

Declarative and Procedural Determinants of Second Languages

Michel Paradis

STUDIES IN BILINGUALISM

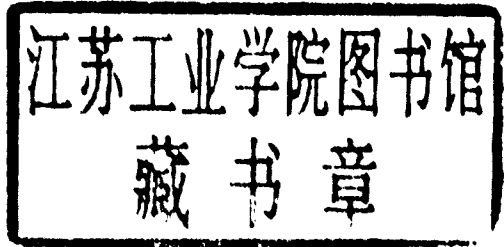
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Declarative and Procedural Determinants of Second Languages

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Declarative and Procedural Determinants of Second Languages

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The focus of this series is on psycholinguistic and sociolinguistic aspects of bilingualism. This entails topics such as childhood bilingualism, psychological models of bilingual language users, language contact and bilingualism, maintenance and shift of minority languages, and socio-political aspects of bilingualism.

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Volume 40

Declarative and Procedural Determinants of Second Languages
by Michel Paradis

Preface

Rather than confidently aiming at absolute truth, scientific research strives to reduce ignorance. Sustainable knowledge is backed by healthy skepticism and constant willingness to critically reconsider even the best entrenched assumptions.

Paul Bouissac, *Semiotix*, 9: May 2007

In Paradis (2004), I proposed a neurolinguistic theory of bilingualism. It integrates a number of hypotheses – namely the three-store hypothesis, the direct access hypothesis, the activation threshold hypothesis, and the subsystems hypothesis – within the framework of a neurocognitive megasystem that comprises a number of independent neurofunctional systems that collaborate in the representation and processing of verbal communication. These independent systems include a common conceptual system; motivation/affect; and, for each language, implicit linguistic competence, explicit metalinguistic knowledge, and linguistic pragmatics.

The present volume takes matters up where the previous one left off. Except for a brief recapitulation in this preface of the main relevant points, none of the contents of the earlier book are repeated. Readers are referred to the latter for further background information in places where it could be of advantage. Updated information on the various topics that were covered and additional evidence for the proposed theoretical constructs, including evidence from previously unexplored research domains, are provided, and new issues that have emerged since are discussed, as they relate to the framework of declarative and procedural memory. The current volume will explore further implications of these constructs for the appropriation, representation and processing of a second language. This will require careful consideration of a number of concepts associated with current issues pertaining to second language research, namely consciousness, interface, modularity, automaticity, proficiency, accuracy, fluency, intake, and ultimate attainment – informed by data from a variety of domains including language pathology and neuroimaging.

A list of constructs not presented in the 2004 volume is provided in the *Summary of key proposals* appendix (pp. 187–190).

Components of verbal communication

Verbal communicative capacity comprises linguistic competence (phonology, morphology, syntax and the lexicon), metalinguistic knowledge (the conscious knowledge of language facts used to keep track of the output when sentences are long and complex, particularly in a formal context), pragmatic competence (the ability to infer meaning from discourse and situational contexts, paralinguistic phenomena and general knowledge, and to use language effectively in order to achieve a specific purpose), and motivation (the desire to acquire a language in order to communicate, modulated by a range of affective factors that result in great variability among second-language learners). Each of these systems is necessary but not sufficient for normal verbal communication and relies on its own specific neural substrate, which is susceptible to selective impairment. Implicit linguistic competence is sustained by procedural memory, metalinguistic knowledge by declarative memory. Pragmatics relies mainly on areas of the right hemisphere. Speakers who have learned a second language after acquiring their native language will compensate for gaps in their implicit competence by relying more extensively on the other components of verbal communication, namely metalinguistic knowledge and pragmatics. The type and degree of motivation may influence the level of success in both the appropriation and use of a second language.

To the extent that the teaching of L2 is formal, it will involve the learner's declarative memory (and result in metalinguistic knowledge); to the extent that it provides motivation, it will engage the dopaminergic system (and improve performance in both learning and acquisition); to the extent that it is communicative, it may involve procedural memory (and result in some implicit linguistic competence). Practice will either speed up controlled processing or promote implicit competence (or both, to different extents and at different times).

A language needs to be used in order to keep its activation threshold sufficiently low to prevent accessibility problems. Within each language, the ease of access to various items is proportionate to the recency and frequency of their use. Both affective factors and pathology may modify this correlation.

Implicit and explicit language processes

The procedural/declarative dimension is a critical element in the appropriation, use and loss of languages. Implicit linguistic competence is acquired incidentally, stored implicitly, and used automatically. In the context of this neurolinguistic study of bilingualism, implicit linguistic competence refers to the cerebral representation of a set of computational procedures (the form of which is not overtly known). These procedures are implemented automatically. We cannot consciously control their

use since we are not aware of their structure. Competence (“knowing-how”) is subserved by procedural memory, as opposed to knowledge (“knowing that”), which is subserved by declarative memory.

Implicit linguistic competence and metalinguistic knowledge are distinct, as suggested by neurofunctional, neurophysiological, and neuroanatomical evidence, and recently confirmed by a number of neuroimaging studies of bilinguals. They have different memory sources (declarative vs. procedural), each subserved by neuroanatomical structures and neurophysiological mechanisms that differ from those subserving the other (hippocampal system and extensive areas of tertiary associative cortex vs. cerebellum, striatum, and focalized cortical areas). Moreover, they bear on different entities (e.g., surface form versus underlying structure; acoustic properties versus proprioception). The former is consciously controlled; the latter is used automatically.

As will be discussed at some length, implicit competence and explicit knowledge coexist. Neither one can become the other. Second-language learners may gradually shift from the almost exclusive use of metalinguistic knowledge to more extensive use of implicit linguistic competence. The output of L2 speakers is not evidence that a given structure has been incorporated in their implicit linguistic competence. It may be the result of controlled use of explicit knowledge (albeit relatively fast). When controlled processes are speeded-up, they can give the illusion of automaticity. But a task component cannot be more or less automatized. It either is automatized or it is not. Conscious production *can* be more or less speeded-up, that is, more or less efficiently controlled. Control admits of degrees of velocity in the performance of a task. But we cannot have more or less control over computational procedures that we are unaware of. Hence, automaticity does not admit of degrees. It is systematic whereas a speeded-up process is variable.

Speakers can only notice and pay attention to what they can perceive. What is internalized as implicit linguistic competence cannot be noticed. Speakers are aware of the output of the computational procedures that underlie implicit linguistic competence, not of the procedures themselves. One can only observe *what* has been produced, not *how* it was produced.

About the contents of this volume

Kathryn Kohnert (2008) proposes to view language from a dynamic interactive processing perspective, which has its roots in five complementary theoretical classes: social construction (Vygotsky, 1978); interactive processing (“top-down” and “bottom-up” processes); functionalism (competition, usage-based, and pragmatic-based models); connectionism (the brain as a network of connected neurons); and dynamic systems theory (de Bot, 2007; De Bot, Lowie, & Verspoor, 2007).

Here, I recognize the relevance of all five and focus on the contributions of declarative and procedural memory systems involved in each.

A chapter on bilingualism and neuropsychiatric disorders, first conceived of as part of this volume, was published separately (Paradis, 2008a) so as to narrow our focus on the appropriation, representation and processing of second languages. In that paper, though it had not been the initial purpose of the research, patterns were detected in an assortment of data that had hitherto been dispersed as unrelated items in the literature (individually uninterpretable, as pieces of a puzzle in isolation tend to be), which turned out to fit a number of hypotheses discussed in Paradis (2004). Several of the hypotheses integrated into a neurolinguistic theory of bilingualism have been shown to be relevant in the neuropsychiatric domain: (1) The activation threshold in the differential abilities to understand and to produce language; (2) the selective impairment of L1, L2, or both, indicating subsystems rather than a single system or two independent systems; (3) the reversibility of symptoms, pointing to the inhibition and disinhibition of subsystems rather than their physical destruction; (4) the fact that the poorer the L2 is, the greater the reliance on declarative memory (metalinguistic knowledge and pragmatics), irrespective of the type of pathology; and (5) the role of affect in sustaining normal and pathological language. Supported by experimental studies and clinical observations, these hypotheses will be considered insofar as they are applicable to the issues treated in this volume, namely the contributions of declarative and procedural memory to second language appropriation and processing.

Throughout in the text, redundancy has been favored over ambiguity. I hope the reader will forgive occasional repetitions that may seem tedious at times, as they generally serve to clarify the meanings of terms in particular contexts. Too many barren controversies stem from different interpretations of statements that lend themselves to more than one possible reading. If something can be misinterpreted, believe me, it will be.

A philosophical note

When I say that thought (or any other neural function) is *subserv*ed by the brain, I do not imply that thought is independent of the brain. Thinking is what the brain does. Thought has no existence outside neural activation; it is not detachable from its organ. Cerebral functions (such as vision, consciousness, or feelings) are emergent properties of the brain (Bunge, 1980; Paradis, 2004). They emerge from the activation of particular neural circuits. Thinking is to the brain what walking is to legs or rotation to the wheel – an abstraction (Bunge, 2007).

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Key concepts, framework, and clarifications

God showed it to them at the Tower of Babel! In order to sow confusion among humans, He gave words new meanings – different meanings for different people – so that His creatures would get all confused and would not be able to communicate among themselves: *Burro* came to mean *butter* to Italians and *donkey* to Spaniards. Hence, the people were not able to continue the construction of the tower.

To avoid such a situation, in scientific English, one must use words with their conventional denotations or define their special technical meanings if a new concept is introduced. Thus, in order to avoid fruitless protracted hollow polemics caused by confusion over the exact intended meaning of propositions related to the various issues considered in this volume, the words that refer to key concepts will be defined below (not that it is claimed that these are the true meanings of these words, but only that, for the sake of clarity, these are the meanings they have in the context of the present discussion). In addition, the background against which some of these notions are debated will be provided.

1. Definition of key concepts

First of all, once the difference between explicit knowledge and implicit competence and between declarative and procedural memory has been acknowledged, there is nothing to be gained by using one term (either *learn* or *acquire*) to mean both *to learn* and *to acquire*, or by using both terms interchangeably to refer to either learning or acquisition. There is an inherent ambiguity in the term *SLA* itself, since the *A* stands for *Acquisition* but this acronym is commonly used unsystematically to refer to conscious second language learning. Therefore, the term *acquire* (and its derivatives *acquisition*, *acquirer*) will be used to refer only to implicit (non-conscious) items and processes, whereas *learn* (and its derived forms *learning*, *learner*) will refer only to explicit (conscious) items and processes (except in direct quotations). When a statement applies to either or both processes, the term *appropriation* will be used. The outcome of acquisition is (implicit) *competence* and the outcome of learning is (explicit) *knowledge*. *Implicit computational procedures* refer to whatever mechanism constitutes what is inferred to be an implicit grammar (the speaker's

implicit linguistic competence), whether a set of rules (as assumed by generativist linguists) or a network of weighted connections (as assumed by connectionist psychologists). *Implicit linguistic competence* refers to the neurofunctional system that allows an individual to speak automatically, without conscious control. Its content is acquired incidentally while focusing on something other than what is internalized. It is stored implicitly (i.e., it remains opaque to introspection).

As pointed out in Paradis (2004), none of the current competing descriptions of linguistic structure is likely to correspond to the actual implicit computational procedures that are activated when people understand and produce sentences; we can only infer that such procedures exist. The neuroimaging techniques that have been used so far to identify the locus and modus operandi of the relevant neural substrates are not adequate for capturing the ultra-rapid and complex phenomena involved in the generation of a sentence from the initial intention to communicate a message to its phonetic realization. We can only hope that one day linguistic theory and brain theory will be unified, but as Beretta (2006) laments, “at present, far from these theories being compatible, any possibility of unification seems utterly remote” (p. 526). This, however, does not mean that we cannot keep trying. Let us just be aware that we are not there yet.

One major problem involves treating current hypotheses as though they were scientific evidence and inferring from them how the brain actually works (and worse, make practical recommendations about language teaching or rehabilitation). There is nothing wrong with (1) formulating hypotheses in theoretical linguistics in an attempt to determine the set of coherent rules that are most compatible with the observed systematic use of language by speakers; or with (2) attempting to verify by all available means (e.g., ERP, neuroimaging, clinical data, etc.) whether there are neural correlates for these theoretical constructs. Nor is there anything wrong with modifying the theory as one goes along. But it should give one cause to tolerate diversity in approaches, to temper one’s conviction of having reached the ultimate truth, and to refrain from treating one’s current theoretical linguistic description as though it corresponds to the way the brain actually processes language. Hypotheses that are considered invalid should be formally refuted; that is, it should be shown *why* they are flawed. We can be certain, on logical and empirical grounds, of what could not possibly be the case; it is much more difficult to determine what *is* the case.

Theoretical linguistic constructs tend to have a short lifespan. There is no point in claiming that the construct hatched last week is precisely how the brain encodes underlying procedures. We simply have not attained this degree of knowledge. Not only are we not reasonably sure that the underlying procedures are rules of any particular type (which is why Chomsky called them implicit), but we do not even know that they are coded as rules at all, rather than, for instance, as statistically driven

connections modulated by the context of each utterance. Let us retain a modicum of humility and a healthy grain of skepticism.¹ At this point we can only infer that procedures (whatever their form) sustain what allows speakers to generate sentences.

1.1 Definitions of “implicit”

Knowledge is said to be represented implicitly when it is inferred to exist from individuals’ systematic behavior (their competence), though these individuals are unaware of the content of their knowledge. *Implicit* is said of something that is not observable but inferred. Implicit linguistic competence is a functional system capable of generating sentences, which is inferred from speakers’ systematic verbal behavior. It is inferred that they must have stored in their brains some entity that can be considered as a grammar that allows them to speak the way they do by combining elements in a consistent fashion; they keep this grammar in memory so as to speak in the same way from day to day.

Implicit memory is a memory system whose existence is inferred from individuals’ verbal behavior and whose contents are not available for description. It contains various constituents according to the domain of application or relevance (procedural memory, priming, conditioned reflexes). The component of implicit memory that sustains skills (including cognitive skills, such as implicit linguistic competence) is called *procedural* memory. It is inferred to contain computational

1. What I caution the reader against is precisely the arrogant attitude of those who are convinced that they hold the Truth and who treat anyone with diverging views as muddleheaded, using intimidation to impose their views – only to discover a decade or less later that they were wrong, at which point they go on to defend and try to impose the new Truth with the same determination and contempt for diverging views. (The disdain displayed for stratificational linguistics by Beretta (2006) on the grounds that it “has very few adherents” (p. 527) is a case in point; so is his attitude towards the study of affect – wondering whether “Schumann and his amygdala are matters that could ever engage” (p. 526) SLA researchers.) This prompts me to point out in passing that scientific truth is not a matter settled by opinion polls, and that if it were, Beretta might find himself in the minority, worldwide. Anyone has a right to focus on a specific component of normal verbal communication. I have not read anything by Schumann that would deny the role of syntax in language use. He does not cast a shadow on the work of theoretical linguists, any more than those who focus on the pragmatic aspects of language, or who stress the imbeddedness of the language module within a set of collaborating complementary cognitive systems. None of these researchers call for a moratorium on the search for whether the brain cares about morphological roots. In fact, Paradis (1998b) argued that, even though the language system (qua implicit linguistic competence) needs to be supplemented by metalinguistic knowledge, pragmatics and motivation/affect to fully account for verbal communication, there is nevertheless a good theory-external justification for the study of context-independent sentence grammar.

procedures or action schemas. Implicit linguistic competence (i.e., what is inferred to support automatic language comprehension and production) is acquired incidentally, by focusing one's attention on something other than what is internalized (meaning and surface form vs. the computational procedures that generate sentences).

Thus, Hulstijn (2003: 360) is right in assuming that *implicit* and *incidental* are not synonymous and in recommending that the distinction be maintained. *Implicit* refers to a property (i.e., that which is not directly observed but inferred) and *incidental* refers to a manner of appropriation (i.e., by focusing attention on something other than what is internalized and eventually stored implicitly). It would be equally beneficial for the sake of clarity to maintain the distinction between (implicit) *acquisition* and (explicit) *learning*, as discussed above.

According to Roehr (2008a), implicit linguistic competence is stored in and retrieved from an associative network during parallel distributed processing, whereas explicit knowledge is processed sequentially with the help of rule-based algorithms. The difference in kind between these two processes results in phonology, morphology, syntax, and lexical retrieval being processed in parallel (hence simultaneously) by linguistic competence, while metalinguistic knowledge is processed only one item at a time; metalinguistic knowledge requires attention, whereas linguistic competence does not.

Implicit linguistic competence refers to the generation of novel sentences (propositionizing) by combining and recombining linguistic units (words, phrases, syntactic frames) into linguistic sequences, which, like Heraclitus' river² are never the same sentences twice although made up of the same type of material and the same structure. The initiation of an utterance is deliberate, but its elaboration is automatic (from the intention to communicate to its articulatory realization in production and from acoustic analysis to the decoding of its conceptual meaning in comprehension).

Acquisition is appropriation of information without awareness on the part of the acquirer of what is acquired and stored in implicit memory. The fact that it is *incidental* is a characteristic of acquisition as a particular manner of appropriation. Schmidt (1994: 16) defines incidental acquisition as learning without intention to learn; learning one aspect of a stimulus while paying attention to another; learning one thing when the learner's primary objective is to do something else, for example, learn formal features by focusing one's attention on semantic features. Granted that we are always paying attention to *something*, this does not mean that attention is involved in acquisition. Attention is not directed to the element that is acquired.

Practice refers to repeated use (involving both comprehension and production) in interactive communicative situations. Structure *generation* refers to the

2. You cannot step twice in the same river because the water that flows is never the same.