# Implicit and Explicit Knowledge About Language

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**Abstract**

Children acquire their first language (L1) by engaging with their caretakers in natural meaningful communication. From this "evidence" they automatically acquire complex knowledge of the structure of their language. Yet paradoxically they cannot describe this knowledge, the discovery of which forms the object of the disciplines of theoretical linguistics, psycholinguistics, and child language acquisition. This is a difference between explicit and implicit knowledge – ask a young child how to form a plural and she says she does not know; ask her "here is a wug, here is another wug, what have you got?" and she is able to reply, "two wugs." The acquisition of L1 grammar is implicit and is extracted from experience of usage rather than from explicit rules – simple exposure to normal linguistic input suffices and no explicit instruction is needed. Adult acquisition of second language (L2) is a different matter in that what can be acquired implicitly from communicative contexts is typically quite limited in comparison to native speaker norms, and adult attainment of L2 accuracy usually requires

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additional resources of explicit learning. The various roles of consciousness in second language acquisition (SLA) include: the learner noticing negative evidence; their attending to language form; their perception focused by social scaffolding or explicit instruction; their voluntary use of pedagogical grammatical descriptions and analogical reasoning; their reflective induction of metalinguistic insights *about* language; and their consciously guided practice which results, eventually, in unconscious, automatized skill. From various divisions of cognitive neuroscience we know that implicit and explicit learning are distinct processes, that humans have separate implicit and explicit memory systems, that there are different types of knowledge of and about language, that these are stored in different areas of the brain, and that different educational experiences generate different types of knowledge.

**Keywords**
Implicit/explicit knowledge • Implicit/explicit learning • Consciousness • Interface • Focus on form(s)

## Early Developments

Theoretical dissociations between implicit and explicit knowledge of language evolved relatively independently in language education, applied linguistics, psychology, and cognitive neuroscience.

In language education, differing assumptions about the nature of language representation and its promotion motivated different teaching traditions (Kelly 1969). Traditional grammar translation foreign language (FL) instruction and the cognitive code method popular in the 1960s and 1970s capitalized on the formal operational abilities of older children and adults to think and act in a rule-governed way. This allowed their instruction, through the medium of language, in pedagogical grammar rules, with lessons focusing on language forms such as, for example, particular tenses and inflectional patterns. These explicit methods were motivated by the belief that perception and awareness of L2 rules necessarily precedes their use. In contrast, more recent "natural" and "communicative" approaches maintained that adult language learning is, like L1 acquisition, implicit. Since language skill is very different from knowledge about language, they consequently renounced explicit grammar-based instruction.

In applied linguistics, the defining distinction between implicit acquisition and explicit learning of L2 was made by Krashen (1982). He argued that adult L2 students of grammar-translation methods, who can tell more about a language than a native speaker, yet whose technical knowledge of grammar leaves them totally in the lurch in conversation, testify that conscious learning about language and subconscious acquisition of language are different things, and that any notion of a "strong-interface" between the two must be rejected. Krashen's input hypothesis, an extreme "noninterface" position, thus countered that (i) subconscious acquisition dominates in second language performance; (ii) learning cannot be converted into acquisition; and (iii) conscious learning can be used only as a monitor, i.e., an editor to correct output after it has been initiated by the acquired system. In Krashen's theory, SLA, just like first language acquisition, comes naturally as a result of implicit processes occurring while the learner is receiving comprehensible L2 input. The input hypothesis was the theoretical motivation behind natural and communicative approaches to instruction.

In psychology, two important foundations were the dissociations of implicit and explicit memory, and of implicit and explicit learning. The dissociation between explicit and implicit memory was evidenced in anterograde amnesic patients who, as a result of brain damage, lost the ability to consolidate new explicit memories (those where recall involves a conscious process of remembering a prior episodic experience) to update their autobiographical record with their daily activities, to learn new concepts, or to learn to recognize new people or places. Nevertheless, amnesiacs maintained implicit memories (those evidenced by the facilitation of the processing of a stimulus as a function of a recent encounter with an identical or related stimulus but where the person at no point has to consciously recall the prior event) and were able to learn new perceptual skills like mirror reading and new motor skills (Schacter 1987). They also showed normal classical conditioning, thus the famous anecdote of the amnesic patient who, having once been pricked by a pin hidden in the hand of her consultant, refused thereafter to shake him by his hand while at the same time denying ever having met him before.

The dissociation between explicit and implicit learning was made by Reber (1976) who had people learn complex letter strings (e.g., MXRMXT, VMTRRR) generated by an artificial grammar. In the course of studying these for later recognition, they unconsciously abstracted knowledge of the underlying regularities, so to be able to later distinguish between novel strings which either accorded or broke the rules of the underlying grammar. However, like young children who can pass "wug tests" in their native language, these adult participants too were unable to explain their reasoning. Such research illustrated quite different styles of learning, varying in the degree to which acquisition is driven by conscious beliefs, as well as in the extent to which they give rise to explicit verbalizable knowledge: Implicit learning is acquisition of knowledge about the underlying structure of a complex stimulus environment by a process which takes place naturally, simply, and without conscious operations. Explicit learning is a more conscious operation where the individual attends to particular aspects of the stimulus array and volunteers and tests hypotheses in a search for structure.

In brain science, neuropsychological investigations of the results of brain damage demonstrated that different areas of the brain are specialized in their function and that there are clear separations between areas involved in explicit learning and memory and those involved in implicit learning and memory (Dehaene 2014). Explicit learning is supported by neural systems in the prefrontal cortex involved in attention, the conscious apperception of stimuli, and working memory; the consolidation of explicit memories involves neural systems in the hippocampus and related limbic structures. In contrast, implicit learning and memory are localized, among other places, in various areas of perceptual and motor cortex.

## Major Contributions

These foundations demonstrated that human learning can take place implicitly, explicitly, or, because we can communicate using language, it can be influenced by declarative statements of pedagogical rules (explicit instruction). These modes of learning apply to differing extents in all learning situations. There are at least some mutual influences in their development too. Consider, for example, that from implicit to explicit knowledge: Although in native language acquisition implicit learning is primary, the development of self-awareness allows reflective examination, analysis, and reorganization of the products of implicit learning, resulting in redescription at a higher level and the formation of new independent and explicit representations. Thus an older child can make a good stab at explaining how to form a plural in English because they have realized the relevant metalinguistic insight of "add –s" from observing themselves forming plurals in this way. The central issue of the interface question is just how much influence there is in the reverse direction, how much do explicit learning and explicit instruction influence implicit learning, and how can their symbiosis be optimized? Subsequent research took up this theme, though now as a better informed interdisciplinary collaboration (Ellis 1994).

In language education, analyses of learners in "grammar-free" immersion L2 and FL programs demonstrated significant shortcomings in the accuracy of their language (Lightbown et al. 1993). This prompted renewed calls for explicit instruction, but the pendulum didn't swing back all the way, this time instruction was to be integrated into the meaningful communication afforded by more naturalistic approaches: learner errors should be picked up by a conversation partner and corrected in the course of meaningful, often task-based, communication by means of negative evidence which offers some type of explicit focus on linguistic form (Doughty and Williams 1998). Long (1991) argued that this type of feedback, which he called focus on form, was a necessary element of successful L2 instruction. Prototypical focus on form instruction involves an interlocutor recasting a learner's error in a way that illustrates its more appropriate expression. Recasts can present learners with psycholinguistic data optimized for acquisition because – in the contrast between their own erroneous utterance and the recast – they highlight the relevant element of form at the same time as the desired meaning-to-be-expressed is still active, enabling the learner to attend the relevant part of the form and engage in conscious input analysis. Long contrasted this with the decontextualized and often meaningless grammar drills of traditional grammar translation instruction, which he termed focus on forms. The period from 1980 to 2000 was a time of concerted research to assess the effectiveness of different types of explicit and implicit L2 instruction. Norris and Ortega (2000) reported a meta-analysis of 49 of the more empirically rigorous of these studies which in sum demonstrated that focused L2 instruction resulted in substantial target-oriented gains, that explicit types of instruction were more effective than implicit types, and that the effectiveness of L2 instruction was durable. This in turn spawned a new wave of research which importantly includes both implicit and explicit outcome measures (Ellis et al. 2009; Rebuschat 2013).

In applied linguistics, critical theoretical reactions to Krashen's input hypothesis (e.g., McLaughlin 1987), together with empirical investigations demonstrating that it is those language forms that are attended that are subsequently learned, prompted Schmidt (1990) to propose that conscious cognitive effort involving the subjective experience of noticing is a necessary and sufficient condition for the conversion of input to intake in SLA. Schmidt's noticing hypothesis was the theoretical motivation for subsequent research efforts, both in laboratory experiments and in the classroom, into the role of consciousness in SLA. The shortcomings in uptake and the consequently limited end state of naturalistic learners, together with the demonstrable role of noticing in SLA, obliged in turn the rejection of the extreme "no-interface" position. Applied linguistics was thus left with something in-between, some form of a "weak interface" position (Ellis 2005b; Long 1991) whereby explicit knowledge plays a role in the perception of, and selective attending to, L2 form by facilitating the processes of "noticing" (i.e., paying attention to specific linguistic features of the input) and by "noticing the gap" (i.e., comparing the noticed features with those the learner typically produces in output). Some weak-interface variants also saw a role of consciousness in output, with explicit knowledge coaching practice, particularly in initial stages, and this controlled use of declarative knowledge guiding the proceduralization and eventual automatized implicit processing of language as it does in the acquisition of other cognitive skills.

In psychology, subsequent research in implicit and explicit learning of artificial languages, finite-state systems, and complex control systems showed: (1) When the material to be learned is simple, or where it is relatively complex but there is only a limited number of variables and the critical features are salient, then learners gain from being told to adopt an explicit mode of learning where hypotheses are to be explicitly generated and tested and the model of the system updated accordingly. As a result they are also able to verbalize this knowledge and transfer to novel situations. (2) When the material to be learned is more randomly structured with a large number of variables and when the important relationships are not obvious, then explicit instructions only interfere and an implicit mode of learning is more effective. This learning is instance based but, with sufficient exemplars, an implicit understanding of the structure will be achieved. Although this knowledge may not be explicitly available, the learner may nonetheless be able to transfer to conceptually or perceptually similar tasks and to provide default cases on generalization ("wug") tasks. (3) Whatever the domain, learning the patterns, regularities, or underlying concepts of a complex problem space or stimulus environment with explicit instruction, direction, and advances clues, heuristics, or organizers is always better than learning without any cues at all (MacWhinney 1997). (4) Although Reber had emphasized that the results of implicit leaning were abstract, unconscious, and rule-like representations, subsequent research showed that there was a very large contribution of concrete memorized knowledge of chunks and sequences of perceptual input and motor output that unconscious processes tally and identify to be frequent across the exemplars experienced in the learning set (Perruchet and Pacton 2006).

On the broader stage of cognitive science, the period from 1980 showed a parallel shift away from an almost exclusively symbolic view of human cognition to one which emphasized the overwhelming importance of implicit inductive processes in the statistical reasoning which sums prior experience and results in our generalizations of this knowledge as schema, prototypes, and conceptual categories. Everything is connected, resonating to a lesser or greater degree, in the spreading activation of the cognitive unconscious, and categories emerge as attractor states in the conspiracy of related exemplars in implicit memory. These are the aspects of cognition that are readily simulated in connectionist models (Elman et al. 1996) and which subsequently have had considerable influence upon our understanding of implicit knowledge of language and its statistical learning (Christiansen and Chater 2001; Rebuschat and Williams 2012).

In cognitive neuroscience, technological advances in functional brain imaging using electroencephalographic (EEG) and functional magnetic resonance imaging (fMRI) triangulated the findings of earlier cognitive neuropsychological studies of brain areas involved in implicit and explicit memory. Subsequent improvements in the temporal and spatial resolution of these techniques afforded much more detailed descriptions of the dynamics of brain activity, promoting a shift of emphasis from knowledge as static representation stored in particular locations to knowledge as processing involving the dynamic mutual influence of interrelated types of information as they activate and inhibit each other over time – as Charles Sherrington had put it 60 years previously, "an enchanted loom, where millions of flashing shuttles weave a dissolving pattern, always a meaningful pattern though never an abiding one; a shifting harmony of subpatterns." The last 20 years have shown a rapid rise in our understanding of the neural correlates of consciousness (NCC) (Dehaene and Changeux 2011; Koch 2012).

## Work in Progress

Thus research in these various disciplines has converged on the conclusion that explicit and implicit knowledge of language are distinct and dissociated, they involve different types of representation, they are substantiated in separate parts of the brain, and yet they can come into mutual influence in processing (Rebuschat 2015).

With regard to language pedagogy, there is now consensus in the acknowledgment of the separable contributions of explicit and implicit language learning, and it is more usual to hear of the necessity of a balanced learning curriculum that provides opportunities for meaning-focused input, meaning-focused output, form-focused learning, and fluency development (Ellis 2005b; Nation 2007). Nevertheless, there is still considerable work involving the particular details of how different tasks encourage the use of different aspects of language, how this processing encourages different learning outcomes, and how they should be structured, sequenced, and coordinated (Long 2014). The pursuit of these goals involves improved operationalizations of implicit and explicit knowledge in educational testing, the investigation of individual differences in implicit and explicit learning, and the determination of interactions between different learner aptitudes and different educational treatments. With regard to language learning, investigation has turned to much more detailed investigations of the processes and outcomes of implicit and explicit SLA:

What is the nature of the implicit knowledge which allows fluency in phonology, reading, spelling, lexis, morphosyntax, formulaic language, language comprehension, grammaticality, sentence production, syntax, and pragmatics? How are these representations formed? How are their strengths updated so to statistically represent the nature of language, and how do linguistic prototypes and rule-like processing emerge from usage? The vast majority of our linguistic processing is unconscious and is underpinned by our history of implicit learning which has supplied a distributional analysis of the linguistic problem space. Frequency of usage determines availability of representation and tallies the likelihoods of occurrence of constructions and the relative probabilities of their mappings between aspects of form and interpretations. Generalizations arise from conspiracies of memorized utterances collaborating in productive schematic linguistic constructions. It is now possible, using fMRI and ERP techniques, to image the implicit processing of words which, despite being presented below the threshold for conscious noticing, nevertheless result in subsequent implicit memory effects, and to identify the very local regions of sensory cortex where this processing takes place (Ellis 2005a). Such implicit learning, operating throughout primary and secondary neocortical sensory and motor areas, collates the evidence of language, and the results of this tallying provide an optimal solution to the problem space of form-function mappings and their contextualized use, with representational systems modularizing over thousands of hours on task (Frequency Effects 2002). There is broad agreement on these generalities and considerable uncertainty of the details (Rebuschat 2015).

If these implicit learning processes are sufficient for first language acquisition, why not for second? One part of the answer must be transfer. In contrast to the newborn infant, the L2 learner's neocortex has already been tuned to the L1, incremental learning has slowly committed it to a particular configuration, and it has reached a point of entrenchment where the L2 is perceived through mechanisms optimized for the L1. The L1 implicit representations conspire in a "learned attention" to language and automatized processing of the L2 in nonoptimal L1-tuned ways. Current research is focused on psychodynamic tensions in the unconscious mind of the second language speaker, not the psychodynamics of Freudian psychology, but of a more psycholinguistic kind: how associative and connectionist learning principles explain the shortcomings of SLA, the fragile features which, however available as a result of frequency, recency, or context, fall short of intake because of one of the factors of contingency, cue competition, salience, interference, overshadowing, blocking, or perceptual learning, all shaped by the L1 (Ellis 2006).

Transfer, learned attention, and automatization provide some reasons why implicit learning does not work for L2 as it does for L1. The pedagogical reactions to these shortcomings involve explicit instruction, recruiting consciousness to overcome the implicit routines that are nonoptimal for L2. What then are the detailed mechanisms of interface? What are the various psychological and neurobiological processes by which explicit knowledge of form-meaning associations impacts upon implicit language learning? This is a question not just about language learning, but involving human cognition and human neuroscience as a whole, an enterprise as fascinating as it is audacious. However naïve our current understanding, we have at least moved on from static conceptualizations of language, of representation, and of physical interface. The interface, like consciousness, is dynamic: It happens transiently during conscious processing, but the influence upon implicit cognition endures thereafter (Dehaene 2014).

The primary conscious involvement in SLA is the explicit learning involved in the initial registration of pattern recognizers for constructions that are then tuned and integrated into the system by implicit learning during subsequent input processing. Neural systems in the prefrontal cortex involved in working memory provide attentional selection, perceptual integration, and the unification of consciousness. Neural systems in the hippocampus then bind these disparate cortical representations into unitary episodic representations. ERP and fMRI imaging confirm these neural correlates of consciousness, a surge of widespread activity in a coalition of forebrain and parietal areas interconnected via widespread cortico-cortico and cortico-thalamic feedback loops with sets of neurons in sensory and motor regions that code for particular features, and the subsequent hippocampal activity involved in the consolidation of novel explicit memories (Koch 2012). These are the mechanisms by which Schmidt's noticing helps solve Quine's problem of referential indeterminacy. Explicit memories can also guide the conscious building of novel linguistic utterances through processes of analogy. Formulas, slot-and-frame patterns, drills, and declarative pedagogical grammar rules all contribute to the conscious creation of utterances whose subsequent usage promotes implicit learning and proceduralization. Flawed output can prompt focused feedback by way of recasts that present learners with psycholinguistic data ready for explicit analysis. We know of these processes, but we too are like those children doing "wug" tests: at present we can say little about their details. It is the results of thinking that come to consciousness, not the thinking itself, but consciousness then broadcasts these results throughout the brain to the vast array of our unconscious sources of knowledge, and by these means, consciousness *is* the interface (Baars 1988; Ellis 2005a).

## Problems and Difficulties

The problems and difficulties are abundant. The understanding of human consciousness is the toughest intellectual problem with which we are set. How do the contents of consciousness, what philosophers call "qualia" – the lilt of Welsh pronunciation, the pleasure of a good pun, the pedant's irritation with bad grammar, the loss and frustration that go with comprehension breakdown, the bitterness of lies – how do these arise from the concerted action of nerve cells? Compared to the vast number of unconscious neural processes happening in any given moment, the stream of consciousness evidences a very narrow bottleneck. How is it that a single percept is elected as the current focus of consciousness from the massively parallel activity of the unconscious mind? And what are the functions of these conscious thoughts? Despite our preoccupation with many of these questions throughout our philosophy, until quite recently their scientific study was stifled. Consciousness reacts to investigation. The unreliability of the introspective methods of early structuralist approaches to psychology led to the denial of any discussion of these ideas within behaviorism. The Association for the Scientific Study of Consciousness was established only as recently as 1996. But despite rich subsequent developments in NCC research, we are still only at the beginnings of understanding consciousness.

Our uncertainties about the nature of consciousness are well matched by those relating to the fundamentals of linguistic knowledge. The last 60 years of linguistic theorizing has seen an impressively contradictory lineup of theories about the nature of linguistic representations, including structuralism, universal grammar (government and binding theory), minimalism, lexico-functional grammar, cognitive grammar, construction grammar, emergent grammar, and many more. Equally contrary are the linguistic positions concerning whether second language has access to the same universal grammar learning mechanisms as does first language: The complete range is still on the table, including "full access/no transfer," "full access/full transfer," and "no-access" positions whereby SLA is fundamentally different from first language acquisition. Such uncertainty about the proper nature of the representations of first and second language does not help in the proper characterization of the learning processes.

Because both consciousness and linguistic knowledge are difficult to conceptualize and operationalize, much existing research has taken a pragmatic approach and, like the drunk who looked for his car keys under a lamppost a block away from where he dropped them, "because the light is better there," used easy to administer grammaticality judgments, or metalinguistic judgments, or multiple choice or other limited response format measures of language proficiency. Such tests have questionable validity as measures of language proficiency and in their very nature they are more likely to tap explicit conscious learning than are measures involving free constructed responses (Norris and Ortega 2000). There have been useful developments in the assessment of implicit and explicit learning and knowledge, but relevant methods can be complicated and time-consuming (Rebuschat 2013).

It is also an area beset by the experimenter's dilemma: should research strive for the research validity afforded by laboratory control and experimentation, or the ecological validity given by observing language learning in its natural environment (Hulstijn et al. 2014)? Every study falls down in one of these respects: Consciousness is hard enough to pin down in the laboratory, never mind the classroom. Connectionist models learn language that is a very small sample compared to yours or mine. It's hard to be natural in a loud and claustrophobic fMRI scanner. Real language learning takes tens of thousands of hours, not the minutes of the typical psychology experiment and so forth.

## Future Directions

The dynamics of language learning are inextricably linked to the dynamics of consciousness, in neural activity and in the social world as well. Input is gated by consciousness, and consciousness is coconstructed in social interaction. In these ways language learning is socially gated. It takes place in social usage, involving action, reaction, collaborative interaction, intersubjectivity, and mutually assisted performance. Speech, speakers, identity, and social relationships are inseparable. Individual learning is an emergent, holistic property of a dynamic system comprising social, individual, and contextual influences. Constructionist approaches to language (Tomasello 2003) emphasize the unique place of social cooperation in humans, and the Vygotskian intelligence hypothesis whereby regular participation in cooperative, cultural interactions during ontogeny leads children to construct uniquely powerful forms of perspectival cognitive representation including language itself. The last 40 years have seen considerable progress in research into social cognition, and within social cognitive neuroscience there is now a rich understanding on the role of implicit and explicit knowledge in social cognition, on consciousness and meta-cognition for social interaction, and in the brain mechanisms involved in these processes (Frith and Frith 2012). SLA is no different: Second language cognition and consciousness are coconstructed in social interaction. So a future priority is the bridging of social and cognitive research into implicit and explicit learning (Hulstijn et al. 2014).

For future research to properly address these issues, the studies of implicit and explicit language knowledge, SLA, applied linguistics, cognition, consciousness, learning, education, social interaction, and brain must proceed in consort within the broader inquiries of cognitive science and cognitive neuroscience. Sophistication in one of these areas is not enough if naivety in others flaws the whole. Interdisciplinary collaboration is essential in the development of both theory and empirical methods. Particular priorities include:

- Measurement: improved operationalizations of implicit and explicit learning, knowledge, and instruction in the classroom, psycholinguistics lab, and brain imaging scanner.
- Triangulation: predictive and concurrent validity assessment of the interrelations of these measures.
- Psychometrics: investigations of the core dimensions and latent structure of these variables.
- Meta-analysis: research synthesis allowing the determination of moderator variables in research outcome.
- Content-validity: the different types of implicit and explicit knowledge of language must be properly represented in batteries of outcome measures in studies of different learning or instructional regimes.
- Individual differences: the assessment of individual differences in implicit and explicit learning aptitude.
- Factorial research: the assessment of aptitude/instruction/outcome interactions.

- Brain imaging: electrical and hemodynamic imaging of the results of learning in cross-sectional comparisons of first language learners and multilinguals and also of the processes of language learning.
- Computational modeling: there are so many variables involved that proper understanding can only come from simulation research.
- Mindfulness of complexity: awareness of the dynamic processes, reactivity, and emergent properties of the complex system that relates language, culture, brains, learners, and their conscious and unconscious knowledge representations.

## Related Articles in the Encyclopedia of Language and Education

Alan Rogers: Learning – Embedded, Situated, and Unconscious. In volume: Literacies and Language Education

Frank Hardman: Guided Co-construction of Knowledge. In volume: Discourse and Education

Rebekha Abbuhl: Second Language Acquisition Research Methods. In volume: Research Methods in Language and Education

## Cross-References

► Cognitive Linguistics and Its Applications to Second Language Teaching

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