hearing, reading, formulation, and comprehension. Each of these individual component skills requires the involvement of large areas of the brain and a complex interplay of local neural processing, functional neural circuits, and high–level strategic organization. Work in cognitive neuropsychology has allowed us to identify some of the basic functions of brain areas in terms of language processing. The use of new scanning techniques in studies of individuals with brain lesions and other language impairments is helping us to understand some of these interactions in terms of the functions of local areas and ways in which local areas are linked together into functional neural circuits for language processing.

Local Processing

In terms of basic–level processing, we know that the temporal lobe has primary responsibility for auditory processing, that the motor strip at the posterior margin of the frontal lobe controls articulation, and that somatosensory input is processed through the sensory strip opposite the motor strip (Goodglass and Geschwind, 1976; Damasio and Damasio, 1988). The cerebellum compiles articulatory gestures from the motor cortex into specific muscle commands. There is a wide area of cortex around the Sylvian fissure and in posterior segments of the frontal lobes where damage can lead to language impairments (Damasio, 1981). Research has pointed toward marked individual differences in such basic attributes as the speed of neural transmission, activation of neural transmitters, involvement of the thalamus and hippocampus in memory and attention, and patterns of neural connectivity.

Commitment and Plasticity

Studies of the development of lateralization during childhood (Farmer, et al., 1991; Aram and Eisele, 1992) indicate that brain areas become progressively committed to particular functions over the course of development. Early in development, the child may lose large areas of cortex, or even an entire hemisphere, and language will still develop normally. As basic linguistic functions develop, they become confined to a smaller area of neural tissue. This leads to an increase in automaticity and speed of processing, but a decline in plasticity and some loss in the potential to function after brain injury. There is also reason to believe that the process that leads to a separation between different languages in bilinguals and second–language learners may also require a commitment of specific neural areas. The plasticity required for these various types of reorganization declines progressively through childhood and adolescence and may be the primary cause of some of the difficulties that adults face in second–language learning.

Integrative Circuits

Current models of the consolidation of episodic memories (Squire, 1992) focus on the role played by the hippocampus (Schmajuk and DiCarlo, 1992; Squire, 1992) in forming higher–level bindings between local areas. In terms of language learning, these bindings allow a variety of local areas to form a series of impressions of the various sensory and conceptual aspects of an utterance or phrase which are then linked together into a new grammatical form or construction. The connections between the hippocampus and local areas are ones used in all mammalian species. However, their use to support language learning is unique in humans and may be supported by other mechanisms. In addition to the hippocampal memory consolidation circuit, there are probably a variety of fairly local circuits that are used in analyzing and breaking apart local memories through a process called 'masking' that has been studied by Cohen and Grossberg (1987). Masking circuits involve the copying of linguistic forms that have been detected successfully to temporary local buffers so that the system can focus its attention on new incoming material that has not yet been fully processed, while still retaining the recognized material in local memory.

Functional Neural Circuits
The types of local integration supported by the hippocampal episodic system and the local masking system are complemented by a variety of other 'functional neural circuits' that integrate across wider areas of the brain. A prime example of such a circuit is the phonological rehearsal loop (Gupta and MacWhinney, 1995) which links together the auditory processing in the superior marginal gyrus of the temporal lobe with attentional and motor processing from dorsolateral prefrontal cortex. We use this loop to store and repeat a series of words or to speed the learning of new words. There is good reason to believe that the rehearsal loop plays a central role in both first and second–language learning. Moreover, we can use the immediate serial recall (ISR) test to estimate the short–term memory (STM) capacity of this rehearsal loop. Differences in the abilities of learners to store items in this loop have been shown to correlate well with differential success in both first (Gathercole and Baddeley, 1989b; 1990; Gathercole, Adams, and Hitch, 1994) and second (Harrington, 1992) language learning. Other functional neural circuits are involved in basic linguistic activities such as imitation, shadowing, simultaneous translation, speech monitoring, and utterance formulation.

Strategic Control
Finally, it is important not to underestimate the extent to which brain functioning is modified, amplified, integrated, and controlled by higher–level strategic processes. These higher–level processes include mood control, attentional control, motivational control, learning to learn, representational remapping, promotion of analogies, and applications of scripts (Naiman, et al., 1978; O'Malley and Chamot, 1990). The degree to which the foreign language learner can use phonemic recoding (Perfetti, Bell, and Delaney, 1988), graphemic visualization, translational equivalents (MacWhinney, 1992), and vocal tract models to facilitate language learning will determine relative success or failure across a wide range of foreign–language skills at various stages in language learning.

Level of Attention
Some learners pay more attention to overall conceptual structure, attempting to process sentences through top–down inferential processes (Bransford and Franks, 1971; Bransford, Barclay, and Franks, 1972; Barclay, et al., 1974; Kintsch, 1977; VanDijk and Kintsch, 1983; and Lombardi and Potter, 1992), whereas other learners focus more on listening to phonetic detail (Flege, Takagi, and Mann, 1995). It is easy to believe that those learners who pay more attention to phonetic detail in listening will acquire better phonological control over the language, but there is no research directly supporting this intuition.

Monitoring
One learner variable that has been shown most clearly to correlate with higher achievement is the use of monitoring or error–checking. Students who attempt to detect and correct their own errors and who make productive use of feedback from their instructors tend to perform better on achievement tests (Carroll and Swain, 1992). Such findings seem to contradict claims about the

importance of disengaging the Language Monitor (Krashen, 1978; 1982) as well as claims about the marginal role of negative evidence (Pinker, 1989). It is also true that learners appear to be differentially sensitive to instruction in the use of good language–learning strategies. If a learner is open to instruction in the use of these strategies, it is not important that the strategies be fully learned and controlled before the beginning of second–language instruction. However, the measurement of the learner's openness to such instruction could be an extremely difficult psychometric problem.

How might these various factors impact the learning of languages differentially? Could it be that learning of 'difficult' languages such as Chinese and Arabic, requires learners who make maximum use of learning strategies, whereas learning of 'simple' languages such as Dutch and Spanish requires little use of language–learning strategies? Although such a relation seems plausible, we do not yet have any data that could allow us to evaluate such hypotheses.

Native–Language Skills
Psychometrically speaking, the simplest model of individual differences in language learning would predict success in second–language learning entirely on the basis of skills that had already been demonstrated in native–language learning. A learner who is fast at processing words in the native language should also be fast at processing newly learned words in the second language. A learner who is good at comprehending complex passages in the native language should eventually be good at comprehending complex passages in the second language. However, there are a variety of reasons to expect that direct prediction of second–language individual differences from native–language individual differences will be far from absolute. Tests of native–language abilities tend to measure the results of the application of these skills, rather than the skills themselves. In the years intervening between basic native-language acquisition and the beginning of second–language learning, these skills may have fallen into disuse or may have atrophied altogether (Werker, et al., 1981; Johnson and Newport, 1989; 1991;). In fact, as basic native-language skills become solidified through neural commitment of local areas, the brain's capacity to add new material to the processing in these areas diminishes. However, if we turn to those higher–level integrative processes that are not supported by specific local areas, the prediction of second–language learning on the basis of native–language skill may be more successful. For example, we might expect that a learner who has a rich ability to process strings of words in the articulatory loop will be able to use this ability to support foreign–language learning.

At still higher levels of language learning, prediction of second–language attainment on the basis of native-language abilities should be fairly powerful. For example, we might well expect that a person who is a successful public speaker in the native language would also be a successful public speaker in the foreign language. We could measure a learner's control of narrative, argumentation, poetry, genre variations, literary criticism, and scientific writing in the native language as an excellent way of predicting eventual control of similar structures in the second language. At the same time, it is likely that the nature of the learner's overall attitude toward the native language will have a great influence on second–language learning. There is a wide variety of behaviors that can reflect a fascination with language use and language learning. These include interest in dictionaries, crossword puzzles, conversation, novels, plays, debates, stories, jokes, and all other forms of verbal entertainment and analysis. Positive experience with these forms in the native language can be generalized to early language–learning experiences in the second language. In addition, the learner may realize that successful learning occurs best when these positive experiences are maximized. Having learned one foreign language successfully, these same strategies can then be reapplied in increasingly successful ways.

Autosupport

Together, we can think of these various high–level strategies as forming a system for 'autosupport' that is crucial to adult second–language learning. The young child benefits directly from two fundamental supports for language learning. The first is the presence of a fresh, uncommitted neurological basis. The second is the provision by the child's caretakers of a rich system of social support. Parents read story–books to children, ask questions and wait patiently for answers, and provide names for unfamiliar pictures. No adult receives this immensely supportive scaffolding for language learning. Instead, the adult learner must compensate for the loss of these support systems by generating 'autosupport' mechanisms that rely on more complex functional neural circuits. Despite the massive individual differences that evidence themselves in native–language learning, nearly all children learn language. The same is not true for second–language learning, where the absence of good acquisition of autosupport strategies can lead to total failure in second–language learning, even when the practical negative consequences of this failure are enormous.

The applications of autosupport strategies allow the adult language learner to compensate for two types of handicaps. On the one hand, the adult learner must work to gain the richness of exposure to primary language data that the young child gets for free. On the other hand, the adult must fight an uphill battle against the commitment that has occurred in local areas of neural processing. The young learner has access to large amounts of uncommitted and fresh neural tissue, whereas the older learner works against direct competition from older, well established structures. The great wonder of adult second–language learning is the fact that learning can occur at all. The fact that it can testifies to the importance of input maximization, the residual capacity of the brain, and the ways in which functional neural circuits can be used to retune local processing areas.

Testing

Psycholinguistic research has devoted a great amount of attention to the testing and measurement of these underlying skills and processes. Measures of articulatory control (MacNeilage, 1970), auditory sensitivity (Tallal and Stark, 1980), baseline reaction speed (Kail, 1992), decision speed, choice speed, short–term memory capacity, rehearsal capacity, sentence span (Daneman and Carpenter, 1980), analogistic processing (Gentner, 1988), retrieval speed (Kilborn, 1989), retrieval accuracy, motivational factors, and attitudes toward language have all received extensive attention in the psycholinguistic literature. However, few of these measures exist in forms that can applied in the context of paper–and–pencil tests, since many of them look at online processing in the context of reaction–time studies.

Orthographic Learning

Having surveyed some of the basic mechanisms supporting language learning, we next consider ways in which linguistic structures can emerge as major roadblocks to progress during language learning. One such area of potential roadblocks is the learning of new and difficult orthographic systems.

There are two major areas of orthographic difficulty that can confront a foreign language learner. The first dimension is the presence of irregularities and inconsistencies in phoneme–grapheme correspondences. The second dimension is the presence of a new set of orthographic characters in the foreign language. For the English–speaking learner, this means the use of non–Roman orthographies, as well as special diacritic markings. Moreover, these two factors can also interact, since non–Roman orthographies can also be irregular in their mappings of phonemes to graphemes. A language like Spanish poses virtually no major orthographic difficulties to an English–speaking learner, whereas a language like Chinese presents the learner with an enormous orthographic learning task.

Phoneme–Grapheme Regularities

Learning to read and spell words in a new language can involve learning of a complex set of spelling patterns and rules. Languages like Polish, Hungarian, and Spanish are extremely consistent in their use of particular letters to mark particular phonemes. These languages tend to use a single letter to mark a single phoneme, leading to a consistent mapping from phonemes to graphemes, as well as from graphemes to phonemes. Languages like German or Dutch show consistency in the mapping of clusters of graphemes to phonemes, but a fair amount of indeterminacy in the mapping of phonemes to graphemes. In these languages, you know how to pronounce a new word if you see it spelled, but you are not sure how to spell a new word if you hear it pronounced. Other, even more difficult, languages, like English and French, tolerate a huge amount of plurifunctional marking and irregular patterns. The factor that is involved in these variations is the regularity of the phoneme–grapheme correspondences in the language (Venezky, 1970).

Simplicity of Mapping

When we move outside the realm of Roman–based orthographies, we find a wide variety in the shapes of the orthographic systems confronting the learner. The basic psycholinguistic principal operative is one of preference for one–to–one mappings. Ideally, the learner wants to find one non–Roman character for each character of the Roman alphabet. To the extent that this can be done, learning is facilitated. In order to read a new word, one takes a character in the new language, translates it to a character in English Roman script and then activates the corresponding phoneme. Eventually this mediation through Roman characters and English phonemes is dropped and the mapping from graphemes to phonemes is reconstructed in the new language. However, it would be a mistake for teachers to think that the mapping can be learned directly right from the beginning. Rather, it is likely that learners who can move quickly through the period of transfer and remapping from a Roman base will be those who are quickest to master the new orthography. Similarity of mapping. In Greek and Cyrillic, the mapping of characters to the Roman system is fairly transparent. Some of the letters even share a few physical characteristics. These iconic relations provide initial retrieval cues to the learner during the acquisition of the new alphabet. However, orthographies such as those of Hebrew, Indian *devanagari*, or Arabic, have no clear mapping to Roman characters. A comparison of the learning of scripts like *devanagari* with the learning of Cyrillic would help to illuminate the actual importance of script similarity within the context of different Indo–European languages. For a procedure that can be used to illuminate these functions crosslinguistically, see Kempe and MacWhinney (1994).

Nonphonemic Scripts

Although most orthographies are based on phoneme–grapheme correspondences, systems such as Chinese and ancient Egyptian use characters that have no match to individual sounds. The learning of non–phonemic scripts is impacted by a rather different set of learner variables. The kinds of learner variables we expect to be important here are similar to those that are important in first language word learning and perception. Learners relying on holistic learning are unable to piece together words from phoneme correspondences and must acquire words as phonological wholes. Such learners would do better with systems oriented towards whole words, such as Chinese. Full literate command of a language with difficult spelling patterns can be a tough matter and can set an upper limit on the achievement of a student. Limits of this type are also found in native–language acquisition for some of the rarer *kanji* forms in Japanese. A native–speaker learner may acquire certain *kanji* in high school which he or she then seldom uses again in later life. However, the majority of the world's orthographic systems are analytic or alphabetic in nature, and most learners will need to apply analytic abilities of the type they initially used as children learning the English alphabet and its use in early reading.

Psycholinguistic Considerations

Patterns of phoneme–grapheme irregularities provide us with a good illustration of ways in which learner characteristics can interact with language features. Highly analytic learners should do better with regular languages and less analytic learners should do comparatively better with languages that have irregular systems. Baron and his colleagues (Baron, 1977a; 1977b; 1979; 1980; Baron and Strawson, 1976) have used psycholinguistic methods to classify readers as either 'Phoenician' or 'Chinese' depending on their relative use of analytic versus holistic approaches to lexical and orthographic learning. In terms of this dimension, we would expect analytic learners to do well with regular systems and holistic learners to do comparatively better with more irregular systems and non–phonemic systems.

Psychologists have created a variety of detailed computational models of orthographic processes in reading and spelling. These models have been tested as accounts of deep dyslexia in adults (Coltheart, Patterson, and Marshall, 1987; Plaut and Shallice, 1991; Plaut and McClelland, 1993), lexical decision processes in normal subjects (Kawamoto and Zemblidge, 1992; Kawamoto, 1993), and word learning in children (Seidenberg and McClelland, 1989). Despite disagreements about general approaches, all models in this area must deal with the distinction between learners who emphasize rules and learners who emphasize rote.

Testing

One way of measuring students' abilities to acquire new orthographies would be to simply present a new alphabet that maps English to new characters. The learner would be required to study the alphabet quickly and then use it to identify possible spellings of English words. The alphabet could be either similar to English or radically different with shapes like that of *devanagari* or *hangul*. In addition there could be a set of whole word forms that the student would need to memorize. These would parallel characters in the Chinese system.

Phonological and Phonetic Learning

It is difficult to overestimate the importance of phonological factors in foreign–language learning. Typically, second–language learners who have not received careful phonetic training find it difficult to lose all traces of their native accent, if they have begun acquisition of the foreign language after age 20 (Oyama, 1976; Johnson and Newport, 1989; 1991).

Receptive Phonology

There is evidence that receptive phonological abilities become locked in on the native language even during infancy (Werker, et al., 1981). Lively, Pisoni, and Logan (1990) have shown that even the most difficult phonological contrasts can be learned during adulthood given sufficient practice, but whether it is possible to reach native–level performance across the board is difficult to demonstrate.

Motor Production

On the articulatory side, Hanson–Bhatt has conducted detailed studies of phonological transfer in second–language learners that have demonstrated feature–by–feature transfer from the native language to the second language. These recent analyses serve to update earlier ideas regarding phonological learning developed within the context of contrastive analysis (Lado, 1971). Careful attention to phonetic detail can help learners overcome some of these limitations (Flege, et al., 1995). However, there is little work that would provide clear guidance regarding the nature of those individual differences that contribute to successful acquisition of second–language accent. In particular, we do not know whether phonological acquisition of a new language is impeded primarily by ossification of the perceptual system or primarily by difficulties in establishing new procedures for controlling motor output (MacNeilage, 1970; Liljencrants and Lindblom, 1972; McNeil and Kent, 1990; Odell, et al., 1991).

Testing

Match–to–sample and same–different tests for prosodic and segmental contrasts are easy ways of testing for ability to perceive phonological contrasts. On the articulatory side, measures used in the field of speech and language disorders, such as rapid syllable repetition rate or syllable shadowing, could be adapted for use in the foreign language–learning context.

Lexical Learning

Perhaps the single biggest task facing the language learner is the acquisition of new words. In order to develop even moderate fluency in a new language, the learner must acquire several thousand new lexical items. Lexical learning involves three basic processes: form learning, function learning, and the establishment of retrieval cues that promote the association of form to function (Keenan and MacWhinney, 1987).

The Phonological Loop

The work of Baddeley and associates (Baddeley, 1986; 1992; Baddeley, Papagno, and Vallar, 1988; Gathercole and Baddeley, 1989a; 1990; Papagno, Valentine, and Baddeley, 1991; and Gathercole, et al., 1992) has underscored the role of articulatory rehearsal in word learning. There is evidence that this loop is used during word learning as well as during immediate serial recall (ISR). Gupta and MacWhinney (1994; 1995) have argued that the loop is based on a specific neural circuit connecting lexical phonological representations in posterior cortex and output forms in anterior cortex. Children with specific language impairment (SLI) seem to have a deficit in the use of this rehearsal loop (Gathercole and Baddeley, 1989b; 1990). In second–language learning, there is good reason to believe that successful language learners would be those who have a maximally well–developed ability to continue verbal rehearsal.

Phonological Processes in Rehearsal

It is likely that the process of verbal rehearsal interacts significantly with the shape of phonological coding. In languages with phonological systems that are close to those of English, learners could make productive use of their full rehearsal abilities. However, in languages with more difficult sound systems, there could be a greater load imposed on articulatory rehearsal and therefore a slower rate of word learning (MacWhinney, 1994). In this regard, problems could arise not only from segmental phonology, but also from suprasegmental markings such as vowel and consonant length, as well as tone and stress. As words place a greater and greater load upon the articulatory loop, we will expect to see simplifications and reductions to English–like forms. In this way, phonological difficulties can be reflected in problems of lexical learning.

Semantic Factors

Languages differ even more markedly in the demands they place on semantic aspects of word learning. In the very worst case, learning of a new word cannot depend on anything available from the first language. The new word would involve a complex set of new and difficult phonological mappings and a totally unfamiliar and complex set of semantic meanings. In languages such as Navajo or West Greenlandic, this worst case scenario may often be the actual case. Languages such as Korean or Japanese may be only marginally better. However, in languages closer typologically and culturally to English, there is a variety of factors that can facilitate learning.

There are at least four support factors that can facilitate this learning: cognate mapping, analogic mapping, semantic transparency, and semantic overlap. The best case for the learner is the case of cognate learning. It is obviously much easier to learn Spanish *republica* for 'republic' than Hungarian *nepkoztarsasag*. In cases where there is no direct cognate, there may still be a certain symmetry between the two languages. Sometimes words with parallel derivational or compound structure across languages are known as 'mirror words'. For example, German *Worterbuch* (words–book) can serve as a reasonable basis for the learning of Hungarian 'szótár' (word–book), whereas English 'dictionary' is much more helpful as a basis for learning Spanish *diccionario*. Even when a word in a new language cannot be perceived as a cognate or a mirror word, it may be relatively easy to decipher its meaning compositionally. For example, it is easy enough to understand that German *zweikeimblattrige* means 'dicotyledon', because the German word can be taken apart as 'two–kernel–leafed'. Or, if the student knows the French word *joie*, it is relatively easy to decipher the meaning of *joyeux* or *joyeusette*.

Semantic Overlap

Even when supports like cognates and semantic transparency are not available, languages may promote lexical learning simply by maximizing the overlap between concepts. For example, the word 'milk' in English means almost exactly the same as the word *Milch* in German. The learner typically begins with the assumption that this overlap is virtually complete. In fact this process is so strong initially, that Kroll and associates (Kroll, 1990; Kroll and Sholl, 1992) have shown that virtually all early lexical learning is mediated through first language concepts. However, for languages such as Korean and Japanese that have words with meanings that are very different from those of English, attempts to transfer meaning can lead to error, and learning itself is often exceedingly incomplete (Ijaz, 1986).

Testing

Given the importance of lexical learning, it is surprising that predictive tests seldom measure of this ability. Kempe and MacWhinney (in press) have developed a test of lexical learning based on the lexical decision task. This test is useful as a measure of early second–language attainment. In order to measure ability quickly to acquire a new set of words, the most obvious test would be one based on the old verbal learning technique of paired–associate learning. In a test of this type, the new words to be learned could be either English–like words or words that resembled those in a new language.

Morphosyntactic Learning

Tests like the DLAB tend to focus on measurement of the skills involved in grammatical learning. These skills certainly constitute an important component of language learning. Let us take a look as some of the component skills involved in grammatical learning and their differential use across languages.

Grammatical Markings

Languages differ markedly in the extent to which they require the learner to pick up large systems of nominal declension and verbal conjugation. At one extreme are languages like Navajo, with rich systems of aspects, person, case, number, and voice—all blended together in intricate phonological alternations in long complex verbs that also mark the shape of the object and properties of the location of the activity and direction of the action in a variety of spatial dimensions. At the other extreme are languages like English, Afrikaans, or Swahili that have only a few affixes and little in the way of obligatory morphological marking of grammatical categories.

The ways in which languages organize their markings of things like tense, number, space, and time (Talmy, 1976; 1977; 1988) are rich and varied (Bloomfield, 1961; Greenberg, 1978). Simplifying enormously, one can reduce this immense complexity to three basic dimensions: marking complexity, class membership complexity, and the complexity of the underlying grammatical categories.

Marking Complexity

In the simplest of grammatical systems, there are very few grammatical markings and the issue of combining of grammatical markings seldom arises. However, even in an analytic language such as English, some combinations can occur. For example, the plural of 'girl' is 'girls' and the possessive of 'girl' is 'girl's'. Combining these two, we might have expected 'girls's', but English prefers brevity and we have only 'girls''. In languages with more category markings, three configurations of categories are available. The most methodical solution is the agglutinative solution which concatenates markers one after another. Good examples of agglutinative languages are Turkish and Quechua. If these markers exercise strong phonological effects on each other, we have polysynthetic systems like Paiute or Greenlandic. The third solution is the fusional solution. In languages such as Latin, a given suffix or article may simultaneously signal three or even four grammatical categories. These distinctions are well–known and there is no need to review them further here. What is more important from the viewpoint of language learning is the distinction between paradigm learning and the learning of formal classes. The evidence currently available indicates that these are separate tasks. For example, in German child language (Mills, 1986) there are very few errors in the learning of case and also few errors in the assignment of nouns to gender class. However, for second–language learners of German, the acquisition of the basic paradigm is very easy but the learning of noun gender is extremely difficult.

Until very recently, the possible existence of individual differences in abilities to learn grammatical systems was totally uncharted territory. Recent work (Gopnik 1990; Gopnick and Crago, 1990; Pinker, 1991; van der Lely 1993; and Van der Lely and Howard,1993) has suggested that some children with language disorders may have a specific disability that blocks them from acquiring grammatical paradigms. Unfortunately, this work is marked by theoretical overstatements and methodological flaws and should not yet be viewed as anything more than suggestive. It may well be the case that some learners have specific problems in the area of inflectional morphology, but the exact nature of these problems remains to be more carefully delineated.

Category Membership

There has been a fair amount of work recently on the learning of grammatical gender in German (MacWhinney, 1978; MacWhinney, et al., 1989; Clahsen and Penke, 1991; Clahsen and Rothweiler, 1992; Clahsen, et al., 1992; and Marcus, et al., 1993). This work has underscored the importance of detailed low–level phonological cues in assigning words to gender class. For example, the ending *–e* is used as a cue to feminine, the ending *–en* as a cue to masculine, and the ending *–chen* as a cue to neuter. Sometimes these cues involve derivational items and sometimes they compete with other cues. There are also important semantic cues such as 'alcoholic beverage', 'stone', or 'superordinate.'

Conceptual Complexity

The formal shapes of paradigms and the membership of specific items in categories can seldom transfer from one language to another during second-language learning. This is certainly true for English learners, whose system of grammatical marking is minimal to begin with. However, the underlying meaning structure of the concepts being expressed by grammar can be transferred from one language to another. Let us compare two different grammatical categories in English and German: plural and dative. The category of plural marking on the noun is quite parallel between the two languages. Neither language has a dual marking. In both there are suffixes to mark plurality. The German system for plural marking is far more complex, but the underlying notion of plurality being expressed is the same as in English. Marking of the German dative, on the other hand, has no real parallel in English. It is true that English uses the preposition 'to' or the double object construction to mark the indirect object. And the student could assume some equivalency between the English indirect object and the German dative. However, this similarity is quite partial. The trade–off between the double object construction and the prepositional dative has no exact match in German. Most importantly, the German dative can also be used to mark the object of certain prepositions and this is in turn conditional upon the nature of the action of the verb. There is also a limited use of the dative in possessives, and there are a number of German forms in which the dative is the experiencer rather than the recipient.

Problems with the conceptual bases of grammatical categories may be some of the crucial determinants of learner problems with 'exotic' languages such as Korean and Japanese. For example, marking of tense or aspect in Japanese or the use of *wa* and *ga* require the learning of new conceptual mappings.

Testing

It is relatively easy to test for learner abilities in the area of paradigm learning and class formation. For example, subsections of the DLAB do a good job measuring these skills. However, it is much more difficult to test for ability to acquire new conceptual structures. One way in which this could be done is through induction of a grammatical category from examples. The contrast in Spanish between *ser* and *estar* could be used as a prototype. It should be possible to present the student with a series of example sentences in which the one form describes a permanent attribute and another form describes a transient quality. If the student can induce new concepts in this context, they would evidence ability to acquire new concepts in the larger language–learning task.

Syntactic Processing and Learning

It is difficult to separate the acquisition of formal marking systems from the overall syntactic system of a language. Perhaps the easiest way to think of the relation is to realize that syntax uses both local morphological markings and non–local word order or configurational patterns to express a variety of underlying concepts and meanings. Chomksy (1981; 1982; 1986) has attempted to characterize syntactic differences between languages in terms of a small set of key parameters, such as treatment of subject pronouns, movement of *wh*–words, and placement of adverbs and other verbal markers. It is difficult to find a single parameter which has received uniform linguistic support. Moreover, the exact role of parameters in language learning is still very unclear (Truscott and Wexler, 1989; Lightfoot, 1989; 1991; Hyams and Wexler, 1993;

Poeppel and Wexler, 1993). Despite these uncertainties, the parameter–setting framework for second–language acquisition syntax has motivated some interesting work, particularly from White and her students (White, 1989; 1990; 1991; 1992; Trahey and White, 1993;). An alternative view of the learning of second–language syntax has been developed within the Competition Model of Bates and MacWhinney (MacWhinney, 1987; MacWhinney and Bates, 1989). The Competition Model emphasizes traditional psychological and psychometric constructs such as transfer, cue strength, cue validity, and processing cost. The Competition Model has been applied to the study of second–language acquisition of grammar in a dozen languages and has made uniformly successful empirical predictions.

A Concrete Example
In order to see how the Competition Model and Chomskyan parameter–setting would deal with a particular aspect of language learning, let us look at the case of the learning of adverb placement. The parameter–setting account of adverb placement grounds learning on the resetting of a parameter for strong AGR marking. This parameter would relate the fact that German places the negative after the verb to its placement of the adverb after the verb. In English, on the other hand, both the adverb and the negative marker precede the verb. English says 'He often watches television' and German says '*Er sieht oft fern*'. White's work with second–language learners shows that instruction focusing on one component of the parameter does not influence learning of the other components. Instead, it appears that each aspect of the syntactic system is learned independently in its own right. This finding matches best with the analysis of the Competition Model. Both the Competition Model and the parameter–setting view assume an initial transfer of word–order patterns from English, and this is certainly what is found. However, parameter–setting requires a linkage between this pattern of learning and other aspects of learning. To date, no strong linkages of this type have yet been empirically confirmed. Given these negative findings and related theoretical problems, it would probably be a mistake at this point to rely on parameter–setting theory as a guide toward elaboration of tests like the DLAB.

Local versus Nonlocal Marking
Studies within the Competition Model framework have suggested another dimension that may be an important determinant of syntactic learning. This is the contrast between local and configurational marking. A clear case of local marking is the use of the Spanish preposition *a* with the direct object. Although this preposition is not formally a case marking, it functions as one in psycholinguistic studies of Spanish sentence processing (Kail, 1989). English learners of Spanish or Italian (Bates and MacWhinney, 1981) may at first attempt to use English word–order strategies to mark the direct object, but they will soon realize that the variable nature of Spanish word order makes this impossible. The prototypical example of a nonlocal marking is the agreement between the verb and the subject. Initially, one might think that languages that use redundant marking of grammatical categories would be somehow easier to learn. However, Competition Model studies of agreement marking in languages such as Hungarian, Arabic, Italian, Spanish, German, Serbo-Croatian, and French have shown that this is not the case. In fact, processing of subject–verb and object–verb agreement cues is one of the most difficult aspects of sentence processing, one which apparently places heavy demands on working memory and phonological rehearsal. Work by Bock and colleagues (Bock and Miller, 1991; Bock and Eberhard, 1993) in English supports this interpretation. Indeed, it appears

that problems in subject–verb agreement marking may be an important dimension to measure as a possible indicator of language–learning limitations. Note, however, that these problems are not so extreme for gender agreement within the noun phrase (Urosevic, et al., 1988), although they do effect gender agreement between the subject and the verb in Arabic, for example.

Testing

Testing could be done using the basic sentence–interpretation task. Test items should be chosen to sample from the various agreement structures and should include both local markings of sentence roles and configuration or word–order markings. A book by MacWhinney and Bates (1989) presents a wide variety of experimental techniques that could be adapted to the study of real–time sentence processing in the second language. Specific studies applying this methodology include McDonald and MacWhinney (1989; 1995). Kilborn (1989) has shown ways in which the imposition of an additional cognitive load through auditory noise or concurrent tasks can reveal deeper processing difficulties in even normal adult native speakers.

Conclusions

This brief survey has examined ways in which language–learning abilities interact with complex linguistic structures. Adult second–language learners face problems using low–level learning mechanisms to acquire the forms of a new language against the interference patterns from the first language. To overcome this, language learners must rely on functional neural circuits, motivational support, and other behaviors under strategic control. It is possible that learners have markedly different profiles of skills and that the interactions of these different profiles with different target languages could produce a variety of stage reversals and skill reversals. In order to understand this possible effect in greater detail, we will need to improve our methods for measuring functional language–learning skills.

It is important to place these potential interaction effects into a broader context. First, we should remember that the largest percentage of the variance in foreign language–learning outcomes will continue to be the main effect based on the overall ability level of the learner and the overall level of difficulty of the language. However, within this general framework, we need to study additional interactions for both practical and theoretical reasons. Secondly, this model of learner–language interactions ignores the other important determinant of the outcome of language learning, which is the nature of the educational treatment. A good teacher may be able to help a good student overcome some particular roadblock during language learning. At the same time, a good learner may be able to make use of the teacher as a resource in the process of overcoming specific disabilities or difficulties.

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Signature: Brian MacWhinney

Printed Name/Position/Title: Brian MacWhinney

Organization/Address: Dept of Psychology
Carnegie Mellon University
Pittsburgh PA 15213

Telephone: 412 268-3793

FAX: 412 268 7251

E-Mail Address: macw@cmu.edu

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