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## **Implicit and explicit processing and their role in second language acquisition**

### **Abstract**

Due to developments in experimental General Psychology much attention was called lately on the distinction between explicit and implicit processes, i.e. between implicit and explicit learning, implicit and explicit memory, and implicit and explicit knowledge. These distinctions will be applied to a special problem in the domain of Psycholinguistic, particularly their role in second language acquisition. The scientific treatment in this research context is motivated by the following observation: Children acquire complex knowledge on the structure of their language by the usual communication with parents and peers, yet they cannot articulate the underlying rules. Its reactivation and use is implicit. Adult acquisition of linguistic and grammatical skills in second language is not based in the same way on implicit (or incidental) learning in communicative contexts, but mostly on instruction of vocabulary and explicit rules. But implicit knowledge is seen as the prerequisite of fluent and effortless speaking. So the question is whether usual language teaching can offer conditions that enable implicit learning mechanism similar to the processes with children when they acquire their first language.

A short overview on a manifold of wide-ranging methodologically and theoretically demanding discussions and research results in this domain will be given, treating the experimental paradigms, the problems of measuring implicit and explicit knowledge, etc.. Exemplary studies and their results will be presented. Neuropsychological observations are presented which contribute to our knowledge on the distinction between implicit and explicit knowledge in this domain.

### **Introduction**

#### ***Basic concepts and distinctions***

Since 1970 the idea came to the fore that great parts of psychic processing are unconscious. Nisbett & Wilson (1977) have reported many situations where people could not articulate what processes and motives had led to certain decisions or other behavior. This is reminiscent of Freuds assumptions concerning the 'unconscious', but in Cognitive Psychology this does not mean that undesirable, instinctive urges and socially forbidden thoughts have to be suppressed, only that we are unaware of great parts of our proceedings but that they nevertheless have psychic effects. Conscious and unconscious processes are nothing else than two complementary forms of mental life.

Due to developments of theory and research in General Psychology much attention was called on the Implicit-Explicit-dichotomy which parallels the distinction between conscious and unconscious processing. The earliest impulse came from experimental results by Reber (1967 and 1993). Without any learning instruction to his subjects he presented letter strings that followed some rules of an artificial grammar (e.g., MXRMXT, VMTRRR), which could barely be revealed. Participants were exposed to these sequences in an experimental task which looked like a short-term memory test. Afterwards they had to perform a grammatical judg-

ment test on new sequences which followed the artificial grammar or not. Subjects were instructed that some strings followed a rule. With new grammatical and non-grammatical strings subjects had to decide whether they conform to rules or not. They were able to identify the grammatical sequences above chance but were unable to describe the underlying system. Reber concluded that persons are able to implicitly acquire an abstract representation of the structure of the grammar which they could not articulate. This observation was then called implicit learning by him and his colleagues. Subjects base their judgments on regularities of structures of which they are unaware.

Explicit learning is input processing with the conscious intention to grasp the presented content or to find out whether the input information contains regularities. It is "...a conscious, deliberative process of concept formation und concept linking" (Hulstijn, 2002, 206). Implicit learning is input processing without such an intentions, taking place without awareness.

Another dichotomy is explicit and implicit memory. Free recall and recognition involve the use of direct instruction to retrieve information stored in memory which we may call explicit. Recollection is conscious and persons know they have stored information, and that it should be available, sometimes it is not, as we all experience some times.

Implicit memory is memory in the absence of conscious recollection. Persons don't know that they have acquired this information and they don't know that they know it. These implicit memory competences have been discovered by the following experiment (Tulving, Schacter & Stark, 1982). Subjects are presented lists of relative rare words (e.g. toboggan). One hour or one week later they are asked to fill in the blanks in word fragments to make a word, e.g. -O-O-GA-. The solution to half of the words were from the earlier presented words, but the subjects were not told this. They completed more fragments correctly when the solution matched items of the earlier presented words. People are usually unaware of their stored knowledge. The existence of implicit memory manifests itself only in better performance. This basic result has been replicated many times in following studies.

One remarkable result of the mentioned experiment was that the length of the retention interval had effects on recognition memory and fragment completion. Recognition memory was considerable worse after one week than after one hour, whereas the fragment completion did not change.

Another dichotomy is explicit and implicit knowledge, which parallels the distinction between declarative and procedural memory. Declarative memory involves factual knowledge and is divided in episodic and semantic memory. We are able to 'declare' the knowledge to other persons, so we can tell other people *what* we know. Procedural or non-declarative memory is reflected in skills, and actions; we know *how* to do things. Examples are often practiced actions and reactions, like biking, typing or playing an instrument. Most of them have been acquired by long and repetitious training, until they have been automatized. Then we act mostly uncontrolled, and are unable, to describe our performance. Classical conditioned responses also reflect procedural memory competences, e.g. fear in circumstances where we had bad experiences.

## **Applications to second-language acquisition**

The just introduced concepts have been applied in second language acquisition research, because the distinction between implicit and explicit processing may hereby be seen as highly relevant. The scientific treatment of second language acquisition on this background is moti-

vated by the following observation: Children acquire complex knowledge on the structure of their language usually by the communication with parents and peers, whereas they cannot articulate these rules, so we may assume that these competences are implicit. Adult second language acquisition of linguistic and grammatical skills is seldom based in the same way on incidental or implicit learning in communicative contexts, but mostly on instruction and explicit learning. Implicit language knowledge may then be supported in a lesser extent. But it is seen as a prerequisite of fluent and effortless speaking and reading.

Many scientific contributions refer to Krashen's (1981) distinction between acquisition and learning. The latter is a conscious process which results in conscious metalinguistic (e.g. grammatical) knowledge, the former is an incidental process that leads to tacit linguistic competences.

Many findings based on theory and research during the last 30 years have been piled up. Classroom instruction is often the source and context for exposure to the second language, and there have been studies which did show that it is effective. But it has been criticized to be rather insufficient if one has the aim to acquire a language as an automatic tool.

A lot of discussion also in second language research has contrasted the two forms of learning or knowledge. A central question has been the connection or interaction between these two forms. That is the interface problem, and the discussion reveals a spectrum of views ranging from a strong to a weak to non-interface position. We will not go further into this topic.

I will first make some remarks about my position. Both explicit and implicit processes play a role in the acquisition of language skills in L2 (second language). Explicit and implicit learning are dynamically and interactionally involved in language learning. There is also some overlap with the declarative and nondeclarative memory system but we must remember that procedural competence, which is normally implicit and automatic, may at least be partially explicit if it is originally the result of proceduralization of declarative knowledge. And sometimes implicit knowledge may be explicitly expressed when the need arises for learners to make it consciously available, if, for instance, one asks himself, what the underlying rule of a sentence construction may be while writing a letter or an article. But implicit learning should be the default method of adult language learning, because adult learners mostly miss the opportunities of acquiring the language competence in communication with their partners as do children. So we see many interactions between both forms of learning or knowledge, but for analytical purposes they have to be separated.

### ***Research: Operationalization problems***

A lot of laboratory and classroom studies tried to realize conditions which would initiate implicit learning. Incidental or implicit learning refers to experimental arrangement in which subjects are confronted with materials that follow hidden rules, and they were not informed that there will be a test of learning, so they may learn something without intending to. In some studies students had to react to grammatical and nongrammatical sentences, often to semantic or syntactic violations.

There have been many attempts to operationalize or measure implicit and explicit knowledge which may be important in second language research. Because you need well-defined concepts and adequate valid operationalizations for uncontested empirical studies. Nevertheless there have been many attempts (and discussions) to separate criteria of implicit and explicit language knowledge.

Two commonly used implicit learning paradigms offer verbal statements as indicators. Designs in the tradition of the Reber-Experiment or of the serial reaction task, ask the subjects if

the presented patterns follow a rule or not. Other operationalizations consisted in confidence ratings in the judgments the learners expressed. If the accuracy of their decisions is above chance when they say they are guessing (that is when they do not know the correct answer), they can be said to have been using implicit knowledge. Ellis (2005, 151) has systematized the distinctions between explicit and implicit knowledge with this aim to get better insight into the structural differences and to use them as base for operationalization (s. Tab. 1).

<i>Knowledge</i>	<i>implicit</i>	<i>explicit</i>
Awareness	Intuitive awareness of linguistic norms	Conscious awareness of linguistic norms
Type of knowledge	Procedural knowledge of rules and fragments	Declarative knowledge of grammatical rules and fragments
Accessibility	Access to knowledge by means of automatic processing	Access to knowledge by means of controlled processing
Systematicity	Variable but systematic knowledge	Anomalous and inconsistent knowledge
Learnability	Potentially only within critical period	Any age
Self-report	Nonverbalizable	Verbalizable
Use of L2 knowledge	Access to knowledge during fluent performance	Access to knowledge during planning difficulty

Table 1. Key characteristics of implicit and explicit knowledge

One conclusion of this list was that some criterions should be based on the automaticity with which implicit judgments are made. That is speed of processing and freedom from attentional control. So oral production and imitation should be regarded as good measures of implicit language knowledge, e.g. speed or fluency of reading (Francis, Schmidt, Carr & Clegg, 2009). Ellis examined the correlations between performances of English learning students on five language tests: An untimed Grammatical Judgement Test, a Metalinguistic Knowledge Test, Oral Imitation, Oral Narrative and a timed Grammatical Judgement Test. The latter three procedures should capture implicit competence, requiring fluency and speed. This prediction has been confirmed. A principal component factor analysis resulted in two factors. The parameters of the two oral tests and the timed Grammatical Judgement Test loaded on the first, the

data from the two other tests loaded on the second factor, both could be classified as explicit measures.

### *Experimental studies*

There are many classroom- and laboratory-based studies on form-focused instruction with the use of explicit measurement, contrasted with implicit measures. In the implicit task students might incidentally learn a rule of grammar in the course of a meaning-focused task without knowing there will be a performance test afterwards.

Artificial grammar learning experiments, reminiscent of the Reber-Paradigm (1967), have been criticized as not being representative of language systems. We will report two or three studies which use verbal material, and they may be seen as prototypical:

Very interesting are the results of an early experimental study by Robinson (1996). His aim was to examine some postulations by Reber and Krashen that implicit learning is more effective than explicit learning when the stimulus domain is complex. One hundred and four (104) adult learners of English as a second language participated (mostly Japanese pupils at the Aoyama Gakuin University of Hawaii) and were randomly assigned to implicit, incidental, rule-search, or instructed computerized training conditions.

The experimental variables (Robinson, 1996, 36-37) (1) The (a) implicit and (b) incidental conditions are alike in not requiring a conscious focus on the grammatical form of the stimuli presented during training. The (a) implicit condition was explained to subjects as a memory test. Subjects viewed sentences conforming to the two rules and were instructed to remember the sentences. After each sentence they were asked whether a particular sequence of two words had occurred. The (b) incidental condition was explained to subjects as an exercise in reading for meaning. Subjects completed a "yes" or "no" comprehension question about the propositional content of each sentence they viewed. (c) The rule-search condition was explained as an exercise in identifying the rules illustrated by sentences. Subjects answered questions requiring a "yes" or "no" response (e.g., "Have you identified the rules yet? Are you still looking for the rules?"). (d) In the instructed condition, subjects read through the rules that were the focus of the study. Four key points of the explanations of these rules were rehearsed during the familiarization phase. Subjects consulted written versions of these rules during the computerized training sessions. During each session, subjects saw sentences and then were asked metalinguistic questions relating the sentences to the explanation of the rule given in the familiarization phase (e.g., "Did the verbs used agree in tense? Did the subject of the sentence come after the verb?"). As in the implicit and incidental conditions, subjects received "correct" or "incorrect" feedback to each response.

Additionally (2) Robinson varied the difficulty of the rules which governed the material consisting of English sentences. The hard rule involved pseudo-clefts of location, for instance,

*Where Mary and John live is in Chicago not in New York and*

An easy rule was based on the fact that subject-verb (SV) inversion is allowed in sentences where adverbials of movement or location are fronted, that is,

*Into the house John ran/ran John*

(Sentences following the hard and the easy rule are possible in English.)

All conditions consisted of a training and a transfer phase. The introduction of the training for all conditions consisted of the same example sentences in the same order. This was followed by two training sessions during which subjects in all conditions saw 40 sentences, presented in a fixed random order and timed to appear for 10 seconds.

After the training phase subjects were confronted with new material and had to judge each sentence grammatically. The dependent measures were speed and accuracy of these respons-

es. Robinson found that implicit learning was second best and explicit learning was worst for hard rules (out of four conditions) and that explicit learning was best and implicit learning was worst for easy rule. So the hypotheses derived from Reber and Krashen were in part confirmed.

Francis, Schmidt, Carr & Clegg (2009) asked if a non-native syntax can non-consciously in an incidental learning arrangement be acquired. Adult native speakers performed a reading task, during which they were exposed predominantly to three-word sequences, in an order which is unusual in English (noun-noun-verb or verb-noun-noun, for instance: *fish-meat-found* or *cried-hat-aunt*). As control condition some strings followed the English syntax (noun-verb-noun, for instance: *boy-swept-floor*). Oral reading time was used as indirect measure, because it has been proven that reading time is faster for syntactically well-structured sentences than for randomly rearranged sentences (when all sentences are novel and unpracticed). The experiment consisted in a training and a test phase. The authors found, that reading time decreased as a result of exposure and that this observation held for strings encountered during der training bloc and also for patterns of words which had not been presented. Afterwards the authors used a grammar reconstruction task as explicit measure. New words were arranged at random and the participants were asked to reconstruct the word order they had seen most often in the sentences they had read. Only 2 (7%) participants seemed to have complete knowledge of the word order rules on all reconstruction strings. 39% were successful with only one third of strings. The correlation between reading time and the extent of correct reconstruction in the second testing bloc was  $r = .07$ . So the performance was independent from the ability to explicitly apply the hidden rule.

The authors concluded that adults can acquire new word order patterns incidentally and that incidental exposure can result – at least in a great part of participant - in unconscious knowledge.

Similarly Rebuschat & Williams (2012) asked whether second language acquisition could also result in implicit knowledge, in this case of an unusual syntax. Adult learners were trained on an artificial language under incidental learning conditions. English declarative sentences were rearranged in German word order, placing in some cases the verb before the subject, for instance:

*Since his teacher criticism voiced, put Christ more effort into his homework. Or:  
Last year visited Susan Melbourne because her daughter in Australia studied.*

The presented sentences followed complex verb placement rules, depending on the type of predicate and clause.

The training consisted in 128 syntactically correct sentences (following the introduced new order), half of them expressed plausible and half of them implausible propositions. Subjects had to judge the plausibility. The testing set consisted of new sentences which were divided into grammatical and ungrammatical items, the latter were similar to the first, but the verb position was incorrect. With the exception of some function words, no words were repeated from the training set.

Thereby subjects had to make grammatical judgments. Sentences that repeated the grammatical structure presented in the trainings phase were accepted at levels above chance whilst performance on ungrammatical sentences was at chance. So it has been shown, that adult learners can acquire the syntax of a novel language without intending to. They were aware that they had acquired new knowledge and it was linked to improved performance, but the rules behind the performance were unverbalizable.

### ***Summarizing remarks on the research situation***

Ellis (2009, 9) maintained that no study has shown that implicit learning worked better than explicit learning, similarly as Norris & Ortega (2000) had found in their metaanalysis of 77 studies of L2-instruction. I think that a comparison is difficult since explicit and implicit processing are very different. Doughty (2003) has emphasized that the case of explicit instruction has been overstated, and that of implicit instruction underestimated, due to very few studies referring to clearly distinguished implicit learning situations. She also criticized the usually short durations of training and short durations to capture the trainings effects.

Doughty (2003) emphasized that the default processing mode in second language acquisition is implicit, but this need not rule out the occasional explicit procedures which seem necessary to overcome the disabling influence of primary language knowledge.

Nevertheless one observation may be emphasized: information which is processed unaware or in the implicit mode is more sophisticated than that which is processed explicitly (Doughty, 2003). These are the results of the classical studies (Reber, 1993, Berry & Broadbent, 1988), which also have shown that the improvements in performance always appear before participants are able to verbalize to any degree of completeness. But there has been similar evidence in SL-Studies. Robinson, for instance, as reported above, found that his explicit learners outperformed the implicit learner on a simple-structure version (subject-verb-inversion), but not on a complex structure (pseudo-clefts). The results of Mathews, Buss, Stanley, Blanchard-Fields, Cho, & Druhan (1989) showed that implicit learning of complex knowledge was more successful than explicit learning. More precisely: Complex artificial grammar knowledge was acquired better from exposure to instances implicitly than in the explicit mode. This occurred in spite of efforts of Matthews et al. (1989) to train subjects explicitly on how to build models of the grammar, allow them to use paper and pencil during training to develop a model of the grammar, etc.

### ***Structures behind processing***

We have reported good arguments for the distinction between implicit and explicit processing. But we have not yet sufficiently treated the question what is behind these modes of learning. And that is the question of structure, to which we refer while processing implicitly or explicitly. The structures behind processing may be seen as the knowledge which is implicitly or explicitly used. Implicit processing is processing which refers to implicit structures without being aware of the structure or even the processing. In the explicit case the processing or the structure are both conscious. Explicit knowledge is defined as knowledge about language (that is intentionally acquired), that contains syntactic and semantic rules, vocabulary, etc. and it is assumed to rely on a *propositional mental representation* (De Graaf & Housen, 2009). This language knowledge refers to explicit structures and is therefore verbalizable.

Implicit learning is assumed to rest on the incremental extraction of invariant or recurring patterns from a large number of single exemplars or processing episodes, it is thus based mainly *on contingencies and associations*. Connectionist models provide the indication of how contingencies could be computed in a plausible way. That means that this knowledge is represented in the form of networks of hidden units in implicit ways, which are not verbalizable,

the patterns influence nevertheless our verbal behavior<sup>1</sup>. This hypothetical representation format is in harmony with discussions and research in General and Social Psychology.

### ***Neurological research***

Recent brain scanning research may be able to contribute to our knowledge on the distinction between implicit and explicit processing and knowledge. There have been many empirical hints (Ellis, 2008, 121), that different areas of the brain are specialized in their function (which has been known long ago), and that there are clear separations between parts that support explicit processing and those that support implicit processing. Explicit learning (and functions like attention, apperception of stimuli etc.) is localized in neural systems in the pre-frontal cortex; implicit learning in various areas of perceptual and motor cortex – among other places. Most research results are based on ERP<sup>2</sup> data. That means Event Related Brain Potentials which indicates brain responses that are linked in time to the presentation of a stimulus. Tokowicz, & McWhinney, (2005) used an L2 grammaticality judgment task to test 20 native English speakers enrolled in the first four semesters of Spanish while recording both accuracy and ERP data simultaneously. They observed ERP responses during a time period between 500 und 900 ms following the onset of the critical words (here: grammatical violations in Spanish sentences). This short presentation may exclude conscious processing, and the reactions have been much shorter than the reactions to offline grammaticality reactions. Thereby subjects could – in contrast to the implicit condition – determine the grammaticality of a sentence with verbal judgments. The results showed that brain responses indicate better comprehension in L2 learners – the judgments were fast and more accurate - than would be suggested by overt responses.

McLaughlin, Osterhout & Kim (2004) used also ERP-measures and reported that adult L2 learners brain activity discriminated between L2 words and L2 ‘pseudowords’ (word-letter-strings) after just 14 h of classroom instruction. The results were remarkable from two perspectives: First (1) the authors showed that adult S2 learning is not uniformly slow and laborious; some aspects of language are required with great speed. And second (2) the results suggest that some behavioral assessment of L2 learning might underestimate what has been learned.

## **Summary**

Starting with the distinction of explicit and implicit learning and knowledge we could show that corresponding processes are applied to second language acquisition with great success. Experimental and neuropsychological studies offered hints that implicit processing is important since adult learners have usually only few opportunities to learn rules and vocabulary

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<sup>1</sup> “An especially interesting type of connectionist model is the ‘simple recurrent network’ (SRN), which is specialized for the kind of sequence learning that is assumed to occur in the procedural system. The details of such models need not concern us here (...); suffice it to say that such models treat sequence learning as a prediction task. For any particular training item, say the string ABCD in an AG experiment (‘artificial grammar’, MG), the network is taught to predict the next element in the string, taking into account not only the current element, but also its context (e.g. it is trained to predict B from A, and C from B in the context of A). The network essentially learns the context-dependent contingencies between elements in training strings” (Williams 2009, 329).

<sup>2</sup> ERPs (event-related potentials) are electrophysiological brain processes that are derived from the electroencephalo-graphic (EEG) record. The EEG is grasped by electrodes placed on the surface of the scalp. ERPs are responses to particular stimulus events; they reflect synchronous depolarization of groups of neurons in the brain as answers to perceptions or thoughts.



effortless and mostly unconscious while communicating with persons in their social contexts like family, peers or friends. This mode of learning and resulting knowledge may be called implicit. Explicit learning is usually realized when grammatical rules and vocabulary are offered by instructions and teaching. On this background measures have been discussed and established to capture the results of explicit and implicit language learning. A manifold of experimental studies in this domain are reported which contrasted explicit and implicit processing and show important contributions to language acquisition.

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