SEQUENTIAL SECOND LANGUAGE ACQUISITION FOR SPEECH PRODUCTION: IMPLICIT LEARNING PROCESSES AND KNOWLEDGE BASES AND INSTRUCTIONAL EXEMPLIFICATIONS FOR GERMAN

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I hereby certify that the work embodied in this thesis is the result of original research and has not been submitted for a higher degree to any other University or Institution.

(Signed) ____________________________
For my wife Veronika
and my daughter Milena.
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ABSTRACT

This thesis is placed in the context of the ongoing debate on the issue whether second language acquisition occurs on the basis of innate language-specific learning mechanisms or general learning mechanisms.

The author shares the view of scholars who propose that an innate knowledge base underlying first language acquisition does not extend to second language acquisition due to the lack of uniform success in the acquisition of native speaker competence, the possibility of fossilisation and the facilitative potential of form-focused instruction. It is, thus, assumed that the sequential second language acquisition process can be accounted for by general learning mechanisms.

The key to these learning mechanisms is, firstly, the investigation of the nature of the knowledge underlying the grammatical encoding procedures for speech production in the context of M. Pienemann’s (1998a) Processability Theory and, secondly, the investigation of the nature of its acquisition process.

Pienemann’s Processability Theory explains and predicts the sequential acquisition process of a second language as the result of the hierarchically ordered development of the processing procedures of the grammatical processor to grammatically encode conceptual information. It shares with Levelt’s (1989) theory of speech production the assumptions concerning the nature of the knowledge underlying the grammatical encoding procedures, which require further investigations for verification. Since the Processability Theory does not specify how the assumed knowledge underlying grammatical encoding is acquired, an investigation of the nature of its acquisition process is necessary.

This investigation highlights the interdependence between the nature of the knowledge to be acquired and the nature of its acquisition process by demonstrating that the knowledge underlying grammatical encoding is predominantly implicit and, consequently, determines the implicit nature of its acquisition process. Such implicit knowledge is dissociated from explicit knowledge, which determines the explicit nature of its acquisition process.

This investigation also demonstrates that explicit grammar teaching and practice in the context of the manipulation of the learners’ attentional orientation mediated by alertness may contribute to the implicit learning process under certain conditions. In conjunction with the provision of guidance by the Processability Theory in regard to the achievement of instructional focus and the independent finding that comprehensible input is needed in order for second language acquisition to occur, these results constitute the basis for the formulation of detailed instructional measures for the effective organisation of the sequential second language acquisition process.

These measures are exemplified by their implementation for the initial stages of the acquisition of German as a second language.
1. INTRODUCTION

Second language acquisition research increasingly focuses on theory construction by addressing the learnability problem (Pinker, 1984; Wexler and Culicover, 1980). This research is strongly influenced by proponents of Universal Grammar who hold that first and second language learning occurs on the basis of language-specific learning mechanisms. The learning mechanisms are manifested in Universal Grammar’s innate principles and parameters. They constrain the generation of logically possible grammatical options and, by interacting with positive input of a particular language, lead to the acquisition of this language.

There is wide acceptance for the position that human beings are endowed with an innate knowledge system (Universal Grammar – Principles and Parameters) (Chomsky, 1981, 1986) that uniformly permits children to attain full adult competence in their first language without explicit instruction or systematic error correction and without exposure to the full range of grammatical possibilities (Bley-Vroman, 1989, 1990; Clahsen, 1988a; Clahsen and Muysken, 1989; Eubank, 1991; Gregg, 1996; Meisel, 1991; Schachter, 1996; Sharwood-Smith, 1994; White, 1989, 1990, 1991a, 1996). However, there is ongoing debate on the issue whether or not second language learners have access to Universal Grammar (White, 1996). Currently, there is no agreement on this issue. There are opposing positions which maintain either that access to Universal Grammar is available to second language learners including adults, or that access to Universal Grammar is not available, at least not to adult second language learners. The former position (Flynn, 1987, 1991, 1996; White, 1989, 1990, 1991, 1996) assumes language domain-specific learning mechanisms. The proponents of the latter position (Bley-Vroman, 1989, 1990; Clahsen, 1988a; Clahsen and Muysken, 1989, Meisel, 1991), argue for general learning mechanisms.

The present author shares the view of the scholars who propose that an innate knowledge base underlying first language acquisition does not extend to second language acquisition due to the lack of uniform success in acquiring native speaker competence (Long, 1990a, 1990b), the possibility of fossilisation (Clahsen, Meisel and Pienemann, 1983; Pienemann, 1981) and the facilitative potential of form-focused instruction (Long, 1991, 1996).

Furthermore, recent research indicates that bilingual children do not
automatically acquire each language according to the sequence and general characteristics of the acquisition process of the first language. They may develop the minority language as the weaker language, which is then acquired according to the sequence and general characteristics of the acquisition process of the second language (Schlyter, 1993). This suggests that the lack of access to Universal Grammar is not restricted to adults, but may also apply to children. Therefore, the present author assumes that adults and children do not have access to Universal Grammar, unless they are ‘balanced’ bilinguals. He concurs with the above scholars that general learning mechanisms can account for the second language acquisition process.

It is in this context that M. Pienemann’s (1998a) Processability Theory becomes relevant.

Based on Levelt’s (1989) theory of oral language production, Pienemann’s Processability Theory is able to explain and predict the sequential acquisition process of a second language as the result of the hierarchically ordered development of the processing procedures of the grammatical processor to grammatically encode conceptual information. It provides a sound explanation of and predictive framework for sequential syntactical and morphological development, which is the manifestation of the sequential acquisition of the knowledge underlying the hierarchy of grammatical encoding procedures and marks the significant progress that has been made in understanding sequential second language acquisition for speech production.

Moreover, Pienemann’s Processability Theory addresses part of the ‘developmental problem’ (Felix, 1984) that any ‘transition theory’ of second language acquisition has to account for (Cummins, 1983; Gregg, 1996), namely, to identify the causes for the sequentiality of the acquisition of linguistic knowledge or competence underlying linguistic performance.

However, the Processability Theory leaves the second part of the ‘developmental problem’ unresolved since it does not specify how the assumed knowledge underlying the grammatical encoding procedures is acquired. Furthermore, Pienemann (1998a) deliberately refrains from relating the Processability Theory to a ‘property theory’ (Cummins, 1983; Gregg, 1996), which would explain the nature of the competence to be acquired, be it in the context of Universal
Grammar or a cognitive theory not based on innately specified knowledge.

It is in this context that the present author’s thesis is placed. It is assumed that the sequential second language acquisition process does not involve an innate knowledge base and that the knowledge constituting second language competence is acquired by non-language-specific general learning mechanisms.

The present author’s investigation aims, firstly, at establishing the learning mechanisms of the different types of knowledge, which constitute linguistic competence, thus, complementing the Processability Theory, secondly, at setting out a comprehensive framework for the development and implementation of instructional measures for the purpose of effectively organising the second language acquisition process, thirdly, at formulating specific instructional measures within that comprehensive framework and, fourthly, at exemplifying the implementation of these measures for the initial stages of the acquisition of German as a second language.

The starting points for this investigation are, on the one hand, the distinction made in the Processability Theory between implicit and explicit knowledge underlying the sequential acquisition of the processing procedures of the grammatical processor, manifested in the sequential syntactical and morphological development and, on the other hand, the processes that have been identified in SLA research as being closely linked to the second language acquisition process.

Pienemann’s (1998a) Processability Theory shares with Levelt's (1989) theory of speech production the assumptions concerning the nature of the knowledge, which forms the basis of the processing procedures of grammatical encoding, the assumed implicit, procedural knowledge stored in the grammatical processor and the assumed explicit knowledge of the lemma and form information of lexical entries stored in the mental lexicon.

However, the above assumptions require further investigations for verification.

Since the Processability Theory does not specify the nature of the acquisition process of the knowledge underlying grammatical encoding, recourse is made to recent SLA research with regard to processes, which may be critical for second language acquisition. These processes are the reception of positive,
comprehensible input and form-focused input as well as the production of output and form-focused output, as reflected in theoretical concepts, such as the ‘Input Hypothesis’, ‘Interaction Hypothesis’, ‘Output Hypothesis’ and the concept(s) of ‘Focus on Form(s)’.

A review of SLA research concerning the above concepts reveals the following: Unequivocal evidence with regard to the ‘Input Hypothesis’ suggests that the reception of comprehensible input is a necessary prerequisite for second language acquisition to take place, which is in line with the Processability Theory, demonstrating that input comprehensibility at the word level is crucial for the activation of the hierarchically ordered processing procedures in the course of grammatical encoding.

The other theoretical constructs that can be considered concepts for the facilitation of the second language acquisition process, mostly, do not explicitly specify the nature of the knowledge to be acquired and the nature of the respective acquisition processes. However, if such specifications are provided, insufficient evidence is given in their support.

In order to determine the contribution of the processes, reflected in the above theoretical concepts, to the second language acquisition process, the assumptions of the Processability Theory concerning the nature of the knowledge underlying grammatical encoding, shared with Levelt’s (1989) theory of speech production, have to be evaluated and the nature of its acquisition process has to be established.

As a consequence, the following hypotheses will be investigated:

1: The grammatical knowledge underlying speech production is predominantly implicit and is dissociated from explicit grammatical knowledge.

This hypothesis is based on the plausible assumption of the Processability Theory, shared with Levelt’s (1989) theory of speech production, that predominantly implicit knowledge underlies automatic grammatical encoding procedures, independent of intentions and awareness. This assumption is due to the time-constrained nature of speaking, but also recognises that the grammatical encoding processes depend on explicit meaning-based knowledge, which has to be
matched with the conceptual information to be conveyed orally. The confirmation of this hypothesis would significantly affect claims made by proponents of the concept of ‘Focus on Forms’ and the ‘Output Hypothesis’. The assumption of proponents of the concept ‘Focus on Forms’ with regard to the conversion of explicitly taught grammatical knowledge into implicit knowledge, given that learners are developmentally ready to acquire that knowledge, would be untenable since implicit knowledge is dissociated from explicit knowledge and cannot be converted into each other. The confirmation of this hypothesis would, therefore, render ineffective the instructional approach of explicitly teaching according to a structural syllabus.

The claim by proponents of the ‘Output Hypothesis’ that learners, who are explicitly ‘noticing a gap’ in their output, are able to close that gap by explicitly analysing their current ‘internal linguistic knowledge’, would be irreconcilable with a predominantly implicit knowledge base underlying speech production since it cannot be analysed explicitly.

2: The sequential acquisition process of the grammatical knowledge underlying speech production is a predominantly implicit learning process operating in particular conditions and is dissociated from explicit learning processes. This hypothesis is deduced from Hypothesis 1. It is argued that, if the dissociation between knowledge of an implicit nature, predominantly underlying speech production, and knowledge of an explicit nature is confirmed, then the acquisition process leading to predominantly implicit knowledge is necessarily dissociated from explicit learning processes and has to operate in particular conditions avoiding the engagement of explicit learning processes. The confirmation of this hypothesis would define the learning conditions that have to be operative in order for implicit learning to occur and, thus, would have a profound effect on an instructional approach aiming at achieving an effective organisation of the second language acquisition process.

3: The explicit grammatical knowledge that may be gained during learning processes can contribute to the implicit learning process under certain conditions.
This hypothesis is motivated by research evidence showing that the instructional application of the ‘Focus on Form’ concept, which may involve explicit grammar teaching, does not unequivocally lead to a facilitation of the second language acquisition process, suggesting that the conditions under which explicit grammatical knowledge can contribute to the acquisition of implicit grammatical knowledge are still to be established. The confirmation of this hypothesis would define such conditions and, subsequently, would strengthen the effectiveness of the concept of ‘Focus on Form’ as an instructional concept.

4: Practice promotes the further acquisition of implicit grammatical knowledge, only, in conjunction with phases of implicit learning. This hypothesis is motivated by research on the concept of ‘Negotiation for Meaning’ within the conceptual framework of the ‘Interaction Hypothesis’, suggesting that the application of this concept provides a rich source of grammatical input for implicit learning and of practice. However, since no distinction is made between learning phases and practice phases, the potential contribution of practice to implicit learning remains unspecified. The confirmation of this hypothesis would distinguish phases of implicit learning from practice phases and would define the contribution of practice to such implicit learning, thus, strengthening the effectiveness of ‘Negotiation for Meaning’ as an instructional concept.

5: The allocation of attentional resources is a necessary condition for implicit learning to occur and must not involve awareness. This hypothesis, firstly, is motivated by pervasive claims made by proponents of the ‘Interaction Hypothesis’, ‘Output Hypothesis’ and of the concept(s) of ‘Focus on Form(s)’ that attention to grammatical information in the input is a necessary prerequisite for acquisition of grammatical knowledge to occur. Secondly, the hypothesis is based on the deductive argument that, in order to achieve the acquisition of predominantly implicit grammatical knowledge, the respective learning process must be implicit, and, consequently, the allocation of
attentional resources must exclude awareness.

The confirmation of the second part of this hypothesis, requiring the confirmation of the first part of this hypothesis, would significantly affect claims made by proponents of the concept of ‘Focus on Form’ and the ‘Output Hypothesis’.

The range of options to focus the attention of the learners on what has to be acquired would be restricted, excluding the application of metalinguistic measures as part of the ‘Focus on Form’ concept, since such explicit direction of the learners’ attention towards particular grammatical information in the input would engage explicit learning processes and awareness. The confirmation of this hypothesis would, therefore, render metalinguistic measures ineffective in regard to the necessary acquisition of implicit knowledge for spontaneous speech production.

Also, the claim by proponents of the ‘Output Hypothesis’ that the ‘noticing of a gap’ by learners in their output will explicitly direct their attention towards input in order to fill the gap is irreconcilable with implicit learning since such explicit direction of attention engages awareness and explicit learning processes.

The confirmation or disconfirmation of the above hypotheses in conjunction with the Processability Theory’s provision of guidance in regard to the achievement of instructional focus as far as processable input is concerned and the confirmation of the need for comprehensible input will constitute the basis for the determination of implications for instruction, formulated as instructional measures and measures in their support to effectively organise the sequential second language acquisition process.

These measures will be exemplified by their implementation for the initial stages of the acquisition of German as a second language.

2. SEQUENTIAL SECOND LANGUAGE ACQUISITION FOR SPEECH PRODUCTION AND INSTRUCTIONAL CONCEPTS IN ITS SUPPORT

2.1 Sequential second language acquisition
Second language acquisition research carried out by researchers from Germany in the 70’s and 80’s marks a principally new approach to understanding the principles of regular, sequential second language development and variation in speech production and, thus, provides the basis for new insights in regard to the constraints affecting instructional concepts aiming at facilitating the acquisition process.


The stages of word order development concerning main clauses (up to Stage X+3) and subordinate clauses (Stage X+4) are as follows:

Stage X-1: Single Words (No word order phenomena evident).
At this stage, utterances mainly consisting of verb or noun are target-like and non-target-like applications of single-word ellipses, but also consist of formulae, that is, utterances made up of unanalysed structures that are acquired whole.

Stage X: Canonical Order (SVO - Subject, Verb, Object).
Preverbal Placement Of Negator (NEG+V).
Based on the evidence from the cross-sectional and longitudinal studies of the ZISA research group, Clahsen (1984,1985) concludes that at stage X and at stage X + 1 the negator is variably placed pre- or postverbally. Meisel (1997) reviewing the acquisition of negation in German (cf. Clahsen, 1984; Clahsen, Meisel and Pienemann, 1983) concurs that preverbal and postverbal placement of the negator occurs at stage X and at stage X+1, the preverbal placement being much more prevalent.
However, learners’ negation occurs only with a small group of verbs, such as ‘wissen’ (to know), ‘sprechen’ (to speak), ‘können’ (to be able), ‘arbeiten’ (to work), ‘interessieren’ (to be interested), leading Meisel (1997) to suggest “that many occurrences are instances of rote learned forms” (p.248). Meisel’s (1997) reported observations, thus, suggest that postverbal placements of the negator are formulaic applications, whereas preverbal placements of the negator seem to be mappings of conceptual structure onto surface form, as Meisel (1997) points out that “…the NEG+X strategy does not fade out completely, not even during later phases” (p.250), which suggests that preverbal placements of the negator may be using “…linear sequencing strategies which apply to surface strings” (p.258).

Hence, it seems plausible to accept Clahsen’s (1988b) revision of the acquisitional sequence of negation, supported by confirming data from von Stutterheim (1987), distinguishing preverbal negation at stage X and stage X+1 and postverbal negation at stage X+2.

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<tr>
<th>Stage</th>
<th>Category</th>
<th>Description</th>
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<tr>
<td>X+1</td>
<td>Adverb Preposing (ADV – Optional rule: Adverbs and Adverbial Prepositional Phrases in clause-initial position).</td>
<td>At this stage, sentences with ADV are deviant, since obligatory Inversion has not been acquired yet. (see stage X+3).</td>
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<tr>
<td>X+2</td>
<td>Preverbal Placement of Negator (NEG+V) (see stage X).</td>
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<td></td>
<td>Verb Separation (SEP/PARTICLE – Obligatory rule: Non-finite part of complex verbal groups and verbs with separable prefix in clause-final position).</td>
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Postverbal Placement of Negator (V+NEG) (see stage X).

Stage X+3

Inversion (INV–Obligatory rule: Subject follows immediately after the finite verb in cases of preposed complements and interrogatives).

Negator In Clause-Final Position (NEG-END – Obligatory rule of propositional negation: Negator in clause-final position with the exceptions of adverbs, adverbial prepositional phrases, non-finite part of complex verbal groups and verbs with separable prefix as well as finite verbs in subordinate clauses that are placed after the negator) (cf. Clahsen, 1985, 1988b).

The Optional Placement Of Adverbs And Adverbial Prepositional Phrases In Sentence-Internal Position Between The Finite Verb And The Object (ADV-VP).

It is not upheld as a separate stage on the basis of Clahsen’s (1984) longitudinal study of the acquisition of German as a second language by Italian, Portuguese and Spanish workers in Germany. However, longitudinal and cross-sectional studies by the ZISA research group (cf. Clahsen, 1984; Clahsen, Meisel and Pienemann, 1983) as well as Pienemann’s (1984) study of ten Italian school children of migrant workers in Germany receiving instruction in German as a second language provide some indirect evidence that ADV–VP is acquired at stage X+3.

Stage X+4

Verb-End (V-End – Obligatory rule: Finite verb in subordinate clause-final position).

The workers on the ZISA project explain the acquisitional sequence on the basis of a sentence processing model (cf. Bever, 1970; Bever and Townsend,
that distinguishes between two processing systems, a grammatical processor (task-specific) and a general problem-solving component (GPS) (non-task-specific) applying a set of processing strategies that represent a hierarchy of processing complexity (cf. Clahsen, 1984; Pienemann, 1984).

In the context of Clahsen’s (1984) view that information processing systems are limited capacity systems, processing strategies compared to operations of the grammatical processor represent processing options for the learner that reduce his/her processing demand and consequently lead the learner to “…first produce structures which conform to these strategies” (Pienemann, 1984, p.199).

Since the processing strategies represent a hierarchy of processing complexity, structures that require the least processing capacity will be acquired first and structures that require the most processing capacity will be acquired late. Clahsen (1984) distinguishes three strategies:

The first strategy, Canonical Order Strategy (COS), is defined in reference to research on sentence comprehension and production of (cf. Fodor, Bever and Garrett, 1974; Osgood and Bock, 1977; Kempen, 1977; Slobin, 1973). Clahsen predicts that at the lowest level of processing complexity second language learners will directly map underlying structures onto surface form, thus, avoiding any interruptions of the linguistic units of the underlying structures, ie. the strict use of SVO word order (SVO) and the pre- or postverbal placement of the negator (NEG+V), as evidenced in the above studies, are in harmony with COS. They are acquired first.

The second strategy, Initialisation/Finalisation Strategy (IFS), is defined in reference to research on perception and memorisation (cf. Neisser, 1967; Slobin, 1973). Clahsen (1984) predicts that at the next level of processing complexity second language learners will first opt for permutations moving constituents into perceptually salient clause-initial or clause-final positions before moving constituents into perceptually less salient clause-internal positions, i.e. ADV, TOPI I (topicalisation of object-noun phrases, SEP/PARTICLE and NEG-END occur earlier than INVERSION and ADV-VP.

The third strategy, Subordinate Clause Strategy (SCS), is defined in reference to suggestions advanced by Bever and Townsend (1979) and Givon (1979) that
subordinate clauses are different from main clauses in regard to processing. Clahsen (1984) predicts that only after second language learners have acquired the word order rules that apply in the main clause will they acquire word order rules that apply only in the subordinate clause, i.e. V-END will be acquired after INVERSION and ADV-VP in main clauses have been acquired.

Hence, developmental stages in the acquisition of word order rules are defined by the inherent implicational hierarchy of processing complexity represented by this set of processing strategies and, thus, predict the order in which structures are acquired. (cf. Clahsen, 1984). These predictions are confirmed by findings obtained from longitudinal and cross-sectional studies by the ZISA research group (Clahsen, 1984; Clahsen, Meisel and Pienemann, 1983; Pienemann, 1981) for German as a second language acquired in natural settings by children and adults.

During the 80’s Pienemann and his associates revise and extend the above outlined explanatory approach by proposing a ‘Predictive Framework for SLA’ (cf. Pienemann, 1987; Pienemann and Johnston, 1987; Pienemann, Johnston and Brindly, 1988) applying to word order phenomena as well as to morphological phenomena acquired in any second language. This approach replaces the mechanism of gradually shedding hierarchically ordered processing strategies that constrain particular transformations with the concept of transfer of grammatical information constrained by the gradual organisation of lexical items into grammatical categories and, thus, the gradual development of phrase structure accessibility. Pienemann et al. (1988) point out that as long as

“…the lexical material has not been organized into categories, phrase structure rules are not accessible to the learner. Thus, the learner would not be able to identify elements within the sentence from which information has to be taken or to which information has to be brought” (p.224-25).

Furthermore, due to the constraints on the accessibility of phrase structure, learners have to rely on ‘nonlinguistic processing devices’, such as the transfer of grammatical information “…on the basis of non-language-specific position
markers, that is, the saliency of initial and final positions” (Pienemann et al. 1988, p.224-25).

Hence, Pienemann et al. (1988) predict the following stages of second language acquisition concerning word order and morphology:

The first stage is characterised by an absence of information transfer. At this stage, only single words appear, apart from formulae, i.e. there is an absence of word order phenomena and morphological development.

The second stage, again, is characterised by an absence of information transfer. At this stage canonical word order appears, representing mapping of underlying structures onto surface form, but morphological development is still not occurring.

At the third stage, information transfer occurs on the basis of “…the saliency of initial and final positions” (p.225) of elements. There is still an absence of morphological development.

At the fourth stage, information transfer occurs from elements in internal positions, identified on the basis of their grammatical categories, to elements in initial and final positions, identified on the basis of their saliency. Local (phrasal) morphemes can be inserted at this stage.

The fifth and last stage is characterised by unconstrained transfer of grammatical information between elements, solely based on the identification of their grammatical categories. Non-local (non-phrasal) morphemes can be inserted at this stage.

Pienemann et al. (1988) point out that the above predictions concerning the stages of morphological development as well as the predictions concerning the stages of syntactical development, such as the stages of word order development in German as a second language, as outlined above on the basis of the findings from the studies of the ZISA research group, are supported by considerable evidence:

“These claims about the accessibility of phrase structure are based on a distributional analysis of a large set of longitudinal data on ESL and GSL development. The predictions made by this framework were borne out in the analysis of a wide range of phenomena in syntax and morphology in the same set of

The generalisation of the sequential character of second language acquisition, inherent in the ‘Predictive Framework for SLA, concurs with Long’s (1991) conclusion:

“With minor variations, the evidence to date suggests that the same developmental sequences are observed in the IL’s (Interlanguages, D.P.H.) of children, adults, of naturalistic, instructed and mixed learners, of learners from different LI backgrounds” (p.6).

Hence, the ‘Predictive Framework for SLA’ constitutes a fundamental revision and important extension of the ‘strategies approach’ (cf. Clahsen, 1984) in that it assumes a gradual development process in regard to the acquisition of grammatical categories of learned lexical items and overcomes the limitations of the ‘strategies approach’ (which only applies to word order phenomena) by introducing the concept of transfer of grammatical information. Subsequently, the ‘Predictive Framework for SLA’ becomes the precursor to Pienemann’s (1998a) Processability Theory. The Processability Theory constitutes a theory that, apart from its explanatory and predictive power in regard to syntactical and morphological development in typologically different languages, provides considerable explanatory detail concerning the sequential grammatical acquisition process and, thus, allows for significant instructional focus in regard to the provision of processable input furthering learners’ acquisition process at their current stage of development as well as at their next stage of syntactical and morphological development.

2.2 Processability Theory:
The development of grammatical encoding procedures

Pienemann’s (1998a) Processability Theory explicates the development of language processing in the learner. The theory logically assumes that one can
only entertain structural hypotheses that one can process. Hence, by determining the development of grammatical processing procedures, predictions can be made as to the structural options available to the learner at a particular point in that development. The Processability Theory is based on Levelt’s (1989) theory of oral language production of mature native speakers which in terms of the grammatical processor is largely based on Kempen and Hoenkamp’s (1987) ‘Incremental Procedural Grammar for Sentence Formulation’.

Levelt’s theory describes the speech production processes of mature native speakers from conceptualisation to articulation and assumes the following major processing components and knowledge stores. In order to express particular intentions, taking into account the discourse record, the ‘Conceptualiser’ draws on declarative knowledge, such as knowledge about the world, situational knowledge and knowledge of current discourse, held in a declarative knowledge store, as well as on procedural knowledge to build assertions of propositions that is part of the ‘Conceptualiser’ itself. The ‘Conceptualiser’ generates ‘preverbal messages’ as input to the ‘Formulator’ and allows for the monitoring and correcting of ‘preverbal messages’.

The ‘Formulator’ grammatically and phonologically encodes ‘preverbal messages’ based on procedural knowledge stored in the ‘Formulator’. Operations of the ‘Formulator’ depend on the availability of information stored in the mental lexicon which Levelt (1989) describes as “…a repository of declarative knowledge about the words” (p.182) of a speaker’s language, comprising at least each lexical entry’s lemma and form information, that is, each lexical entry’s meaning and syntactical specification as well as its morphological and phonological specification.

As Frauenfelder and Tyler (1987) pointedly note, there is “…development of grammatical theories which attribute considerable structural information to the lexicon (e.g. Bresnan, 1978)” (p.2). And this development subsequently affects theories of grammatical encoding, such as Kempen and Hoenkamp’s (1987) lexically driven ‘Incremental Procedural Grammar’ that forms the basis of Levelt’s (1989) grammatical processor, which he considers the “…natural companion to Bresnan’s Lexical Functional Grammar” (p.235), (cf.
Bresnan, 1982; Kaplan and Bresnan, 1982), as well as Levelt’s (1989) theory of phonological encoding.

Grammatical encoding involves automatically accessing lemmas of lexical entries, leading to the activation of syntactic building procedures and, subsequently, to the generation of ‘surface structure’ fragments. Phonological encoding begins as soon as ‘surface structure’ fragments become available. However, ‘surface structure’ fragments can temporarily be stored in the ‘Syntactic Buffer’ if there is an asynchronism regarding the availability of ‘surface structure’ and phonological encoding procedures.

Phonological encoding involves automatically accessing the ‘lexical form’ of lexical entries, activating procedures that “…retrieve or build a phonetic or articulatory plan for each lemma and for the utterance as a whole” (Levelt, 1989, p.12). This ‘internal speech’ constitutes the input for the ‘Articulator’ generating ‘overt speech’. ‘Internal speech’ can temporarily be stored in the ‘Articulatory Buffer’ if the generation of ‘internal speech’ and articulation are not synchronous.

‘Overt speech’ is received by the ‘Audition’ component that is connected to the ‘Speech-Comprehension System’. ‘Internal speech’ as well as ‘overt speech’ can be monitored by the ‘Conceptualiser’ through parsing by the ‘Speech-Comprehension System’ (cf. Levelt, 1989, 1993) which has access to the lexical entries in the mental lexicon, an assumed declarative knowledge store holding the semantic, syntactic, morphological and phonological information of each lexical entry.Parsed ‘internal speech’ and ‘overt speech’ can be represented in Working Memory and, thus, can be attended to, i.e. monitored by the ‘Conceptualiser’ (cf. Levelt, 1983).

Levelt’s theory of speech production is a psychologically plausible theory since it accounts for the time-constrained nature of speaking by assuming (i) that processing components are relatively autonomous processors, i.e. each processor operates in parallel, “…largely without further interference or feedback from other components” (Levelt, 1989, p.27), (ii) that the grammatical processor and the ‘Articulator’ operate largely automatically, i.e. their operations “…are speedy and reflex-like, require very little attention, and can proceed in parallel” (Levelt, 1989, p.28), and (iii) that processing occurs incrementally, i.e. fragments of characteristic input are processed in parallel, whereby “…the speaker is able
to build up a syntactically coherent utterance out of a series of syntactic fragments each rendering a new part of the meaning content” (Kempen and Hoenkamp, 1987, p.201).

Levett (1989) points out that incremental speech processing necessitates the availability of appropriate memory stores that have the capacity to hold fragments of characteristic input. He proposes that fragments of ‘preverbal messages’ generated by the ‘Conceptualiser’ as well as ‘internal’ and ‘overt speech’ monitored by the monitoring component of the ‘Conceptualiser’ in conjunction with the ‘Speech Comprehension System’ can be represented in Working Memory (cf. Baddeley, 1986, 1990), operating under executive control involving highly controlled processing requiring attention and awareness10. Fragments of ‘surface structure’, on the other hand, are stored in the ‘Syntactic Buffer’ and fragments of internal speech are stored in the ‘Articulatory Buffer’, all of which are highly task-specific, short-term memory stores that are part of the grammatical processor that “…is not subject to central control, (i.e.) its functioning is automatic” (Levett, 1989, p.20).11

Levett’s (1989) assumptions about different knowledge sources underlying the overall architecture of speech production, but in particular his assumptions about the procedural knowledge stored in the ‘Formulator’s’ grammatical processor and the declarative knowledge of lexical entries stored in the mental lexicon will be evaluated below in the context of Pienemann’s (1998a) Processability Theory and recent advances in cognitive and neuro-psychological research on distinct kinds of memory, knowledge and knowledge acquisition, in order to arrive at an understanding of the nature of acquisition processes of the kinds of knowledge instrumental in the development of grammatical encoding capabilities. It will be demonstrated that procedural knowledge, for instance, to grammatically encode ‘preverbal messages’, as a kind of implicit, nondeclarative knowledge is well supported by observed dissociations between implicit, nondeclarative knowledge and explicit, declarative knowledge. However, Levett’s assumption of the mental lexicon being a store of purely declarative knowledge will have to be revised, leading to a more differentiated view concerning the implicitness or explicitness of the knowledge segments making up the lexical entries.

Since “The architecture of human language processing […] forms the
basis for Processability Theory” (Pienemann, 1998a, p.1), it takes as its point of departure the architecture of the grammatical processor, that is, the ‘Grammatical Encoder’ of Levelt’s (1989) ‘Formulator’ as well as the mental lexicon. Levelt (1989) outlines the interplay between the ‘Formulator’ and the mental lexicon by describing the major processes involved in generating a sentence. He assumes that grammatical and phonological encoding operations are lexically driven, that is, he considers the mental lexicon “…an essential mediator between conceptualization and grammatical and phonological encoding” (p.181) in that ‘preverbal messages’ are matched with meaning specifications of lexical entries, leading to the selection of particular lexical entries that then make available their syntactic, morphological and phonological specifications which, subsequently, activate respective encoding processes of the ‘Formulator’. Grammatical encoding draws on each lexical entry’s lemma information (cf. Kempen and Huijbers, 1983), that is, its meaning and syntactic specifications, whereby the meaning specifications entail the lexical entry’s conceptual specification and its conceptual arguments. For example, the conceptual specification of ‘sparrow’ is: “…sparrow is a special kind of bird” (Levelt, 1989, p.11) and the conceptual arguments of ‘give’ are: “…some actor X causing some possession Y to go from actor X to recipient Z” (Levelt, 1989, p.11). Once the ‘preverbal message’ is matched with the meaning specification of a lexical entry, its syntactic specifications become available. The syntactic specifications entail the lexical entry’s syntactic category (e.g. noun, verb etc.) and its grammatical functions (e.g. subject, direct object etc.) as well as its lexical pointer (address) to the word form information and its diacritic parameters, (e.g. tense, aspect, mood, person, number, case etc.) connecting it with the phonological encoding process, drawing on each lexical entry’s morphological and phonological specifications. That is, through the lemma information of a lexical entry, its morphological specifications are accessed, entailing its morphological structure (e.g. a stem and a suffix) and its metrical pattern\(^{12}\) including syllabic peaks. Through the morphological specifications, the lexical entry’s syllables and segmented composition are accessed, making up the phonological specifications. The segmental composition is made up of each word’s sequence of syllables, whereby each syllable consists of syllable constituents\(^{13}\) which provide the
basis for the generation of a phonetic plan\textsuperscript{14} (‘internal speech’) to be executed by the ‘Articulator’.

Although Levelt (1989) points out that lexical entries’ form information, consisting of morphological and phonological specifications, is not directly relevant to the grammatical encoding processes, this knowledge is crucial for the sequential morphological development in that it builds up the respective links to the lemma information via its addresses or ‘lexical pointers’ and ‘diacritic parameters’ and provides the essential processing resources for incremental ‘phonological’ (morphological and phonological) encoding processes occurring in parallel to incremental ‘grammatical’ (syntactical) encoding processes. Hence, the acquisition of morphological word form information will be considered in the context of the grammatical encoding process.

The Processability Theory assumes that the nature of the grammatical processor does not change across distinctly different learners, such as children and adults, and languages learned, such as primary or secondary languages, based on Pienemann’s (1998a) demonstration that the same set of hierarchically ordered processing procedures of the grammatical processor, outlined below, when implemented into a psychologically plausible theory of grammar (Lexical-Functional Grammar), predicts the sequential acquisition of, for instance, German, English, Japanese and Swedish as second languages as well as of, for instance, German as a first language.\textsuperscript{15} However, the language-specific processing resources that are available to the native speaker of a particular language have to be reconstructed when learning a second language in order to acquire the grammar of that language.

The plausibility of this assumption by Pienemann (1998a) becomes apparent when considering his elaboration on the language-specificity of particular processing resources below, but is also supported by strong arguments for the development of differentiated language systems in bilinguals by Genesee (1988) and Meisel (1989) and supportive evidence from a study of bilingual language development of eight children by Meisel (1985, 1986, 1989). Genesee (1988) re-examines several language samples of oral interactions between bilingual children (age range:1;10 to 2;5) and their parents
from studies by Murrell (1966), Redlinger and Park (1980) and by Volterra and Taeschner (1978). By taking into account whole discourse samples, Genesee argues that observed language mixing does not support the hypothesis of a unitary language system in the early phases of bilingual language development since the language samples can be interpreted as

“…evidence that the children use items from their two languages differentially as a function of context” (Genesee, 1988, p.72).

Meisel (1989), referring in particular to Volterra and Taeschner’s (1978) three-stage model of language development in bilingual children, concludes that the empirical evidence adduced by Volterra and Taeschner rather suggests “…that social-psychological factors may lead to language mixing or code-switching” and does not “…represent convincing evidence in favor of an early phase of mixing through which all children would have to go” (p.17). Furthermore, Meisel (1989) reports a study of the acquisition of French and German by two children, out of a total of eight children investigated, over a period of three years (from age 1;0 until age 4;0) that provides strong evidence for the separation of the two simultaneously acquired grammatical systems from the beginning.

In this case of ‘balanced’ bilingual development both children “…acquire each of the two languages very much like monolingual children (Meisel, 1989, p.31). Meisel (1989) reports:

“…I have shown that bilingual children consistently use different word order in both languages no later than with the appearance of two – or more – word utterances. At about the same time, they begin to mark for case (see Meisel, 1986) and they also start using verb inflection to encode grammatical person, number and tense (see Meisel, 1985). In doing so, they use what may be reasonably be labeled syntactic subjects, and whenever a subject is supplied, the verb agrees with it in person and usually also in number” (p.36).

Grammatical encoding processes begin as soon as fragments of the ‘preverbal
message’ are received by the ‘Formulator’ in that the grammatical processor accesses lemmas of lexical entries whose semantic properties match the preverbal message. The lemmas’ syntactic information will then “…call specialized syntactic procedures16 in some orderly fashion, so as to produce a unified surface structure as eventual output” (Levelt, 1989, p.236).

Exemplified for the surface structure ‘the child’ as part of the sentence ‘the child gave the mother the cat’ to be generated, the following procedures are necessary to grammatically encode the conceptual message fragment ‘CHILD’ received from the Conceptualiser:

First, as soon as the ‘preverbal message’ fragment is received by the ‘Formulator’s’ grammatical processor, the lemma of a lexical entry into the mental lexicon is retrieved whose conceptual specification match the concept ‘CHILD’.

Second, the retrieval of the lemma ‘child’ makes available its syntactic specifications and the syntactic category noun (N) calls a categorial procedure to build a phrasal category, that is, a noun phrase (NP) categorial procedure that builds a NP in which N is the head.

Third, the NP categorial procedure assigns the head function to the noun ‘child’ and inspects the conceptual ‘preverbal message’ ‘CHILD’ for further specifications, such as determiners, quantifiers and complements and, subsequently, calls a subroutine DET in order to generate a definite determiner, based on the appropriate ‘Functorisation Rule’17. DET, in turn, calls the lemma ‘the’.18 Furthermore, the NP categorial procedure inspects relevant head-of-phrase lemma information. Firstly, the inspection of the conceptual specification of the lemma ‘child’ reveals that it is a count noun, which in turn leads to the inspection of its diacritic parameter ‘number’ and results in the return of the value ‘singular’ to the NP. Secondly, the inspection of the lemma’s syntactic specifications reveals that its syntactic category is noun (N), which in turn leads to the inspection of its diacritic parameter ‘person’ and results in the return of the value ‘third person’.

Fourth, once the values of the NP categorial procedure and subprocedures are returned, the NP categorial procedure decides the grammatical function of the NP built, based on a ‘preferential destination order’ for each categorial
procedure\textsuperscript{19} called ‘Appointment Rules’ by Kempen and Hoenkamp (1987). The grammatical function is subject of S\textsuperscript{20}, the higher-order categorial procedure specialised in building sentences.

Fifth, the categorial procedure S is called by NPsubj and is accepted as its subject by S.

Sixth, the categorial procedure S inspects the conceptual ‘preverbal message’ fragment for a mood marker. Since the unmarked mood is assumed to be ‘declarative’ and no marker is available\textsuperscript{21}, the appropriate ‘Word Order Rule’ determines the position in the holder of the S procedure which is made up of several slots that will eventually store the surface structure ‘the child gave the mother the cat’.

These grammatical encoding processes generating ‘surface structure’ constitute the basis for Pienemann’s (1998a) proposition of a ‘hierarchy of processing procedures’\textsuperscript{22} that have to be constructed by language learners. Beginning from the lowest level, the hierarchy consists of:

(i) Word/Lemma Access, i.e. only if a word has been entered into the mental lexicon, can its conceptual specification be accessed and its syntactic category be assigned,

(ii) Category Procedure (lexical category), i.e. the assignment of a syntactic category to a lexical entry is the prerequisite for a Category Procedure to be called, constituting “…a building instruction for the phrasal category” in which N, V, A “…can fulfil the function of head” (Levelt, 1989, p.238),

(iii) Phrasal Procedure (head), i.e. the assignment of a syntactic category to the head of the phrase is the prerequisite for a Phrasal procedure to be called that “…inspects the message for conceptual material that can fill its obligatory or optional complements and specifiers […] can provide values for diacritic parameters […] can also inspect the message for relevant head-of-phrase information”, and can call “…functional procedures for handling all the complements, specifiers, and parameter values it has found” (Levelt, 1989, p.238)\textsuperscript{23}. All together, the results from these subprocedures in conjunction with a set of Functorisation Rules lead to the generation of a phrase structure, i.e. only after the values of the Phrasal Procedure have been returned, can the grammatical function of the
phrase be determined by a set of Appointment Rules defining functional destinations,

(iv) S-Procedure, i.e. only as soon as the function of the phrase is assigned, can the phrase call the S-procedure “…which is a specialist in building sentences” (Levelt, 1989, p.240) and can the phrase “…be attached to the S-node and sentential information be stored in the S-holder” (Pienemann, 1998a, p.80). The S-Procedure, receiving subtrees as values from the subprocedures, combines these subtrees into a single, grammatical clause by depositing these subtrees into ‘slots’ of ‘holders’ which “…are chosen on the basis of a set of Word Order Rules” (Kempen and Hoenkamp, 1987, p.221), and

(v) S’-Procedure, i.e. in order to process subordinate clauses further elements – ‘Lemma Functions’ – are necessary “…to refine the list of procedure calls contained in the lemma” since “…standard Appointment Rules...fail to apply” (Kempen and Hoenkamp, 1987, p.225).

However, the grammatical encoding procedures and their underlying resources, such as the grammatical information stored in the mental lexicon, are typically language-specific and, thus, have to be constructed in order to acquire the grammar of a particular primary or secondary language.

Referring to de Bot’s (1992) bilingual speech production model, based on Levelt’s (1989) monolingual speech production model, Pienemann (1998a) acknowledges de Bot’s (1992) conclusion derived from Paradis’ (1987) hypothesis concerning the coherence between the linguistic distance between two languages and the separate or shared storage of linguistic knowledge. That is, in cases of closely related languages, the bilingual speaker may use encoding procedures and lexical knowledge of his L1 for L2 speech production.

Nevertheless, Pienemann (1998a) stresses

“...that such L1 transfer always occurs as part of the overall reconstruction process. Any other type of transfer of L1 procedures would not be in tune with the intermediate L2 procedures constructed at that point and would therefore be unable to feed into the processor” (p.81-82).
He points out that in cases where no close relationship between L1 and L2 exists, language-specific processing resources have to be acquired. These may include:

(i) the syntactic category, the grammatical functions as well as the diacritic parameters of each lexical entry in the mental lexicon, all of which may vary from language to language,

(ii) the syntactic procedures and their holders storing language-specific values returned from subprocedures which may differ between languages, since particular phrasal categories may not exist or the Word Order Rules may differ, thus, rendering the existing Phrasal Procedure(s) inoperable, or in case of the S-Procedure, rendering the storage of the values returned from subprocedures on the basis of existing Word Order Rules an impossible task,

(iii) the Functorisation Rules of inserting functors, that is, function words such as articles, prepositions etc. that are morphemes with word status as well as inflectional morphemes which may differ considerably between languages, as a brief comparison of the German and English determiner system (definite article) by Pienemann (1998a) demonstrates,

(iv) the Appointment Rules defining functional destinations of phrases which may be different to the first language, and

(v) the Word Order Rules which, again, may vary considerably from language to language.

Furthermore, as Pienemann (1998a) points out, even if processing resources of the L2, such as diacritic parameters, for example, are partly compatible with diacritic parameters of the L1,

“...there is no obvious a priori way for the learner to know this [...] Unless the learner simply limits herself or himself to the L1 Formulator, thus not acquiring the L2, there is no other obvious choice than to re-construct the set of diacritic features specific to the L2” (p.81).

If a language-specific processing resource is not constructed, learners will
revert to direct mappings of conceptual structures, generated by the ‘Conceptualiser’, onto surface form, dependent on the availability of lemmas matching the meaning of the preverbal message.

This is exactly what occurs, for instance, in German as a second language before the processing resources ‘Appointment Rules’ and ‘S-Procedure’ are available to second language learners. They revert to a strictly serial word order to map semantics onto surface form up to and including Stage X+1 (ADV). (For a detailed account of stages of word order development of German as a second language, see chapter 2.1).

Hence, the grammatical processor of the ‘Formulator’ for the first language, typically, is not capable to serve as the grammatical processor for a second language.

There is considerable evidence supporting this claim. For instance, Clahsen, Meisel and Pienemann (1983) report that their subjects from a Romance language background have pronounced difficulties with the German word order rule INVERSION although it is a word order rule occurring in Romance languages as well. Similar problems in the acquisition of German as a second language by Swedish learners are revealed in Håkansson’s (1996) study reported by Pienemann (1998a). In spite of the similarity between Swedish and German in regard to the structural contexts requiring INVERSION, “…Håkansson’s subjects had to learn it and continued to have problems with it for a long time” (Pienemann, 1998a, p.82).

Furthermore, Clahsen and Muysken’s (1983) comparative study of the acquisition of German as a second language by learners with a Romance language background and Turkish learners reveals the obvious incompatibility of first and second language grammatical processors. Clahsen (1985) reports pertinent findings from the above study concerning the Turkish learners. Although the rule of placing finite verbs into subordinate clause-final position is obligatory in German and Turkish, Turkish learners of German have considerable difficulty in acquiring this rule, as evidenced in their continued use of verb-second patterns in subordinate clauses.

The above outlined hierarchy of processing procedures constitutes a
hierarchy of accessibility to their processing resources, which is captured by the gradual reduction of constraints on necessary exchanges of grammatical information, in line with the development of the language-specific processing procedures.

Furthermore, Pienemann (1998a) complements the principle of grammatical information exchange by the cognitive principle of perceptual salience whereby clause-initial and clause-final positions can be identified solely based on their salience.26 Subsequently, Pienemann (1998a) identifies five major stages, including one intermediate stage in the development of the grammatical processor, that reflect the gradual reduction of constraints on the exchange of grammatical information.

The first stage in the development of the grammatical processor is characterised by the entry of lexical items into the mental lexicon in the absence of language-specific syntactic procedures and of an assignment of syntactic categories to these lexical entries. That is, neither the lexical categorical procedure (‘Category Procedure’) nor any subsequent procedures can be called. Pienemann (1998a) points out:

“…that the L2 learner is initially unable to deposit information into syntactic procedures, because (1) the lexicon is not fully annotated and more importantly (2) because even if the L1 annotation was transferred, the syntactic procedures have not specialised to hold the specific L2 syntactic information” (p.76).27

Hence, in order to speak, second language learners have to map conceptual structures onto single words and/or formulae. The second stage is characterised by the development of the Category Procedure, once syntactic categories have been assigned to lexical entries. Since the Phrasal Procedure is not yet available, no phrase structures can be generated and, thus, no inter-phrasal exchange of grammatical information can occur. Subsequently, second language learners revert to mapping conceptual structures directly onto surface structure. Pienemann (1998a) describes the learners’ option of circumventing the lack of procedural resources:
“One such procedure for the mapping of semantic roles onto surface form is a strictly serial word order – similar to the NVN sequence discussed by Bever (1970) […] In its simplest form, all this procedure requires is the identification of lexical categories” (p.84).

Hence, stage X of the developmental sequence of the acquisition of German word order rules, being described above as the acquisition of the SVO word order rule, is in actual fact the acquisition of the processing resources – grammatical categories of words – permitting the production of N V N serial word order sequences, representing the mapping of conceptual structures, onto sequences of words, representing particular syntactic categories – nouns and verbs – but not the construction of sentences based on the assignment of grammatical functions to particular words.

However, ‘lexical morphemes’ can be produced since they do not involve the exchange of grammatical information between constituents, given that the respective morphological forms have been entered into the mental lexicon. That is, as soon as the lemma of a lexical entry is retrieved, because its semantic properties match the concept of the ‘preverbal message’ fragment, the syntactic category becomes available and with it it’s diacritic parameters.

If conceptual information in the preverbal message fragment provides a value for a diacritic parameter, the particular morphological form of that parameter is activated, i.e. for example, the conceptual information PAST provides a value for the diacritic parameter TENSE and activates its morphological form.

The third stage in the development of the grammatical processor is characterised by the availability of the Phrasal Procedure. That is, phrasal procedures can be called that inspect ‘preverbal message’ fragments for information essential to build phrase structures, whereby the head-of-phrase imposes some of its grammatical features on other phrasal constituents (cf. Jackendoff, 1977), for instance, “…if the head noun of a noun phrase is plural, then the whole noun phrase is plural” (Levelt, 1989, p.168), i.e. if ‘Häuser’ in German is plural, then ‘die roten Häuser’ is plural. In other words, grammatical information exchange occurs between head and other phrase constituents. This process involves
storing lemma information in ‘holders’ of the Phrasal Procedure and providing values for lemmas called subsequently, thus, building phrases that are characterised by intra-phrasal agreement between the head-of-phrase and other phrasal constituents, which is the basis for the production of ‘phrasal morphemes’ at this stage of the construction of language-specific processing resources.

However, since ‘Appointment Rules’ and ‘S-Procedure’ are not developed yet, no inter-phrasal exchange of grammatical information can occur, blocking non-serial word order and ‘inter-phrasal morphemes’.

Subsequently, second language learners are still mapping conceptual structures directly onto surface structure, but since Phrasal Procedures can build phrases, their position, for instance, in the canonical sequence NP V NP, is now defined in terms of phrases rather than syntactic categories.

However, further development in regard to syntactic phenomena is possible in that learners apply the cognitive principle of salience, that is, serial word order is maintained, but the positions external to the NP V NP sequence can be identified on the basis of their perceptual salience: I]NP V NP[F.

The fourth developmental stage, including an intermediate stage, is characterised by the availability of Appointment Rules and S-Procedure as well as Word Order Rules. These procedures permit the determination of functional destinations of phrases and the syntactic formation of sentences according to second language-specific word order requirements as well as the production of inter-phrasal morphemes, i.e. morphemes based on agreement between different heads of phrases. For instance, in the case of subject verb agreement in English where values for diacritic parameters person and number of the verb phrase need to be in agreement with the values for the same diacritic parameters of the noun phrase, the insertion of the s-affix into the verb phrase presupposes the following procedures as a basis for grammatical information exchange: First, values for the diacritic parameters person and number of the noun phrase are returned to the NP Procedure. Second, the grammatical function of the phrase is determined by Appointment Rules. Third, the S-Procedure is called and the phrase is “…attached to the S-node and sentential information is stored in the sentence procedure” (Pienemann, 1998a, p.7).

The intermediate developmental stage is characterised by the interplay of the
above described developing language-specific processing resources, Appointment Rules and S-Procedure, and the cognitive principle of perceptual salience, affecting the unfolding of the syntactic formation of sentences. That is, grammatical information transfer to constituents in salient positions precedes information exchange between constituents in non-salient positions.

The fifth stage in the development of the grammatical processor is characterised by the availability of the S’-Procedure permitting the processing of subordinate clauses, that is, “…the distinctive syntactic features of subordinate clauses will be acquired after interphrasal exchange of grammatical information (in matrix clauses, D.P.H.)” (Pienemann, 1998a, p.86).

Once processing procedures are available, acquired structures are processed automatically. That is, once learners have acquired certain structures, they have acquired the procedural skills to process these structures. These procedural skills are comparable to the procedural skills of native-speakers. This ‘Procedural Skill Hypothesis’ advanced by Pienemann (1998a) is firmly anchored in Levelt’s (1989) model of speech production that accounts for the time-constrained nature of speaking in that “…linguistic skills are integrated into parallel distributed routines which can all be executed at optimal times [...] irrespective of syntactic complexity” (Pienemann, 1998a, p.221).

Pienemann adduces evidence in support of the ‘Procedural Skill Hypothesis’ by referring to an experiment measuring reaction time of native speakers of German, non-native speakers of German who have already acquired subject-verb agreement and non-native speakers who have not yet acquired subject-verb agreement. The experiment entails the execution of the task of matching two sentences at a time as ‘same’ or ‘different’ that occur sequentially on a screen and may be grammatical or ungrammatical in regard to subject-verb agreement.

The results show more similar response times for either grammatical or ungrammatical sentences by native speakers and non-native speakers that have already acquired subject-verb agreement, but considerably different response times by non-native speakers that have not yet acquired subject-verb agreement. Hence, Pienemann (1998a) concludes that “…the grammatical skill that produces subject-verb agreement develops in NNS in the same way as in NS” (p.229).
However, it seems that Pienemann’s assumption about the nature of grammaticality effects, observable in RT (Reaction Time) experiments, such as SM (Sentence Matching) tasks (cf. Bley-Vroman and Masterson, 1989; Forster and Stevenson, 1987; Freedman and Forster, 1985), incorporates a link between the grammatical processor and the ‘Speech Comprehension System’ that goes beyond mutual access to the mental lexicon entailing meanings, syntactic properties, morphological and phonological specifications of lexical entries. Pienemann (1998a) states:

“I assume reaction time experiments with linguistic stimuli to measure the execution of automated linguistic routines. Processability Theory implies that the acquisition of grammatical structures entails the automatization of the underlying routines. For instance, when SV-agreement is acquired, one can assume that the learner has acquired the routine that processes SV-agreement. It can now be predicted for this learner that the availability of this routine releases processing procedures in sentences with SV-agreement. Therefore the learner will display response times more like those of NSs” (p.222).

Thus, it seems that the explanation of grammaticality effects, as the ones observed by Pienemann in his RT experiment, is not only based on the comprehension system’s access to the mental lexicon as well as to contextual knowledge (cf. Levelt, 1993), but also based on the release of processing procedures by the grammatical processor. Hence, Pienemann’s assumption seems to contradict Levelt’s (1989) concept of ‘processing components as relatively autonomous specialists’ in that the ‘Speech Comprehension System’ has access, for instance, to the syntactical and morphological information of lexical entries, but not to the grammatical processor.

In the same vein, Levelt (1983, 1989, 1993) does not explain how the ‘Speech Comprehension System’ or ‘Parser’ is not only capable to derive a message from speech input, such as one’s own internal or overt speech or other’s speech, but also “…to detect deviations from linguistic standards”, that is to “…discern deviant sound forms, deviant morphology, and deviant syntax”
(Levelt, 1989, p.470), although, for instance, word order rules as part of the processing resources of the grammatical processor, as outlined above, cannot be accessed by the ‘Speech Comprehension System’.

In sum, both, Pienemann’s assumption about the release of processing procedures of the grammatical processor in the processing of input by the comprehension system to execute SM tasks and Levelt’s assumption of the ‘Speech Comprehension System’s’ capacity to detect linguistic deviations in the input remain irreconcilable, unless a link of some kind between the ‘Speech Comprehension System’ and the knowledge underlying the grammatical encoding processes is assumed, as, for instance, suggested by de Bot, Paribakht and Wesche (1997). De Bot et al. (1997) “…propose that, at the representational level, the same organization and components apply to both comprehension and production” (p.311), entailing that the knowledge underlying the grammatical encoding procedures, stored in the grammatical processor of the ‘Formulator’, also is stored in the grammatical processor of the ‘Parser’ carrying out the grammatical decoding procedures.

This seems plausible, since speakers of primary or secondary languages undoubtedly have the capacity to detect grammatical deviations in oral or written input (see footnote 28).

Pienemann (1998a) explicitly refrains from specifying the process of acquiring the language-specific processing procedures of the grammatical processor and the processing resources of the mental lexicon, i.e. he refrains from specifying the acquisition process of the language-specific knowledge underlying the hierarchy of processing procedures. There is, however, an indication of his general position in regard to such a process of procedural skill acquisition when considering his agreement with Paradis’ (1994) position that implicit, procedural knowledge dissociates from explicit, declarative knowledge. This position implies the implicitness of the acquisition of procedural knowledge and is, therefore, seen in contrast to Anderson’s (1982, 1983) view regarding the acquisition of cognitive skills whereby procedural knowledge always starts out as declarative knowledge. Pienemann (1998a) agrees with Paradis (1994) who cites considerable evidence
in support of the dissociation between implicit, procedural knowledge and explicit, declarative knowledge. Paradis (1994) summarises his position as follows:

“Not only are implicit and explicit knowledge of language subserved by different cerebral memory systems, but they have different contents, and hence one cannot become the other, or be ‘converted’ to the other, or be ‘transferred’ to the other” (p.405).

This position is congruent with Levelt’s (1989) assumption about the procedural knowledge underlying the grammatical encoding processes being implicit knowledge stored in the ‘Formulator’s’ grammatical processor and has important ramifications for the process of procedural skill development.

Since procedural knowledge is acquired as implicit knowledge, there is no conversion process of explicit knowledge into implicit knowledge (cf. Anderson, 1982, 1983), that is, procedural skills to grammatically encode conceptual input do not develop through practice from controlled to automatic processing as assumed for instance by Levelt (1977), McLaughlin (1987), McLaughlin, Rossman and McLeod (1983) in the context of theories of automaticity of processing evolving from controlled processing through practice (cf. Schneider and Shiffrin, 1977; Schneider, Dumaïs and Shiffrin, 1984; Shiffrin and Schneider, 1977).

Hence, once the language-specific knowledge underlying the processing procedures at a particular stage in the development of the hierarchy of processing procedures is acquired, consisting of the stage-appropriate procedural knowledge of the grammatical processor and stage-appropriate knowledge constituting the processing resources of the mental lexicon, then, within the scope of the latter kind of knowledge and given a functional need to use a particular structure in order to convey a particular message, such grammatical structure processable at that stage will be processed automatically, signalling its emergence. That is, the emergence of a structure manifests the beginning of the acquisition process, continuing until the particular structure is used in all obligatory contexts.

The above five stages in the development of the grammatical
processor, thus, represent five stages of the acquisition of the processing prerequisites underlying the sequential second language acquisition process. However, the processability of grammatical forms, which depends on the availability of the respective processing procedures, does not guarantee their emergence. First, as already pointed out above, the emergence of grammatical forms presupposes a functional need and second, functional complexity interacts with processability. For example, even if learners of German as a second language have reached the third stage of the development of the grammatical processor, permitting the production of phrasal morphemes, the morphological marking of noun phrases for gender occurs later than markings for number since

“….the diacritic feature ‘number’ can be read off the conceptual structure (‘preverbal message’, D.P.H.) while the feature ‘gender’ has to be introduced one by one into the lexicon, and this process is complicated by the fact that there is no simple one-to-one relationship between the three classes of gender and certain classes of nouns. On the contrary, German gender assignment is highly arbitrary” (Pienemann, 1998a, p.11).

Hence, form-function relationships may lead to an asynchronism in regard to the acquisition of structures in different domains – morphology and syntax – although the processing resources for these structures have been acquired.

As already foreshadowed above, Levett’s (1989) and Pienemann’s (1998a) congruent assumption about the implicitness of the procedural knowledge of the grammatical processor, as well as their congruent assumption about the explicitness of the knowledge constituting the processing resources of the mental lexicon will be examined in the light of recent advances in cognitive and neuropsychological research.

It will be demonstrated below that the dissociation between implicit and explicit knowledge, mirrored in the dissociation between implicit and explicit memory, subsequently, determines the implicitness or explicitness of the acquisition process of the language-specific knowledge underlying the hierarchy of processing procedures. Such language-specific knowledge consists of the procedural knowledge of the grammatical processor and the
knowledge constituting the processing resources of the mental lexicon, and entails the automaticity of the use of this knowledge. In the context of the above outlined sequential development of the grammatical processor, this permits further specifications of the acquisition process.

In order to make predictions in regard to the development of syntactical and morphological phenomena in typologically different languages, Pienemann (1998a) implements the above outlined hierarchical development of the grammatical processor into a psychologically plausible theory of grammar, Lexical-Functional Grammar (cf. Bresnan, 1982; Kaplan and Bresnan, 1982) since

“…unification of lexical features, which is one of the main characteristics of LFG (Lexical-Functional Grammar, D.P.H.), captures a psychologically plausible process that involves (1) the identification of grammatical information in the lexical entry, (2) the temporary storage of that information and (3) its utilisation at another point in the constituent structure” (Pienemann, 1998a, p.73).

Pienemann (1998a) demonstrates for German, English, Swedish and Japanese as a second language that once syntactical and morphological phenomena of a language are characterised within Lexical-Functional Grammar, these phenomena can be analysed in regard to the necessary transfer of grammatical information between constituents as a prerequisite for their production. By relating the analysis of these phenomena to the hierarchy of processing procedures that determines the gradual reduction of constraints on grammatical information exchange in conjunction with the cognitive principle of perceptual salience, the order of acquisition of the above morpho-syntactical phenomena can be predicted. Furthermore, Pienemann (1998a) demonstrates that predicted orders of acquisition are borne out by large sets of data from studies of the acquisition of the above range of languages as second languages, thus providing strong empirical support for the Processability Theory.
Processability Theory predicts the sequential acquisition of grammatical processing procedures and, thus, as Pienemann (1998a) puts it, also predicts the range of structural hypotheses – ‘Hypothesis Space’ - learners can entertain at any point in the development of the grammatical processor. ‘Hypothesis Space’ is determined in two ways. First, the range of structural hypotheses is vertically constrained in that the hierarchically ordered development of the grammatical processor strictly limits processability and, thus, determines the sequential acquisition of syntactical and morphological phenomena. Second, the range of structural hypotheses is horizontally constrained in that the processing resources available at a particular point in the development of the grammatical processor determine the range of structural options within the limits of processability at that stage, and, thus, define interlanguage variation in an a priori manner.\footnote{31}

For instance, at the developmental stage X+1 in German second language acquisition – Adverb Preposing (ADV) – a manifestation of the third stage of the development of the grammatical processor, learners applying ADV can only produce deviant sentences since the processing procedures permitting non-serial word order have not been acquired yet. However, the range of structural options available to learners is defined by the constraints of processability. Pienemann (1998a) demonstrates that learners at stage X+1 in German have three options – the ‘violation option’, the ‘avoidance option’ and the ‘omission option’ – a priori defining the possible interlanguage variation regarding word order. Observations of these three options are reported by Clahsen, Meisel and Pienemann (1983) and Pienemann (1981) and are briefly summarised below in the context of processability:

(i) the ‘violation option’ means that the word order rule of inversion is violated by preserving the NP V NP serial word order sequence after a preposed adverb or adverbial prepositional phrase,

(ii) the ‘avoidance option’ means that structural context – ADV – requiring the application of the word order rule inversion is avoided, for instance, by placing adverbs or adverbial phrases into sentence-final position, permitting the
preservation of the NP V NP serial word order sequence, and
(iii) the ‘omission option’ means that, by omitting the verb (V) or the noun phrase (NPsubj), constituting the subject of the serial word order sequence following the preposed adverb or adverbial prepositional phrase ADV] NPsubj V NP, the application of the word order rule inversion is circumvented.

‘Hypothesis Space’ reflects the constraints imposed by the gradual development of the grammatical processor and, thus, implies that potential effects from variables external to the processability constraints could not override such constraints, but would always have to be within the margin defined by ‘Hypothesis Space’. The term ‘Hypothesis Space’ may invoke the notion of explicitness, i.e. the notion of second language learners being aware of one particular or all structural options available to them at each stage of development, and subsequently, being aware of their selection in the speech production process. However, within the context of the findings resulting from the investigation of the knowledge forms of the processing resources underlying automatic grammatical encoding processes, presented below, the implicit nature of most processing resources renders the explicit selection of structural options during speech production an unlikely process.

‘Hypothesis Space’ provides the theoretical framework for Pienemann’s (1984) ‘Teachability Hypothesis’, “…a subset of Processability Theory” (Pienemann, 1998a, p.13). Within the context of ‘Hypothesis Space’ the ‘Teachability Hypothesis’ (cf. Pienemann, 1984, 1986, 1987) predicts (i) that the acquisition of syntactical and morphological phenomena occurs in stages that cannot be left out, due to the hierarchical order of language-specific processing procedures that become accessible in stages and (ii) that the acquisition process is facilitated if instruction focuses on the grammatical structures processable at the following stage of the hierarchy of language-specific processing procedures, with the proviso that processability of a structure does not predict its acquisition since, apart from the existence of a functional need to use a particular structure in order to convey a particular message, the acquisition of grammatical structures may be delayed due to the asynchronous acquisition of particular processing resources or the

Pienemann (1984, 1986) reports details of a classroom experiment in support of the first and second part of the ‘Teachability Hypothesis’ involving ten 7 to 9 year old Italian children learning German in Germany in a mixed setting, i.e. these children attending elementary school receive supplementary formal instruction in German. All children are at stages ranging from the Canonical Order stage (stage X) to the Verb Separation stage (stage X+2) before the experiment commences. After instruction, focusing on structural contexts for Inversion (stageX+3), Pienemann (1986) reports that

“…only learners already at stage X+2 have transferred this ‘knowledge’ to their actual speech production. Since the instruction was the same for all of the learners in the sample, we can conclude that the differential effects of the teaching can be attributed to differences in the stage of development which each informant had reached” (p13).

Furthermore, Pienemann (1984) reports that two learners33 that are at the Verb Separation stage (stage X+2) begin to apply Inversion (stage X+3) after instruction focusing on structural contexts for inversion. But instruction not only accelerates the progression from stage X+2 to stage X+3, it also considerably increases the frequency and widens the scope of rule application.34

In the same vein, a study reported by Pienemann (1998a), involving twelve university students beginning to learn German as a second language, confirms the successful instruction of inversion. After testing of all subjects during the language course reveals that 11 out of 12 subjects are at the Verb Separation stage, they receive instruction focusing on the word order structure of the next stage – Inversion. All eleven subjects acquire inversion during that experiment.

Pienemann (1986,1987) also conducts a longitudinal study of the formal acquisition of German as a second language by three beginning learners at the
University of Sydney, which provides evidence in support of the first part of the ‘Teachability Hypothesis’.

By comparing instructional input related to learning objectives and learner output, Pienemann examines the relationship between focused instruction and the sequential acquisition of word order rules by these three students.

Although the learning objectives encompass structural contexts for all stages of word order development, except for stage X+4 (Verb-End), and the subsequent input is provided very early in the course (fifth and seventh week), the acquisition process follows the same sequence of word order development as in natural settings regardless of the instructional sequence. For instance, one of the students - Guy - only begins to acquire Inversion (stage X+3) in week 19 although some structural contexts are already introduced in week 1.

Further evidence in support of the ‘Teachability Hypothesis’ is provided by various studies that confirm word order sequences of German as a second language acquired in formal settings where instruction is not adjusted to the predicted acquisitional sequence (cf. Boss, 1996; Daniel, 1983; Ellis, 1989; Jansen, 1991; Weinert, 1987; Westmoreland, 1983).  

Boss (1996), for instance, reports a study of the acquisition of German as a second language by eight university students from various L1 backgrounds and varying exposure to German (up to 6 months) attending a beginner’s course. Subsequently, learners are at different stages of development at time 1 of the data collection (12th week, semester 1). However all learners progress in their word order development according to the established sequence of word order development in the acquisition of German as a second language, although instructional input following the organisation of the textbook used in the course is not adjusted to the sequential acquisition of word order phenomena. For instance, structural contexts for Inversion (stage X+3) are already introduced with content from the first section of the textbook but at time 2 of the data collection (12th week, semester 2) only three learners out of eight have acquired inversion.

All other studies referred to above confirm that the sequential acquisition of word order phenomena in formal settings is the same as in natural or mixed settings regardless of the instructional sequence.

These studies are Daniel’s (1983) study, conducting a cross-sectional study of
first year university students acquiring German as a second language, and applying two different teaching approaches – a modified audio-lingual approach and the ‘Natural Approach’ proposed by Terrell (1977), Ellis’ (1989) study, investigating the acquisition of three obligatory German word order rules (Verb Separation, Inversion and Verb-End) by 39 students learning German as a second language in two separate educational institutions in London, with no specific instruction provided in regard to the word order rules in focus. Jansen’s (1991) study, conducting a cross-sectional study of 20 adults learning German as a second language at university, Weinert’s (1987) study, investigating the development of negation by 42 Scottish students, aged 10-16 years, learning German as a second language at school, compared to the development of negation in natural settings, and Westmoreland’s (1983) study, conducting a cross-sectional study of the acquisition of German as a second language by eight beginning university learners.  

In sum, all these studies provide considerable evidence in support of the Teachability Hypothesis.

To sum up, Pienemann’s (1998a) Processability Theory marks the significant progress that has been made in understanding sequential second language acquisition for speech production. It affords us a sound explanation of and predictive framework for sequential syntactical and morphological development. The ‘Teachability Hypothesis’ as part of the Processability Theory, with the above evidence in its support, provides important guidance in regard to achieving instructional focus as far as stage-appropriate, i.e. processable input is concerned, in order to facilitate learners’ acquisition process at their current stage of development as well as at their next stage of syntactical and morphological development. However, the Processability Theory leaves unspecified the nature of the acquisition process of the language-specific knowledge underlying the hierarchy of processing procedures, consisting of the procedural knowledge of the grammatical processor and the knowledge constituting the processing resources of the mental lexicon, and entailing the automaticity of its use, that could bring about such facilitation.
Hence, since the ‘learning device’ is not specified within the Processability Theory, recourse has to be made to SLA research in order to evaluate processes that are potentially critical for the sequential acquisition of the processing procedures of the grammatical processor and the processing resources of the mental lexicon accessed by the grammatical processor.

2.3 Theoretical concepts for instruction reflecting potentially critical processes for second language acquisition: ‘Input Hypothesis’, ‘Interaction Hypothesis’, ‘Output Hypothesis’, ‘Focus on Form(s)’

Processes that may have the potential to facilitate the acquisition of the different processing resources underlying the grammatical encoding processes are three processes that have come to prominence. First, the reception of input, second, the production of output and, thirdly, form-focused input reception and output production.


Concerning the reception of input, both, Krashen and Long consider the comprehension of meanings conveyed by others to be a necessary prerequisite for acquisition, i.e. the recognition and intake of the forms of the target language that encode the meanings.

Hence, the provision of comprehensible input is seen to be essential for
acquisition to take place. Krashen’s (1982) ‘Input Hypothesis’ claims that the acquisition of structures that are “…a bit beyond our current level of competence (i+1)” (p.21) is caused by comprehending input, containing i+1. Such input, containing i+1, is automatically provided when the learner understands the input and enough comprehensible input is provided.

Krashen (1994), restating the ‘Input Hypothesis’, reiterates:

“...we acquire language by understanding messages”, that is, “‘comprehensible input’ is the essential environmental ingredient in the language acquisition” (p.46).

“Only comprehensible input is consistently effective in increasing proficiency: in other words, more comprehensible input results in more language acquisition and literacy development” (p.48).

However, fundamental criticism points out the lack of direct evidence in the support of the ‘Input Hypothesis’ (cf. Ellis, 1990; Gregg, 1984; McLaughlin, 1987) as well as the lack of a theory, explaining how comprehensible input becomes intake (cf. Chaudron, 1985a; Ellis, 1990; Faerch and Kasper, 1986; Gregg, 1984; McLaughlin, 1987; Pienemann, 1985b; White, 1987). But on the other hand, there is compelling evidence provided by studies confirming that learners do not acquire the language if exposed to large amounts of incomprehensible input of a second or a first language (cf. Long, 1981, 1983b, 1990b; Loschky, 1994; Shaffer, 1985, 1993).

For instance, Snow, Arlman-Rupp, Hassing, Jobse, Joosken and Vorster (1976), studying a group of Dutch children, observe that despite the children’s considerable exposure to German television programmes as the only source of second language input, they do not acquire German at all.

A similar lack of first language acquisition when exposed to unadjusted, incomprehensible television input is reported by Sachs, Bard and Johnson (1981) and by de Villiers and de Villiers (1979). Sachs et al.’s (1981) study of a hearing child (Jim, age 3; 9) of non-signing deaf parents whose only oral input is the language received when watching television reveals that ‘Jim’ only acquires some lexical items and a few formulaic expressions. However, once normal
conversational input is provided, Jim’s acquisition reaches age norm at age six. This is in line with Schiff-Myers’ (1988) report of normal first language development of five hearing children (approximately 2 years old) of deaf parents when exposed to hearing and speaking adults, for at least 5 to 10 hours per week (cf. Schiff, 1979).

De Villiers and de Villiers’ (1979) study of a hearing child (4 years old) of deaf parents signing only to each other whose only oral input, again, is the language received when watching television, also, reveals a lack of acquisition. Furthermore, Long (1981) provides some anecdotal evidence concerning the non-acquisition of Chinese (Mandarin and Cantonese) as a second language by English-speaking adults living in China. Long reports that after seven months the acquisition of these adults encompasses only some lexical items and formulaic expressions due to a constant exposure to unadjusted, incomprehensible input. The above evidence, thus, provides strong support for comprehensible input as a necessary prerequisite for first and second language acquisition (cf. Larsen-Freeman and Long, 1991), though, the evidence provided does not support a direct relationship between comprehensible input and acquisition.

However Long’s ‘Interaction Hypothesis’ posits such a direct relationship, thus, reflecting the influence of Krashen’s ‘Input Hypothesis’. Based on findings of significant differences in the frequency of interactional modifications used by NS when speaking to NNS compared to NS-NS conversations, Long (1981) advances the ‘strong’ version of his ‘Interaction Hypothesis’ by claiming that

“…participation in conversation with NS, made possible through the modification of interaction, is the necessary and sufficient condition for SLA” (p.275).

Due to counterevidence provided by Schmidt (1981) who reports an early fossilisation of the English as a second language acquired by a Japanese-speaking adult (‘Wes’) living in the USA (Honolulu) for several years and receiving large amounts of comprehensible input, Long (1983d) revises his ‘strong’ version of the ‘Interaction Hypothesis’ and proposes a ‘weak’ version of the ‘Interaction Hypothesis’. This ‘weak’ version of the ‘Interaction Hypothesis’ holds that
“…there appears to be sufficient evidence of (a) an adjustments-comprehension relationship, and (b) a comprehensible input-acquisition relationship to warrant the deduction of (c) an adjustments-acquisition relationship” (p.191), but considers modifications of the interactional structure a necessary but not sufficient condition for acquisition.

Furthermore, Long (1983c) gives a detailed account of the interactional modifications occurring in meaning negotiations in order to achieve mutual comprehension and, subsequently, (Long, 1983b) claims that such interactionally adjusted, comprehensible input is optimally provided in two-way information exchange tasks leading interactants to modify the interactional structure in the process of meaning negotiation in order to achieve mutual comprehension. Long’s ‘Interaction Hypothesis’, claiming a causative relationship between comprehensible input and acquisition, whereby meaning negotiation towards mutual comprehension provides the optimal source for comprehensible input and, thus, for acquisition to take place, stimulates a considerable amount of research. This research, particularly, investigates the contribution of meaning negotiation towards mutual comprehension in the provision of comprehensible input to learners (cf. Doughty, 1991; Ellis, 1985a; Ellis, Tanaka and Yamazaki, 1994; Gass and Varonis, 1984, 1985, 1994; Long, 1983b; Loschky, 1994; Pica, 1987, 1994; Pica, Young and Doughty, 1987; Varonis and Gass, 1985) and the role of tasks in promoting meaning negotiation, encompassing task types, task qualities, participation patterns, group makeups and participant qualities (cf. Brown, 1991; Bygate, 1988; Doughty and Pica, 1986; Duff, 1986; Ellis, Tanaka and Yamazaki, 1994; Fotos, 1994; Gass and Varonis, 1985; Long and Porter, 1985; Loschky, 1994; Pica, 1987, 1994; Pica and Doughty, 1985a, 1985b, 1988; Pica, Kanagy and Falodun, 1993; Pica, Lincoln-Porter, Paninos and Linnell, 1996; Plough and Gass, 1993; Porter, 1986; Rulon and McCrea, 1986; Shortreed, 1993; (see chapter 6.1).

The available evidence clearly suggests that interactional modifications facilitate input comprehension. For instance, Doughty (1991), comparing the
effectiveness of three distinctly different instructional approaches in acquiring relative clause structures in English as a second language by 20 intermediate-level adults, reports that the comprehension of the meaning-oriented group (MOG), compared to the rule-oriented group (ROG) and to the exposure-only control group (COG), is significantly greater due to the redundancy provided by the interactive computer programme involving “…lexical and semantic rephrasings” and “…isolated semantic repetition via the dictionary assistance” (p.462).38

Ellis, Tanaka and Yamazaki (1994) report two classroom studies, one involving 79 high-school students with 5 years of previous study and the other involving 127 high-school students with 3 years of previous study of English as a second language. Both studies investigate the effects of three different verbal input conditions on the acquisition of vocabulary, first, unmodified input without interaction (B Group), second, premodified input with no interaction (PM group) (native speaker uses explanations and, thus, increases repetition of lexical items) and, third, interactionally modified input (IM group) (students use clarification requests – native speaker responds with modified input, thus, increasing repetition of lexical items.

Ellis et al. (1994) report that the IM group achieves significantly higher comprehension scores than the PM group and B group. Ellis et al. point out that in both studies subjects in the IM group receive quantitatively more input as well as more redundant input involving repetition of key items, due to interactional modifications of the input.

Loschky (1994), tests the ‘Interaction Hypothesis’ with 41 beginning-level adults learning several vocabulary items and two locative structures in Japanese as a second language under three different verbal input conditions, “…(1) unmodified input with no interaction, (2) premodified input with no interaction (native speaker uses elaborations or simplifications to clarify the preceding sentence, D.P.H.), and (3) unmodified input with the chance for negotiated interaction”(p.303). Loschky (1994) confirms the results of Pica, Young and Doughty’s (1987) study that interactional modifications facilitate comprehension. All subjects under input condition (3) achieve the highest level of comprehension compared to subjects under input conditions (1) and (2). Frequent interactional modifications by the learners consist of clarification requests and confirmation
checks, whereas NS tutors frequently use confirmation checks and repetitions (redundancy).

Pica, Young and Doughty (1987) compare the comprehension of 16 non-native speakers of English receiving directions from native speakers under two input conditions, premodified input (native speaker reduces linguistic complexity, increases repetitions and rephrasings) and interactionally modified input (interactants use comprehension checks, confirmation checks and clarification requests). Their results clearly support Long’s claim that comprehension is facilitated through modifications of the interactional structure in negotiations towards mutual comprehension. Pica et al. (1987) report that comprehension is aided most by interactional modifications comprising confirmation checks, comprehension checks and clarification requests, since they lead to frequent repetitions and rephrasings of native speaker input. A reduction of linguistic complexity (premodified input), on the other hand, does not significantly affect comprehension.

To sum up, the evidence so far provided supports (i) the claim that input needs to be comprehensible in order for acquisition to occur and (ii) the claim that interactionally modified input is superior to unmodified and premodified input without interaction in regard to achieving comprehension of input.

However, there is considerable indirect evidence and growing direct evidence suggesting that there is no direct link between comprehensible input and acquisition. Concerning the available direct evidence, one has to realise that due to the fact that many of the early studies working within the framework of Long’s ‘Interaction Hypothesis’ concern themselves with the facilitative role of interactional modifications in achieving comprehension (cf. Ellis, 1985a; Gass and Veronis, 1984, 1985; Long, 1983b; Pica, 1987; Pica, Young and Doughty, 1987; Varonis and Gass, 1985), that is, they rather seem to assume the correctness of Long’s claim of a causal relationship between comprehensible input and acquisition, but only “…relatively few studies to date have attempted to show that comprehensible input actually leads to the acquisition of new linguistic features” (Ellis, 1994a, p.27) (‘Input Hypothesis’ and ‘Interaction Hypothesis’), and those studies (cf. Doughty, 1991; Ellis, 1995a; Loschky, 1994) clearly show that there is no direct link between comprehensible input and acquisition.
Firstly, there is Doughty’s (1991) study investigating the acquisition of relative clause structures by 20 intermediate-level adults under three different instructional conditions: meaning-oriented instruction, rule-oriented instruction and no instruction-exposure only.

Subjects belong to either one of the experimental groups, the MOG (meaning-oriented instructional group), the ROG (rule-oriented instructional group), or to the control group COG (exposure-only control group).

Doughty reports that students in both experimental groups equally achieve gains in relativisation compared to the control group. However, the level of comprehension is equally minimal in the ROG and COG compared to the substantial level of comprehension in the MOG. Hence, Doughty concludes:

“Because the ROG subjects were able to internalize the structural component of the instruction, comprehension of the message was shown not to be a prerequisite of the internalization of grammatical rules” (p.462-63).

Secondly, there is Ellis (1995a) study investigating the acquisition of English word meanings by 51 Japanese High-school students of low proficiency under two different verbal input conditions: premodified (native speaker uses repetitions and paraphrases) and interactionally modified input (students use clarification requests – native speaker responds with modified input, thus, increasing repetition of lexical items). Ellis reports the following findings in regard to the relationship between input comprehension and the acquisition of word meanings:

“...comprehending directions containing the target items was only weakly related to the acquisition of the items. In fact, as an inspection of the scores for the individual items shows [...] there were many cases where comprehension was quite high but acquisition low [...] It should also be noted, however, that when comprehension was extremely low, so too was acquisition” (p.424-25).
He concludes that “…the results suggest that the relationship between comprehension and acquisition is complex” (p.425) in that word meanings have to be comprehended to be acquired, but not the complete message containing these word meanings. Furthermore, message comprehension does not automatically lead to the acquisition of new word meanings contained in the message.

Thirdly, there is Loschky’s (1994) study testing the ‘Interaction Hypothesis’ with 41 beginning-level adults learning several vocabulary items and two locative structures in Japanese as a second language under three different input conditions: unmodified and premodified input without interaction and unmodified input with interaction. Concerning the relationship between comprehensible input and acquisition, Loschky reports that although there is a significant difference in comprehension between the subjects in the groups receiving input under the first two input conditions (without interaction) and the subjecting input under the third input condition (with interaction), all three groups score significant gains in vocabulary recognition and acquisition of structures. Subsequently, Loschky concludes:

“...it seems that the results of both this study and that of Doughty (1991) suggest that positing a linear relationship between comprehension of input and intake of the structures contained therein may be untenable. Though both studies clearly showed significant gains after participation in comprehension-based language activities, acquisition of structures did not covary with levels of comprehension” (p.320).

And finally, there is considerable indirect evidence provided by the results of studies of the Canadian immersion programmes for native English speaking pupils learning French as a second language (cf. Genesee, 1987; Harley, Allen, Cummins and Swain, 1990; Lapkin, Swain and Cummins, 1983; Swain, 1984, 1985; Swain and Lapkin, 1982, 1995) and the results of ongoing research by Lightbown and Spada (cf. Lightbown, 1990) concerning the acquisition of English as a second language by primary school children attending
intensive second language courses that follow a communicative language teaching approach.

Swain and Lapkin (1995), summarising results of studies of the Canadian immersion programmes for native English speaking pupils learning French as a second language, point out that early immersion students’ skills of listening and reading comprehension are comparable to native speakers’ skills by the end of elementary school, however, immersion students’ speaking and writing skills are not comparable to native speakers’ skills. Swain and Lapkin consider these results as strong counterevidence regarding “…a theory of second language acquisition that claims that the only source of second language acquisition is comprehensible input”, (p.372) since immersion students received considerable amounts of comprehensible input throughout their school years.  

Lightbown (1990), summarises the results of ongoing research by Lightbown and Spada of 5 and 6 year old francophone learners of English as a second language attending intensive language courses of 5 months’ duration in Quebec and following a communicative language teaching approach. She points out that the extensive provision of comprehensible input within the adopted communicative language teaching approach does not lead to an acceptable level of accuracy, although students’ discourse skills, fluency and richness of vocabulary are at a high level.

In the same vein, Lightbown and Spada (1994) make reference to a study by members of their research group that

“…gives evidence that students in these mostly meaning-based instructional environments seem to reach a plateau in the formal accuracy of their language use while the communicative effectiveness continues to grow (Turner and Upshur, 1993)” (p.573).

In summary, the existing evidence suggests that, in general, if comprehensible input is not provided at all, acquisition does not take place or is extremely limited, that comprehension is optimally achieved through interactionally modified input, and that any direct relationship between comprehension of meaning and
acquisition of form, as claimed by proponents of the ‘Input Hypothesis’, is untenable.

Apart from the finding that interactionally modified input is optimally facilitating comprehension, which is unrelated to the Processability Theory, the other two findings are in line with the Processability Theory and Levelt’s (1989) model of speech production. Firstly, the lexically driven grammatical encoding process of conceptual information (messages), requiring the acquisition of the meaning specifications of words and minimally entailing the lexical entry’s conceptual specification at the first stage of the hierarchy of processing procedures, explains why, if the acquisition of such meaning-based word knowledge is unsuccessful due to the reception of predominantly incomprehensible input, any further development is blocked, too. It also explains why, in case of the reception of partly incomprehensible input leading to the partly unsuccessful acquisition of meaning-based word knowledge, learners are constrained in their ability to grammatically encode particular conceptual information and, thus, to convey that information orally.

Secondly, since the hierarchically ordered acquisition process of processing procedures unequivocally shows that the grammatical knowledge underlying the encoding process of conceptual information is acquired sequentially, with the meaning-based word knowledge to be acquired first, it is plausible that there cannot be a direct relationship between meaning comprehension and acquisition of form.

In Long’s (1996) update of the ‘Interaction Hypothesis’, he consistently argues that comprehensible input is necessary in primary or secondary language acquisition, but at least concedes that it is “…insufficient for learning certain specifiable aspects of an L2” (p.425), as evidenced, for instance, by the failure of Canadian immersion students to acquire certain grammatical structures, though receiving considerable amounts of comprehensible input.

By taking into account important results from second language acquisition research and cognitive psychology, having emerged since his first formulation of the ‘Interaction Hypothesis’ (Long, 1981) and its subsequent first revision (Long, 1983d), Long (1996) summarises his latest, updated ‘Interaction Hypothesis’ as follows:
“...it is proposed that environmental contributions to acquisition are mediated by selective attention and the learner’s developing L2 processing capacity, and that these resources are brought together most usefully, although not exclusively, during negotiation for meaning. Negative feedback obtained during negotiation work or elsewhere may be facilitative of L2 development, at least for vocabulary, morphology, and language-specific syntax, and essential for learning certain specifiable L1-L2 contrast” (p.414).

Long’s (1996) update, however, is ‘weaker’ than the preceding one (Long, 1983d), in that negotiation for meaning with its inherent modifications of the interactional structure does not constitute a necessary condition for acquisition any more, but one amongst other facilitating contributors to the second language acquisition process, though a very useful one.41 Nevertheless, this updated position seems plausible on the basis of the currently available evidence supporting Long’s (1996) position that modifications of the interactional structure during negotiation for meaning provide input for learning (cf. Ellis, Tanaka and Yamazaki (1994); Gass (1988a, 1991); Gass and Varonis, 1994; Pica, 1994) and becomes even stronger by taking into account that environmental contributions, such as comprehensible input and negative feedback, are mediated by learners’ respective stages of development, that is, their underlying processing capabilities, and the allocation of attentional resources. Taken together, Long’s (1996) updated ‘Interaction Hypothesis’ is in line with the present author’s conclusion drawn from the above presented evidence that comprehensible input is needed for second language acquisition to occur, but that there is no direct relationship between comprehension of meaning and acquisition of form (‘Input Hypothesis’). As Long (1996) states:

“…input must be comprehensible for acquisition to occur […] Although necessary for L1 and L2 acquisition, however, there is
abundant evidence that comprehensible input alone is insufficient” (p.423).

Long’s (1996) updated ‘Interaction Hypothesis’ also incorporates a facilitative function of ‘negative feedback’ in L2 acquisition, particularly indirect feedback that does not involve metalinguistic measures, which is a reflection of the widely held view amongst scholars in the field of second language acquisition research that form-focused input facilitates L2 acquisition and will be discussed below in the context of the concept of ‘Focus on Form’.

Furthermore, Long’s (1996) update is in agreement with Pienemann’s (1998a) Processability Theory in that it acknowledges that the second language acquisition process is a gradual process that constrains the learning process, and it is in agreement with pervasive claims made by proponents of the ‘Output Hypothesis’ and the concepts of ‘Focus on Form’ and ‘Focus on Forms’, to be presented below, that the second language acquisition process requires the allocation of attentional resources. However, Long (1996), contrary to Schmidt (1990) but in line with Tomlin and Villa (1994), argues that ‘noticing’, i.e. ‘detection’ with awareness of grammatical structures, rules and regularities “…could not be necessary for all aspects of an L2. The fact that untutored, linguistically naive learners often are successful […] suggests, therefore, that they usually learn […] implicitly (i.e. without conscious analysis or understanding)” (Long, 1996, p.427).

Since the availability of comprehensible input over extended periods of time does not explain the evidence from performance tests of second language learners in various French immersion programmes (cf. Lapkin, Swain and Cummins, 1983; Swain and Lapkin, 1982; Swain, Lapkin and Andrew, 1981), Swain (1985) reappraises the role of interactionally modified, comprehensible input in the second language acquisition process and advances her ‘Output Hypothesis’. The ‘Output Hypothesis’ considers comprehensible output a “…necessary mechanism of acquisition independent of the role of comprehensible input” (p.252), though Swain (1985) considers comprehensible input as “…crucial to grammatical acquisition” (p.248) in that once a message is understood, learners can pay
attention to the form of the message being conveyed. However, she argues that immersion students’ underachievement in their production skills, for instance, in regard to their speaking skills, is due to limitations in comprehensible output. These limitations are the lack of adequate opportunities to use the second language, for instance, for testing hypotheses, and the lack of demands placed on learners that would ‘push’ them “…toward the delivery of a message that is not only conveyed, but that is conveyed precisely, coherently, and appropriately” (p.249).

Such limitations in regard to the grammaticality of output seem to be only related to accuracy, i.e. they do not seem to concern grammatical development but rather aspects of variation. However, Swain and Lapkin (1995) explicitly consider the Output Hypothesis not only to apply to the more accurate deployment of already acquired grammatical knowledge as demonstrated by Nobuyoshi and Ellis’ (1993) study, but as well to the internalisation of new forms as shown by Pica, Holliday, Lewis and Morgenthaler’s (1989) study. Swain and Lapkin (1995) claim:

“…‘pushing’ learners beyond their current performance level can lead to enhanced performance, a step which may represent the internalization of new linguistic knowledge, or the consolidation of existing knowledge” (p.374).

Moreover, output production is now considered to be one of several sources of second language acquisition and not as earlier claimed by Swain (1985), “…a necessary mechanism of acquisition” (p.252).

In order to accommodate this more elaborate Output Hypothesis within the above line of argument, Swain and Lapkin (1995) re-emphasise the role of comprehensible input in SLA, but still consider output and input as different contributors to SLA. They argue that processes of input comprehension do not necessitate the focusing of attention on grammatical properties of the input (cf. Gary and Gary, 1981; Van Dijk and Kirtsch, 1983) whereas processes of output production do, for instance, through hypothesis testing. Hypothesis testing may generate explicit or implicit feedback or ‘conscious reflection’ about output (cf. Kowal and Swain, 1997; Swain, 1995) and, thus, potentially may trigger the
‘noticing of a gap’ (cf. Schmidt, 1990; Schmidt and Frota, 1986) by learners in their productive competence. This, in turn

“…may trigger an analysis of incoming data, that is, a syntactic analysis of input, or it may trigger an analysis of existing internal linguistic resources, in order to fill the knowledge gap” (Swain and Lapkin, 1995, p.375).

Hence, input as a contributor of knowledge to fill the ‘noticed gap’ is called upon if no solution can be found, based on existing ‘internal linguistic resources’ in that learners attend to the form of comprehended input in order to extract grammatical information to fill the ‘noticed gap’. Swain and Lapkin (1995) conclude that these processes of second language acquisition considered “…from an output perspective” (p.386) are explicit learning processes. However, they do not specify the nature of the knowledge already internalised or still to be acquired. There is some evidence provided by Nuboyoshi and Ellis (1993) in support of the part of the ‘Output Hypothesis’ claiming that ‘pushed’ output is a source for ‘consolidating’ existing grammatical knowledge in the sense of increasing the accuracy of output through monitoring (cf. Levelt, 1983, 1989). Nuboyoshi and Ellis’ (1993) study, using NS clarification requests to stimulate modified learner output in regard to ESL past tense forms, reveals that modifications of output by NNS leads to gains in accuracy over time. Nuboyoshi and Ellis’ (1993) study is conducted in the context of Pica, Holliday, Lewis and Morgenthaler’s (1989) finding that NNS modifications of their output is “…influenced by the linguistic demands of NS signals of comprehension difficulty” (p.63-64) in that, compared to confirmation requests, NS clarification requests most often lead to semantic and morphosyntactic modifications of NNS output. The successful stimulation of more accurate learner output by Nuboyoshi and Ellis (1993) provides evidence for an increase in monitoring (cf. Levelt, 1983, 1989) and self-correcting based on existing internal linguistic knowledge, but that does not constitute evidence for explicit analyses underlying increased accuracy in speech production. Swain and Lapkin’s (1995) own study of the thinking processes of intermediate and advanced learners of French as a second
language during a writing task, however, is mute due to the time-constrained nature of speech production and, thus, cannot be considered to be supportive evidence.

Furthermore, to the best of my knowledge there is no evidence available to support the other part of the ‘Output Hypothesis’ claiming that ‘pushed’ output is a source for internalising new linguistic knowledge.

As already foreshadowed above, strong claims are being made in support of form-focused input facilitating grammatically improved output. The wide spectrum of proposals for such form-focused input, best described as induced-salience measures (cf. Sharwood Smith, 1991, 1993) varies along the dimensions of positive or negative input, as well as in regard to the degree of explicitness and elaboration and ranges from

(i) paralinguistic means, for instance, by visually and/or physically highlighting a particular feature (cf. Doughty, 1991; Harley, 1993; Lightbown and Spada, 1990; Schmidt, 1990; Sharwood Smith, 1991),

(ii) linguistic means, for instance, by frequently exposing learners to particular forms in focus, i.e. by increasing the redundancy level (cf. Doughty, 1991; Ellis, Tanaka and Yamazaki, 1994; Larsen-Freemann and Long, 1991; Rutherford and Sharwood Smith, 1985; Schmidt, 1990) or by interactional modifications (cf. Long, 1996; Pica, 1994; Pica, Holliday, Lewis, Berducci and Newman, 1991; Pica, Holliday, Lewis and Morgenthaler, 1989), to

These proposals for form-focused input have in common that they focus learners’ attention on what has to be acquired and, thus, are considered to be facilitative in regard to the second language acquisition process. However, these proposals differ in that paralinguistic and linguistic means do not entail making learners aware of what has to be learned, whereas metalinguistic means entail the explicit teaching of what has to be learned and, thus, involve awareness.

Apart from the attention-focusing function, the proposals for form-focused input neither specify the nature of the acquisition process nor the nature of the knowledge to be acquired.

In the most prominent domain of metalinguistic means, two fundamentally different concepts are proposed, ‘Focus on Form’ (Long 1991, 1996) and ‘Focus on Forms’ (Ellis, 1993, 1994b, 1995b, 1998).

The former concept proposes the integration of grammar teaching into meaning-focused learning tasks in contrast to isolated grammar teaching. This proposal has emerged on the basis of research conducted in the context of efforts to overcome learners’ grammatical shortcomings when learning second languages in acquisition-rich environments, such as immersion programmes and communicative language teaching programmes providing considerable amounts of comprehensible input.

The proponents of the ‘Focus on Form’ concept consider the need to focus learners’ attention on certain grammatical properties of the target language at times in order to prevent or remedy grammatical shortcomings. They claim that the acquisition process is best served in meaning-focused learning environments that are considered to be acquisition-rich.

Research findings, referred to above, provide growing evidence in support of the ‘Focus on Form’ concept, suggesting that the application of this concept improves the correctness of learner production. For instance, Spada’s (1987) study investigates instructional differences and learning outcomes of 48 adults
learning ESL in Canada. The learners are distributed across three groups: Group A receiving primarily form–focused instruction, Group B receiving instruction focusing on form as well as on meaning, and Group C receiving primarily meaning–focused instruction. Spada (1987) finds, for instance, that learners’ oral skills in Group B improve significantly compared to the other two groups, thus, corroborating Savignon’s (1972) earlier findings of improved oral performance by learners receiving both form–focused instruction and meaning–focused instruction compared to learners receiving only form–focused instruction.

Similar findings are reported by McKay (1994) investigating instructional differences in four Australian junior secondary French classes following a communicatively oriented teaching approach. McKay (1994) finds that, for instance, learners receiving additional form–focused input performed significantly better on an oral interview test than learners receiving meaning–focused instruction only.

There also is some evidence that the application of the concept ‘Focus on Form’ facilitates the further progression in the sequential acquisition process. For instance, Spada and Lightbown (1993) report on a study investigating form–focused instruction of English as a second language within a communicative teaching approach, involving 10 to 12 year old francophone learners. The study, in particular, focuses on learners’ developmental progress in question formation during a two-week period of form–focused instruction, using two experimental groups and one comparison group.

All subjects receive oral pretests establishing their respective developmental stages in regard to question formation (cf. Pienemann and Johnston, 1986; Pienemann, Johnston and Brindley, 1988) before commencement of instruction, oral posttests immediately after the cessation of the instructional period, oral follow-up posttests 5 weeks after the posttest and 5 months later oral long–term follow–up tests.

All three groups receive form–focused instruction, but in different ways. The two experimental groups receive predominantly explicit training on question formation, encompassing instruction in the formation of questions, corrective feedback and exposure to correct question formation through teacher input,
whereas the comparison group consistently receives instruction, organised

“…in such a way as to draw the learners’ attention to error in their interlanguage development within the context of meaningful and sustained communicative interaction” (Spada and Lightbown, 1993, p.218). Spada and Lightbown (1993) point out:

“In Long’s (1991) terms the comparison teacher provided focus on form, not focus on forms in an acquisition–rich environment. That is, classes were organized around communicative activities, and language was brought into focus as an aid to clarity and precision in communication” (p.218).

Spada and Lightbown (1993) report that the comparison group’s test performance is at least comparable but often even better than the test performance of the two experimental groups regarding accuracy and developmental progress. Based on this somewhat unexpected result, Spada and Lightbown (1993) raise the issue that the effectiveness or ineffectiveness of different instructional approaches regarding the application of the Focus on Form concept needs further investigations.

In a similar way, results of DeKeyser’s (1993) study on error correction raises concerns regarding the generalisability of form–focused instruction without specifying the necessary learning conditions to optimally facilitate the second language acquisition process.

DeKeyser’s (1993) study investigates the effectiveness of frequent explicit error correction, for instance, in regard to improving oral accuracy, compared to an approach of avoiding error correction as much as possible over a period of one year.

The subjects are 35 Dutch–speaking, senior high school students learning French. All classroom communication, including communicative tasks, occurs in French and is meaning–based, however, tests strongly focus on form.

One experimental class receives error corrections “…as frequently and explicitly as possible” (DeKeyser, 1993, p.505), making the students self–correct, and the other experimental class receives error corrections only if the students
explicitly ask for them or in rare cases in an indirect manner “…without explicitly saying ‘no’, ‘wrong’, or anything of the kind, and without making the student(s) self–correct” (DeKeyser, 1993, p.506).

DeKeyser (1993) concludes:

“No main effect (on written grammar, oral fluency, oral accuracy, D.P.H.) exists for error correction, i.e., no overall significant difference in learning outcome is discernible between the group that receives frequent and elaborate error correction and the group that receives virtually no error correction during communicative activities” (p.505).

In other words, particular applications of the concept of ‘Focus on Form’ may induce conditions that are not conducive to the facilitation of the acquisition process.

The other concept of ‘Focus on Forms’ mentioned above proposes a structural syllabus (Ellis, 1993) operating in parallel to a meaning-focused syllabus. This proposal is based on the assumption that the grammatical knowledge underlying language production is implicit knowledge and that explicit grammatical knowledge can either become implicit knowledge if learners are developmentally ready (weak interface between explicit and implicit knowledge), or that explicit knowledge can facilitate the acquisition of implicit knowledge at a later point in time when learners have made appropriate progress in their respective development. That is, Ellis’ (1993) ‘Focus on Forms’ concept assumes that systematic explicit teaching of grammatical structures, for instance, structured according to criteria, such as the relative difficulty or usefulness of structures, will, firstly, be acquired as explicit knowledge that will be directly converted into implicit knowledge if that explicit knowledge of grammatical structures concurs with the order of their acquisition in the sequential acquisition process, or is independent of the sequential acquisition process. In the latter case Ellis’ (1993) ‘Focus on Forms’ concept assumes that such explicit knowledge of grammatical structures will serve as a means to facilitate ‘noticing’ the structures in future input and ‘noticing the gap’ between the
structures in future input and output production (cf. Fotos, 1993; Schmidt, 1990; Schmidt and Frota, 1986), thus, facilitating their acquisition, once learners are developmentally ready for their acquisition.

This aspect of the concept of ‘Focus on Forms’ is similar to the concept of ‘Focus on Form’ in that it draws on the attention-focusing function of such form-focused input, but is different to it in that it follows a structural syllabus and is not embedded in a meaning-focused instructional approach.

The major shortcoming of the concept of ‘Focus on Forms’ is the lack of specific supportive evidence for its assumption that explicit knowledge can turn into implicit knowledge given learners are ready to acquire it. Ellis (1993, 1994b) only refers to findings “…from research into the effects of grammar instruction on L2 learning (see Ellis, 1990, and Larsen-Freeman and Long, 1991)” (Ellis, 1993, p.96) as being in line with his assumption.

A similar lack of supportive evidence is apparent in regard to the claim that the second language acquisition process is facilitated by the implementation of the concept of ‘Focus on Forms’ in that the explicit teaching of grammatical structures facilitates explicit noticing of these structures in future input and, subsequently, their acquisition. This claim, based on Schmidt’s (1990) ‘Noticing Hypothesis’ is only supported by evidence in the form of a diary study by Schmidt and Frota (1986) and is further weakened by strong arguments against the ‘Noticing Hypothesis’ claiming that ‘noticing’ or ‘detection’ need not involve awareness (cf. Long, 1996; Tomlin and Villa, 1994).

Furthermore, the above concept of ‘Focus on Forms’ aiming to facilitate the explicit noticing of grammatical structures, which is considered to be the necessary prerequisite for their acquisition, does not specify the nature of the acquisition process, although it specifies the implicit nature of the knowledge eventually to be acquired.

Taken together, the above review of processes deemed to be potentially critical for the second language acquisition process reveals the following: Firstly, the evidence concerning the contribution of comprehensible input to the second language acquisition process suggests that comprehensible input is a necessary prerequisite for acquisition to take place, though any direct relationship between the comprehension of meaning and acquisition of form, as claimed by
proponents of the ‘Input Hypothesis’, is untenable and, thus, will not be investigated further.

The conclusion that comprehensible input is a necessary prerequisite for acquisition to take place is in line with the Processability Theory demonstrating that the acquisition of meaning-based word knowledge is the basis for the activation of the hierarchically ordered processing procedures in the course of grammatical encoding for speech production. This implies that the acquisition of meaning-based word knowledge is crucially dependent on the comprehensibility of the words making up the input. The meaning-based lemma information of words, stored in the mental lexicon, is plausibly assumed to be of an explicit nature and to be acquired explicitly.

Secondly, evidence concerning the application of the concept of ‘Negotiation for Meaning’ in the context of the ‘Interaction Hypothesis’ suggests that modification of the interactional structure during meaning negotiations provides ample input for learning, be it as positive, comprehensible input or as indirect, negative input and extended periods of practice.

The concept of ‘Negotiation for Meaning’, entailing input reception that may be form-focused at times, does not explicitly specify the nature of the knowledge to be acquired and the nature of the acquisition process. It seems to imply a predominantly implicit knowledge base acquired implicitly through the reception of positive, comprehensible input in meaning-focused oral interactions as well as through the reception of indirect, negative feedback, that is, feedback that does not involve explicit, metalinguistic means. Such positive or indirect negative input requires the allocation of attentional resources in order to detect what has to be acquired, whereby indirect negative feedback orients learners’ attention towards what has to be acquired and, thus, facilitates the acquisition process. The allocation of attentional resources mostly does not require awareness.

Furthermore, the concept of ‘Negotiation for Meaning’, entailing extended periods of practice does not distinguish learning phases from practice phases and does not specify how practice may contribute to the learning process.

Thirdly, there is hardly any evidence in support of the ‘Output Hypothesis’ claiming that output production facilitates the second language acquisition process in that learners, explicitly noticing a gap in their output
production, (i) explicitly analyse their current internal linguistic knowledge, or (ii) explicitly focus attention on future input in order to fill the explicitly ‘noticed gap’. The proponents of the ‘Output Hypothesis’ do not explicitly specify the nature of the knowledge already internalised or still to be acquired, but describe the learning process as an explicit process involving awareness, with attention deliberately focused on internal linguistic knowledge or future input.

The explicit learning process, thus, implies that the knowledge to be acquired is considered to be of an explicit nature.

Fourthly, there is evidence in support of the concept of ‘Focus on Form’, claiming that focusing learners’ attention on what has to be acquired, at times, as a complement to a predominantly meaning-focused instructional approach, facilitates the second language acquisition process. But, at the same time, there also is evidence showing that the application of the concept of ‘Focus on Form’, for instance, in regard to explicit error correction is ineffective in facilitating the second language acquisition process.

These results suggest that particular applications may induce conditions that are not conducive to the facilitation of the acquisition process.

Apart from the attention-focusing function, the concept of ‘Focus on Form’ does neither specify the nature of the acquisition process nor the knowledge to be acquired.

And, fifthly, concerning the concept of ‘Focus on Forms’ there is a lack of evidence in support of the claim that explicit knowledge can convert into implicit knowledge. There is some evidence in support of the claim that explicit grammar teaching facilitates the explicit noticing of the structures taught in future input, but there is insufficient evidence in support of the claim that explicitly noticing grammatical structures in the input facilitates their acquisition.

Although the implicit nature of the knowledge to be acquired is specified the nature of the acquisition process remains unspecified.

The above review, thus, shows that most of the theoretical constructs discussed neither explicitly specify the nature of the knowledge to be acquired nor the nature of the acquisition process. If such specifications are provided, they lack evidence in their support. However, proponents of the theoretical constructs ‘Interaction Hypothesis’, ‘Output Hypothesis’, ‘Focus on Form’ and
‘Focus on Forms’ pervasively claim that attention to grammatical information in the input is a necessary prerequisite for acquisition of grammatical knowledge to occur, but differ in respect to the involvement of awareness. Hence, in order to determine with certainty the contribution of each of the above concepts, it is necessary to evaluate the Processability Theory’s underlying assumptions about the nature of the knowledge underlying grammatical encoding, shared with Levelt’s (1989) theory of speech production, and to establish the nature of the acquisition process of such knowledge. These necessary tasks in the context of the above review motivate the set of hypotheses to be investigated.

3. SEQUENTIAL SECOND LANGUAGE ACQUISITION FOR SPEECH PRODUCTION: A PREDOMINANTLY IMPLICIT LEARNING PROCESS – RESEARCH HYPOTHESES

The following set of hypotheses will be investigated:

Hypothesis 1: The grammatical knowledge underlying speech production is predominantly implicit and is dissociated from explicit grammatical knowledge.

This hypothesis is based on the plausible assumption of Pienemann’s Processability Theory, shared with Levelt’s (1989) theory of speech production, that the time-constrained nature of speaking requires a predominantly implicit knowledge base, permitting automatic grammatical encoding processes independent of intentions or awareness, but, at the same time, also recognises the dependency on explicit meaning-based knowledge that has to be matched with the conceptual information to be produced as speech. The confirmation of this hypothesis would render the still prevalent application of the instructional concept of ‘Focus on Forms’ an untenable concept since implicit and explicit knowledge dissociate and cannot convert into each other. In other words, the instructional approach of explicitly teaching grammatical knowledge according to a structural syllabus would be rendered ineffective in
regard to the necessary acquisition of implicit grammatical knowledge for spontaneous speech production.

However, the validity of such an instructional concept for the development of literary skills is assumed, but is not investigated as part of the thesis.

Furthermore, the confirmation of this hypothesis would render the claim by proponents of the ‘Output Hypothesis’ untenable that output facilitates second language acquisition in that learners explicitly ‘noticing a gap’ in their output will explicitly analyse their current ‘internal linguistic knowledge’ in order to close the gap. The claim’s implication that the ‘internal linguistic knowledge’ is of an explicit nature would be irreconcilable with the confirmation that the grammatical knowledge underlying speech production is predominantly of an implicit nature since it cannot be analysed explicitly.

Hypothesis 2: The sequential acquisition process of the grammatical knowledge underlying speech production is a predominantly implicit learning process operating in particular conditions and is dissociated from explicit learning processes.

This hypothesis, closely linked to Hypothesis 1, is based on the deductive argument that in order to achieve the acquisition of predominantly implicit grammatical knowledge, the respective learning process must be implicit, operating in particular conditions avoiding the engagement of explicit learning processes and is, thus, dissociated from explicit learning processes.

The confirmation of this hypothesis would define the learning conditions that have to be established in order for implicit learning to occur and would profoundly effect an instructional approach aiming at achieving an effective organisation of the second language acquisition process.

Hypothesis 3: The explicit grammatical knowledge that may be gained during learning processes can contribute to the implicit learning process under certain conditions.

This hypothesis, closely linked to Hypothesis 1 and Hypothesis 2, is
motivated by conflicting research results of grammatically improved or unchanged output as an outcome of the instructional application of the concept of ‘Focus on Form’ that may involve explicit grammar teaching, though embedded in a mainly meaning–focused teaching approach. Such results suggest that explicit grammatical knowledge can have an effect on the acquisition of implicit grammatical knowledge, but do not speak to the conditions under which such explicit grammatical knowledge can contribute to the implicit learning process. The confirmation of this hypothesis would define the conditions under which the explicit grammatical knowledge can contribute to the implicit learning process and, thus, would strengthen the effectiveness of the concept of ‘Focus on Form’ as an instructional concept.

Hypothesis 4: Practice promotes the further acquisition of implicit grammatical knowledge, only in conjunction with phases of implicit learning.

This hypothesis, closely linked to Hypothesis 1, Hypothesis 2, and Hypothesis 3, is motivated by findings from research on the concept of ‘Negotiation for Meaning’ within the conceptual framework of the ‘Interaction Hypothesis’, suggesting that the application of this concept provides for an acquisition-rich environment. This environment entails extended practice and ample grammatical input for implicit learning, be it as positive, comprehensible input or as indirect, negative input. However, within the concept of ‘Negotiation for Meaning’ no distinction is made between learning phases and practice phases and, subsequently, no specification is provided in regard to the potential contribution of practice to the implicit learning process. The confirmation of this hypothesis would distinguish phases of implicit learning from practice during oral interactions and, thus, would strengthen the effectiveness of the concept of ‘Negotiation for Meaning’ as an instructional concept.

Hypothesis 5: The allocation of attentional resources is a necessary condition for implicit learning to occur and must not involve awareness.
This hypothesis’ first part is motivated by pervasive claims made by proponents of the ‘Interaction Hypothesis’, ‘Output Hypothesis’ and the concept(s) of ‘Focus on Form(s)’ that attention to grammatical information in the input is a necessary prerequisite for acquisition of grammatical knowledge to occur.

This hypothesis’ second part, closely linked to Hypothesis 2, is based on the deductive argument that, if in order to achieve the acquisition of predominantly implicit grammatical knowledge, the respective learning process must be implicit, then the allocation of attentional resources must not involve awareness.

The confirmation of the first part of this hypothesis constitutes the prerequisite for the second part of this hypothesis. The confirmation of this hypothesis would render metalinguistic measures to direct attention towards particular grammatical information in the input unsuitable for implicit learning since this particular application of the concept of ‘Focus on Form’ would engage awareness and explicit learning processes.

The confirmation of this hypothesis would also render the claim by proponents of the ‘Output Hypothesis’ untenable that output facilitates second language acquisition in that learners ‘noticing a gap’ in their output will explicitly direct their attention towards input in order to fill the gap. Such explicit direction of attention engages awareness and explicit learning processes and is, thus, irreconcilable with implicit learning.

4. EVALUATION OF THE ASSUMED FORMS OF KNOWLEDGE UNDERLYING THE SEQUENTIAL ACQUISITION PROCESS OF GRAMMATICAL ENCODING PROCEDURES AND INVESTIGATION OF THE NATURE OF THEIR ACQUISITION PROCESSES

The knowledge forms of the processing resources underlying the automatic grammatical encoding procedures as they are defined in Levelt’s (1989) theory of speech production and subsequently in Pienemann’s (1998a) Processability Theory and the nature of their acquisition processes will be examined in the light of recent advances in cognitive and neuropsychological research on distinct kinds of memory, knowledge and knowledge acquisition. It will be shown that to the extent that processing resources represent implicit, nondeclarative
knowledge stored in the grammatical processor and partly stored in the mental lexicon, this knowledge is acquired implicitly.

And it will be demonstrated that to the extent that processing resources represent explicit, declarative knowledge stored in the mental lexicon, this knowledge is acquired explicitly.

Levelt’s theory distinguishes between declarative knowledge stored in declarative memory, thus, being available to awareness, that is, being available to recall, and procedural knowledge stored in procedural memory, not being available to awareness.

Particular procedural knowledge is held in procedural memory as part of the various processing components – ‘Conceptualiser’, ‘Formulator’, ‘Articulator’ and ‘Speech Comprehension System’ – and particular declarative knowledge, such as knowledge about words, knowledge about the world, situational knowledge and current discourse knowledge, is held in declarative memory and can be accessed by particular processing components only.

According to Levelt’s (1989) ‘blueprint’, the knowledge about words, i.e. the lemma and form information of each lexical entry in the mental lexicon, is accessible by the ‘Formulator’ and the ‘Speech Comprehension System’, whereas the other kinds of declarative knowledge mentioned are accessible by the ‘Conceptualiser’. Within the context of Pienemann’s (1998a) Processability Theory and on the basis of Levelt’s (1989) knowledge and memory distinctions, the kinds of knowledge and memory that are instrumental in the development of syntax and morphology are the procedural knowledge stored in the procedural memory of the ‘Formulator’s’ grammatical processor and the assumed declarative knowledge about words stored in the mental lexicon, entailing lemma and morphological form information of lexical entries.

The development of operations of the grammatical processor, which is central to the predictability of sequential grammatical development in SLA, is based on the sequential acquisition of procedural knowledge underlying the hierarchy of language-specific processing procedures, which has been outlined above. The outline of the hierarchy of language-specific processing procedures reveals
that the procedural knowledge underlying the language-specific hierarchy of language processing procedures is not only reflected in the language-specific operations or procedures of the grammatical processor, but also, interconnected with it, in the availability of particular language-specific processing resources of the grammatical processor, such as Functorisation Rules, Appointment Rules and Word Order Rules. That is, the procedural knowledge of the grammatical processor consists of operational knowledge and integrated grammatical knowledge.

Procedural knowledge of how to grammatically encode conceptual input accounts for the time-constrained nature of speaking in that it permits automatic grammatical encoding processes that are not based on intentions and awareness, “…do not share processing capacity with other processes” (Levelt, 1989, p.20) (cf. Schneider, Dumais and Shiffrin, 1984; Shiffrin and Schneider, 1977) and, thus, allows parallel, incremental processing of incoming conceptual ‘preverbal message’ fragments without leading to any interference in processing.

As will be demonstrated below, such procedural knowledge stored in the grammatical processor is implicit, nondeclarative knowledge held in implicit, nondeclarative memory and, thus, is acquired implicitly.

Knowledge about words, on the other hand, i.e. lemma and form information of lexical entries stored in the mental lexicon accessed by the ‘Formulator’s’ grammatical (and phonological) processors, is defined as declarative knowledge, i.e. knowledge that is available to awareness. Levelt (1989) states:

“The mental lexicon is, we assume, a passive store of declarative knowledge about words. It does not contain procedural knowledge” (p.185)

However, recent advances in cognitive and neuropsychological research, demonstrating clear dissociations between implicit and explicit memory for words, lead to a more differentiated account to be presented below, of the kinds of knowledge – implicit and explicit – making up the mental lexicon and the acquisition processes involved.

The nature of the knowledge components making up the mental
lexicon and the nature of the acquisition processes of the knowledge components constituting essential processing resources for the grammatical (and phonological) encoding processes will be investigated first, followed by an investigation regarding the nature of the procedural knowledge, its memory store and its acquisition process.

4.1 The mental lexicon

4.1.1 Meaning-based lemma information of lexical entries is explicit knowledge acquired explicitly and stored in explicit memory

Syntactic lemma information of lexical entries is implicit knowledge acquired implicitly and stored in implicit memory

Form-based information of lexical entries is implicit knowledge acquired implicitly and stored in implicit memory


The term explicit, declarative memory is used “…in the sense that one can bring to mind or declare the content of this kind of memory” (Squire, 1992, p.204), that is, such memory content is available to awareness, constituting explicit, declarative knowledge.

On the other hand, the term implicit, nondeclarative memory is used in the sense that its content “…is accessible only through performance” (Squire, 1986, p.1614), constituting implicit, nondeclarative knowledge and demonstrating “…facility for operating in the world” changed by experience “…but without affording conscious access to past episodes” (Squire, 1992, p.210).

Such unambiguous dissociations are, for instance, observable abundantly in priming studies in that implicit memory for familiar words and, most importantly in the context of the acquisition of the lemma and form information of lexical
entries, in that implicit memory for novel words dissociates from explicit memory of words.

Priming as a form of implicit, nondeclarative memory

“…is present whenever items are processed faster or differently as a result of having been recently perceived. Priming can occur with items that already exist in well-established memories and with items that were novel before their presentation” (Mayes, 1988, p.275-76).

Repetition or direct priming studies most commonly use tasks of lexical decision, word identification or perceptual identification and word-stem or word-fragment completion to tap into subjects’ implicit memory (cf. Schacter, 1987), but also employ word production tasks to measure implicit memory (cf. Graf, Shimamura and Squire, 1985).

Priming of a familiar word, that is, a word that is already represented in a subject’s memory facilitates the processing of that word in a subsequent encounter without the subject being aware of the prior encounter. Subjects demonstrate implicit memory (i) in lexical decision tasks when showing decreased latencies in deciding whether a string of letters, presented a second time, is a real word or not, (ii) in word identification tasks when the minimum exposure to correctly identify a word is lower for repeated words, (iii) in word-stem or word-fragment completion tasks when subjects show an enhanced tendency to complete stems or fragments with words encountered recently, and (iv) in word production tasks when subjects show an increase in producing the primed words. Explicit memory, on the other hand, is demonstrated in recall and recognition tasks. Such tasks test subjects’ competence to remember words they have previously encountered, which involves awareness of the prior encounter (cf. Haist, Shimamura and Squire, 1992; Squire 1992, 1994; Tulving, 1983).

Since results from earlier studies, investigating the priming of unfamiliar,
novel words (nonwords), are not unequivocally showing priming effects for nonwords, an evaluation of these results in the light of more recent results will be carried out below in the context of the presentation of evidence from priming studies with amnesic patients.

Suffice it to say that the evidence reviewed below strongly suggests that priming of nonwords (novel words) is intact in normal subjects as well as in amnesic patients.

N. Ellis (1994a) and Schacter (1987), for instance, report on the findings of several studies that provide evidence for dissociations between implicit memory for words, whereby implicit memory is demonstrated by repetition priming effects on lexical decision tasks (cf. Forbach, Stanners and Hochhaus, 1974; Scarborough, Cortese and Scarborough, 1977; Scarborough, Gerard and Cortese, 1979), word identification task (cf. Jacoby and Dallas, 1981) and word-stem as well as word-fragment completion tasks (cf. Durgunoğlu and Roediger, 1987; Graf, Mandler and Haden, 1982; Tulving, Schacter and Stark, 1982), and explicit memory for words is demonstrated by effects on recall and recognition tasks.

Studies, like the above mentioned, provide robust evidence for the phenomenon of priming in that a mere single exposure to a word facilitates its processing at a later point in time without awareness of the prior encounter of such a word, which is dissociated from the recollection of such a previously encountered word in recall or recognition tasks involving awareness.

The evidence for such dissociations between implicit and explicit memory is further strengthened by consistent results from studies manipulating study-task conditions in regard to duration of presentations (cf. Hirshman and Mulligan, 1991; Jacoby and Dallas, 1981; Neill, Beck, Bottalico and Molloy, 1990) and in regard to continuity of multiple presentations (massed repetition) (cf. Challis and Brodbeck, 1992; Challis and Sidhu, 1993; Greene, 1990; Jacoby and Dallas, 1981; Roediger and Challis, 1992), (see Roediger and McDermott, 1993 for a review), showing minimal or no effect on priming but significant effects on recall and recognition tasks.

However, evidence from studies manipulating study-task conditions in
regard to the distribution of presentations, is mixed. As Roediger and McDermott (1993), reviewing pertinent studies, point out, manipulating the number of intervening items may or may not affect priming (cf. Challis and Brodbeck, 1992; Green, 1990; Jacoby and Dallas, 1981; Roediger and Challis, 1992; Parkin, Reid and Russo, 1990) and, thus, may indicate “…that spacing and lag effects on perceptual implicit tests are not well understood” (p.96).

Nonetheless, a more recent study by McKone (1995) provides a more fine-grained picture of spacing effects on priming of words and nonwords, demonstrated in lexical decision and naming tasks (Experiments 1 and 2), as well as from spacing effects on the explicit recollection of words and nonwords, demonstrated in a recognition task (Experiment 4).

McKone (1995), manipulating the distribution of presentations by re-presenting words and nonwords at lags of 0,1,2,3,4,5,9 and 23 intervening words, reports stable long-term priming effects over 23 intervening words with very short-term effects on priming of familiar words over three intervening words and for novel words (nonwords) over one intervening word, after which the decay of the short-term effect leads to a stable long-term priming effect. Effects on explicit recognition, though, clearly dissociate from short-term effects on priming in that the decay of explicit recognition occurs over ten intervening words for both words and nonwords.

In the same vein, studies investigating possible dissociations between implicit and explicit memory in regard to retention of priming and explicit recollection of previously presented words do not provide consistent evidence for such dissociations. The available evidence reflects the overall spectrum of possible outcomes entailing dissociations: In cases of persistent priming effects across delays of days and weeks, explicit recognition memory declines across the same delays (cf. Jacoby and Dallas, 1981 – word identification task; Graf, Squire and Mandler, 1984 – word-stem completion task; Komatsu and Ohta, 1984; Naito, 1990 Tulving, Schacter and Stark, 1982 – word-fragment completion task); in cases of only relatively transient priming effects across delays of minutes and hours, explicit recognition memory persists across the same delays (cf. Chen and Squire, 1990; Graf, Squire and Mandler, 1984; Shimamura and Squire, 1984;
Squire, Shimamura and Graf, 1987 – word-stem completion task; Forster and Davis, 1984 – lexical decision task); and most recently in cases of declining priming effects on a word-stem completion task; recall effects on a word-stem cued recall task over 90 minutes decline similarly (cf. McBride and Dosher, 1997), (see also McBride and Dosher, 1997, Roediger and McDermott, 1993, and Schacter, 1987, for reviews). Nonetheless, Moscovitch, Vriezen and Goshen-Gottstein (1993) argue, based on the evidence of long-lasting priming effects (cf. Sloman, Hayman, Ohta, Law and Tulving, 1988), that such

“effects cannot result only from a temporary activation of pre-existing representations. Some relatively long-lasting neural changes must underly the observed effects” (p.140-41).

Further evidence in support of the dissociation between implicit and explicit memory for words comes from numerous priming studies with varied study-task conditions in regard to the depth of processing, confirming Craik and Lockhart’s (1972) and Craik and Tulving’s (1975) ‘levels-of-processing’ assumption that the depth of processing of a stimulus has a profound effect on its memorability, whereby

“‘Depth’ is defined in terms of the meaningfulness extracted from the stimulus rather than in terms of the number of analyses performed upon it” (Craik, 1973, p.48).

Craik and Lockhart (1972) argue that depth of processing is achieved through ‘elaborative rehearsal’ involving semantic analysis, whereas ‘maintenance rehearsal’, such as the repetition of a stimulus does not have an enhancing effect on the formation of long-term representations.

In other words, subjects in the study-task condition of elaborative processing show significant effects on explicit memory tasks, but only minimal or no effects on implicit memory tasks.

For instance, Jacoby and Dallas (1981) demonstrate that priming effects on a word identification task are unaffected by elaborative processing, such as
responding to questions concerning the meaning of the target word, whereas explicit memory tested by a yes/no recognition task is affected by elaborative processing. Similar results, obtained by Graf, Mandler and Haden (1982), are demonstrated by a word-stem completion task tapping into implicit memory and a free recall task accessing explicit memory. Other studies, for instance, by Graf and Mandler (1984) and by Rueckl, Mikolinski, Raveh, Miner and Mars (1997) confirm that the type of study-task processing - elaborative or nonelaborative - has dissociable effects on implicit and explicit memory. For example, Rueckl, Mikolinski, Raveh, Miner and Mars (1997) vary the study-task conditions by asking subjects in the ‘deep’ study-task condition (elaborative processing) to rate the familiarity of a series of words presented visually and by asking subjects in the ‘shallow’ study-task condition (nonelaborative processing) to count the number of sounds in each word. Rueckl et al. (1997) introduce a modified fragment completion task in order to achieve quick performances comparable to word identification in real time. They report considerable priming effects on the performance of the masked fragment completion task, unaffected by manipulation of study task conditions and clear effects on the recall of words from the study list, due to the manipulation of levels of processing of the study task. Durgunoğlu and Roediger’s (1987) study of same-language priming effects on word-fragment completion tasks under study-task conditions involving elaborative processing by bilingual subjects corroborates the above findings by showing that elaborative processing, such as translating a word from Spanish to English or generating an image of a word, facilitates free recall of the particular word, demonstrating explicit memory, whereas elaborative processing does not have an effect on word-fragment completion, demonstrating implicit memory. Overall, priming studies manipulating study-task conditions in regard to levels of processing unequivocally show effects on explicit memory tests, with the greatest effects measured under the study-task condition of elaborative processing, but typically show little or no effect on implicit memory tests under either study-task condition – elaborative or nonelaborative.
conditions by Brown and Mitchell (1994), Challis and Brodbeck (1992) and Roediger and McDermott (1993) reveal that, although in most cases implicit memory tests are only slightly (insignificantly) affected by levels of processing (LOP) manipulations, there are some cases of significant LOP effects and, thus, raise the issue whether or not these LOP effects can be parsimoniously explained within the paradigm of implicit and explicit memory dissociations.

Challis and Brodbeck (1992) and Roediger and McDermott (1993) argue that current evidence supports three explanations compatible with observed implicit and explicit memory dissociations. Nevertheless, after reviewing their arguments, it appears to me that only two of the three explanations are compatible with the respective evidence available, though all three explanations are in line with observed implicit and explicit memory dissociations.

First, Challis and Brodbeck (1992) and Roediger and McDermott (1993) canvass the possibility that explicit retrieval may be the contaminator of performance on implicit perceptual tests in that

“...subjects treat the task, at least on some items, as an explicit cued-recall test” resulting “...in better performance with items studied in the semantic study condition (elaborative processing, D.P.H.) than in the physical study condition (nonelaborative processing, D.P.H.)” (Challis and Brodbeck, 1992, p.604).

Evidence in support of such contamination effects comes from Graf and Mandler (1984), demonstrating distinct effects on implicit and explicit memory tests relative to the particular study-task instructions given to subjects.

Explicit memory instructions to remember study-list words lead to an increased recall of words under elaborative study-task conditions compared to nonelaborative study-task conditions. Implicit memory instruction, on the other hand, to write down the first word coming to mind in response to a word-stem cue, does not affect the magnitude of priming.

Moreover, Rueckl, Mikolinski, Raveh, Miner and Mars (1997) hint at an important difference between, for instance, word-fragment completion tasks and perceptual identification tasks that illuminates the contamination potential
inherent in some commonly used implicit memory tests, such as word-fragment completion tasks:

“...whereas the duration of the identification process is typically on the order of hundreds of milliseconds, fragment completion (when successful) often occurs much more slowly, in many cases on the order of 5-10s (Weldon, 1993). Hence, given this extended duration, fragment completion is in some ways a form of problem solving and thus relies heavily on processes that are not typically involved in normal word identification” (p.387).

Subsequently, Rueckl et al. (1997) modify the commonly used word-fragment completion task in order to achieve quick performances comparable to word identification in real time and test the so called masked fragment completion task under varied study-task conditions. The results of Experiment 1 unambiguously show that priming is only insignificantly affected by LOP (LOP effect: .03). This LOP effect on priming is comparable to the reported minimal (insignificant) LOP effects on perceptual identification tests in Challis and Brodbeck’s (1992) review of 35 experiments from 11 studies including 5 experiments involving perceptual identification tests and on all but 18 of 20 experiments involving perceptual identification tests in Brown and Mitchell’s (1994) review of 131 experiments from 38 studies (LOP effects: .05 or less).

Second, Challis and Brodbeck (1992) suggest that implicit memory tests may not be pure measures of perceptual processes, but rather show some sensitivity to conceptual or semantic processes.

In support of this explanatory approach, Challis and Brodbeck refer to some recent reports by Hirshman, Snodgrass, Mindes and Feenan (1990), Masson and MacLeod (1992) and Weldon (1991), showing that study-task manipulations of a conceptual nature produce LOP effects in implicit perceptual tests, such as word-fragment completion tests and perceptual identification tests. They argue that LOP effects observed in implicit perceptual tests, in a similar way, may be sensitive to semantic processes.

Third, Roediger and McDermott (1993) suggest that LOP effects on implicit
perceptual tests may be due to subjects truncating the perceptual analyses of study items in the shallow (nonelaborative) study-task condition, thus, leading to less priming in the shallow study-task condition relative to the deep (elaborative) study-task condition. Roediger and McDermott (1993) point out that, for instance,

“...in checking for an e, or counting the number of syllables or the number of ascending and descending letters, subjects may be less likely to process the word as a lexical unit. If perceptual/lexical processing is short-circuited during study in the ‘shallow’ processing conditions relative to the ‘deep’ conditions, this would explain why the ‘shallow’ conditions show slightly less priming on the perceptual implicit tests” (p.101).

However, the supporting evidence adduced by Roediger and McDermott (1993), a study by Hayman and Jacoby (1989) showing that, if words are not processed as whole lexical units during the study phase, no priming occurs on a perceptual identification test, seems too strong to account for the substantial priming effects on perceptual identification tests reported by Brown and Mitchell (1994) and Challis and Brodbeck (1992) under nonelaborative, shallow study-task conditions. Hence, it appears to me that only the first two explanations seem to be compatible with the evidence presented above. Since there is no compelling evidence in favour of one of these two explanations, it may be that both explanations are necessary to account for the observed LOP effects on implicit memory tests. Neither of the two explanations, though, renders the conclusion invalid that, overall, there are no or only small LOP effects on implicit tests.

It has to be pointed out, though, that most priming studies operate within the visual domain. Hence, it is of utmost importance, not the least in the wider context of the acquisition of the knowledge about words from oral input, to establish whether or not priming effects as well as dissociations between implicit memory and explicit memory comparable to the visual domain can be observed in the auditory domain. Schacter and Church’s (1992) study of auditory priming adduces crucial
evidence in support of auditory priming effects and the dissociation between implicit and explicit memory.

Schacter and Church (1992), manipulating study-task conditions by using two study tasks, a semantic task requiring subjects to make category judgements about target words (elaborative study condition) and a nonsemantic task (nonelaborative study condition) requiring subjects to make pitch judgements about the voices of the speakers presenting the target words, report dissociations between implicit and explicit memory. That is, implicit memory, demonstrated by significant priming effects on auditory word identification clearly dissociates from explicit memory, demonstrated by large effects of the semantic study-task condition on the recognition task in the absence of any effect on the priming task (Experiment 2).

Moreover, Schacter and Church (1992) replicate these dissociations in another experiment (Experiment 4), using an auditory word-stem completion task and two study tasks different to Experiment 2, a semantic task requiring subjects to rate the meaning of each word on a 4-point scale and a nonsemantic task requiring subjects to rate the clarity of each word on a 4-point scale, as well as a cued-recall test. Significant priming is not affected by the study condition using the semantic task, whereas significant effects of the semantic task on the cued-recall test are observed.

Studies employing cross-modal designs, investigating modality effects on priming, however, show reduced priming if study task and test task are not within the same modality, for instance, if modality changes occur from an auditory study task to a visual perceptual identification test (cf. Graf, Shimamura and Squire, 1985; Jacoby and Dallas, 1981; Kirsner, Milech and Standen, 1983; Levy and Kirsner, 1989), to a lexical decision test (cf. Kirsner, Milech and Standen, 1983; Scarborough, Gerard and Cortese, 1979) or to a word-fragment completion test (cf. Roediger and Blaxton, 1987).

On the other hand, study-to-test modality shifts show little or no effect on recognition and recall tests (cf. Graf, Shimamura and Squire, 1985; Jacoby and Dallas, 1981; Roediger and Blaxton, 1987). Modality effects of reduced priming are also evidenced in further studies.
involving study-to-test modality shifts from visual study tasks to auditory perceptual identification tests (cf. Ellis, 1982; Jackson and Morton, 1984) and auditory word-stem completion tests (cf. Bassili, J., Smith, M. and MacLeod, C., 1989), (see Richardson-Klavehn and Bjork, 1988, Roediger and McDermott, 1993, Schacter, 1987 and Schacter and Church, 1992, for reviews).

In the same vein, cross-lingual and context effects of minimal priming or no priming at all are observable. Firstly, Durgunoglu and Roediger’s (1987) study confirms the language specificity of priming observed in earlier studies with bilinguals by Kirsner, Brown, Abrol, Chadha and Sharma (1980) and Scarborough, Gerard and Cortese (1984) using lexical decision tasks and Watkins and Peynircioglu (1983) using a word-stem completion task. The language specificity is further supported by a more recent study by Gerard and Scarborough (1989) using, again, a lexical decision task (cf. Roediger and McDermott, 1993). That is, cross-lingual priming is typically insignificant, whereas same-language priming is significant.

Secondly, studies by Jacoby (1983), Levy and Kirsner (1989), MacLeod (1989) and Oliphant (1983) reveal context effects of minimal priming or no priming at all if study tasks present words in context rather than in isolation, such as reading texts with words (priming targets) embedded in sentences. These studies use ‘standard’ implicit memory tasks, as test tasks, such as a perceptual identification task in case of Jacoby’s (1983) study and Levy and Kirsner’s (1989) study, a fragment completion task in case of MacLeod’s (1989) study, and a lexical decision task in case of Oliphant’s (1983) study.

Levy and Kirsner (1989) (Experiment 1) and Oliphant (1983) report normal priming if the study task involves isolated words, but demonstrates no priming if the study task presents words in a textual context. Jacoby (1983) and MacLeod (1989) (Experiments 1 and 2) confirm the normal priming effect if the study involves isolated words, but also report priming effects, though small, if the study task presents words in a textual context.

These results may suggest that priming is affected if the study of words is only indirectly related to the task requirements. This conclusion is drawn by Levy and Kirsner (1989) who hold that successful transfer of perceptual processing crucially depends on the reinstatement of the same textual context during the
test task. Hence, Levy and Kirsner (1989), acknowledging Jacoby’s (1983) and MacLeod’s (1989) findings, conclude:

“...that transfer is not as ‘all or none’ as our data and those of Oliphant might suggest’, but “...that reinstatement of the original processing event appears to be critical to the later transfer observed” (p.414).

However, the adduced supportive evidence, coming from Levy and Kirsner’s (1989) Experiments 2 and 3 and showing that successful transfer of perceptual processing occurs if the textual context is reinstated during testing, is to be considered weak evidence since the test tasks used are explicit memory tasks, such as recall tasks and tasks to fill in blanks in the reinstated texts and, thus, cannot be compared with the above priming studies using implicit memory tasks. Hence, research on context effects is still to be expanded before Levy and Kirsner’s (1989) claim can be considered as confirmed. The above context effects, though, may be explained as an attentional phenomenon and, thus, will be reconsidered below.

It is obvious that in most priming studies subjects are adults. However, it is of utmost importance, in particular, in the wider context of the acquisition of the knowledge about words, to establish whether the priming phenomenon is also observable with children. Hence, in addition to the above-mentioned studies with adults only, some findings from priming studies involving children are presented. Naito and Komatsu (1993) report priming studies with children of different age, ranging from 3 year olds to 12 year olds as well as adults, using, for instance, a word production task (cf. Greenbaum and Graf, 1989) and a word-fragment completion task (cf. Naito, 1990) and providing evidence for dissociations between implicit and explicit memory for words in children as well as in adults. Greenbaum and Graf (1989), for instance, provide strong evidence for similar priming effects on word production tasks across the investigated age range (3, 4 and 5 year olds), but increased effects on explicit recall tasks, suggesting that
implicit memory does not change in early childhood, whereas explicit memory increased with age.

These results are corroborated and extended by Naito’s (1990) priming study involving school children from 6 to 12 years of age and adults. Again, strong evidence is provided in regard to the similarity of priming effects on word-fragment completion tasks across the overall age range from middle childhood to adulthood as well as an increase in recall and recognition with age.

Naito and Komatsu (1993) conclude that

“…explicit memory improves with age, implicit memory remains stable from 3-year-olds to adults”, that is, “…implicit memory in schoolchildren is functionally equivalent to that in adults” (p.246).

In the same vein, as various perceptual implicit tasks demonstrate repetition or direct priming effects in regard to word identification, studies investigating morphological priming, using identification tasks (cf. Murrell and Morton, 1974) and, more recently lexical decision tasks (cf. Bentin and Feldman, 1990; Feldman, 1992, 1994; Forbach, Stanners and Hochhaus, 1974; Fowler, Napps and Feldman, 1985; Schriefers, Friederici and Graetz, 1992; Stanners, Neiser, Hernon and Hall, 1979), clearly demonstrate morphological priming effects in regard to inflections and derivations across various languages, such as English, German, Hebrew and Serbian. These morphological priming effects are dissociated from effects of repetition or direct priming of words in that words prime morphologically related words, even if orthography or phonology of prime and target do not overlap (cf. Feldman, 1994).

In addition, compared to equivocal results of earlier studies by Fowler et al. (1985) and Stanners et al. (1979) with native speakers of English showing either insignificant or significant differences respectively concerning priming effects of inflectional and derivational morphology, Feldman (1994), provides convincing evidence for significant differential priming effects in regard to inflections and derivations. Feldman (1994), conducting a series of priming experiments involving native speakers of Serbian, concludes:
“The primary finding [...] was that inflectional primes produced significantly greater facilitation (of lexical decisions, D.P.H.) than did derivational primes” (p.464), whereby, “Similarity of form defined by orthographic and phonological overlap of morphologically-related primes and targets is not a necessary condition to produce facilitation” (p.466).

However, Feldman’s study shows only minimal, insignificant priming of nonwords that are morphologically related. These results will be evaluated below in the context of the discussion of the current status of novel word (nonword) priming.

Although these results illuminate the word identification process in that the presentation of a morphologically related word primes the identification of a word, it is only until Rueckl, Mikolinski, Raveh, Miner and Mars’ (1997) recent study, reporting morphological priming effects in regard to inflections and derivations and dissociations between implicit and explicit memory, that the implicitness of morphological priming becomes apparent. Rueckl et al. (1997) use a modified word-fragment completion task (‘masked fragment completion task’) and a free recall task and manipulating the levels of processing through an elaborative study task (rating of familiarity of presented words) and a nonelaborative study task (counting the number of sounds in each word presented). Rueckl et al. (1997), firstly, ascertain the absence of contaminations of priming effects by explicit memory processes by demonstrating only insignificant effects of LOP on priming in the masked fragment completion task, but significant effects of LOP on free recall (Experiment 1). Rueckl et al. (1997), secondly, employ the masked fragment completion task to investigate morphological priming, using four different study-task conditions: (i) the repeated condition – prime and target word are the same, (ii) the morphologically related condition – prime contains inflection or is a derivation of the target word, (iii) the formally related condition – prime is a morphologically unrelated word containing the target word as its initial segment, and (iv) the unprimed
condition – prime is neither morphologically nor formally related to the target word (Experiment 2). The results show significant priming in the morphologically related condition, though less priming than in the repeated condition and insignificant priming in the formally related condition.

However, a further experiment (Experiment 3) investigating orthographic similarity effects on morphological priming provides evidence that the magnitude of morphological priming is affected by orthographic similarity, which is in line with Feldman’s (1994) findings in that orthographic and phonological overlap is not a necessary condition for morphological priming to occur.

In short, the above presented findings from priming studies involving adults and children operating in the visual domain, as well as in the auditory domain provide considerable evidence in support of the dissociation between implicit and explicit memory of words, but also provide insights into the conditions that constrain priming of words, such as study-to-test changes of language, modality and probably textual context as well as insights into the conditions that do not affect priming of words, such as duration of presentation or massed presentation during study and depth of processing.

Furthermore, findings from priming studies, investigating morphological priming, provide compelling evidence in support of the dissociation between implicit and explicit memory for morphologically related words, whereby the priming of morphologically related words is not dependent on orthographical or phonological similarity of prime and target.

Additional, compelling evidence for the dissociation between implicit and explicit memory for words comes from numerous repetition priming studies with patients suffering from anterograde amnesia characterised by “…poor acquisition and retention of new episodic and semantic information” (Mayes, 1988, p.124), showing intact implicit memory but deficient explicit memory for words. Studies reported by N. Ellis (1994a), Schacter (1987), Schacter, McAndrews and Moscovitch (1988) and Shimamura (1986, 1989) provide unequivocal evidence for priming effects on the retention of words, demonstrated in lexical decision tasks (cf. Moscovitch, 1982), perceptual identification tasks (cf. Cermak, Talbot, Chandler and Wolbarst, 1985), and word-stem as well as word-fragment

Taken together, there is unequivocal evidence for the priming of words in normal and amnesic subjects without any mediating role of explicit memory.61

However, results from studies investigating the priming of novel words (nonwords) is not as straightforward, neither in normal nor in amnesic subjects (cf. Schacter, 1987; Bowers and Schacter, 1993).

Priming studies with normal subjects provide mixed results with some studies showing no priming or minimal priming of nonwords (cf. Bentin and Moscovitch, 1988; Forbach, Stanners and Hochhaus, 1974; Forster and Davis, 1984; Scarborough, Cortese and Scarborough, 1977) and others demonstrating significant priming of nonwords (cf. Carr, Brown and Charalambous, 1989; Cermak, Talbot, Chandler and Wolbarst, 1985; Feustel, Shiffrin and Salasoo, 1983; Rueckl, 1990; Salasoo, Shiffrin and Feustel, 1985; Whittlesea and Cantwell, 1987).

Recent priming studies with amnesic patients, on the other hand, provide strong evidence for nonword priming in amnesics (cf. Gabrieli and Keane, 1988; Haist, Musen and Squire, 1991; Musen and Squire, 1991) and a convincing argument put forward by Haist et al. (1991) demonstrates the lack of priming effects for nonwords in earlier studies by Cermak, Talbot, Chandler and Wolbarst (1985) and Diamond and Rozin (1984) may well have been “…due to normal subjects’ employing explicit memory strategies rather than to amnesic patients’ failing to exhibit implicit memory” (Haist, Musen and Squire, 1991, p.276).

Haist, Musen and Squire (1991) point out that Cermak et al. (1985) report some degree of nonword priming in amnesic patients but far better results for the normal, control subjects. They argue that the impaired priming in amnesics relative to normal, control subjects can be explained as a consequence of multiple presentations on nonwords until word identification in a perceptual identification task is achieved, allowing normal subjects to use explicit memory (recall) to retrieve previously studied nonwords, but not amnesic patients due to their impaired explicit memory. A comparable advantage/disadvantage
may have caused the impaired priming of nonwords in amnesics relative to controls in Diamond and Rozin’s (1984) study in that the explicit nature of the used cued-recall test allows normal, control subjects but not amnesics to use explicit memory (cf. Graf, Squire and Mandler, 1984; Schacter, 1987).

Furthermore, Bowers and Schacter (1993) highlight the possibility that the lack of priming effects or minimal priming effects for nonwords in studies with normal subjects (cf. Bentin and Moscovitch, 1988; Forbach, Stanners and Hochhaus, 1974; Forster and Davis, 1984) and with amnesic patients (cf. Gordon, 1988; Smith and Oscar-Berman, 1990) may have been due to the particular task type – lexical decision test – used to test for nonword priming effects since significant nonword priming effects have been observed, for instance, in studies with normal subjects, using identification or naming latency tasks (cf. Cermak, Talbot, Chandler and Wolbarst, 1985; Feustel, Shiffrin and Salasoo, 1983; Rueckl, 1990; Salasoo, Shiffrin and Feustel, 1985; Whittlesea and Cantwell, 1987) and in studies with amnesic patients, using identification or reading tasks (cf. Gabrieli and Kean, 1988; Haist, Musen and Squire, 1991; Musen and Squire, 1991).

This would also explain the minimal, insignificant morphological priming of nonwords in normal subjects (cf. Feldman, 1994) reported below.

Haist et al.’s (1991) study, investigating the priming of words and nonwords in amnesia, takes into account of the above, potentially confounding variables by using a perceptual identification task and by introducing measures to prevent the use of explicit memory. These measures are an increase in the number of test items, a reduction in the number of presentations of test items to one, and instructions in line with the implicit nature of the test (cf. Graf, Squire and Mandler, 1984).

The results of Haist et al.’s (1991) study clearly show

“…that equivalent word and nonword priming occurred in both amnesic patients and normal subjects, despite the fact that amnesic patients were impaired relative to normal subjects on a recognition memory test involving the same words and nonwords that served as old items on the perceptual identification test” (Haist, Musen and Squire, 1991, p.282).
In other words, the dissociation between implicit and explicit memory for words is observed in the priming of words and nonwords in normal subjects as well as in amnesic patients.

Although there is currently lack of evidence in support of morphological priming of nonwords, the available data involving a lexical decision task (cf. Feldman, 1994), showing only minimal, insignificant morphological priming of nonwords in normal subjects, point to the same task-specific problems encountered in all studies of nonword priming employing lexical decision tasks. Hence, it seems to be plausible to assume that further studies using more suitable task designs will eventually confirm the morphological priming of nonwords.

Converging evidence from neurological investigations in the dissociation of brain systems related to implicit and explicit memory (cf. Paller, 1990; Squire, Ojemann, Miezlin, Petersen, Videen and Raichle, 1992) reported by Squire (1992) gives additional strength to the above evidence for the dissociation between implicit and explicit memory systems in the priming paradigm.

Paller’s (1990) study, eliciting ERP’s (Event Related Potentials) in distinct study-task conditions, shows electrophysiologically distinct processes related to subsequent priming in word-stem completion and recall. Squire (1992) comments on Paller’s study results:

“...when word stems were presented with instructions to form the first word to come to mind (i.e. priming instructions), there was reduction in blood flow in right extrastriate cortex compared with the baseline condition. By contrast, in a condition that was identical except that subjects were instructed to complete
word stems with study words (i.e. memory instructions), there was an increase in blood flow in the right hippocampal region compared with both the priming and the baseline conditions” (p.214).

Squire (1992) concludes:

“Thus, brain systems related to declarative memory could be distinguished anatomically from brain systems related to priming” (p.214).

Hence, it seems that the explanatory approach assuming distinct memory systems parsimoniously accounts for the evidence outlined above, whereas other prominent explanatory approaches can not.

Schacter (1987), reviewing current explanatory approaches regarding priming, points out shortcomings in all approaches. First, the ‘activation approach’ (cf. Graf and Mandler, 1984; Mandler, 1980; see also Mandler, 1989) holding that priming effects are due to the activation of preexisting representations, for instance, cannot account for the evidence of implicit memory for novel words (nonwords) that do not have preexisting representations. Second, the ‘processing approach’ (cf. Jacoby, 1983; Roediger and Blaxton, 1987; see also Roediger, Srinivas and Weldon, 1989; Roediger, Weldon and Challis 1989) holding that dissociations in performance on implicit perceptual tests and on explicit recall and recognition tests are due to the involvement of distinct processes in the respective tests – data-driven processes in implicit tests and conceptually driven processes in explicit tests – cannot account for the absence of awareness of a prior presentation of a word in data-driven processes compared with conceptually driven processes that are typically associated with awareness64. And third, the ‘multiple memory systems approach’ (cf. Cohen, 1984; Cohen and Squire, 1980; Squire, 1982, 1986, 1987; Tulving, 1972, 1983, 1985a; Weiskrantz, 1987) holding that dissociations between implicit and explicit memory are due to differences in the properties of their underlying systems, such as, the property of explicit recollection of knowledge stored in explicit, declarative memory and the property of
“on-line modification of procedures or processing operations” (Schacter, 1987, p.511) of implicit, procedural knowledge considered to entail skill learning and priming without awareness, cannot account for more recent evidence suggesting a dissociation between priming and skill learning (cf. Butters, 1987) and the mixed results in the priming of novel words (nonwords) in amnesic patients. However, in the light of the current evidence outlined above, in particular, in the light of recent evidence in support of successful priming of nonwords in amnesic patients (cf. Gabrieli and Keane, 1988; Haist, Musen and Squire, 1991; Musen and Squire, 1991) and in support of a more differentiated multiple memory systems approach (cf. Schacter, 1992a; Squire, 1992; Tulving and Schacter, 1990) distinguishing implicit, procedural memory from implicit memory involved in priming, weaknesses of the multiple memory systems approach highlighted by Schacter (1987) are being rendered obsolete. Considering the lack of explanatory solutions to the above mentioned shortcomings of the activation and processing approaches, the plausibility of the multiple memory systems approach is compelling.

In conclusion, results from priming studies presented above suggest that, when encountering a novel word, form-based knowledge of that word is acquired implicitly and stored in implicit memory and that newly acquired form-based knowledge primes the identification of that word at a later point in time without awareness of the prior encounter. Meaning-based knowledge of that word, on the other hand, is acquired explicitly and stored in explicit memory and facilitates the recall or recognition of that word at a later point in time, involving awareness of the prior encounter. In case of encountering a familiar word, priming is based on the activation of preexisting, implicit form-based knowledge and recall and recognition are facilitated by preexisting explicit meaning based knowledge. The particular kind of form-based knowledge acquired mostly depends on the modality and language the word encountered is in. That is, firstly, in case of a visual encounter of the word the orthographic word form is acquired and in case of an auditory encounter of the word the phonological word form is acquired, whereas the morphological word form is acquired in either of the conditions. Secondly, the acquisition of all three kinds of form-based knowledge has to
occur in each language to be acquired except in cases of overlaps between these languages.

Evidence in support of these conclusions is being adduced, firstly, by the consistent finding of a dissociation between implicit and explicit memory for words manifested in an improved performance on implicit word identification unaffected by explicit memory for the words identified and an improved performance on explicit word recall and recognition affected by explicit memory. The psychological reality of implicit memory holding implicit knowledge derived from the perception of word features – orthographical and phonological as well as morphological features – and explicit memory holding explicit knowledge derived from the extraction of meaning from presented words is, however, not only demonstrated by the time lag between presentation of a word or nonword and the respective memory tests, requiring storage of the particular knowledge in order to affect priming or recollection, but is also demonstrated by evidence showing longer-term retention of effects on priming and recollection.

Secondly, evidence in support of the above conclusions is also provided by findings from studies manipulating levels of processing (LOP). These studies suggest that priming effects are due to implicit, form-based knowledge, since explicit meaning-based word knowledge, acquired during elaborative processing of the study task, has no or only a minimal effect on implicit word identification, but a large effect on explicit word recall and recognition.  

Thirdly, further evidence in support of the above conclusions is provided by the finding that priming also occurs with novel words. Since novel words do not have preexisting representations in memory, observed successful performances on implicit and explicit tests suggest that the knowledge to perform these tests must have been acquired on the basis of at least one prior encounter and, thus, cannot be explained as an activation of preexisting representations.

Fourthly, more evidence in support of the above conclusions is coming from findings involving study-to-test modality changes. The acquisition of
modality-specific word form knowledge is supported, since modality changes at test consistently show a reduction in priming. Such a reduction can be expected, because the acquired word form during study does not appear during the testing administered in a modality relying on different word form knowledge. Hence, orthographic word form knowledge does not prime phonological word form knowledge and vice versa, since they are modality-specific. It can be acquired during a visual or an auditory encounter with a word, which is in line with the finding presented above that morphological priming does not depend on orthographical or phonological similarity.

This finding may also explain why modality shifts still lead to significant priming effects (cf. Kirsner, Dunn and Standen, 1989; Roediger and Blaxton, 1987), though reduced and thus, supports Schacter’s (1992a, 1994) cautious view not to assume explicit memory to be involved in cross-modal priming.

Finally, in a similar vein as the foregoing argument, insignificant priming due to study-to-test lingual changes does reflect the language-specificity of word form knowledge, which typically can be expected. Nevertheless, overlaps between L1 and L2 word forms may account for intact priming also reported (cf. Roediger and McDermott, 1993).

The above evidence in support of the conclusions drawn from the findings of priming studies presented is in line with Schacter’s (1992a, 1994) argument in support of a ‘perceptual representation system’ (RPS) (see also Schacter and Church, 1992 and Tulving and Schacter, 1990), but extends his argument by including morphological word form knowledge as another kind of word form knowledge that is acquired when encountering a word. Since morphological word form knowledge is not modality-specific, it can be acquired either when encountered in the visual domain or the auditory domain. Furthermore, contrary to Schacter (1992a, 1994), the locus of the store of implicit word form knowledge is defined. Processability Theory inferred from Levelt’s (1989) theory of speech production holds that word form knowledge is stored in the mental lexicon, a crucial processing resource in the Formulator’s grammatical (and phonological) encoding procedures.
Applied to the internal structure of a lexical entry in Processability Theory based on Levelt’s (1989) theory, the form information about a lexical item’s morphology and phonology, that is, its morphological structure, and its metrical pattern as well as segmental composition constitutes knowledge of an implicit nature and is acquired implicitly.66

The semantic information of a lemma, on the other hand, as distinct from the syntactic information of a lemma, i.e. the lemma’s meaning, defined by its conceptual specification and its conceptual arguments, constitutes knowledge of an explicit nature and is acquired explicitly.

On the surface, the conclusions drawn in regard to the acquisition of form and lemma information seem to mirror N. Ellis’ (1994a) conclusions drawn from his review of research related to vocabulary acquisition.67 N. Ellis (1994b) summarises:

“These diverse areas of research reveal that vocabulary acquisition neither depends solely on implicit learning, nor does it purely reflect explicit learning. Rather, there is a dissociation whereby the recognition and production aspects of vocabulary learning rely on implicit learning, but meaning and mediational aspects of vocabulary heavily involve explicit, conscious learning processes” (p.12).

Leaving aside the production aspects that are to be analysed below and N. Ellis’ (1994a) exclusive focus on orthography and phonology in regard to word identification, which is understandable since it is only very recent research that shows the contribution of morphology in the word identification process, it is not clear to me how N. Ellis (1994a, 1994b) could arrive at his conclusion regarding the implicitness of the acquisition process of word form information. N. Ellis’ (1994a, 1994b) conclusion drawn from the evidence of observed minimal nonword priming or the total lack thereof is: “...it is generally found that nonwords show either no or minimal priming effects” (p.225). This conclusion, firstly, ignores studies showing significant priming of nonwords and,
secondly, but most importantly, disregards the explanatory weight of recent arguments, explicated above, in conjunction with recent studies providing strong evidence for successful priming of novel words (nonwords) in normal subjects and amnesic patients, thus, giving away the crucial evidence for the acquisition of form information of new words, that is, words without preexisting representations.

Hence, N. Ellis’ (1994a, 1994b) conclusion regarding the implicitness of the acquisition process of word form information is irreconcilable with his view that novel words (nonwords) do not show priming effects.

In order to appreciate the above conclusions drawn from memory research, illuminating the nature of the knowledge representing of lemma and form information of lexical entries into the mental lexicon and the nature of the acquisition process of this knowledge, it seems appropriate to point out another approach pursued by de Bot, Paribakht and Wesche (1997), aiming to model the processes leading from an encounter of a word to its entry into the mental lexicon.

De Bot et al. (1997) take Levelt’s (1989) theory of speech production and Levelt’s (1993) update, detailing the working of the ‘Comprehension System’ or ‘Parser’, as the basis for the development of a lexical processing model that could serve as a point of departure for further studies investigating the acquisition of second language vocabulary.

De Bot et al. (1997) plausibly assume that in order to arrive at the meaning of a novel word the comprehension process may hold some cues as to how incoming novel words may be processed.

Levelt’s (1993) ‘Comprehension system’ or ‘Parser’, taking into account recent theoretical advances in word recognition (cf. Marslen-Wilson, 1987, 1989), consists of two components, one a phonological decoder of incoming messages and the other a grammatical decoder of input from the phonological decoder that have both access to the mental lexicon. That is, these two processors, although hierarchically ordered, are not autonomous, but rather open to feedback from higher order processors, which led de Bot et al. (1997) to point out the
difference between comprehension and production:

“...whereas in production all information is basically top-down, in comprehension there is an interaction between bottom-up information (letters or sounds, morphemes, etc.) and top-down information (knowledge of the world, the discourse setting, the text, the sentences, etc.)” (p.316),

thus, potentially requiring a gradual building-up of form (lexeme) and lemma information of each incomplete lexical entry.

However, as de Bot et al. (1997) concede:

“...we can as yet only speculate about how the process of extracting meaning from context and adding information to a developing lemma actually takes place” (p.317),

it becomes evident that their approach is only the very beginning of a potentially fruitful research programme, but does not offer any conclusions that could provide guidance for instructional intervention in order to effectively organise the second language acquisition process.

So far, the above investigation, firstly, disconfirms Pienemann’s (1998a) and Levelt’s (1989) assumption about the explicit nature of the word form knowledge stored in the mental lexicon in that it demonstrates that form information of a lexical item is implicit, nondeclarative knowledge, stored in implicit, nondeclarative memory and is acquired implicitly. And, secondly, the above investigation confirms Pienemann’s (1998a) and Levelt’s (1989) assumption that meaning-based lemma information is explicit, declarative knowledge, stored in explicit, declarative memory and is acquired explicitly.

However, that still leaves unanswered the question, whether or not the syntactical lemma information of a lexical entry, that is, a word’s syntactic category (e.g. noun, verb, adjective, preposition etc.) and the arguments it can take (e.g. subject, direct object, indirect objective etc.), constitutes implicit or explicit
knowledge. Unfortunately, memory studies do not speak directly to that issue.
In order to arrive at some plausible assumptions about the implicitness or explicitness of syntactical lemma information, such as, for instance, the syntactic category of ‘sparrow’ is

“…a count noun” and “…the verb ‘give’ is characterized as a verb (V) which can take a subject expressing the actor X, a direct object expressing the possession Y and an indirect object expressing the recipient Z” (Levelt, 1989, p.11),

strong arguments and supportive evidence are presented below for an acquisition process mainly based on distributional analysis of pertinent input. Such acquisition process can be assumed to be implicit, but can also be affected by semantic information in the input, which can be assumed to be explicit. Although arguments and evidence in support of an implicit acquisition process, to be presented below, are concerned with first language acquisition, it is assumed that the implicitness or explicitness of syntactical lemma information is the same across primary and secondary languages. Since the general premise of Processability Theory is that the nature of the grammatical processor does not change across distinctly different learners and languages, that must imply that the nature of the mental lexicon does not change either since it is pivotal to the functioning of the grammatical processor.

Bowerman (1982), Braine (1987, 1988), Maratsos (1982, 1988) and Maratsos and Chalkley (1980) argue that syntactic categories and syntactical relations cannot be acquired purely on the basis of semantic information inherent in words belonging to a particular word class, but rather that

“...formal grammatical categories are formed and shaped by the sets of grammatical operations in which their members participate” (Maratsos, 1982, p.241).

Maratsos (1982, 1988) acknowledges that nouns, for instance, are generally made up of persons and places and that languages that distinguish between
verbs and adjectives have most action words in the word class ‘verb’ and most stative words in the word class ‘adjective’, but, at the same time, points out that semantic information in categories is by no means consistently available, as evident, for instance, in the arbitrariness of German noun gender classes and the English -ed past tencing of the verb class.

Maratsos (1982) concedes that there are German nouns that denote masculine entities, such as ‘Mann’ (man) or ‘Junge’ (boy), or feminine entities, such as ‘Frau’ (woman), that belong to respective masculine or feminine noun gender classes, but, on the other hand, highlights the arbitrariness of noun gender classes for words, such as ‘Löffel’ (spoon), (masculine), ‘Gabel’ (fork), (feminine) and ‘Messer’ (knife), (neuter).

The lack of predictive power of semantic information in regard to German gender noun classes is also evident in regard to the English verb class.

For instance, many verbs denoting action or action-like qualities take -ed past tencing, but many verbs that do not denote action or action-like qualities take -ed past tencing as well (e.g. liked, consisted, belonged, comprised etc.).

Maratsos (1982, 1988) argues that predictability, for instance, in regard to the German gender noun classes or the English verb class is not to be found in the semantic denotations of words but rather in their commonly shared grammatical combinations. Concerning German gender noun classes, Maratsos (1982) points out that the combinational possibilities of each German gender noun set constitute a system that enables

“…a knowledgeable speaker” when hearing “…a single definite determiner use of a noun in a nominative or accusative context” to “…predict all of the other determiner, pronominal and adjectival uses of the class” (p.243).

In regard to the English verb category, Maratsos (1982) highlights the predictive power of related grammatical uses making up the distinctive properties of that word class, such as -ed past tencing that is predicted by its relations to present tencing and the use of do:

“A good predictor of whether a relational term will take -ed past
tensing is whether it can take -s tensing, or nothing at all (He likes it; I like it; We liked it; He kicks it; I kick it; We kicked it) [...] Other possible predictors include whether a term can take preceding forms of do; if it can, it can also take -ed past tensing (He doesn’t like it; I don’t like it; I didn’t like it; I liked it)” (p.244).

Subsequently, Maratsos argues for a process of syntactic category acquisition as a process of acquiring knowledge of grammatical uses that predict each other:

“This system of cross-implicational uses must form the basis for a process of category formation which operates when some groups of words share enough structural properties to justify forming a category” (Maratsos, 1988, p.34).

A similar argument is put forward in regard to the acquisition of syntactical relations (grammatical functions) of syntactic categories, such as subject, object etc.

Maratsos and Chalkley (1980) demonstrate the inadequacy of explanatory approaches basing the acquisition of syntactical relations on purely semantic analyses. They point out that the acquisition of important properties making up the grammatical subject in English, such as its placement in initial position, before the main verb or copula verb in declarative sentences, its’ number agreement with the verb, its use of pronouns in the nominative case and others, cannot be predicted on the basis of a purely semantic account. For instance, the semantic roles, such as agent, patient, experiencer, stimulus, possessor, possessed object, location, located object etc., in relation to a verb do not predict which argument is the subject in a declarative sentence and, thus, can be expected to be in the initial position, before the verb since the

“...semantic-structural pattern [...] to be used is dictated by the particular pattern controlled by the relational term. ‘Own’ places the possessor NP initially, ‘belong (to)’ places the
possessed object initially. ‘Like’ takes experiencers first […] ‘please’ and ‘infuriating’ place the stimulus NP in initial position” (Maratsos and Chalkley, 1980, p.154).

Bowerman (1982), arguing strongly that syntactical relations of syntactic categories can be acquired without relying on semantic categories, adduces evidence in support of Maratsos and Chalkley’s (1980) as well as in support of her own conviction. Bowerman (1982) reports the study of two children’s early period of word combinations (cf. Bowerman, 1976), showing that there is only minimal reliance “…on semantic categories like ‘agent’” (Bowerman, 1982, p.333) by one child (Christy), but no reliance on such categories by the other child (Eva). Bowerman (1976) concludes about Eva’s quick transition to a mature application of rules or word combination:

“There is no evidence that she achieved this transition with the aid of relational concepts at a level of abstraction between the semantics of particular words and syntactic notions that are independent of any particular semantic content, such as ‘subject’ and ‘direct object’” (p.58).

However, Maratsos does not ignore the fact that semantic information may have an effect on the acquisition of syntactic categories and syntactical relations. For instance, in cases where German words have a truly masculine or truly feminine (mostly true) denotation, it may affect their categorisation as a member of the respective gender noun class, sharing the same set of grammatical uses of their class. Maratsos (1988) points out that similar semantic effects are reported to occur in the acquisition of Russian and Polish gender noun classes (cf. Maratsos and Chalkley, 1980; Smoczyńska, 1986). Semantic effects may also occur in cases where words denote concrete objects that may affect their categorisation as a member of the class of concrete common nouns. Similarly, words mapped onto semantic roles may affect their syntactic categorisation as well as their syntactical relations (cf. Bowerman, 1973; Braine, 1976; Maratsos, 1982, 1988; Maratsos and Chalkley, 1980).
In the same vein, Braine (1987, 1988) argues that, at least in some circumstances, the use of semantic categories may lead to the acquisition of syntactic categories and syntactical relations. He refers to his study of children’s first word combinations (cf. Braine, 1976) and shows that children map words onto semantic roles, such as ‘actor + action’, ‘possessor + possessed’ and others in the absence of syntactic categories and syntactical relations.

Hence, Maratsos’ (1982, 1988) Maratsos and Chalkley’s (1980) and Bowerman’s (1982) arguments and supportive evidence plausibly support the view that semantic information cannot be the knowledge that is centrally involved in the process of forming syntactic categories and syntactical relations, but may affect both in particular circumstances.

In agreement with Maratsos (1982, 1988) and Maratsos and Chalkley (1980), it is concluded that if semantic information cannot be the organising source, it must be the knowledge of grammatical uses shared by the words that defines their syntactic categories and syntactical relations. In other words, it is the memorisation of occurrences of related uses of words in combination with others that leads to the discovery of overall patterns of cross-correlations and the establishment of the distinctive properties of syntactic categories and syntactical relations.

In the context of the provision of evidence supporting the assumption that the procedural knowledge necessary to grammatically encode conceptual input (‘preverbal message’) is implicit, nondeclarative knowledge, acquired implicitly, particular evidence will be adduced below, showing that knowledge of syntactic categories and syntactical relations, acquired on the basis of distributional analysis is implicit, nondeclarative knowledge, too, acquired implicitly and held in implicit, nondeclarative memory.

Semantic information, on the other hand, that may support the process of defining syntactic categories and syntactical relations is explicit knowledge, acquired explicitly and stored in explicit, declarative memory or semantic memory (cf. Schacter and Tulving, 1994; Squire, 1986, 1992; Tulving, 1983, 1985a).

Hence, the overall conclusion drawn from the evidence to be adduced below, is, contrary to Pienemann’s (1998a) and Levelt’s (1989) assumption, that the syntactical lemma information of a lexical entry is implicit, nondeclarative
knowledge, acquired implicitly and stored in implicit, nondeclarative memory.

### 4.1.2 The allocation of attentional resources is a necessary condition for explicit and implicit learning, but must not involve awareness during implicit learning

There is considerable evidence from studies using dual-task designs in order to divide attention during stimulus identification (study task) (cf. Gabrieli, Stone, Shackleton, Thompson-Schill, Ladd, Vaidya and Chari, 1996; Kellogg, Newcombe, Kammer and Schmitt, 1996; Mulligan, 1998; Mulligan and Hartman, 1996; Parkin, Reid and Russo, 1990; Parkin and Russo, 1990; Smith and Oscar-Berman, 1990; Szymanski and MacLeod, 1996), showing that priming of known (old) words is not or only minimally affected under divided attention, thus, suggesting that priming of known (old) words is not dependent on attention during word encounter (study task).

At the same time, the above studies also demonstrate that performance on explicit tests is negatively affected by dividing attention during word encounter.

For instance, Mulligan (1998) (Experiment 3) compares the performance of normal subjects on an implicit word-fragment completion task with their performance on an explicit word-fragment cued-recall task. Mulligan manipulates the attentional load during the study task by asking subjects to randomly select digits and letters from respective sets of these items according to two rules.

The study task involves the presentation of the target words, one at a time, whereby subjects are instructed to read each word aloud and to memorise it. Mulligan (1998) finds that

“…dividing attention had a significant impact on word-fragment cued recall but no measurable impact on word-fragment completion” (p.35).

In other words, since orthographic, morphological and phonological word form knowledge is already represented in implicit memory, no attentional resources need to be allocated during word encounter, given that the identification
of stimuli during the study task is not disrupted (cf. Mulligan, 1998), in order to show priming effects when performing an implicit memory task drawing on such implicit knowledge. On the other hand, attentional resources need to be allocated during word encounter in order to perform an explicit memory task drawing on explicit meaning-based work knowledge stored in explicit memory. The latter finding corroborates well established earlier research results showing that performance on recall and recognition tasks (explicit memory tasks) is negatively affected by divided attention during stimuli presentation compared to focused attention (cf. Baddeley, 1986; Martin, 1970; Trumbo and Milone, 1971). However, the study by Smith and Oscar Berman (1990) also reveals that contrary to the priming of known (old) words, the priming of novel words (nonwords) depends on attention during the study task.

Smith and Oscar-Berman (1990) (Experiment 1) use a dual-task design as well as a single-task design. The dual-task design permits the division of attention during study by asking subjects to attend to certain events happening during the visual presentation of stimuli and to keep a mental record of the number of occurrences of such events. The single task design, on the other hand, does not disrupt the allocation of attentional resources during study.

Smith and Oscar-Berman (1990) report that in the single-task condition priming of novel words (nonwords) occurs, whereas in the dual-task condition priming of words is eliminated completely.

These findings clearly suggest that the initial encoding of, in this case, orthographical and morphological word form knowledge of a novel word in implicit memory requires the allocation of attentional resources during encounter. Furthermore, the findings from studies investigating the priming of novel words involving normal subjects and amnesic patients confirm that the word form knowledge acquired at encounter is acquired implicitly, i.e. without intention to learn and without awareness of the prior encounter of primes. Hence the implicitness of the acquisition process implies that the instructional condition during the learning phase is neutral in regard to the word form knowledge to be acquired in that it does not concurrently engage processes to explicitly acquire word form knowledge, which depend on intention and awareness.
In other words, the implicit acquisition of word form knowledge, which is independent of intention and awareness, requires the operation of a neutral instruction condition during study avoiding the concurrent engagement of explicit learning processes that are dependent on intention and awareness, though both learning processes, implicit as well as explicit, require attention. In this context, Smith and Oscar-Berman’s (1990) findings not only show that implicit learning of word form knowledge in the dual-task condition is eliminated due to the division of attention, but also indicate that the concurrent operation of implicit and explicit learning processes in their study, constituting such dual-task learning condition, may also lead to a disruption of the neutral instruction condition during study with subsequent detrimental effects on the implicit acquisition process of word form knowledge.

It seems plausible that in case of concurrently operating implicit and explicit learning processes, the implicit learning condition of neutral instruction is violated if concurrent explicit learning processes would aim at the acquisition of the very knowledge to be acquired implicitly, in this case word form knowledge. However, the possibility cannot be totally discounted that a disruption of the implicit learning condition characterised by the absence of intention to learn and awareness already occurs due to the concurrent engagement of explicit learning processes regardless of their focus, which would apply to Smith and Oscar-Berman's (1990) study.

In short, the negative effect of awareness on the implicit acquisition process of word form knowledge, manifested in the concurrent engagement of explicit learning processes may be twofold. It certainly generates a dual-task condition that leads to the division of attention, but it may also disrupt the neutral instruction condition.

The most likely source of disrupting the neutral instruction condition of implicit learning in a form acquisition setting seems to be the implementation of measures to induce a degree of salience in order to facilitate the implicit acquisition process.

Salience can be understood as the means by which learners’ attention is oriented towards the information to be detected. Since Posner and Petersen’s (1990) outline of the human attention system of interrelated attentional functions
identifies the attentional function of orientation to incoming stimuli as facilitative in regard to detection, the manipulation of the degree of salience can be considered a legitimate instructional measure to facilitate implicit learning processes (see chapter 2.3).

The importance of the operation of the condition of salience during the implicit learning of word form knowledge becomes apparent when considering the effects of contextually embedded word presentations on priming.

As reported above, studies by Jacoby (1983), Levy and Kirsner (1989), MacLeod (1989) and Oliphant (1983) reveal context effects of minimal or no priming if study tasks present words in context rather than in isolation, as can be typically observed in priming studies. These results suggest that the isolation of words provides the necessary salience, whereas the presentation of words in context does not provide such salience, unless measures are taken to increase the degree of salience.

It is in this context of deliberate manipulation of the degree of salience that the allocation of attentional resources must not involve awareness.

In other words, awareness as the manifestation of the concurrent engagement of explicit learning processes must be avoided in order to prevent the disruption of the neutral instruction condition.

This claim, based on the above argument is supported by evidence presented below in the context of the investigation of the nature of the acquisition process of predominantly implicit knowledge of complex rule-governed structures and of artificial and natural languages as second languages.

This investigation reveals that this acquisition process is predominantly of an implicit nature that requires the operation of the learning conditions of neutral instruction and salience and the allocation of attentional resources, but must not involve awareness.

Since the conditions of implicit learning of complex rule-governed structures and second languages do not differ from the conditions of implicit learning of word form knowledge, the exploitation of the evidence in support of the above claim that the allocation of attentional resources during the implicit acquisition process of word form knowledge must not involve awareness, is considered to be permissible (see chapters 4.2.4 and 4.2.5).
4.2 The grammatical processor

Neither Levelt (1989) nor Pienemann (1998a) specify the acquisition process of first and second language-specific processing resources respectively, but both assume that the procedural knowledge underlying the operations of the grammatical processor accounts for the time constrained nature of speaking by permitting automatic grammatical encoding processes that are not based on intention or awareness, and that such procedural knowledge is stored in the grammatical processor. Pienemann (1998a) indicates his position regarding the implicitness of procedural knowledge by pointing to the evidence in support of a dissociation between procedural and declarative knowledge cited by Paradis (1994). But he does not elaborate on the currently available evidence concerning dissociations between implicit, nondeclarative – procedural – and explicit, declarative knowledge and memory and their relevance for the acquisition process of language-specific processing resources.

Hence, the presentation of such evidence below is paramount in its contribution to the confirmation of the implicit nature of the procedural knowledge stored in procedural memory and underlying the time-constrained grammatical encoding operations of the grammatical processor.

4.2.1 Implicit knowledge of complex rule-governed structures stored in implicit memory, predominantly underlying procedural and cognitive skills, is dissociated from explicit knowledge stored in explicit memory


The first evidence for the dissociation between implicit and explicit memory dates
back to the 1960s, involving the well-known case of H.M.. H.M., a patient with severe anterograde amnesia, demonstrates the acquisition of motor skills, such as mirror tracing and pursuit rotor tracing in the absence of any recall of previous performances of the tasks (cf. Milner, 1962; Milner, Corkin and Teuber, 1968). Results from memory research in the 1980s, involving the acquisition of other skills, provide a substantial body of evidence in support of the dissociation between implicit, nondeclarative and explicit, declarative memory.

Studies involving amnesic patients provide particularly compelling evidence for such a dissociation due to amnesics’ deficient explicit memory. Therefore, the observation of normal performance based on a comparison with normal control subjects constitutes strong evidence for the dissociation between the two kinds of memory.

Evidence for such normal performance of perceptual and cognitive skills by amnesic patients will be presented below, as well as evidence from studies with normal subjects, supporting the dissociation between implicit, nondeclarative memory and explicit, declarative memory.

For instance, Nissen and Bullemer’s (1987) study (Experiment 4) uses a serial reaction time task, whereby amnesic patients as well as normal control subjects acquire the serial pattern of appearances of a stimulus in particular locations on a screen by reacting to the appearance of such stimulus in one of four possible locations in that they press one out of four keys aligned with the respective stimulus locations “…as fast as possible without making errors” (Nissen and Bullemer, 1987, p.7). By completing four blocks of 100 trials each in the ‘repeating condition’ with the pattern of appearances in particular locations embedded in a 10-trial sequence and another four blocks of 100 trials each in the ‘random condition’ with random appearances of the stimulus in a particular location, amnesic patients and normal control subjects show a similar reduction in reaction time during the first four blocks and a similar sharp increase in reaction time in the fifth block. Nissen and Bullemer interpret the reaction time reduction during the first four blocks as a reflection of the acquisition of the underlying serial pattern and the increase in reaction time in the random condition as further support for the above interpretation, since the acquired serial pattern could not be transferred to the random sequence. Furthermore, subjective reports
obtained from amnesic patients clearly show a lack of awareness of the acquired serial pattern.

In short, the implicit, nondeclarative knowledge acquired by amnesics, underlying the acquisition of perceptuo-motor skills and reflected in decreased reaction times, as well as the lack of awareness of the acquired serial pattern, reveal the dissociation between implicit, nondeclarative knowledge and explicit, declarative knowledge and subsequently reveal the dissociation between the respective memory stores holding the two kinds of knowledge.

These results are confirmed by another study with amnesic patients reported by Nissen, Willingham and Hartman (1989).

Willingham, Nissen and Bullemer (1989), following up the study reported by Nissen and Bullemer (1987) with normal subjects (Experiment 1), again, use the serial reaction time task of the Nissen and Bullemer (1987) study. However, in order to establish the acquisition of the serial pattern in the absence of declarative knowledge, they, firstly, obtain subjects’ reports concerning their awareness of the serial pattern and analyse data from the reaction time task. They distinguish three groups of subjects on the basis of the subjects’ reports, a group ‘with no explicit knowledge’ of the serial pattern, a group ‘with some explicit knowledge’ and a group ‘with full explicit knowledge’. Secondly, they introduce a general task designed to engage explicit knowledge by requiring the same subjects to react to the appearance of the stimulus in one of four possible locations on a screen, in that they press one out of four keys aligned with the respective stimulus locations that would match the expected location of the stimulus to appear next, thus, generating the serial pattern. The analysis of the data, again, distinguishes the above three groups according to the degree of explicit knowledge acquired.

Data from the completion of four blocks of 100 trials, each in the ‘repeating condition’, whereby subjects react to the appearance of a stimulus in one of four possible locations in that they press one out of four keys aligned with the respective stimulus locations “…as fas as possible without making errors” (Willingham et al., 1989, p. 1048), demonstrate a substantial reduction in reaction time by the group ‘with no explicit knowledge’ (94msec) reflecting a substantial acquisition of implicit knowledge of the serial pattern underlying the perceptuo-motor skills, but even more substantial reductions in reaction time
by the group ‘with some explicit knowledge’ (118 msec) and the group ‘with full explicit knowledge’ (205 msec).

Willingham et al. (1989) point out that these exceptionally fast responses can be explained as anticipatory responses, that is, subjects anticipate the onset of the stimuli and initiate a response before its appearance, facilitated “...by the use of the consistent response-to-stimulus interval” (Willingham et al., 1989, p.1050). A reanalysis of the reaction time data of all subjects, excluding ‘anticipatory responses’, i.e. responses

“...with latencies of less than 100 ms because such responses are much faster than what one would expect to obtain in a simple reaction time task” and are unlikely to reflect any process other than response execution”,

reveals that

“...subjects with no, some, and full explicit knowledge of the sequence demonstrated no significant differences in rate of learning” (Willingham et al. 1989, p.1050).

Hence, the results of Willingham et al.’s (1989) study, involving normal subjects confirm Nissen and Bullemer’s (1987) finding with amnesics. By removing the effect of explicit knowledge, i.e. by excluding anticipatory responses, the implicit, nondeclarative knowledge acquired by normal subjects, reflected in decreased reaction times, is dissociated from explicit, declarative knowledge and, thus, reflects the dissociation between the respective memory stores holding the two kinds of knowledge.

As pointed out by Willingham et al. (1989), these findings also constitute counterevidence to Anderson’s (1983) ACT* theory, which claims that “...all knowledge [...] starts out in declarative form and must be converted to procedural (production) form” (Anderson, 1987, p.196), in that implicit knowledge can be acquired in the absence of explicit knowledge, demonstrated by equivalent rates of learning by amnesic patients with deficient explicit memory and normal
subjects with no explicit knowledge compared to subjects with some or with full explicit knowledge.

Comparable results are reported by Lewicki, Czyzewska and Hoffman (1987). Their study with normal subjects demonstrates the acquisition of implicit, nondeclarative knowledge, underlying the acquisition of perceptuo-motor skills, in the absence of any explicit, declarative knowledge of the regularities underlying their performance and thus, supports Nissen and Bullemer’s (1987) finding of dissociations between implicit, nondeclarative knowledge and explicit, declarative knowledge and their respective memory stores.

If, however, as Willingham et al.’s (1989) second part of Experiment 1 reveals, a follow-on task, as the ‘generate task’, engages explicit knowledge, such knowledge, if acquired during the reaction time task or during the subsequent ‘generate task’, may contribute to the accuracy of performance. That is, the three groups of subjects distinguished according to their degree of explicit knowledge acquired during the initial reaction time task clearly show an increase of accuracy in the performance of the ‘generate task’ commensurate with the degree of explicit knowledge acquired. Data from the first block of trials on the ‘generate task’ show the following percentages of correct predictions: the group with no explicit knowledge: 42.6% correct, the group with some explicit knowledge: 62.4% correct, and the group with full explicit knowledge: 77.5% correct.

Further results in support for such dissociations come from memory research involving the learning of cognitive skills, such as the ability to perform grammatical classifications based on the implicit learning of the underlying artificial grammar as well as the ability to control production and social systems based on the implicit acquisition of the respective underlying rule system. These findings are of particular importance in that they provide a link between memory research and a considerable body of research on the implicit and explicit learning of the rules underlying complex systems, such as artificial grammars, production systems and social systems. Considering these results together affords us a more comprehensive understanding of the nature of the acquisition process of complex structures, the nature of the knowledge acquired and the memory stores holding such knowledge, which, subsequently, will have a bearing on the argument put forward below concerning the implicit nature of the acquisition process of the
knowledge constituting the language-specific processing resources underlying grammatical encoding.

Studies within the paradigm of artificial grammar learning provide considerable evidence for the implicit acquisition of knowledge underlying an array of presented, rule-governed letter strings generated by a finite-state grammar (Markovian grammar), which enable normal subjects to make judgements about the grammaticality or nongrammaticality of new letter strings well above chance level. 

Subjects in these studies typically receive neutral instructions, explaining the procedure of repeated presentations of letter strings and of the subjects’ task to reproduce presented items in writing. They are not told until after the presentation that letter strings presented reflect the regularities of an underlying rule system. On the basis of the presentation of letter strings generated by an artificial grammar and the successful reproduction of the letter strings, subjects implicitly acquire a knowledge base that enables them to classify new items as grammatical or nongrammatical well above chance level without being able to give a detailed account of the rules underlying the letter strings presented, or the rules underlying their own grammaticality judgements. That is, subjects are not aware of their knowledge permitting successful classification. Such knowledge is, thus, considered to be implicit.


Knowlton, Ramus and Squire’s (1992) study with amnesic patients applies the typical procedure used in studies of artificial grammar learning and described above.

The results of the classification task show no significant difference in correct classifications between amnesic patients (63.2%) and normal subjects (66.9%). However, in order to strengthen the evidence suggesting a dissociation between implicit and explicit memory in artificial grammar learning as well as
suggesting the implicitness of the knowledge materially underlying classification performance, Knowlton et al. (1992) firstly, also employ a recognition task, a typical explicit memory task (cf. Haist, Shimamura and Squire, 1992; Knowlton and Squire, 1995; Squire, 1992, 1994; Tulving, 1983) requiring subjects to respond with ‘yes’ or ‘no’ to the presentation of previously presented items (grammatical strings) and new items (nongrammatical strings). These previously presented items are, however, generated by an artificial grammar different to the one underlying the items in the above classification task.

Amnesic patients show a clear impairment in recognising letter strings shortly after their presentation (62%) compared to normal subjects (72.2%).

Knowlton et al. (1992), secondly, also employ a similarity judgement task, which is a classification task identical to the above mentioned classification task, with the exception that subjects are instructed to use their explicit memory for exemplars when judging the similarity of new items presented – grammatical and nongrammatical strings generated by the same artificial grammar already used in the above classification task – compared to the items previously presented.

Again, amnesic patients show a poorer performance on judging the similarity of new items to previously presented items (61.4%) compared to normal subjects (69.9%).

Furthermore, the repeated presentation of new items, generated by the same artificial grammar, prior to the first classification task and the later employed similarity judgement task, lead to an improvement of similarity judgements of normal subjects’ performance from 66.9% to 69.9% correct, whereas amnesic patients’ performance shows a decrease from 63.2% to 61.4% correct.

Taken together, the above results refute proposals advanced by Dulany, Carlson and Dewey (1984) and Perruchet and Pacteau (1990) that classification performance is based on acquired explicit knowledge of the underlying rule system, though imperfect and only partially correct.

Subsequently, Knowlton et al. (1992) conclude:

“If classification learning depended materially on explicit memory, for example, conscious knowledge of imperfect rules
(Dulany et al., 1984), explicit knowledge of permissible bigrams (Perruchet and Pacteau, 1990) or explicit comparisons to stored exemplars, then amnesic patients should have performed more poorly than normal subjects. The finding that amnesic patients performed normally indicates that implicitly acquired information is adequate for grammatical classification” (p.177).

Nevertheless, the improvement of normal control subjects’ performance and the impairment of amnesic patients’ performance on the similarity judgement task, compared to their equally good performance on the classification task, as well as the normal performance of normal control subjects, compared to the impaired performance of amnesics on the recognition task, illuminate the distinctive role of explicit memory in regard to the performance on each particular task. The performance on both tasks, the similarity judgement task as well as the recognition task, reveal that normal control subjects may gain explicit knowledge stored in explicit memory of items presented repeatedly, and may exploit their explicit memory for exemplars when carrying out these tasks. Amnesic patients, on the other hand, that are typically impaired in regard to explicit memory, either do not benefit from instructions to make use of their explicit memory for exemplars when performing the similarity judgement task or only benefit when performing the recognition task, since the task is sensitive enough to engage any residual explicit memory they may have.

In other words, if normal subjects are able to gain explicit knowledge from an extended presentation of exemplars, as, for instance, in the case of Knowlton et al.’s (1992) study using the same grammar to generate letter strings for study in both tasks administered sequentially, the classification task and the similarity judgement task, they may benefit from instructions to make use of such explicit memory. That is, if a classification task engages explicit memory for exemplars through instructional manipulations, like the similarity judgement task, there may be a ‘synergistic’ effect (cf. Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan, 1989) on classification performance in that explicit knowledge of exemplars stored in explicit memory complements implicit knowledge stored
in implicit memory, which is materially underlying classification performance. In short, Knowlton et al.’s (1992) findings, firstly, suggests a dissociation between implicit and explicit memory in artificial grammar learning by showing amnesic patients’ equally good classification performance compared to normal control subjects, but impaired recognition performance for studied exemplars compared to normal control subjects and, secondly, illuminates the implicitness of the knowledge materially underlying classification performance by showing that explicit knowledge of exemplars has only a complementary role in classification performance, given that such knowledge becomes available, for instance, through extended presentations of exemplars, and tasks which engage explicit memory, for instance, through instructional manipulations.

A further study of artificial grammar learning by amnesic patients and normal subjects by Knowlton and Squire (1994) supports the above findings of the dissociation between implicit and explicit memory, the implicitness of the knowledge materially underlying classification performance as well as the findings that only if subjects are able to gain explicit knowledge of exemplars, stored in explicit memory, may such explicit memory for exemplars have a complementary role in performing a classification task which engages explicit memory.

Firstly, Knowlton and Squire’s (1994) results (Experiment 1) corroborate the previous finding that amnesic patients do not differ significantly from normal control subjects in their performance on a classification task. Moreover, in contrast to the results from Knowlton et al.’s (1992) study, amnesic patients in Knowlton and Squire’s (1994) study even numerically outperform normal control subjects – 59.1% correct classifications by amnesic patients compared to 58.3% correct classifications by normal control subjects. These results provide strong supportive evidence for the dissociation between implicit and explicit memory in that amnesic patients’ equally good performance compared to normal control subjects, in spite of their impairment in regard to explicit memory, underscores that implicit memory materially underlies classification performance.

Secondly, Knowlton and Squire’s (1994) results show that if opportunities to build up explicit knowledge of exemplars are decreased, performance
on a similarity judgement task by normal control subjects does not significantly differ from the performance of amnesic patients – 59.2% correct classifications by amnesic patients compared to 60.5% correct classifications by normal control subjects. In contrast to Knowlton et al.’s (1992) study, Knowlton and Squire (1994) minimises the possibility of gaining explicit knowledge through extended presentations of exemplars by using a different grammar to generate letter strings for study in each of the two tasks carried out sequentially, the classification task and the similarity judgement task.

Hence, the adduced evidence underscores the previous findings that the performance on the similarity judgement task is materially dependent on implicit knowledge and that potential ‘synergistic’ effects involving explicit knowledge of exemplars are dependent on the availability of an appropriate knowledge base, even if the task has the potential to engage explicit memory, as in the case of the similarity task that instructs subjects to use their explicit memory for exemplars when judging the similarity of new items presented.

The results of classification performance on new items from the above memory studies, as well as from the results of earlier studies (cf. Reber, 1976; Reber and Allen, 1978; Reber, Kassin, Lewis and Cantor, 1980) to be presented below, clearly show that the implicit knowledge gained during the learning phase can be transferred to the classification of items that have not been presented before, but are based on the same artificial grammar and the same letter set as the items presented during the learning phase. Under these conditions, such knowledge transfer leads to an above-chance level of performance. If, however, as Knowlton and Squire’s (1996) study shows, the letter set of the letter strings to be classified as either grammatical on nongrammatical is changed, transfer occurs, too, but leads to a decreased performance level, which points to the potential effects of exemplar-specific information in the former cases and the lack thereof in the latter case.

Knowlton and Squire’s (1996) study of artificial grammar learning (Experiment 3), subsequently, investigates the transfer of knowledge acquired during the learning phase by amnesic patients and normal control subjects, to the classification of items either based on a new letter set or based on the same
letter set. Firstly, results from the same letter set condition show that both groups perform at an above-chance level – amnesic patients 57.2% correct and normal subjects 59.9% correct. Secondly, results from the different letter set condition, also, show that both groups perform at an above-chance level – amnesic patients 54.6% correct and normal subjects 56.1% correct - though at a lower level than in the same letter condition.

These findings for the same letter set condition confirm the results obtained by Knowlton, Ramus and Squire (1992) and Knowlton and Squire (1994) and by by Reber (1976), Reber and Allen (1978) and Reber, Kassin, Lewis and Cantor (1980) in the domain of artificial grammar learning as well as Berry and Broadbent’s (1988) study in the domain of learning to control complex production and social systems. The former results show that implicit knowledge gained during the learning phase can be transferred to the classification of new items based on the same letter set, reflected in an above-chance performance level. The latter results, on the other hand, demonstrate that implicit knowledge gained during the first set of trials to control a production or social system can be transferred to the second set of trials to control a conceptually similar production or social system, reflected in an improved control performance.

Knowlton and Squire’s (1996) findings for the different letter set condition, too, confirm the results obtained by Reber (1969) and Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan (1989) in the domain of artificial grammar learning as well as by Berry and Broadbent (1984, 1988) and Squire and Frambach (1990) in the domain of learning to control complex production and social systems.

The former results show lower performance levels, though above-chance, compared to the same letter set condition, whereas the latter results reveal a lack of improvement or only a minimal improvement in control performance if the system to be controlled is conceptually dissimilar to the system in the first set of trials, which indicates the highly specific nature of the implicit knowledge underlying the particular skill.

Knowlton and Squire (1996) suggest that the poorer performance of amnesic patients and normal control subjects in their study (Experiment 3), when operating in the different letter set condition, indicates an effect of
acquired exemplar-specific knowledge on classification performance in the same letter set condition, but a non-effect in the different letter set condition since such exemplars-specific knowledge cannot be transferred to the new letter set. Similarly, the specificity of the implicit knowledge underlying control performance that can not be transferred may be the reason for the lack of improvement or the only minimal improvement of the performance on conceptually dissimilar tasks. Comparable results are reported by Altmann, Dienes and Goode (1995) in the domain of artificial grammar learning by normal subjects, employing study-to-task modality shifts, for instance, by presenting either letter sequences or musical tones during the study task and vice versa during testing (Experiments 1 and 2). That is, subjects’ test task is the classification of a set of 50 sequences consisting of 25 grammatical sequences and 25 ungrammatical sequences in one modality opposite to the study task, and generated by the same computer programme (i.e. grammar) as the 20 sequences presented during study. The results are similar to the results reported on above in the context of study-to-task letter set changes in that above-chance level classification performance is observed though at a lower level compared to the performance of subjects operating in the same modality during study and test. These findings suggest that modality-specific knowledge cannot be transferred to the different modality, thus, leading to a decrement in performance. All in all, Knowlton and Squire’s (1996) findings show, firstly, that classification performance in the different letter set condition is still above-chance, demonstrating that the knowledge materially underlying classification performance is not exemplar-specific knowledge, but abstract knowledge. And they show, secondly, an equivalent performance of amnesic patients and normal control subjects in both letter set conditions, strongly demonstrating, again, the implicitness of the knowledge acquired, whereby the predominant part is abstract knowledge and the lesser part is exemplar-specific knowledge. In addition, findings by Mathews et al. (1989) showing decrements in classification performance, when using a new letter set for items to be classified, in the absence of consistent feedback during extended classification trials, suggest that the lack of feedback leads to less implicit, abstract knowledge being acquired, subsequently, causing a lower performance level compared to
classification performance with consistent feedback. However, the aspect of how explicit knowledge, such as explicit feedback, may contribute to an improved classification performance will be discussed below in the context of the presentation of research on the nature of the acquisition process of complex rule-governed structures.

As foreshadowed above, further supportive evidence for the dissociation between implicit and explicit memory also comes from memory research with amnesic patients and normal control subjects, involving the learning to control complex production and social systems.

For instance, Squire and Frambach’s (1990) study employing two different tasks that are identical to the two tasks used by Berry and Broadbent (1984), either requires amnesic patients and normal control subjects to learn to control the production of sugar in a sugar production factory, or to interact with a computer person and control that person’s behaviour.

The former task requires to achieve particular sugar output levels, whereby learning to control the system occurs through the manipulation of the input variable ‘workforce’. The latter task requires to achieve particular behavioural output levels of the computer person whereby learning to control the system occurs through manipulation of the input variable ‘one’s own behaviour’. However, compared to Berry and Broadbent’s (1984) study (Experiment 1), which provides two sets of 30 trials each, Squire and Frambach’s (1990) Experiment 1 extends control practice even further by providing 3 sets of 30 trials, each followed on by a second session of 3 sets of 30 trials after an average delay of 27 days.

On the one hand, the results after the first session of 90 trials show an equal performance level of both amnesic patients and normal control subjects, thus, providing further supportive evidence for a dissociation between implicit and explicit memory in that amnesic patients demonstrate intact learning to control the sugar production system in spite of their deficient explicit memory.

On the other hand, the results after the second session of 90 trials show an improved performance level of the normal control subjects, but an almost identical performance level of the amnesic patients, compared to the first session. These results concerning the amnesic patients reflect significantly less
acquired explicit knowledge compared to normal control subjects, as pointed out by Squire and Frambach (1990). However, the findings concerning the normal control subjects cannot be interpreted straightforwardly as a reflection of an increased acquisition of explicit knowledge due to extended control practice (cf. Willingham, Nissen and Bullemer, 1989, Experiment 2) since questionnaires administered after each session reveal that normal control subjects do not significantly increase their explicit knowledge during extended practice. Squire and Frambach (1990), thus, speculate:

“One possibility is that the declarative knowledge exhibited at the end of Session 1 became available too late in the session to materially benefit the skill measure. Unfortunately, no data are available on this point” (p.116).

This speculative explanation, though, points into the right direction. It is in accordance with conclusions drawn from studies investigating the relative contribution of explicit knowledge acquired during artificial grammar learning as well as during learning to control complex production and social systems that will be analysed below. Suffice it to say that extended practice may, firstly, facilitate the acquisition of implicit knowledge, as revealed by the increasing performance levels by both, amnesic patients and normal control subjects during the first session of 90 trials, and the equivalent results at the end of the first session. It may, secondly, lead to the acquisition of explicit knowledge by normal control subjects and, in the context of successive learning phases, may affect the degree of salience of the rule system underlying the production system in the second learning phase (Session 2), thus, facilitating the acquisition of implicit knowledge and, subsequently, leading to an improved control performance.

In short, the above memory studies investigating skill learning - motor skills, perceptuomotor skills and cognitive skills – by amnesic patients with deficient explicit memory and normal subjects, firstly, clearly suggest a dissociation between implicit and explicit memory, storing implicit and explicit knowledge respectively, in that amnesic patients’ performance on serial reaction time
tasks, grammatical classification tasks and on tasks to control production and social systems equals normal subjects’ performance. The findings of a dissociation between implicit and explicit memory and the respective kinds of knowledge they store, subsequently, disconfirm theoretical claims suggesting that skill learning always begins with explicit knowledge which is then converted to implicit knowledge. Secondly, results from several of the above studies suggest that normal subjects may gain explicit knowledge during the skill learning process, for instance, through extended presentations of exemplars in artificial grammar learning studies and may benefit from it by improving their task performance if the task engages explicit memory. In other words, the evidence provided suggests that the task performance reflecting skill learning is materially dependent on implicit knowledge, but may be improved if explicit knowledge has been gained and the task engages explicit memory.

These findings that implicit knowledge stored in implicit memory is materially underlying skilled performance, subsequently, disconfirm theoretical claims that, for instance, classification performance is materially dependent on explicit memory storing explicit knowledge of imperfect rules or permissible bigrams of letter strings.

Thirdly, the above artificial grammar learning studies, as well as studies in the domain of learning to control complex production and social systems suggest that implicit knowledge stored in implicit memory can be transferred to classification tasks involving perceptually similar items or to conceptually similar control tasks, whereas performance decreases if perceptually dissimilar items or if conceptually dissimilar control tasks are involved, but is still above chance level.

These results indicate that amnesic patients as well as normal subjects acquire some exemplar-specific implicit knowledge, which in conjunction with the predominantly abstract implicit knowledge underlies equally good performance in case perceptually similar items are classified or conceptually similar control tasks are carried out. In case perceptually dissimilar items have to be classified or conceptually dissimilar control tasks have to be carried out, however, the lack of transfer of exemplar-specific knowledge causes decreases in performance.

And fourthly, Squire and Frambach’s (1990) study suggests that extended skill practice may facilitate the acquisition of implicit knowledge as well as explicit
knowledge, whereby the latter may affect the degree of salience of the rule system underlying control skills to be learned in successive learning phases.

A further discussion of these conclusions, except for the third conclusion, will be carried out below in the context of the analysis of findings from studies investigating the nature of the acquisition process of complex rule-governed structures, such as artificial grammars and production and social systems.

4.2.2 The acquisition of predominantly implicit knowledge of complex rule-governed structures is dissociated from the acquisition of explicit knowledge, requires certain conditions of instruction and saliency, and is necessary for the performance of procedural and cognitive skills under time pressure

Research on the nature of the acquisition process of complex rule-governed structures, such as artificial grammars and production and social systems, confirms the dissociation between implicit, nondeclarative and explicit, declarative knowledge, and thus, their respective memory stores, demonstrated by the above presented evidence from memory studies, and reveals that skill performance at the highest level, under severe time constraints, can only be achieved if the knowledge underlying such skill performance is of a predominantly implicit nature. It, finally, provides valuable insights into the relative contribution of different instructional set and saliency conditions operating during single and successive learning phases and the relative contribution of explicit knowledge to the acquisition process of implicit knowledge, the relative contribution of practice to the acquisition process of explicit and implicit knowledge, the relative effect of partly nongrammatical input on the acquisition process of implicit grammatical knowledge as well as the contribution of attention to the acquisition process of implicit knowledge. (cf. Allen and Reber, 1980; Berry, 1991; Berry and Broadbent, 1984, 1988; Broadbent, 1977; Broadbent and Aston, 1978; Broadbent, Fitzgerald and Broadbent, 1986; Dienes, Broadbent and Berry, 1991; Hayes and Broadbent, 1988; Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan
Early studies on implicit learning of complex structures, such as artificial grammar learning (Reber, 1967) and learning to control a city transport system (Broadbent, 1977), as well as to control a model of the British economy (Broadbent and Aston, 1978) provide evidence for subjects’ ability to implicitly exploit such complex structures leading to the acquisition of implicit knowledge materially underlying their above-chance performance in regard to the classification of grammatical and nongrammatical letter strings in Reber’s (1967) study and of improved decision-making performance in regard to the control of bus loads in terms of the number of passengers and the number of parking spaces in Broadbent’s (1977) study as well as in regard to the control of the model of the British economy in Broadbent and Aston’s (1978) study, while at the same time showing a lack of explicit (verbalisable) knowledge.

Reber’s (1967) artificial grammar learning study, for instance, consists of two main phases. First, a learning phase under neutral instructions that exposes subjects to a series of letter strings generated by a finite-state or Markovian grammar without informing them of the existence of such a grammar and instructs subjects to memorise the letter strings presented. Second, a testing phase that unexpectedly has subjects perform a classification task after being told that the letter strings conform to underlying rules. The classification task requires subjects to judge the grammaticality or nongrammaticality of a new series of letter strings, half of which are grammatical and half of which are nongrammatical without imposing time limits on subjects’ responses (standard classification task). It is followed by an introspective task that has subjects explain how their classification decision came about and what rules were underlying the regularities of the letter strings.

Reber’s (1967) study reveals that subjects implicitly apprehend enough knowledge from the ‘neutral’ presentation of exemplars generated by the artificial grammar to achieve a level of classification performance that is
significantly above chance. However, they fail to explicate the knowledge underlying their performance.

Broadbent’s (1977) study of learning to control a city transport system, as another example, investigates the learning of complex structures in a different context. Subjects learn to reach certain given target values of bus load and empty parking spaces by manipulating the time interval between busses and the fee for car parking. That is, through manipulation practice subjects implicitly acquire enough knowledge to improve their ability to reach and maintain the specified target values. Nevertheless, subjects’ improvement in control performance is not correlated to their ability to answer questions when given a post-task questionnaire asking them to predict the direction of change of an output variable (bus load, empty parking spaces) given a certain manipulation of an input variable (time-interval between buses, carparking fee) and to justify their predictions. Follow-on studies by Berry and Broadbent (1984) Broadbent, Fitzgerald and Broadbent (1986) and Berry and Broadbent (1988) in the domain of learning to control production and social systems, and by Reber and Lewis (1977) in the domain of artificial grammar learning, firstly, confirm that subjects implicitly acquire sufficient knowledge underlying such complex structures, enabling them to perform grammatical classifications and to control production and social systems at above chance level. These studies, secondly, confirm the discrepancy between subjects’ above-chance control and classification performance and their poor explicit (verbalisable) knowledge related to their performance. Nevertheless, the findings of these studies suggest that some explicit (verbalisable) knowledge may be gained in such learning processes, but that such knowledge is not sufficient to account for subjects’ overall performance.

Berry and Broadbent’s (1984) study employs two different tasks. One, task requires subjects to learn to control the production of sugar in a sugar production factory, and the other task requires subjects to interact with a computer person and to control that person’s behaviour.

In the sugar-production-control task, the learning task is to reach and maintain a certain given sugar output level by manipulating the number of workers involved in the sugar production, whereas in the person-interaction task the learning task is to reach and maintain a given level of behaviour (‘very friendly’) by the
computer person through manipulation of one’s own behaviour. Both control tasks investigate the relationship between subjects' performance on these tasks and explicit (verbalisable) knowledge of what underlies their performance considering three variables that may have an effect on that relationship: the amount of practice (Experiment 1), explicit training on how to control the sugar production and the computer person’s behaviour (Experiment 2), and concurrent verbalisations of reasons underlying subjects’ decisions (Experiment 3).

Across the set of experiments, all subjects in groups without exposure to one of the above variables achieve a level of performance that is above chance, based on implicitly acquired knowledge underlying the rule-governed sugar production and personal interaction. After the reception of neutral (written) instructions “explaining the nature of the system and the task” (Berry and Broadbent, 1984, p.216), such knowledge is simply acquired by subjects manipulating the size of the work force, in case of the sugar production, in order to reach and maintain a certain target output, or by subjects manipulating their own behaviour within the parameters of 12 grades of behaviour ranging from ‘very rude’ to ‘loving’, in case of the personal interaction, in order to reach and maintain a certain behaviour of a computer person. However, the same subjects are poor on verbalising knowledge related to their performance when tested with post-task questionnaires with questions closely related to each control task and a more general question about how they reached and maintained given target values.

When taking into account two of the three variables that are of particular interest due to their relevance to the second language acquisition process, Experiment 2 reveals that prior explicit training significantly improves subjects' ability to explicate knowledge underlying their decisions in each control task, but only insignificantly affects their control performance (see below for a re-evaluation of this finding in the context of further evidence on and discussion of the effects of explicit training on classification and control performance considering response time limitations and successive learning phases). And Experiment 1 reveals that increased practice – 60 trials instead of 30 trials of control practice – significantly improves control performance, but only insignificantly affects verbalisation, thus, suggesting that the knowledge acquired during control practice and materially underlying an above-chance level of control performance is implicit
knowledge. The latter findings are corroborated by the results from studies by Broadbent, Fitzgerald and Broadbent (1986) and Berry and Broadbent (1988) using, again, the city-transport-system control task (cf. Broadbent, 1977) and the person-interaction control task (cf. Berry and Broadbent, 1984) respectively. Both studies find that practice improves subjects’ control performance, but does not correlate with an improvement in verbalisation.

However, evidence provided by Squire and Frambach’s (1990) study, employing the sugar production control task, shows that, compared with Berry and Broadbent’s (1984) extension to 60 trials, a further extension of practice to 90 trials increases normal subjects’ (verbalisable) explicit knowledge, demonstrated by their questionnaire performance in regard to answering ‘general strategy’ questions compared to the performance of amnesic patients who are impaired in their memory of explicit knowledge. As already indicated in the above presentation of results from Squire and Frambach’s (1990) memory study and as will be shown below in the context of learning in successive learning phases, the explicit knowledge acquired by the normal control subjects has a performance effect on a successive set of 90 practice trials.

In the same vein, Reber and Lewis’ (1977) artificial grammar learning study reveals that re-presenting the exemplars each day over a period of four days leads to a steady improvement of the performance on an anagram task and to an exceptional high performance level after the fourth day on a standard classifications task compared to results reported by Reber (1967, 1976). Moreover, Reber and Lewis (1977) study, firstly, reveals the implicitness of the acquisition process of the knowledge underlying the above classification performance by showing that the presentation of letter strings generated by an artificial grammar suffices for subjects to extract sufficient knowledge for the successful performance on an unexpectedly administered grammatical classification test. Secondly, it demonstrates the implicitness of the knowledge materially underlying classification performance by showing that performance data do not correlate with the results from introspective reports. These reports are based on analyses of subjects’ concurrent verbalisation’s of reasons for their decisions to classify letter strings as grammatical or nongrammatical and subjects’ written post-experimental essays asking them for instance, to elaborate on...
the rules discovered underlying the order of letters in the letter strings. Reber and Lewis (1977) stress that 93 out of 177 responses indicating nongrammaticality, given by subjects performing the classification task, either provide no “…formal rationale for their choice” or “…an irrelevant one” (p.352). They also point out that post-experimental essays reveal that subjects may become aware of salient letter sequences. Nevertheless, Reber and Lewis (1977) come to the conclusion that, overall, introspective reports show a discrepancy between subjects’ statements and the rules underlying the artificial grammar, and even the subjects’ own classification decisions:

“...while the ability to make explicit what is known implicitly increases with performance levels, the conscious apprehension of structure always lags behind what is known unconsciously” (p.333).

Similar results, showing subjects’ implicit acquisition of knowledge underlying the subsequent classification performance at an above-chance level, based on the ‘neutral’ presentation of exemplars which discourages the engagement of explicit learning processes, as well as showing discrepancies between subjects’ explicit (verbalisable) knowledge and their classification performance, are reported on by Reber and Allen (1978), Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan (1989) and Dienes, Broadbent and Berry (1991). Furthermore, Mathews et al. (1989) confirms Reber and Lewis’ (1977) finding of improved classification performance through extensive practice presented above.

In the above studies, the implicitness of the acquisition process is typically being achieved by the ‘neutral’ presentation of grammatical exemplars, generated by an artificial grammar, leading to the acquisition of sufficient knowledge of the underlying rules governing the letter strings to perform a classification task at an above-chance level.

However, Dienes, Broadbent and Berry’s (1991) artificial grammar learning study (Experiment 1) demonstrates that even the ‘neutral’ presentation of 25 grammatical and 25 ungrammatical exemplars during each of the two
successive learning phases leads to an above-chance classification performance (.60 - proportion of items judged correctly), though lower, when compared to the ‘neutral’ presentation of grammatical exemplars, only, (.65 – proportion of items judged correctly). The consistency of judgements observed in each of the two groups, one receiving grammatical input, only, and the other receiving grammatical and nongrammatical input during the learning phases, suggests that the decrements in classification performance are due to decrements in the acquisition of implicit knowledge.\textsuperscript{87}

In addition to the above, further evidence presented below suggests that, in spite of any gains of explicit knowledge, the knowledge gained under neutral instructions and materially underlying classification performance is of an implicit nature.

For instance, results from Reber and Allen’s (1978) artificial grammar learning study show that subjects “…only supplied reasons for 821 of the 2000 decisions that they made” (p.209). They stress that, although all subjects gain explicit knowledge of some rules and become aware of salient letter sequences, this knowledge only accounts “…for a distinct minority of our subjects’ judgements” (p.217).

Furthermore, Mathews et al.’s (1989) artificial grammar learning study (Experiment 1), using an expanded version of Reber, Kassin, Lewis and Cantor’s (1980) artificial grammar, reveals that subjects’ verbal reports collected after each block of 10 grammaticality judgements, and then used by yoked subjects\textsuperscript{88} to perform the same string discrimination task, lead to a poorer performance by the yoked subjects compared to the experimental subjects. However, although the above discrepancy between grammaticality judgement performance and explicit (verbalisable) knowledge persists, there is a gradual improvement in performance due to extensive practice – 4x200 trials of discriminating grammatical from nongrammatical strings over 4 weeks requiring about 10 hours of practice.

And, finally, results from Dienes, Broadbent and Berry’s (1991) artificial grammar learning study (Experiment 1) demonstrate that subjects’ explicit knowledge of rules\textsuperscript{89}, explicated in free-report tests\textsuperscript{90} and then used to produce a predicted classification performance, “…underpredicted actual performance” (p.897).
In short, the evidence presented above, focusing on the discrepancy between subjects’ classification or control performance and their inability to explicate knowledge commensurate with their respective performance, strongly suggests that under neutral instructions prior to the learning phase an implicit learning mode is engaged, leading to the acquisition of implicit knowledge of complex rule-governed structures, such as artificial grammars and production and social systems, which forms the fundamental basis for above-chance classification and control performance. That is, although explicit knowledge may also be acquired under neutral instructions, it cannot account for the level of performance observed, as Reber (1993) and Winter and Reber (1994) pointedly put it. However, the acquisition of implicit knowledge may be negatively affected if the input for learning partly does not fully reflect the underlying rule-governed structure, i.e. if the input for learning is partly nongrammatical. This may lead to a lower performance level, though still above chance.

In addition, the evidence presented above clearly suggests that classification and control performance is affected by practice, whereby practice in the domain of artificial grammar learning entails re-presentations of old exemplars and presentations of new exemplars during the learning phase, both generated by the same artificial grammar, as well as extended classification practice during the testing phase. In the domain of learning to control production and social systems, practice entails manipulations of input values in order to reach certain output values.

These findings (see footnote 87) will be discussed further in the context of the gradual acquisition of implicit knowledge in successive learning phases.

The investigation of the nature of the acquisition process of complex rule-governed structures, such as artificial grammars and production and social systems continues with the presentation of findings that illuminate the relative contribution of explicit knowledge to the acquisition process of implicit knowledge. This presentation draws on results from studies, for instance by Reber (1976), Reber, Kassin, Lewis and Cantor (1980), Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan (1989) and Turner and Fischler (1993), investigating artificial grammar learning, as well as on results from
studies, for instance by Berry and Broadbent (1984, 1988) investigating the learning to control production and social systems. The above mentioned studies use instructional manipulations to engage explicit learning processes.

Instructional manipulations investigated encompass rule search instruction as well as implicit instruction. Studies investigating the effect of rule search instructions on classification or control performance compared to neutral instructions assume that rule search instructions engage an explicit learning mode and neutral instructions (e.g. to memorise letter strings presented or to control the rate of production or the behaviour of a computer person by manipulating a particular input variable) engage an implicit learning mode (cf. Berry and Broadbent, 1988; Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan, 1989; Reber, 1976; Reber, Kassin, Lewis and Cantor, 1980; Turner and Fischler, 1993).

Reber’s (1976) explication of the aim of his study, also underlying the follow-on studies to be presented below, clearly reveals the above assumption:

“...the aim was to explore the differences between (a) subjects who maintained a relatively naive stance with regard to rule structure and operated in a neutral mode insofar as the formulation of hypotheses and strategies is concerned, and (b) subjects who actively searched for rules and operated in an explicit hypothesis-testing mode (p.89).

Reber (1976) finds considerable differences between the two experimental groups investigated, with the group receiving rule search instructions prior to the learning phase performing poorer on a standard classification task than the group receiving neutral instructions, though both groups perform at an above-chance level. Subsequently, Reber, Kassin, Lewis and Cantor (1980) (Experiment 1) investigate the effect of saliency of the patterns underlying the letter strings presented during the learning phase on subjects’ classification performance, whereby subjects receive either neutral instructions or rule search instructions prior to the learning phase.

Reber et al. (1980), thus, compare four experimental groups: One group
receiving neutral instructions and being exposed to a set of exemplars presented in a ‘high-salience format’, a second group receiving neutral instructions and being exposed to a set of exemplars presented in a ‘low-salience format’, a third and fourth group receiving rule search instructions and being exposed to sets of exemplars presented in a ‘high-salience format’ or ‘low-salience format’ respectively.

They find a strong interaction between rule search instructions prior to the learning phase and the salience of the display of letter strings presented to the subjects during the learning phase. That is, a ‘high-salience format’ of the display of letter strings in combination with rule search instructions leads to the highest performance on the standard classification task, whereas a ‘low-salience format’ in combination with rule search instructions produces the lowest performance. Neutral instructions, on the other hand, lead to an intermediate level of performance with a better performance if the display of exemplars is of a ‘high-salience format’. But all four groups perform at a level significantly above-chance.

Hence, Reber et al. (1980) point out that their study confirms Reber’s (1976) results. Reber (1976) uses a ‘low-salience format’ for his display of exemplars during the learning phase and involves two experimental groups, one receiving neutral instructions and the other receiving rule search instructions. Reber’s (1976) results are comparable to Reber et al.’s (1980) results in that a lack of saliency in the display of exemplars contributes to a poorer performance on a standard classification task.

In a similar vein, Berry and Broadbent’s (1988) findings support Reber et al.’s (1980) results, which subsequently extend to Reber’s (1976) results. In part of their study of learning to control a social system (Experiment 1), Berry and Broadbent (1988) use two experimental groups operating in salient and nonsalient conditions defined by the salient or nonsalient response characteristics of the computer person interacting with the subjects. The subjects are given either neutral instructions (following Berry and Broadbent, 1984) or rule search instructions.

After two sets of 20 trials each (Set 2), the study shows an inferior control performance if subjects are instructed to search for rules and interact with a
computer person with nonsalient response characteristics (2.5) (mean number of
trials correct out of 20 – chance performance level: 4.4 trials). A superior control
performance is observed if subjects are instructed to search for rules and interact
with a computer person with a salient response characteristics (12.25). The above
results unequivocally support Reber et al.’s (1980) findings.
The study also corroborates Reber et al.’s (1980) results concerning the control
performance levels of the two groups operating under neutral instructions in
either a salient or nonsalient condition.
After the second set, each of the two groups operating under neutral instructions
performs at an intermediate level, with a higher control performance level in the
salient condition (6.92) and a lower control performance level in the nonsalient
condition (5.83). However, with extended practice, this small performance
difference develops into a large performance difference and, thus, extends the
effects of saliency in the neutral instruction condition. That is, after the third set
of 20 trials, the group operating in the salient condition achieves a much higher
control performance level (10.42) than the group operating in the nonsalient
condition (6.83).
In short, the findings by Reber (1976) and Reber et al. (1980), and the findings by
Berry and Broadbent (1988) of varying classification and control performance
levels, depending on the combination of instructional set and saliency of the
stimuli presented during the learning phase, seem to reveal an interaction between
the two conditions – instructional set and saliency. The results seem to suggest,
firstly, that the underlying assumption that neutral instructions engage an implicit
learning mode and that rule search instructions engage an explicit learning mode
is correct, secondly, that the greatest positive performance effect is observed
when subjects are instructed to search for rules and the stimuli are presented in a
‘high-salience format’, thirdly, that the greatest negative effect is observed when
subjects are instructed to search for rules and the stimuli are presented in a ‘low-
salience format’, and, fourthly, that the high or low salience of the stimuli
presented also leads to more distinct control performance differences in the
implicit mode of learning with extended practice, compared to Reber et al.’s
(1980) results. That is, performance results after the second set of trials are still
comparable with Reber et al.’s (1980) results in that they show an intermediate
performance under neutral instructions if the computer person either displays salient or non-salient response characteristics, with a better performance involving the computer person displaying salient response characteristics, but, after the third trial, the control performance levels of the same two groups operating under neutral instructions become highly distinct, with a high level of performance in the salient condition and a low level of performance in the non-salient condition. However, follow-on studies by Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan (1989) and Turner and Fischler (1993) in the domain of artificial grammar learning produce results presented below that are in conflict with the above findings by Reber (1976), Reber, Kassin, Lewis and Cantor (1980) and Berry and Broadbent (1988) in regard to the interaction between instructional set and the salience of the stimuli presented. Nevertheless, results by Reber and his associates as well as by Berry and Broadbent can be explained in the context of these more recent findings if inadvertently induced response time limitations during classification testing are considered.

Firstly, Mathews et al.’s (1989) results (Experiments 1, 2 and 3) show, contrary to Reber’s (1976) results, reinterpreted by Reber et al. (1980), that rule search instructions given to subjects prior to the learning phase and the presentation of a non-salient stimuli during the learning phase leads to an equivalent performance – not an inferior performance – on a grammaticality judgement task, compared to subjects that are given neutral instructions prior to the learning phase and are also presented with non-salient stimuli during the learning phase.

Secondly, Turner and Fischler (1993) (Experiment 1), investigating the interaction between instructional set and saliency of stimuli display during the learning phase under induced response time limitations during the testing phase, contrary to Reber et al.’s (1980) results (Experiment 1), Reber’s (1976) results as well as contrary to Berry and Broadbent’s (1988) findings (Experiment 1), corroborate Mathews et al.’s (1989) results in that instructional set and saliency do not interact, but rather that instructional set as well as saliency interact with response deadline.

Turner and Fischler (1993) investigate four experimental groups distinguished by instructional set (neutral instructions or rule search instructions given prior to the learning phase) and by saliency (salient or non-salient presentation of stimuli
during the learning phase) that are comparable to the experimental groups in Reber et al.’s (1980) study. However, in addition, they introduce two different response deadline conditions for the performance on the classification task, a short response deadline of 2 seconds and a long response deadline of 6 seconds.

Turner and Fischler (1993) report on the following results of paired comparisons of performance on a standard classification task under either a long or short response deadline and under either neutral instructions or rule-search instructions or under either a salient or nonsalient presentation of stimuli: First, the interaction between instructional set and response deadline is reflected in the findings showing two different accuracy levels in the rule search condition, a higher accuracy level (64%) under the long response deadline and a lower accuracy level (58%) under the short response deadline. By contrast, accuracy levels in the neutral instruction condition are only minimally different under the two response deadlines (63%, long response deadline and 61%, short response deadline) and are close to the high accuracy level as achieved in the rule search condition under the long response deadline. Second, the interaction between saliency and response deadline is reflected in the findings showing two different accuracy levels in the nonsalient condition, a higher accuracy level (64%) under the long response deadline and a lower accuracy level (58%) under the short response deadline. By contrast, accuracy levels in the salient condition are only minimally different under the two response deadlines (63%, long response deadline and 61%, short response deadline) and are close to the high accuracy level as achieved in the nonsalient condition under the long response deadline.

Turner and Fischler (1993) also report that no significant interaction between instructional set and saliency and no significant three-way interaction between response time deadline instructional set and saliency occurs. Subsequently, no significant synergistic effects are observable in all combinations of conditions either under the long or under the short response deadlines. This becomes particularly obvious in some conditions under the short response deadline. That is, under the long response deadline all four experimental groups, the rule search-salient group, the rule search-nonsalient group, the neutral instruction-salient group and the neutral instruction-nonsalient group, produce comparably high performance levels, roughly equivalent to the values of each individual
condition obtained from paired comparisons and outlined above. In contrast, under the short response deadline all experimental groups, except the neutral instruction-salient group, produce comparably low performance levels, roughly equivalent to the values of the rule search and nonsalient conditions obtained from paired comparisons, whereas the neutral instruction-salient group’s performance level is slightly higher than the values of the neutral instruction and salient conditions obtained from paired comparisons. Furthermore, although performance values obtained from paired comparisons under the short response deadline in the neutral instruction condition as well as in the salient condition are high compared to the rule search condition as well as the nonsalient condition, these higher values do not affect performance outcomes in the neutral instruction – nonsalient and in the rule search-salient conditions. As indicated above, Mathew et al.’s (1989) and Turner and Fischler’s (1993) studies provide evidence contradicting Reber’s (1976), Reber et al.’s (1980) (Experiment 1) and Berry and Broadbent’s (1988) (Experiment 1) results. Contrary to the results from these earlier studies, no interaction between instructional set and saliency is observed, for instance, under long response deadlines assumed to apply to the above studies by Reber and his associates, as Turner and Fischler (1993) point out:

“Under long deadlines, we did not observe the interaction of instruction and display type in which rule-discovery salient subjects performed best and rule-discovery nonsalient subjects performed worst (e.g., Reber et al. 1980)” (p.1169).

However, as will be shown below, it is doubtful if Turner and Fischler’s (1993) assumption about the long response deadline condition applying to the above earlier studies by Reber and his associates and by Berry and Broadbent is correct. This prevents them from being able to explain the contradicting results in the context of their own findings. Nevertheless, Turner and Fischler’s results inadvertently point to a potential lack of control of the response time variable in Reber’s (1976) and Reber et al.’s (1980) studies that may explain the
contradicting performance results, as well as the concurring performance results.
Firstly, the potential lack of control of the response time variable in the above
mentioned studies becomes evident when scrutinising the information given to
subjects prior to the testing phase. Reber (1976) points out:

“There was no time limit on the subjects during this phase
although they were told that latencies were being recorded” (p.90).

And Reber et al. (1980), too, state:

“All subjects were informed at the beginning of the test phase
about [...] (c) the fact that latencies were being recorded” (p.495).

By informing subjects prior to the testing phase of the recording of response
latencies, Reber and his associates, inadvertently, may have introduced a certain
response time limitation akin to a short response deadline induced by Turner and
Fischler in their study (Experiment 1). But due to the uncontrolled manner, it may
have caused different inducements in each experimental group, ranging from long
to short response deadlines. Thus, contrary to Mathews et al.’s (1989) and Turner
and Fischler’s (1993) results, Reber and his associates’ results show distinct
differences in performance levels on a standard classification task in the two
experimental groups in Reber’s (1976) study, the rule search-nonsalient group
and the neutral instruction-nonsalient group, as well as in three out of four
experimental groups in Reber et al.’s (1980) study, the rule search-nonsalient
group, the neutral instruction-nonsalient group, and the rule search-salient group.
However, at the same time, concurring with Turner and Fischler’s (1993) results,
Reber et al.’s (1980) findings show the second highest performance in the fourth
experimental group, the neutral instructions-salient group, as if obtained under a
shorter response deadline, with the group achieving the highest performance
level, the rule search-salient group, subsequently, representing the performance
level obtained under a long response deadline.
The contradicting performance results, as well as the concurring performance
results pointed out above, can be accounted for by Turner and Fischler’s
(1993) findings. These findings show that subjects operating in the combined rule search-nonsalient, in the neutral instruction-nonsalient and in the rule search-salient conditions, in conjunction with an induced reduction of response time, are negatively affected in regard to grammaticality judgements, whereas subjects operating in the combined neutral instruction-salient condition, in conjunction with an induced reduction of response time, are not or only minimally affected in regard to grammaticality judgements.

That is, if response time reductions are induced, but vary, experimental groups operating under conditions that can be affected by such reductions may show performance levels relative to the reduction of response time, whereas experimental groups operating under conditions that can not significantly be affected by response time reductions may show insignificant differences under varying response time limitations. However, in the absence of any upper limit of response time, the gap between the performance level under a longer response time and under a shorter response time may become wider than in Turner and Fischler’s (1993) study and, thus, would explain the larger performance differences in Reber et al.’s (1980) study as well as in Berry and Broadbent’s (1988) study between the rule search-salient group, assumed to be under a longer response time condition, and the other three experimental groups, as, for instance, the neutral instruction-salient group working under varying shorter response time conditions.

In short, differential effects of induced response time limitations on classification performance are twofold. This is revealed by paired comparisons of accuracy levels under either a long or a short response deadline in each one of the conditions of instructional set and saliency of presentation of stimuli as well as by comparison of accuracy levels under either a long or a short response deadline in combinations of one of the instructional set conditions and one of the saliency conditions.

Firstly, the response deadline variable interacts with instructional set and saliency of presentation of stimuli in that classification performance is negatively affected under the short response deadline in the rule search-nonsalient, the rule search-salient and the neutral instruction-nonsalient conditions, but not or only minimally in the neutral instruction- salient condition, whereas classification
performance is comparably high under the long response deadline in all four combinations of conditions.

Secondly, there are no significant interactions between instructional set and saliency as well as between response time deadline, instructional set and saliency. Paired comparisons of performance values under the long response deadline and each one of the instructional set and saliency conditions show consistently high performance levels in all conditions. Under the same long response deadline, however, no synergistic effects are observed in any one of the combinations of the instructional set and saliency conditions. Paired comparisons of performance values under the short response deadline in each of the instructional set and saliency conditions only show consistently high performance levels in the neutral instruction and the salient presentation conditions. In the rule search and nonsalient presentation conditions, consistently low performance levels are achieved. Again, in conditions combining an instructional set condition with a saliency condition under the short response deadline, even if one condition has a high performance value and the other has a low performance value as in the rule search-salient and the neutral-nonsalient conditions, no synergistic effects are discernible.

The above results, firstly, suggest that Reber’s (1976), Reber et al.’s (1980) and Berry and Broadbent’s (1988) findings concerning an interaction between rule search instruction and saliency of presented stimuli cannot be upheld, but rather can be reinterpreted in the context of inadvertently induced response time limitations.

Secondly, the non-effects or minimal effects on classification performance in the neutral instruction conditions and the salient presentation condition as well as in their combination under the short response deadline, suggest that the two conditions predominantly engage an implicit learning mode, leading to a predominantly implicit knowledge base that is relatively unaffected by both short and long response deadlines, and underlies a consistently high performance level. On the other hand, the negative effects on classification performance under the short response deadline in the rule search condition and the nonsalient presentation condition as well as in their combination under the short response deadline suggest that the two conditions predominantly engage an explicit
learning mode, leading to a predominantly explicit knowledge base that is significantly affected by response time limitation and accounts for the decrements in performance.95

Taken together, the above conclusion drawn from Turner and Fischler’s (1993) results imply that non-effects or minimal effects on classification performance under the long response deadline are due to the readily available, either predominantly implicit or explicit knowledge bases acquired in the neutral instruction-salient and rule search-nonsalient conditions respectively, or due to the readily available implicit and explicit knowledge bases acquired in the neutral instruction-nonsalient and rule search-salient conditions. Furthermore, the above conclusions imply that under the short response deadline, it is only the predominantly implicit knowledge base, acquired in the neutral instruction-salient condition, that is readily available, thus, leading to non-effects or minimal effects on classification performance, whereas the explicit knowledge bases acquired in the rule search-nonsalient, the rule search-salient and the neutral instruction nonsalient conditions are not readily available under the short response deadline, thus, leading to negative effects on classification performance. Hence, it becomes apparent that under the constraints of limited response time, superior classification performance is achievable only with predominantly implicit knowledge implicitly acquired in the combined neutral instruction-salient condition.

4.2.3 The acquisition of predominantly implicit knowledge of complex rule-governed structures occurs gradually, requires successive learning phases that must lead to implicit learning phases operating in the combined neutral instruction-salient condition, and permits explicit knowledge of complex rule-governed structures as well as practice to contribute to the implicit learning processes under certain conditions

The above conclusions drawn from Turner and Fischler’s (1993) findings (Experiment 1) provide an important point of reference, illuminating other earlier results obtained by Mathews et al. (1989) (Experiment 3), Reber et al. (1980) (Experiment 2), Berry and Broadbent (1984) (Experiment 2) and Turner and Fischler’s (1993) recent results from Experiment 3. Firstly, the above
conclusions suggest that successive learning phases have effects on classification and control performance under a particular response time condition since each phase operates in a particular instructional set condition, ranging from the neutral instruction condition over the rule search condition to the explicit training condition and in a particular condition of saliency. And, secondly, the above conclusions suggest that explicit training has only a limited effect on classification performance under an induced response time limitation.

Concerning the effects of successive learning phases, Mathews et al.’s (1989) study (Experiment 3), investigating the sequential use of implicit and explicit learning processes, provides a post-hoc confirmation of Turner and Fischler’s (1993) findings as to the interaction between response time and instructional set, as well as between response time and saliency of presentation of stimuli. Mathews et al. (1989) distinguish two learning tasks, an implicit learning task – the match task – and an explicit learning task – the edit task – that are employed sequentially, either as a match task-edit task sequence, or as an edit task-match task sequence, but also in an either match task or edit task fashion. Both tasks present the stimuli in a nonsalient way. The testing carried out with a multiple-choice classification task occurs under a ‘long deadline’ inferred from Mathews et al.’s (1989) statement:

“Subjects were allowed to take as long as they wished to respond to each screen” (p.1094).

Hence, during the learning phase employing the ‘match task’, the combination of instructional set and saliency can be described as neutral instruction-nonsalient, whereas during the phase employing the ‘edit-task’, the combination of instructional set and saliency can be described as rule search-nonsalient. Based on the conclusions drawn from Turner and Fischler’s (1993) results, learning in the neutral instruction-nonsalient condition leads to the acquisition of implicit and explicit knowledge and learning in the rule search-nonsalient condition leads to the acquisition of predominantly explicit knowledge. Considering the match task/edit task sequence, the implicit and explicit knowledge acquired in the first
learning phase would have an effect on the second learning phase with the implicit knowledge constituting the first contribution to the further growing implicit knowledge base, and the explicit knowledge changing the saliency condition into a salient condition, thus, leading to a conditional change for the second learning phase from the rule search-nonsalient into rule search-salient.

And considering the edit task/match task sequence, the predominantly explicit knowledge acquired in the first learning phase would have an effect on the second learning phase with the explicit knowledge changing the saliency condition into a salient condition, thus, leading to a conditional change for the second learning phase from neutral instruction-nonsalient into neutral instruction-salient.

Hence, the sequential uses of the two tasks produce a changed saliency condition in each case, but leave the respective instructional set condition intact. Turner and Fischler’s (1993) result would predict that under a long response deadline neither the rule search-salient condition nor the neutral instruction-salient condition would lead to a significantly different classification performance. Results from Mathews et al.’s (1989) study (Experiment 3) confirm these predictions.

However, one has to bear in mind that, depending on the particular combination of instructional set and saliency conditions operating during the first learning phase, the implicit and/or explicit knowledge gained may differ and, thus, when transferred to the second learning phase may carry a different weight. Such different weight, subsequently, may differentially affect respective classification performance levels under a short response deadline as well as under a long response deadline, or respective control performance levels, as, for instance, concluded above from Squire and Frambach’s (1990) study.

Based on the evidence for the applicability of the above conclusions drawn from Turner and Fischler’s (1993) study to the context of effects of successive learning phases on classification and control performance under a particular response time condition, with each phase operating under a particular instructional set and in a particular saliency condition, it seems plausible to predict that a succession of learning phases generating a comparably high performance level under a long and short response deadline must be one leading to a learning phase operating in the combined neutral instruction-salient condition. Only such learning phase
brings about a predominantly implicit knowledge base unaffected or only minimally affected by response time limitations when applied, for instance, to a classification or control task. On the basis of this plausible prediction, a framework of options of instructional set and saliency conditions that successive learning phases can operate in can be deduced.

Considering, for the moment, a sequence of two learning phases, there are only two options for the second learning phase regarding the combination of instructional set and saliency conditions. These optional conditions can either be neutral instruction-salient or neutral instruction-nonsalient. In case of the option of a second learning phase operating in the combined neutral instruction-salient condition, the salient condition is not due to learning effects from the first learning phase, transferred to the second learning phase, but is induced. Such induced salience provides a level of transparency of the respective complex system through the presentation of the stimuli during the learning phase as demonstrated in several studies presented above.

Any implicit knowledge acquired in the first learning phase gives weight to the further growing implicit knowledge base in the second learning phase, whereas any explicit knowledge acquired in the first learning phase gives weight to the salient condition facilitating the implicit learning process and, subsequently, the acquisition of implicit knowledge.

Hence, the first learning phase can, in principle, operate in any combination of instructional set and saliency conditions – the explicit training condition, the rule search-nonsalient condition, the rule search-salient condition, the neutral-nonsalient condition and the neutral-salient condition – and will always contribute something to the second learning phase if this phase is operating in the neutral instruction-salient condition.

If, however, the option is a second learning phase operating in the neutral instruction-nonsalient condition, any implicit knowledge acquired in the first learning phase, again, gives weight to the further growing implicit knowledge base in the second learning phase, whereas the acquisition of explicit knowledge in the first learning phase is a necessary requirement to bring about the crucial change of the saliency condition from nonsalient to salient.

Combinations of instructional set and saliency conditions meeting the above
requirement, are, in principle, the explicit training condition, the rule search-nonsalient condition, the rule search-salient condition and the neutral instruction-nonsalient condition, but not the neutral instruction-salient condition, which predominantly induces an implicit learning mode leading to the acquisition of a predominantly implicit knowledge base.

Squire and Frambach’s (1990) study, investigating the learning to control a complex production system (Experiment 1) by amnesic patients and normal control subjects, is as an example of successive learning phases operating within the framework of options of instructional set and saliency conditions and illuminates the contribution of explicit knowledge gained during the initial learning phase and transferred in this case, to a second delayed learning phase administered after 27 days.

Both learning phases operate in the neutral instruction-nonsalient condition with the second learning phase changing into the neutral instruction-salient condition. The transfer of explicit knowledge constitutes different degrees of salience for each experimental group commensurate with the relative increase in explicit knowledge acquired during the first learning phase by amnesic patients and by normal control subjects.

Squire and Frambach (1990), using Berry and Broadbent’s (1984) sugar production control task (Experiment 1) extend the number of practice trials to 90 trials (3 sets of 30 trials) compared to Berry and Broadbent’s (1984) 60 trials (2 sets of 30 trials) in the first learning phase and administer another 90 trials in the second learning phase.

In contrast to Berry and Broadbent’s (1984) finding of subjects’ extremely poor questionnaire performance, for instance, in regard to general strategy questions, Squire and Frambach (1990) report that after the 90 trials (first learning phase) normal control subjects’ respective questionnaire performance is well above chance level (55.0% correct) and is significantly higher than the respective questionnaire performance level of the amnesic patients (28.6% correct). However, comparable to Berry and Broadbent’s (1984) findings, both experimental groups perform poorly on specific strategy questions – normal control subjects 36.0% correct and amnesic patients 30.0% correct.
Hence, both experimental groups operating in the neutral instruction-nonsalient condition gain some explicit knowledge reflected in their questionnaire performance, but, in the main, it is the implicit knowledge gained during the first learning phase that materially underlies their above-chance control performance. This conclusion is suggested by the amnesic patients’ demonstration of an equal above-chance performance level in the control of the sugar production system compared to the normal control subjects – amnesic patients 6.0/30 trials correct and normal control subjects 6.6/30 trials correct after 90 trials – despite their deficient explicit memory.

In the second learning phase, both experimental groups initially operate in the neutral instruction-nonsalient condition, but, due to the transfer of explicit knowledge gained from extended practice trials during the first learning phase, the nonsalient condition changes into a salient condition. However, after the first learning phase, the degree of salience provided by the explicit knowledge transferred differs significantly between the two experimental groups, as reflected in the normal control subjects’ questionnaire performance, being well above chance level, and the amnesic patients respective performance being just above chance level. These different degrees of salience constitute different facilitation potentials in regard to the further acquisition of implicit knowledge, as subsequent control performance results, obtained during the second learning phase, reveal an improvement by the normal control subjects (7.4/30 trials correct) and a lack thereof by the amnesic patients (5.7/30 trials correct) compared to the results from the first learning phase.

These performance values are comparable, regardless of any response time limitations that may have been inadvertently induced – Squire and Frambach (1990) do not control the response time variable – since the knowledge base underlying the control performance of both groups is predominantly an implicit knowledge base. Since neither experimental group’s explicit knowledge base changes significantly during the second learning phase, their performance can not or can only be minimally affected by response time limitations. Furthermore, the lack of an improvement in control performance
during the second learning phase by the amnesic patients in spite of extended practice (90) trials suggests that there is no linear relationship between an increase in implicit learning opportunities and an increase in the acquisition of implicit knowledge, reflected in an improved control performance. This conclusion subsequently confirms the necessity of the second learning phase to either initially operate or change into the neutral instruction–salient condition, with the salient condition constituting a sufficiently high degree of salience in order to facilitate the acquisition of implicit knowledge. Such an increased degree of salience means an increased level of transparency of the respective complex system which is not necessarily synonymous with an increased explicit knowledge base.

In other words, in order to acquire a predominantly implicit knowledge base of the rule system underlying a complex system, such as an artificial grammar or production system or social system, allowing for a high level of performance under response time limitations, successive learning phases must lead to implicit learning phases operating in the combined neutral instruction-salient condition. How important it is to adhere to this requirement becomes apparent in Berry and Broadbent’s (1984) study of learning to control a production and a social system in conjunction with Turner and Fischler’s (1993) artificial grammar learning study.

Berry and Broadbent (1984) (Experiment 2), investigating the effect of explicit training on control performance, set up two experimental groups learning to control a production and a social system in two successive phases. The experimental groups are the training group, operating in a neutral instruction-nonsalient condition during the first learning phase and an explicit training condition during the second learning phase, and the nontraining group, continuously operating in a neutral instruction-nonsalient condition during both learning phases.

Berry and Broadbent (1984) do not find any significant effect of training on control performance and are unable to explain these results. Since it is only the predominantly implicit knowledge base that is not or only minimally affected by response time limitations, these results may be, however, an indication of an
operation under response time limitation in conjunction with an either predominantly explicit knowledge base or a mixed implicit and explicit knowledge base acquired by the two experimental groups during the two learning phases. This seems possible due to the lack of response time control that may have led to self-induced response time limitations. An analysis of the two learning phases reveals the following: During the first phase in a neutral instruction-nonsalient condition, both experimental groups can be expected to gain implicit and explicit knowledge.

Considering the nontraining group first, the transfer of implicit knowledge to the second learning phase would be a contribution to the further growing implicit knowledge base, whereas the transfer of explicit knowledge to the second learning phase would provide a degree of salience to the nonsalient condition. Hence, the neutral instruction-nonsalient condition most probably would experience a limited change towards a salient condition since the limits in regard to explicit (verbalisable) knowledge, reported on above, make it unlikely that this knowledge would provide the same degree of salience as that induced, for instance, by Berry and Broadbent (1988).

Considering the training group, the implicit knowledge gained during the first learning phase would be preserved, whereas the explicit knowledge would add weight to the considerable explicit knowledge gained through the explicit training phase and, thus, most probably would tilt the balance between implicit and explicit knowledge held towards the explicit knowledge.

All in all, the nontraining group would not be expected to have gained a predominantly implicit knowledge base at the end of the second learning phase due to a lower degree of salience. The training group, on the other hand, would even be expected to have gained a predominantly explicit knowledge base due to the explicit training condition in the second learning phase. Subsequently, it is predicted that both experimental groups would be affected in their control performance if response time is limited.

The lack of significant differences between the performance level of both groups suggests the occurrence of self-induced response time limitation and, thus, indirectly confirms the above predictions.
Taken together, the framework of options of instructional set and saliency conditions that successive learning phases can operate in, outlined above, reveals the two-phase learning sequence as a most efficient unit to organise, without delay, the acquisition process of implicit knowledge. However, the variety of combinations of conditions of instructional set and saliency do not predict the relative contribution of implicit and/or explicit knowledge of the rules underlying complex systems, such as artificial grammars, production and social systems, acquired during the first learning phase, to the second learning phase. That is, the weight of the particular kind of knowledge transferred to the second learning phase may differ between learners and, thus, differentially affect performance levels, which is of particular relevance if the salient condition of the second learning phase is not induced independently of any contribution of explicit knowledge acquired during the first learning phase, but is dependent on such a contribution from the first learning phase.

Since there are degrees of salience, as implied in the above characterisation of salience as a level of transparency of the respective complex system, it becomes apparent that changes from a nonsalient to a salient condition through the transfer of explicit knowledge acquired during the first learning phase most certainly will differ according to the weight of the knowledge transferred, as demonstrated above in the context of the discussion of Squire and Frambach’s (1990) findings and, in some cases, may not even lead to a degree of salience, as demonstrated in the studies reported above, or may even lead to a higher degree of salience, as in the case of explicit training to be demonstrated below.

Hence, the option of a second learning phase initially operating in the neutral instruction-nonsalient condition is less preferable than the option of a second learning phase operating in the neutral instruction-salient condition. Furthermore, the salient condition defined by a predetermined, induced level of saliency is a preferable complement to the preferred option of a second learning phase operating in the neutral instruction-salient condition since predictions about the potential weight of the explicit knowledge to be gained during the first learning phase are difficult to make for the various combinations of instructional set and saliency conditions, except for the explicit training condition which potentially leads to the highest degree of salience, as will be shown below.
Nevertheless, the preferability of a second learning phase operating in the neutral instruction-salient condition is not only based on the independence from any transfer of explicit knowledge to be acquired during the first learning phase, but also on the fact that such independence subsequently provides scope for differentiated measures to achieve a certain degree of salience that may vary along a continuum encompassing specific increases, taking into account particular weaknesses observed in a previous performance, or encompassing general increases. Such measures to achieve a certain degree of salience may vary, ranging from measures of providing a level of transparency of the respective complex system, as, for instance, demonstrated by Reber (1976) Reber, Kassin, Lewis and Cantor (1980) and Berry and Broadbent (1988), to measures of teaching subjects the rules underlying the respective complex system, as, for instance, demonstrated by Reber et al. (1980) and Turner and Fischler (1993).

The provision of such scope for differentiated measures to achieve a certain degree of salience is of particular importance, since all studies reported above show that performance levels under short response deadlines cannot be expected to immediately be at ceiling level. That is, performance levels can only be gradually built up in order to reach ceiling level.

As foreshadowed above, evidence will be provided, demonstrating the potential contribution of explicit training to the acquisition of a predominantly implicit knowledge base by potentially achieving the highest degree of salience.

Reber et al.’s (1980) results (Experiment 2) clearly suggest such a facilitative role of explicit training during the first learning phase, even under the assumption that the lack of control in regard to response time may have led to self-induced response time limitations.102

Reber et al.’s (1980) artificial grammar learning study investigates the effect of timing in regard to the introduction of explicit knowledge into the learning process by combining distinct learning phases. These learning phases encompass an explicit phase (E) entailing the teaching of an artificial grammar and the generation of letter strings based on this grammar and an implicit phase (I) operating in the neutral instruction-nonsalient condition. Successive learning phases consist of the sequences E-I, I-E, I-E-I. Each experimental group’s
learning takes place in one of the learning sequences, whereas the learning of two control groups takes place either in an explicit phase (E) or an implicit phase (I). Classification performance results reveal a large performance difference between the E-I experimental group and the I-control group, illuminating the effects of explicit training in a two-phase learning sequence within the framework of option of successive learning phases outlined above.

The E-I-experimental group works through the explicit training phase followed by the second learning phase operating in the combined neutral instruction-nonsalient condition but changed to a neutral instruction-salient condition due to the transfer of explicit knowledge gained from the explicit training phase. This group achieves a very high level of classification performance (performance value: .76). This performance level can be seen as a valid performance indicator, since the predominantly implicit knowledge gained in the neutral instruction-salient condition is not or only minimally affected by response time limitations.

On the other hand, the level of classification performance of the I-control group, working through one learning phase, only, operating in the neutral instruction-nonsalient condition, is much lower (performance value: .62). This performance level might represent a level comparable either to one achieved under a long response deadline or under a short response deadline, since one does not know whether or not self-induced response time limitations occurred. In the latter case a lower performance level would be expected, whereas in the former case a higher performance level would be expected, since response deadline interacts with instructional set and saliency of presentation of stimuli, leading to negative effects in the neutral instruction-nonsalient condition under a short response deadline, but not under a long response deadline (cf. Turner and Fischler, 1993).

Nevertheless, Turner and Fischler’s (1993) results would also predict that even in the case of the achievement of a higher performance value by the I-control group than the reported .62, assuming that this value reflects a short response deadline effect and, subsequently, would go up under a long response deadline, the performance difference between the E-I experimental group and the I-control group would still be expected to be significant.

That is, the high performance level of the E-I experimental group
demonstrates the facilitative role of explicit training in a two-phase sequence with the second learning phase operating in the neutral instruction-nonsalient condition, but changed into the neutral instruction-salient condition on the basis of the explicit knowledge gained from the first learning phase, the explicit training phase.

Hence, these results suggest that within the framework of options of instructional set and saliency conditions that successive learning phases can operate in, the sequence of an explicit training phase followed by a second learning phase, either in the neutral instruction-nonsalient or in the neutral instruction-salient condition, stands out in regard to its potential to facilitate the acquisition of implicit knowledge predominantly underlying, for instance, high classification performance results regardless of response time limitations. The contribution of explicit knowledge, gained from explicit training and transferred to the second learning phase, is that it either changes the neutral instruction-nonsalient condition to neutral instruction-salient or increases the degree of salience in the neutral instruction-salient condition and, thus, renders this option the most potent one in facilitating the acquisition of implicit knowledge.

The importance of the framework of options of instructional set and saliency conditions that successive learning phases can operate in for the effective organisation of the acquisition process of a predominantly implicit knowledge base, which is unaffected or only minimally affected by response time limitations, can not be underestimated, since Turner and Fischler’s (1993) study (Experiment 3) unequivocally shows the limited effects of explicit knowledge gained from explicit training on its own on classification performance if response time limitations are induced.

Turner and Fischler (1993) compare the classification performance of two experimental groups operating under a long response deadline (10 seconds) and a short response deadline (2 seconds). The experimental groups consist of an explicit training group being taught the rules underlying a set of letter strings and being given practice trials in the classification of presented letter strings as grammatical or nongrammatical, including corrective feedback, and a group operating in the neutral instruction-nonsalient condition. This group is
being instructed about the procedure of presentation and reproduction of letter strings and then being presented with individual letter strings making up a set of randomly ordered letter strings and instructed to reproduce each letter string presented with up to five opportunities to attempt reproduction again if incorrect. Turner and Fischler’s (1993) results show a near ceiling level classification performance (92.6)\textsuperscript{104} of the explicit training group under a long response deadline, but a near 30% drop in the performance level (63.9) under a short response deadline. Concerning the group operating in the neutral instruction-nonsalient group, findings show a performance level well below the rule training group (66.7) under the long response deadline and at a distinctly lower level (54.4) under the short response deadline.\textsuperscript{105} The closeness of the explicit training group’s classification performance level to the ceiling level under the long response deadline suggests that the explicit knowledge base must be correspondingly comprehensive in order to achieve such a high performance level.

That is, if the explicit knowledge base is relatively comprehensive and still can only achieve a near 30% lower performance under a short response deadline, compared to a long response deadline, even further practice would not be able to close the gap between the two performance levels and, thus, reveals the limitations of a predominantly explicit knowledge base in reaching a ceiling level performance under a short response deadline.

At the same time, the above results also imply that, although the performance level of the group operating in the neutral instruction-nonsalient condition is lower than the performance level of the explicit training group (under a short response deadline) (54.4 compared to 66.7), this relatively low performance level can be systematically raised with extended practice entailing, for instance, representations of exemplars and presentations of new exemplars generated by the same artificial grammar, as well as extended classification practice (cf. Mathews et al., 1989, Reber and Lewis, 1977), all within the context of two-phase learning sequences.

In short, within the framework of options of instructional set and saliency conditions that successive learning phases can operate in, adherence to the
principle of imposing the instructional set condition ‘neutral’ and the saliency condition ‘salient’ on the second learning phase which induces a predominantly implicit learning mode, appears to be the foremost requirement for the acquisition of a predominantly implicit knowledge base of the rules underlying complex systems in order to perform tasks at a high level of accuracy under considerable time constraints.

Hence, the second learning phase has to either operate in the neutral instruction-salient condition, with the salient condition induced independently of any explicit knowledge contribution from the first learning phase, or the second learning phase has to operate in the neutral instruction-nonsalient condition, requiring the first learning phase to contribute to the acquisition of explicit knowledge in order to provide a degree of salience and, thus, to change the nonsalient condition into the required salient condition. The latter case precludes the neutral instruction-salient condition operating in the first learning phase since it induces a predominantly implicit learning mode leading to a predominantly implicit knowledge base, but permits all other combinations of instructional set and saliency conditions leading to the acquisition of explicit knowledge, though to varying degrees depending on the particular combination of conditions operating. This unpredictability of the potential weight of the explicit knowledge to be gained during the first learning phase, with the exception of an explicit training phase, renders the option of a second learning phase, operating in the neutral instruction-nonsalient condition, the less preferable option. A second learning phase operating in the neutral instruction-salient condition is preferable since it is independent of any transfer of explicit knowledge gained during the first learning phase, thus, providing instructional scope for achieving particular degrees of salience, which is of importance, since ceiling level performance under a short response deadline cannot be expected to be achieved on the basis of one two-phase sequence.

Hence, it can be plausibly assumed that the acquisition of a predominantly implicit knowledge base can be achieved by employing multiple two-phase learning sequences and by manipulating the degree of salience in order to overcome performance weaknesses.

Moreover, in the context of manipulations of the degree of salience,
the explicit training option has the potential to achieve the highest degree of salience, thus, contributing maximally to the acquisition of implicit knowledge. Implicit knowledge is readily available when performing, for instance, a grammatical classification task under a short response deadline, whereas the explicit knowledge gained from explicit training, in itself, is not readily available for such a performance under a short response deadline and leads to an inferior performance, even if the same knowledge base leads to a near ceiling performance under a long response deadline.

Another, though less predictable way to manipulate the degree of salience is practice.

As Squire and Frambach’s (1990) study of learning to control a production system reveals, there is no linear relationship between an increase in practice and an increase in the acquisition of implicit knowledge. That is, considerably extended procedural practice including feedback leads to the acquisition of explicit knowledge of the complex production system, which provides for salience and, subsequently, in this study, transforms the combined neutral instruction-nonsalient condition, operating initially, into the neutral instruction-salient condition.

In case of Berry and Broadbent’s (1988) study of learning to control a social system acquired explicit knowledge of the system it leads to an increased level of salience in the neutral instruction-salient condition.

It is this finding by Berry and Broadbent (1988) that highlights the necessity for a further differentiation of learning phases according to their engagement of implicit or explicit learning processes.

Berry and Broadbent’s (1988) study shows that extended performance on the control task improves the level of performance. As Squire and Frambach’s (1990) study reveals, such improvement on a comparable task is mediated by an increased degree of salience due to the acquisition of explicit knowledge during the process of learning to control a production system.

In order to reconcile the occurrence of predominantly implicit learning processes in the neutral instruction-salient condition as well as explicit learning processes as an outcome of extended performance on the control task in Berry and Broadbent’s (1988) study, it is necessary to consider these different learning processes –
implicit and explicit – as different learning phases within a particular implicit learning phase determined by the particular instructional set and saliency conditions. That is, these different learning phases do not occur simultaneously, which would generate a conflict with the neutral instruction condition in either combination, ‘neutral instruction-salient’ (Berry and Broadbent, 1988) or ‘neutral instruction-nonsalient’ (Squire and Frambach, 1990). The neutral instruction condition constitutes a learning condition requiring neutrality in regard to the knowledge to be acquired and, thus, excludes explicit learning processes to occur concurrently.

Hence, practice is considered as extended exposure to input for implicit learning and extended applications of already acquired implicit knowledge that extend learners’ opportunities to gain explicit knowledge. However, it is only in the context of successive implicit learning phases that explicit knowledge gained can have an effect on the acquisition of implicit knowledge by increasing the degree of salience of the salient or the nonsalient condition.

Subsequently, practice effects have to be distinguished from gains of implicit knowledge due to extended implicit learning processes.

Apart from studies by Berry and Broadbent (1988) and Squire and Frambach (1990) investigating the learning to control social and production systems, studies by Reber and Lewis (1977) and Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan (1989), investigating the learning of artificial grammars, also reveal practice effects reflected in improved classification performance. Practice effects, most likely, are complemented by performance effects resulting from gains of implicit knowledge through extended provisions of input for implicit learning.

4.2.4 The allocation of attentional resources without involving awareness is a necessary condition for implicit learning leading to the acquisition of predominantly implicit knowledge

There is unequivocal evidence suggesting that implicit learning is dependent on the allocation of attentional resources.

For instance, Nissen and Bullemer’s (1987) study presented above, using a dual-task design, shows that, in the divided attention condition, subjects’ implicit acquisition of the serial pattern of appearances of a stimulus in particular
locations on a screen is minimal compared to the high level of implicit acquisition in the single-task condition.

That is, if subjects fully attend to the task, their implicit acquisition of the underlying pattern, reflected in reduced reaction time, is positively affected, whereas if attention has to be divided between two tasks, the implicit acquisition of the underlying pattern is affected negatively.

Cohen, Ivry and Keele (1990), extending Nissen and Bullemer’s (1987) results by investigating the dependency on attention of implicitly acquiring simple, hybrid and ambiguous structured sequences, find that simple and hybrid sequences can be learned under divided attention, whereas ambiguous sequences – like the ones used by Nissen and Bullemer (1987), as Carr and Curran (1994) point out – cannot be learned under distraction. These findings are confirmed by Curran and Keele (1993) and, thus, extend to the learning of complex rule-governed structures, such as artificial grammars underlying a set of letter sequences.

In the context of the above evidence, Winter and Reber’s (1994) assertion seems plausible:

“...the process (implicit learning, D.P.H) is conceived as being a by-product of the application of attention to relevant rule-governed structures in the environment” (p.117).

Hence, the available evidence concerning the implicit learning of complex rule-governed structures suggests that the allocation of attentional resources during the learning task is a necessary condition for learning to occur.

Moreover, considerable evidence presented above, suggests that awareness is unnecessary for implicit learning to occur. Evidence in support of this conclusion is derived, in particular, from studies investigating procedural and cognitive skill learning by amnesic patients and normal subjects, demonstrating equally good implicit learning by amnesic patients compared to normal control subjects, but impaired explicit learning and awareness due to their impaired explicit memory compared to normal control subjects.

However, the above investigation of implicit learning processes of complex rule-governed structures reveals that awareness is not only unnecessary, but
must not be involved in order to acquire predominantly implicit knowledge. This finding is supported by the evidence adduced above, showing that the acquisition of predominantly implicit knowledge depends on the operation of the combined neutral instruction-salient condition during learning. Therefore, with regard to awareness, it is the neutral instruction condition which is relevant in that it constitutes an instructional condition during the learning phase that is neutral in regard to the knowledge to be acquired.

That is, in order to avoid any disruption of the neutral instruction condition, this condition requires that explicit learning processes are not concurrently engaged to acquire such knowledge, which depend on intention and awareness.

Further complementing evidence in support of the finding that awareness must not be involved in implicit learning processes that lead to the acquisition of predominantly implicit knowledge comes from results of dual-task studies. These studies show that the division of attention has detrimental effects on the implicit acquisition process.

Since the concurrent operation of implicit and explicit learning processes constitutes such dual-task learning conditions, detrimental implicit learning effects are accounted for by the above evidence from dual-task studies.

4.2.5 The dissociation between implicit and explicit knowledge and their respective acquisition processes, the necessity of implicit knowledge for the successful performance of procedural and cognitive skills under time pressure, the contribution of explicit knowledge and practice to the implicit acquisition process under certain conditions, and the necessary allocation of attentional resources without involving awareness for implicit learning to occur generalise to the acquisition of artificial and natural languages as second languages.

As foreshadowed above, some of the findings derived from studies investigating the learning of complex rule-governed structures, such as modality effects and effects of ungrammatical input for learning, will not be investigated further, due to a lack of pertinent findings in the field of language acquisition, whereas, in regard to the general availability of the explicit training option to children, the lack of studies involving children learning complex rule-governed structures will be made up by research from the field of language acquisition.
Hence, the following brief summary will only demonstrate their relevance for second language acquisition.

Firstly, the results from several studies of artificial grammar learning reveal that exemplar-specific knowledge, for instance, modality-specific knowledge cannot be transferred from one modality to another, thus, leading to decrements in classification performance if the modality shifts from the study task to the test task.

In the context of second language acquisition, this would mean that in order to achieve optimal results in acquiring the processing resources for grammatical encoding procedures, input for learning need to be provided orally.

Secondly, Dienes, Broadbent and Berry’s (1991) artificial grammar learning study shows that partly ungrammatical input for learning negatively affects the acquisition of implicit grammatical knowledge underlying subsequent classification performance, although performance is still at an above-chance level. Porter’s (1986) study of interactions between second language learners supports this finding in that it shows that, although learners provide each other with ungrammatical input, learners rarely incorporate other learners’ miscorrections or errors.

These results suggest that, in order to achieve optimal results in acquiring the processing resources for grammatical encoding procedures, input provided by the teacher need to be non-deviant, but, at the same time, leaving room for useful learner interactions that may lead to partly ungrammatical input.

And thirdly, it is obvious that all the studies presented above concern the learning of complex rule-governed structures by adults. The lack of studies involving children is, however, of no particular concern in regard to the availability of the explicit training option to children in order to potentially achieve the highest degree of salience in subsequent learning phases preferably operating in the neutral instruction-salient condition. Since there is general agreement that children’s metalinguistic awareness only develops relative late during the school years (cf. Birdsong, 1989; Shaffer 1985, 1993), the availability of the explicit training option to children is severely constrained.

For instance, de Villiers and de Villiers’ (1979) summary of research results concerning children’s awareness of their native language as well as Karmiloff-
Smith’s (1986) data, generated by Karmiloff-Smith’s (1979) study involving children aged between 4 to 12 years, clearly show a developmental gap between the ability to use their first language and their metalinguistic awareness. Such awareness is minimal at 4 years of age, but considerably grows during the school years. Karmiloff-Smith’s (1986) data show that awareness of the linguistic system begins to develop at about age 6, but it is only at about age 8 that this development accelerates, whereas awareness of certain grammatical features, such as, for instance, linguistic markers, already develops at age 4, accelerating from age 5 onwards.

Hence, children’s speech production of their native or a second language at an early age cannot depend on such explicit knowledge. That is, the acquisition of the grammatical knowledge underlying speech-production must occur implicitly, leading Karmiloff-Smith (1986) to conclude “…that metalinguistic awareness has little or no role to play macrodevelopmentally in language acquisition” (p.139).

The following presentation of findings from some recent language studies will provide evidence in support of the dissociation between implicit, nondeclarative grammatical knowledge and explicit, declarative grammatical knowledge, and, subsequently, the dissociation of their respective memory stores, the contribution of implicit knowledge, in contrast to explicit knowledge, to high levels of performance on language tasks under response time constraints, the requirement of learning phases to operate in the combined neutral instruction-salient condition in order for an acquisition of predominantly implicit knowledge to occur, the relative contribution of explicit knowledge to the acquisition of implicit grammatical knowledge in the context of particular instructional set and saliency conditions operating during successive learning phases, the relative contribution of practice to the acquisition process of implicit and explicit grammatical knowledge, and the allocation of attentional resources without awareness as a necessary condition for implicit learning.

First, Green and Hecht’s (1992) study investigates the discrepancy between explicitly taught rules of grammar to German ESL learners, ESL learner’s explicit rule knowledge and their performance on an error correction task, compared to
native English speakers’ explicit rule knowledge and error correction performance. The group of German ESL learners consists of 300 subjects with a formal ESL teaching exposure ranging from 3 years to 12 years, encompassing high school and university students, whereas the group of native speakers of English consists of 50 high school students.

Based on frequently occurring grammatical errors in written and oral production tasks, subjects’ tasks entail the naming of 12 different rules transgressed in nongrammatical exemplars presented to the subjects and the correction of errors in the nongrammatical exemplars presented. No time constraints are induced on performance.

Green and Hecht’s (1992) findings provide evidence for the dissociation between explicit and implicit grammatical knowledge underlying a substantial proportion of correct corrections.

German ESL learners, having acquired the explicit knowledge of particular rules, provide correct corrections in 97% of all cases. For native speakers of English the figure is 100%.

These near ceiling-level performances match the performance of Turner and Fischler’s (1993) subjects (Experiment 3) after explicit training under a long response deadline, as reported on above. However, all 300 ESL learners can produce a correct rule in only 46% of the cases, but achieve correct corrections in 78% of the cases. Native speakers of English, on the other hand, can produce a rule in 42% of the cases, but achieve correct corrections in 96% of the cases.

Hence, both groups show that large proportions of their correct corrections are not related to explicit rule knowledge, but are due to an implicit knowledge base.

Second, de Graaff’s (1997) study investigates the effect of explicit instruction on the acquisition of implicit grammatical knowledge of an artificial language (eXperanto – a simplified version of the artificial language Esperanto) entailing two morphological and two syntactical rules.

Based on the assumption that “Implicit language knowledge is generally considered to form the basis for L2 performance” (de Graaff, 1997, p.249), the acquisition of the above rules is tested with a grammaticality judgement task under time pressure and without time pressure (midtest, immediate posttest...
and delayed posttest). De Graaff (1997) distinguishes two experimental groups of native speakers of Dutch, an ‘explicit’ group and an ‘implicit’ group, according to the instruction they receive.

Such static descriptions, though, do not reflect potential changes to the learning conditions during the entire learning process, such as changes to the instructional set and saliency conditions and their potential effects on the learning process in regard to the kind(s) of knowledge – implicit and/or explicit knowledge – acquired.

Nevertheless, in the context of detailed descriptions of instructional procedures, the data generated by this study and other studies presented below that also use static descriptions of ‘explicit’ and ‘implicit’ experimental groups provide valuable evidence of the overall learning process. This learning process can be reconstructed as a succession of learning phases operating in particular instructional set and saliency conditions, determining the acquired kind(s) of knowledge materially underlying time constrained performance on language tasks.

De Graaff (1997) provides input for learning and practice for the ‘implicit’ and ‘explicit’ group during 10 sessions of approximately 1.5 hrs. duration each (two sessions per week), incorporating a selection of tasks – dialogues and meaning comprehension tasks (1a), translation tasks (into Dutch) (1b), vocabulary tasks in context (2), form-meaning tasks (3a), production tasks (in writing) (3b, 3c)– and providing immediate feedback on every item’s correctness, including the correct answer. The above tasks of each session are carried out sequentially.

However, the ‘explicit’ group receives extra metalinguistic input, consisting of grammatical explanations of the target structures, after the dialogues and meaning comprehension tasks (1a), the form-meaning tasks (3a) and production tasks (3b, 3c).

Hence, in each session, both groups go through a fixed sequence of learning phases leading to the acquisition of implicit and explicit knowledge in regard to the target structures in each group.

Based on the above described sequence of input and practice during one session, the sequence of 6 learning phases and their instructional set and saliency conditions can be identified.
For the ‘implicit’ group, initially, all learning phases (1a, 1b, 2, 3a, 3b, 3c) operate in the neutral instruction-nonsalient condition. The ‘neutral instruction’ condition is fulfilled in that the input and practice tasks are being kept neutral in regard to the target structures to be acquired. De Graaff (1997) states:

“Throughout the course, the target structures were treated among other input material in situational settings, in order to increase the authenticity of the course material and to avoid too obvious a focus on the target structures” (p.259).

The initial ‘nonsalient’ condition is fulfilled in that no particular measures to render the target structures salient are being taken. This combination of instructional set and saliency conditions typically leads to both the acquisition of implicit and explicit knowledge. However, due to consistent feedback and extended practice over 10 sessions, leading to extra gains in explicit knowledge transferred to successive learning phases, a subsequent change of the neutral instruction-nonsalient condition into the neutral instruction-salient condition can be expected, including a gradual increase of the degree of salience. Such change into the neutral instruction-salient condition, as well as the increase of the degree of salience will facilitate the acquisition of implicit knowledge.

For the ‘explicit’ group, initially, all learning phases, except the second learning phase (1b), operate in the neutral-nonsalient condition, too. The second learning phase immediately operates in the neutral instruction-salient condition, whereby the salient condition is induced by the highlighting of the target structures contained in the dialogues to be translated into Dutch. Again, extra gains in explicit knowledge transferred to successive learning phases will lead to a subsequent change of the neutral instruction-nonsalient condition into the neutral instruction-salient condition, but, due to the extra grammatical explanations provided in excess of the consistent provisions of feedback and highlighting of the target structures (in learning phase 1b, only), the expected increase in the degree of salience will be higher than the degree of salience achieved in the
learning conditions in the ‘implicit’ group, increasing the facilitation potential for
the acquisition of implicit knowledge even further, compared to the ‘implicit’
group.

Hence, both groups can be expected to make strong gains in implicit knowledge
due to the respective change of the combination of instructional set and saliency
conditions to neutral instruction-salient, although, the gains can be expected to
differ due to the different degrees of salience to be achieved in each group, with
the ‘explicit’ group potentially making larger gains than the ‘implicit’ group.

Both groups can also be expected to make gains in explicit knowledge, though,
larger gains can be expected for the ‘explicit’ group receiving extra explicit
training in excess of consistent feedback and extended practice provided to both
groups.

Subsequently, both groups’ overall performance on the grammaticality judgement
task (midtest, immediate posttest) is expected to show an increase over time for
each group in both conditions – with time pressure or without time pressure –
leading to an above-chance performance level due to gains in implicit as well as
explicit knowledge. Implicit knowledge is expected to materially underlie
performance of both groups in the ‘time pressure’ condition as well as in the ‘no
time pressure’ condition and explicit knowledge is expected to contribute to
performance of both groups in the ‘no time pressure’ condition.

Furthermore, one can expect a higher performance level of the ‘explicit’ group
compared to the ‘implicit’ group, firstly, in the ‘time pressure’ condition due to a
larger increase of implicit knowledge, readily available under response time
constraints in contrast to explicit knowledge, and, secondly, in the ‘no time
pressure’ condition due to the larger increase of implicit as well as explicit
knowledge, both readily available in the condition that does not induce any
constraints on response time.

De Graaff’s (1997) presentation of the performance results of the ‘explicit’ and
‘implicit’ group operating either in the ‘time pressure’ condition or the ‘no time
pressure’ condition confirms the above expectations concerning performance
increases leading to an above-chance level of accuracy in classification.
The mean scores over all target structures for the ‘implicit’ group raise from
values between 0.5 and 0.6 (midtest) to values between 0.6 and 0.7 (immediate
This steady performance increase to an above-chance level is observable in the ‘time pressure’ condition as well as in the ‘no time pressure’ condition.

The mean scores over all target structures for the ‘explicit’ group raise from values between 0.6 and 0.7 (midtest) to values between 0.7 and 0.8 (immediate posttest). Again, this steady performance increase to an above-chance level is observable in both conditions – with time pressure or without time pressure.

Furthermore, the above mean scores over all target structures for both groups confirm the expectations of a higher performance level of the ‘explicit’ group compared to the ‘implicit’ group by showing a significantly higher performance level for the ‘explicit’ group compared to the ‘implicit’ group in each response time condition.

However, direct support for the hypothesis of a predominant role of implicit knowledge and a complementary role of explicit knowledge in subject’ classification performance is difficult to obtain from de Graaff’s (1997) results.

Although the reduction in reaction time, induced by the ‘time pressure’ conditions, is considerable over time, ranging from 16.3 sec. (‘explicit’ group) or 14.3 sec. (‘implicit’ group) at midtest to 7 sec. (‘explicit’ and ‘implicit’ group) at immediate posttest, the latter reaction time value does not straightforwardly permit the conclusion that the knowledge underlying performance under such time pressure must be implicit knowledge.

Unfortunately, studies using artificial languages do not afford us a comparison between reaction time data obtained from learners and those obtained from native speakers.

Hence, one can only extrapolate from findings, for instance, by White and Genesee (1996) and Pienemann (1998a), showing that subjects’ reaction time is longer if they have not yet acquired the grammatical competence underlying their grammaticality judgement performance, compared to native speakers or near-native speakers.

Based on de Graaff’s (1997) results, demonstrating that none of the group performance levels approaches ceiling level, which would indicate the full-acquisition of the target structures by all subjects, one can plausibly assume that the knowledge underlying procedural skills for classifying sentences as
grammatical or nongrammatical is not acquired yet by all subjects, that is, one can assume that the lowest reaction time of 7 sec. at immediate/posttest by both the ‘explicit’, as well as the ‘implicit’ group operating under time pressure, does not represent the shortest reaction time and, thus, does not preclude a significant contribution of explicit knowledge to the classification performance. Nevertheless, there is indirect evidence, suggesting that the knowledge materially underlying both groups’ classification performance in the ‘time pressure’ as well as in the ‘no time pressure’ condition is of an implicit nature.

If one compares the mean scores over all targets obtained under time pressure with the respective scores obtained without time pressure, their relative consistent but small difference becomes apparent. In the context of Turner and Fischler’s (1993) findings and the above conclusions drawn from their results, this consistency and the relative small difference between performance scores of each group, when operating either under time pressure or without time pressure, suggest that the knowledge materially underlying the respective performance of each group is implicit knowledge since it is readily available regardless of response time and constraints and, thus, leads to the same or minimally different performance levels in both response time conditions.

These conclusions are in line with potential gains of implicit knowledge to be expected due to the change of the combination of instructional set and saliency conditions from neutral instruction-nonsalient to neutral instruction-salient.

Third, DeKeyser’s (1995) study aims at a comparison between explicit-deductive learning and implicit-inductive learning of an artificial language - ‘Implexan’. ‘Implexan’ consists of 98 words that can be used for sentences based on the word order rule Subject-Verb-Object and several morphological rules regulating “…number and case marking on the noun and number and gender marking on the verb” (DeKeyser, 1995, p.387).

However, an analysis of the instructional set and saliency conditions of the successive learning phases reveals that the ‘implicit-inductive’ experimental group is in actual fact an ‘explicit-inductive group’. It will be demonstrated below that the poor performance of this experimental group and the other ‘explicit-deductive’ experimental group in the final grammaticality judgement
and production tasks are due to an insufficient implicit knowledge base and due to response time constraints affecting the availability of the explicit knowledge base acquired by both experimental groups, thus, seriously weakening DeKeyser’s conclusions that explicit-deductive learning is superior to implicit-inductive learning.

Subjects of both experimental groups in DeKeyser’s (1995) study are provided with input and practice opportunities during 20 sessions of approximately 25 min. duration each – 4 sessions per week as 2x2 consecutive sessions.

The input for both experimental groups during each session consists of the presentation of 124 pictures and their corresponding ‘Implexan’ sentences, except for session 1 using English sentences corresponding to the pictures, with the ‘explicit-deductive’ group receiving extra metalinguistic input in form of grammar rule presentations prior to sessions 2, 3 and 11, each of approximately 10 min. duration. Practice for both experimental groups during each session – except for the first session – consists of grammaticality judgement tests, each using 20 grammatical sentences out of the pool of 124 sentences generated for the study, and feedback concerning the correctness or incorrectness of subjects’ judgements. These grammatical judgement tests are not performed as a block of 20 judgements, but rather at random during the presentation of the 124 sentences.

For the ‘explicit-deductive’ group, receiving explicit training prior to the second, third and eleventh session and regular grammaticality judgement practice during each session, all learning phases can be clearly considered to operate in an explicit training condition, leading to the acquisition of predominantly explicit knowledge. The ‘implicit-inductive’ group, on the other hand, does not fulfill the criterion of learning in the instructional set condition ‘neutral-instruction’, which is a precondition for the acquisition of predominantly implicit knowledge, as concluded above in the context of Turner and Fischler’s (1993) results.

Such ‘neutral instruction’ only provides explanations as to the procedure of presentations of stimuli but is neutral in regard to structures or rules underlying these stimuli, as well as in regard to future testing in order to avoid subjects changing into a rule search mode. As Reber (1976) pointedly put it:

“...the implicit acquisition process seems to be most
effective when the subjects are in a relative neutral, passive set and allow themselves to be inundated by the stimulur material. The efforts on the part of the Group E (Rule search group, D.P.H.) subjects to break the code precludes the operation of this implicit mode” (p.93).

Hence, DeKeyser’s (1995) ‘implicit-inductive’ group’s learning occurs in the rule search or ‘explicit-induction’ condition. As Appendix D reveals, DeKeyser’s (1995) introductory instruction does not just explain the procedure of presentations of stimuli, but already points out future testings and what they entail. In conjunction with the regular testing during each session and the provision of feedback regarding the correctness or incorrectness of subjects’ responses, subjects are indirectly encouraged to search for underlying rules in order to succeed.113

Furthermore, since no particular measures are taken to render the target rules salient, learning of the ‘implicit-inductive’ group, which really is an ‘explicit-inductive’ group, operates in the combined rule search-nonsalient condition, leading to the acquisition of predominantly explicit knowledge.

DeKeyser (1995) employs two testing instruments, a grammaticality judgement task and a production task, using the same set of sentences. Each set contains 8 sentences using old forms and 36 sentences using new forms. The grammaticality judgement task restricts response time to 5 seconds, whereas the production task of typing an ‘Implexan’ sentence corresponding to a particular picture presented restricts the overall response time to 30 seconds, including the time for looking at the particular picture and spelling/typing the corresponding sentence, which, conservatively calculated, amounts to a response time limitation of approximately 10 seconds.114

Based on the above identification of the instructional set and saliency conditions operating during the learning phases of each experimental group – the ‘explicit-deductive’ group operating in the explicit training condition and the ‘explicit-inductive’ group operating in the rule search-nonsalient condition – each experimental group is expected to acquire a predominantly explicit knowledge base.
The ‘explicit-deductive’ group’s predominantly explicit knowledge base will be largely due to explicit training received, whereas the ‘explicit-inductive’ group’s predominantly explicit knowledge base will be largely due to extended practice entailing repeated presentations of stimuli and practice in making grammaticality judgements.

Plausibly, the explicit-deductive group’s explicit knowledge base is expected to be stronger in regard to knowledge of the rule system underlying number, case and gender marking of nouns and verbs.

With a predominantly explicit knowledge base, decrements in the performance of both experimental groups, commensurate with response time limitations imposed, are to be expected.

These predictions are borne out in the data provided by DeKeyser (1995) if one calculates the means of percentages correct for new forms, old forms in new sentences and old forms in old sentences together, which are 79.33 for the ‘explicit-deductive’ group’s and 70.03 for the ‘explicit-inductive’ group’s final production test, and compares them with the respective means of percentages correct, calculated from the error scores, which are 49.73 for the ‘explicit-deductive’ group and 49.46 for the ‘explicit-inductive’ group’s final grammaticality judgement test.

However, DeKeyser’s (1995) data from the final production and grammaticality judgement tests as well as data from the regular grammaticality judgement tests carried out during each learning session, differentiating according to performance on old or new forms (final production test) and performance on old forms (regular grammaticality judgement tests), or old and new forms (final grammaticality judgement test), reveal two kinds of explicit knowledge underlying the performance on old or new forms respectively, rule knowledge that is generalisable to new forms and exemplar-specific knowledge that is applicable to old forms only.

Although the availability of both kinds of explicit knowledge during test performance is significantly affected by response time limitations, it is the rule knowledge that is most significantly affected during the performance on new forms, as the following data comparisons show:
The mean percentages of correct scores for new forms are 57.10 for the ‘explicit-deductive’ group’s performance and 33.3\(^{115}\) for the ‘explicit-inductive’ group’s performance on the final production test, and 49.73 for the ‘explicit-deductive’ group’s performance and 49.46 for the ‘explicit-inductive’ group’s performance on the final grammaticality judgement test (the latter two values are calculated from the error scores) compare to the mean percentages of correct scores for old forms, calculated from the values for old forms, which are 90.45 for the ‘explicit-deductive’ group’s performance and 88.4 for the ‘explicit-inductive’ group’s performance on the final production test (calculated from the values for old forms in old and new sentences), and which are 69.05 for the ‘explicit-deductive’ group’s performance and 70.15 for the ‘explicit-inductive’ group’s performance on the regular grammaticality judgement tests (calculated from all error scores obtained during 19 learning sessions).

Hence, the poor performance of both experimental groups in regard to transfer to new grammatical items, based on predominantly explicit knowledge, indirectly confirms the above findings of the superiority of an implicit knowledge base that is not or only minimally affected by response time limitations, but, due to its mostly abstract knowledge, can be transferred to new grammatical items within the same grammatical domain.

The reanalysis of DeKeyser’s (1995) data provides an additional outcome that has been foreshadowed above in the context of the discussion about the implicitness or explicitness of syntactical lemma information, that is, knowledge of syntactic categories and syntactical relations of lexical entries. The reanalysis of DeKeyser’s (1995) results provide strong evidence in support of the implicit nature of the knowledge of syntactic categories and syntactical relations.

Based on the above explicated conclusions drawn from Maratsos’ (1982, 1988), Maratsos and Chalkley’s (1980) and Bowerman’s (1982) arguments and supportive evidence regarding the acquisition of syntactic categories and syntactical relations, the acquisition of lexical entries’ syntactic categories – verb and noun – as well as their syntactical relations – subject/object–verb agreement – in DeKeyser’s (1995) study would be predicted to manifest itself in the acquisition of the morphological rules underlying number and case marking on nouns and number and gender marking on verbs in ‘Implexan’, reflected in a
performance on the production and classification tasks that is well above chance level.
However, the poor performance of both experimental groups under response time constraints in regard to transferring their predominantly explicit knowledge to new grammatical items clearly suggests that, even if one assumes the successful acquisition of explicit knowledge of syntactic categories and syntactical relations in conjunction with the successful acquisition of explicit knowledge of the morphological rules, such knowledge is not readily available under response time limitations and, thus, provides strong evidence in support of the implicit nature of the knowledge of syntactic categories and syntactical relations underlying the time constrained grammatical encoding process.

The fourth study to be presented is Doughty’s (1991) study, investigating the effect of instruction on subjects’ rate of acquisition of relativisation in ESL. Doughty (1991) sets up two experimental groups and one control group. All subjects are pretested on relativisation, using grammaticality judgement tasks, sentence combination tasks and oral production tasks, in order to select subjects with only little knowledge of relativisation that can be considered to be developmentally ready to acquire relativisation. Pretests of all three groups reveal the emergence of relative clauses – the lowest pretest score is 31.44. All three groups are exposed to input containing a marked relative clause type of English by reading text for comprehension. However, the control group (COG) is exposed to a one-by-one presentation of each sentence of the text for comprehension, whereas each of the two experimental groups, the meaning-oriented instructional group (MOG) and the rule-oriented instructional group (ROG), receive particular instructional treatments in order to improve subjects’ ability to relativise. The instructional treatment for the MOG group consists of a comprehension support facility – ‘Dictionary Help’ – and a facility of expansion or clarification of the content of each sentence of the text presented – ‘Explanation’ – with the target structure in that input rendered salient through highlighting and capitalisation. The ROG group, on the hand, receives explicit grammatical training in conjunction with sentence manipulation through an ‘Animated Grammar’ programme.
Only the two experimental groups – MOG and ROG – receive extended presentations of different sentences containing the target structure, that is, the degree of redundancy is significantly different to the COG group.

The treatment period is ten consecutive working days and, thus, can be considered as a succession of ten learning phases followed by posttesting encompassing two grammaticality judgement tasks, one using 24 correct and 24 incorrect sentences and the other using 13 correct sentences and 16 incorrect sentences. All tests together represent each type of relativisation. No time constraints are being imposed on test performance.

Hence, drawing on the above outlined framework of options for successive learning phases, each group can be identified as learning in a particular combination of instructional set and saliency conditions, thus, determining the kind(s) of knowledge – implicit and/or explicit knowledge – acquired.

The COG group’s learning through exposure only, at least initially, operates in the neutral instruction-nonsalient condition. Potentially, though, through gains of some explicit knowledge during extended exposure, transferred to successive learning phases, the nonsalient condition may change to a salient condition. However the degree of salience can be expected to be at a relative low level due to the, most likely, limited gains in explicit knowledge to be expected.

In any case, the acquisition of a predominantly implicit knowledge base and a relatively lower performance level compared to the two experimental groups are to be expected, whereby the former is due to the particular instructional set and saliency conditions and the latter is due to the lack of redundancy in conjunction with a nonsalient or a salient condition operating at a low degree of salience, affecting the strength of the predominantly implicit knowledge base acquired.

The MOG group’s learning through exposure and the reception of extra input, in order to maximise comprehension by rendering the target-structure salient, operates in the neutral instruction-salient condition. The acquisition of a predominantly implicit knowledge base and a relatively high performance level compared to the COG group are to be expected, whereby the former is due to the particular instructional set and saliency conditions and the latter is due to the provision of redundancy combined with complementary measures to increase the
degree of salience, affecting the strength of the predominantly implicit knowledge based acquired.

And, finally, the ROG group’s learning through extended exposure in conjunction with explicit rule training and sentence manipulation presentations operates in the explicit training condition. Hence, the acquisition of a predominantly explicit knowledge base and, due to a lack of response time constraints, a relatively high performance level, compared to the COG group, is to be expected.

As far as performance levels are concerned, predictions on the basis of instructional set and saliency conditions are borne out in the data provided by Doughty (1991). Unfortunately, due to unlimited response time during testing, no complementary evidence in support of the above predictions as to the kind(s) of knowledge underlying the performance of all three groups as well as to the superiority of implicit knowledge when performing under time pressure is available.

Nevertheless, the confirmation of predicted performance differences between the COG group and the MOG group corroborates the above presented results from Berry and Broadbent’s (1988) study (Experiment 1) of the effects of practice on performance to control a social system.

Berry and Broadbent (1988) report that each of two groups operating under neutral instructions initially performs at an intermediate level, with a higher control performance level in the salient condition and a lower control performance level in the nonsalient condition.

However, with extended practice, this small performance difference develops into a large performance difference in that the acquisition of explicit knowledge during practice leads to an increase in the degree of salience of the rules underlying the successful control of the social system, but disproportionally extends the effects of salience in the neutral instruction condition. That is, after the third set of 20 trials, the group operating in the neutral instruction-salient condition achieves a much higher control performance level than the group operating in the neutral instruction-nonsalient condition.

The fifth and sixth study to be presented in the context of demonstrating that the results from memory research and from studies on acquiring complex rule-
governed structures extend to artificial and natural languages are Van Patten’s (1990a) study investigating simultaneous attention to meaning and form and DeKeyser’s (1993) study investigating the effectiveness of frequent explicit error correction. Firstly, Van Patten’s (1990a) study involves 202 students learning Spanish as a second language at university level. He sets up four groups at each of the three levels of proficiency:

“...Level I = first semester; Level II = fourth semester; Level III = third semester” (Van Patten, 1990a, p.290). The groups at each level are distinguished by the task they have to perform after exposure to a text presented orally to them. The tasks are:

“Task I [...] listening [...] for content only. Task II [...] listening [...] for content and simultaneously noting the key lexical item, ‘inflaci★n’. Task III [...] listening for content and simultaneously noting the definite article ‘la’. Task IV [...] listening for content and simultaneously noting the verb morpheme ‘-n’” (Van Patten, 1990a, p.291)

Van Patten (1990a) uses a dual-task design as well as a single-task design. The dual-task design (Tasks II, III and IV) divides attention between comprehension of the presented text and the detection of “...non-communicative grammatico-morphological forms” (p.294) in this text. The results confirm, for instance, that the detection of the morpheme ‘n’, which would be important, for example, in the context of acquiring the morphological rules of the target language (Functorisation Rules), requires the allocation of attentional resources, which, under dual-task conditions, detrimentally affects the simultaneous allocation of attentional resources for comprehension. Such effect is reflected in significantly lower recall scores obtained from performance on Task IV compared to the recall scores obtained from performance on Task I, regardless of the level of proficiency.

In short, Van Patten’s (1990a) results suggest that the allocation of attentional resources is necessary for the detection of grammatical features in the input and
thus, for the acquisition of underlying grammatical rules and regularities, but also for the comprehension process.

Since Van Patten (1990a) uses instructional manipulations that explicitly focus subjects’ attention on the particular tasks, thus, involving awareness, the results do not provide evidence in support of the generalisability of the findings from studies investigating the nature of the acquisition process of complex rule-governed structures to the second language acquisition process. These findings show that implicit learning, too, requires attention, though, in the absence of awareness, both of which are preconditions for the implicit acquisition of predominantly implicit knowledge.

Evidence in support of the generalisability of these findings to the second language acquisition process is provided by results from DeKeyser’s (1993) study, revealing the ineffectiveness of frequent direct error corrections during learners’ meaning-focused oral interactions. DeKeyser’s (1993) study investigates the effectiveness of frequent explicit error correction over a period of one year, for instance, in regard to improving oral accuracy, compared to an approach of avoiding error correction as much as possible.

The results show:

“…no overall significant difference in learning outcome is discernible between the group that receives frequent and elaborate error correction and the group that receives virtually no error correction during communicative activities” (DeKeyser, 1993, p.505).

The learning environment for both groups is mainly characterised by meaning-focused interaction, constituting the neutral instruction condition, and interspersed form-focused instructions providing for salience. Hence, learning phases predominantly operate in the combined neutral instruction-salient condition. Although the group receiving frequent error correction should benefit from a potential increase in salience by improving the acquisition of implicit
knowledge, reflected in an improved oral production, no difference between it and the other group is discernible.

DeKeyser’s (1993) description of the error correction treatment as explicit, making students self-correct, and frequent, however, explains the absence of any discernible improvement in regard to the oral performance of the error correction group. Since, after a period of one year, the acquired explicit knowledge from error correction does not lead to an improved oral performance it is most likely that the error correction treatment affects the other learning condition necessary for the acquisition of predominantly implicit knowledge, the neutral instruction condition.

That is, the frequent, explicit error corrections engage concurrent explicit learning processes that disrupt the neutral instruction condition, characterised by the avoidance to engage explicit learning processes and, thus, become ineffective. Furthermore, in the context of Van Patten’s (1990a) results, reported on above, DeKeyser’s (1993) findings may also be due to dual-task effects of divided attention. Since the concurrent operation of implicit and explicit learning processes constitutes such dual-task learning conditions, the lack of implicit learning effects is accounted for by the above evidence adduced by Van Patten (1990a).

In conclusion, the investigation of memory studies, studies investigating the nature of the acquisition process of complex rule-governed structures, and studies investigating or revealing the knowledge bases resulting from the acquisition of grammatical features of artificial and natural languages, as second languages provides strong, consistent evidence, suggesting, firstly, that language-specific knowledge underlying the processing procedures of the extremely time-constrained processes of grammatical encoding for speech production is predominantly of an implicit nature, and that such implicit knowledge can be dissociated from meaning-based lemma information of lexical entries, secondly, that the acquisition process, which leads to the acquisition of predominantly implicit language-specific knowledge, is of an implicit nature, requiring it to operate in the combined neutral instruction-salient condition, thirdly, that explicit language-specific knowledge transferred across successive implicit
learning phases may increase the degree of salience constituting the salient condition, thus, contributing to the acquisition of implicit knowledge, fourthly, that extended practice may lead to the acquisition of explicit language-specific knowledge, which, transferred across successive implicit learning phases, may increase the degree of salience constituting the salient condition, thus, contributing to the acquisition of implicit knowledge, and, fifthly, that the allocation of attentional resources is necessary for both implicit and explicit learning processes, but that such allocation for implicit learning processes must not involve awareness.

Evidence in support of the first conclusion is twofold. The first block of evidence consists of findings from memory studies as well as of findings from studies investigating the nature of the acquisition process of rule-governed structures, such as, for instance, artificial grammars and a study investigating the acquisition of grammatical features of a second language.

The memory studies demonstrate that implicit knowledge materially underlies motor skills, perceptuomotor skills and cognitive skills performed at an above-chance level by amnesic patients with deficient explicit memory comparable to normal control subjects, and that implicit knowledge can be dissociated from explicit knowledge. Both amnesic patients and normal subjects either lack awareness of the implicit knowledge of the complex structures underlying their performance, or in case of gains in explicit knowledge by normal subjects, for instance, through extended practice, such knowledge may affect the magnitude of performance improvements if the task engages in explicit memory, but cannot account for the above-chance level of performance as such. These findings are corroborated by studies investigating the nature of the acquisition process of complex rule-governed structures, such as, for instance, artificial grammars and extend to second language learning.

Although Van Patten (1994) is correct in cautioning against the extrapolation of findings from artificial grammar learning studies to natural languages and their grammars, I agree with Schmidt (1994b) who points out that

“...the artificial grammars used in implicit learning studies are very roughly analogous to natural languages, in the sense that
sentences of the language are viewed in both cases as the product of a complex underlying system” (p.167).

Hence, one would expect that if subjects are able to acquire implicit knowledge of complex structures, such as artificial grammars, demonstrated by the performance of grammatical classification tasks at an above-chance level,\textsuperscript{117} and such implicit knowledge can be dissociated from their explicit knowledge, evidenced in subjects’ inability to explicate knowledge commensurate with their performance level, then second language learners should demonstrate the acquisition of implicit knowledge of the rule system underlying the target language, which is dissociated from explicit knowledge.

This prediction is borne out, for instance, in Green and Hecht’s (1992) results, presented above, showing the discrepancy between 300 ESL learners’ performance on an error correction task and their explicit respective rule knowledge, whereby a high level of correct corrections compares with a low level of explicit rule knowledge, implying that a large proportion of ESL learners’ correct corrections are due to an implicit knowledge base.

The second block of evidence, suggesting that the knowledge underlying the hierarchy of processing procedures is implicit, nondeclarative knowledge, consists of findings drawn from the above investigation of research studying the nature of the acquisition process of rule-governed structures, such as, for instance, artificial grammars as well as investigating the acquisition of grammatical features of artificial languages as second languages.

The findings of the former studies demonstrate that it is only implicit knowledge that is readily available for the performance of tasks, such as grammatical classification tasks, under response time constraints, whereas explicit knowledge is not readily available if response time constraints apply, leading to inferior performance levels.

These findings fit well with the time-constrained nature of the operations of the grammatical processor based on an implicit knowledge base and extend to the performance on sentence classification and sentence production tasks aimed at demonstrating the acquisition of grammatical knowledge underlying artificial languages as second languages.
In case of de Graaff’s (1997) artificial language study, presented above, a comparison of the available classification performance data for both experimental groups, obtained in the time pressure condition, with the data obtained in the no time pressure condition, reveals a performance level of both groups that is well above chance level. Both groups show a consistent but small performance difference, indicative for an implicit knowledge base, since performance materially based on implicit knowledge is not or only minimally affected by response time constraints.

In case of DeKeyser’s (1995) artificial language study, presented above, the predominantly explicit knowledge base of both experimental groups becomes obvious when comparing data from sentence production performance obtained in the less/no time pressure condition with the data from sentence classification performance obtained in the time pressure condition. Significant performance decrements affected by response time constraints, reducing the performance level from well above chance level to chance level, clearly indicate a predominantly explicit knowledge base.

Taken together, the differential effects of response time constraints on the implicit and explicit knowledge base underlying sentence classification in de Graaff’s (1997) study and underlying sentence classification and sentence production in De Keyser’s (1995) study respectively reveal the superiority of implicit grammatical knowledge when performing under time pressure, thus, providing strong evidence, suggesting that the language-specific knowledge underlying the processing procedures of grammatical encoding is predominantly of an implicit nature and can be dissociated from explicit language-specific knowledge.

In the same vein, DeKeyser’s (1995) study reveals the implicit nature of a lexical entry’s syntactical lemma information (i.e. its syntactic category and syntactical relations), which can be dissociated from explicit knowledge of syntactical lemma information.

Since the acquisition of each lexical entry’s syntactical lemma information is inextricably linked to the acquisition of morphological rules, the performance results obtained in the ‘no time pressure’ condition in DeKeyser’s (1995) study imply that such knowledge can be assumed of having been acquired in order to
assign correct number and case markings to nouns and number and gender markings to verbs.

Due to the learning condition operating during the learning phases of the two experimental groups, such knowledge acquired can be expected to be of an explicit nature. This is confirmed by its inferiority in case of imposed response time constraints when the above-chance performance level drops to chance level. This result unequivocally confirms that explicit syntactical lemma information is not readily available when task performance has to occur under time pressure and, thus, suggests the necessarily implicit nature of the knowledge of syntactic categories and syntactical relations underlying the time-constrained grammatical encoding process.

Evidence in support of the second and third conclusion consists of findings drawn from studies investigating the nature of the acquisition process of rule-governed structures, such as, for instance, artificial grammars, as well as of findings from studies investigating the acquisition of grammatical features of artificial and natural languages as second languages. The findings of the former studies demonstrate that the particular instructional set and saliency conditions operating in a learning phase determine the particular kind(s) of knowledge – implicit and/or explicit knowledge – being acquired.

Artificial grammar learning studies, distinguishing the neutral instruction, rule search and explicit training conditions as possible instructional set conditions and the salient and nonsalient conditions as possible saliency conditions, reveal, firstly, that learning in the combined neutral instruction-salient conditions leads to the acquisition of predominantly implicit knowledge, whereby the degree of salience may facilitate the acquisition process, secondly, that learning in the combined rule search-nonsalient condition as well as learning in the explicit training condition leads to the acquisition of predominantly explicit knowledge and, thirdly, that learning in the combined neutral instruction-nonsalient conditions as well as learning in the combined rule search-salient condition lead to the acquisition of both implicit and explicit knowledge. Furthermore, the above studies reveal that the transfer of the particular kind(s) of knowledge acquired across successive learning phases affects the relative strength of
knowledge of the same kind, but in case of explicit knowledge also affects the strength of knowledge of a different kind – implicit knowledge – by increasing the degree of salience, that is, the level of transparency of the complex system to be acquired. These findings provide the basis for the deduction of a framework of options of instructional set and saliency conditions that successive learning phases can operate in, outlined above, which recognises that in order to acquire a predominantly implicit knowledge base, learning phases have to operate in the combined neutral instruction-salient condition.

These findings extend for instance to the results from de Graaff’s (1997) and De Keyser’s (1995) studies of the acquisition of artificial languages. Given that the predominant knowledge bases acquired by the experimental groups are already determined by the above analyses, involving comparisons of reaction time data from performance under time pressure and under no time pressure, the instructional set and saliency conditions leading to the acquisition of particular kinds of knowledge are predictable. In case of de Graaff’s (1997) two experimental groups, the predominant knowledge base is implicit knowledge, whereas in case of DeKeyser’s (1995) two experimental groups, the predominant knowledge base is explicit knowledge.

The predominantly implicit knowledge acquired by de Graaff’s (1997) experimental groups in six successive learning phases would predict that the prevalent combination of instructional set and saliency conditions operating during the successive learning phases is the neutral instruction-salient combination.

Furthermore, inferred extra gains in explicit knowledge, transferred across successive learning phases, predict an increase in the degree of salience and, subsequently, an increase in implicit knowledge, whereby inferred differences in gains of explicit knowledge predict differential degrees of salience and, subsequently, differential gains in implicit knowledge reflected in respective performance differences.

All predictions are borne out in the analyses of the six learning phases and the performance data.

The predominantly explicit knowledge, acquired by DeKeyser’s (1995)
experimental groups in twenty successive learning phases would predict that the prevalent combination of instructional set and saliency conditions operating during the successive learning phases is the rule search-nonsalient combination or just the explicit training condition.

Furthermore, inferred extra gains in explicit knowledge in the experimental group operating in the explicit-training condition, compared to the other experimental group operating in the rule search-nonsalient condition, predict differential performance results by both experimental groups.

All predictions are borne out in the analyses of the twenty learning phases and the performance data.

The findings drawn from studies investigating the nature of the acquisition process of rule-governed structures, such as, for instance, artificial grammars also extend to the results of Doughty’s (1991) ESL study.

However contrary to de Graaff (1997) and DeKeyser (1995), Doughty (1991) does not offer the extra confirmational evidence regarding the implicitness and/or explicitness of the knowledge acquired by the two experimental groups and the control group since no time constraints are imposed on performance. Hence, no a priori predictions regarding the prevalent, respective instructional set and saliency conditions can be made. But by drawing on the possible options of instructional set and saliency conditions and by considering the relevant information regarding these conditions given by Doughty (1991), each of the experimental groups and the control group can be identified as initially learning in particular instructional set and saliency conditions. Analyses of this kind in conjunction with analyses of the transfer of knowledge across ten successive learning phases finally permit the identification of the prevalent instructional set and saliency conditions operating during the learning phases of each group, which would predict the kind of knowledge acquired as well as the performance results on the basis of that knowledge. If the performance results concur with the predictions, this would at least constitute some confirmation of the predictions concerning the kinds of knowledge acquired.

Doughty’s (1991) control group operates in the neutral instruction-salient condition. The degree of salience, compared to the experimental group operating in the neutral-salient condition, is low.
The other experimental group operates in the explicit training condition.
An evaluation of the learning conditions presented above clearly distinguishes the control group from the two experimental groups, leading to the predictions of a relatively low performance level of the control group and a comparably high performance of the two experimental groups.
These predictions are borne out in the data provided by Doughty (1991).

The above presented unequivocal evidence in support of the third conclusion, however, has to account for DeKeyser’s (1993) finding of the ineffectiveness of frequent direct error corrections during meaning-focused oral interactions. Such explicit error corrections do not compare favourably with the observed positive effects of gained explicit knowledge on successive implicit learning phases operating in the neutral instruction-salient condition or in the neutral instruction-nonsalient condition.

Although such error corrections may lead to gains in explicit grammatical knowledge, it is the simultaneity of such explicit learning processes and implicit learning processes that prevents them from contributing to implicit learning processes. Since it is only the implicit learning process operating in the learning conditions ‘neutral instruction’ and ‘salience’ that leads to the acquisition of predominantly implicit knowledge, it is the manipulation of the salient condition that involves the greatest risk of disrupting the neutral instruction condition by engaging explicit learning processes. Nevertheless, prior gains of explicit knowledge, transferred to successive implicit learning phases, obviously do not disrupt the neutral instruction condition, but rather contribute to the acquisition process of predominantly implicit knowledge by increasing the degree of salience. Explicit error corrections during implicit learning phases, on the other hand, violate the neutral instruction condition’s premise, the absence of explicit learning processes. Furthermore, they generate a dual-task conditions affecting the allocation of attentional resources to implicit learning processes as discussed in the context of the discussion of the evidence in support of the fifth conclusion below.

Hence, in order for explicit knowledge to effectively contribute to the acquisition process of predominantly implicit knowledge, it is necessary to keep
implicit learning phases and explicit learning phases sufficiently distanced.

Evidence in support of the fourth conclusion consists of findings drawn from memory studies, from studies investigating the nature of the acquisition process of complex rule-governed structures, as well as from studies investigating the acquisition of grammatical features of artificial and natural languages as second languages.

Memory studies demonstrate that in contrast to amnesic patients with deficient explicit memory, normal control subjects acquire explicit knowledge, for instance, through extended control performance on a production system that, transferred to successive learning phases, affects the saliency condition by increasing the degree of salience. Such increased salience, subsequently, facilitates the further acquisition of implicit knowledge, leading to improved control performance. Amnesic patients, on the other hand, do not show any further improvement in the succeeding learning phase (cf. Squire and Frambach, 1990), which suggests that there is no linear relationship between an increase in implicit learning opportunities and an increase in the acquisition of implicit knowledge.

In a similar vein, artificial grammar learning studies demonstrate improved performance, predominantly based on implicit knowledge, if during successive learning phases re-presentations of exemplars occur or presentations of new exemplars based on the same grammar as the re-presentations are extended in conjunction with extended classification performance (cf. Reber and Lewis, 1977; Mathews, Buss, Stanley, Blanchard-Firlds, Cho and Druhan, 1989). These performance improvements are typically due to practice effects and, most likely, also based on gains of implicit knowledge through extended provisions of input for implicit learning.

Practice is considered as extended exposure to input for implicit learning and extended applications of acquired implicit knowledge that extend learners’ opportunities to gain explicit knowledge. It is through these gains of explicit knowledge that practice affects an increase of the implicit knowledge base in that transfer of that knowledge across successive implicit learning phases
leads to an increase of the degree of salience of the salient or nonsalient condition.

Similar practice effects are reported on by Berry and Broadbent (1988). Their study, investigating the learning to control a social system, demonstrates that, if successive learning phases operate in the neutral instruction-salient condition and the degree of salience is high, then extended control practice has a large effect on control performance, whereas, if the degree of salience is low, the effect is significantly smaller (cf. Berry and Broadbent, 1988).

In short, there is neither a linear relationship between increases in implicit learning opportunities through extended provisions of input for implicit learning, nor is there a linear relationship between increases in explicit learning opportunities through extended practice and the acquisition of implicit knowledge. These relationships are mediated by the degree of salience of the salient or nonsalient condition operating in conjunction with the neutral instruction condition.

These findings extend, for instance, to the results from Doughty’s (1991) ESL study, demonstrating the mediating role of salience, which is achieved to different degrees in the MOG group and COG group.

The MOG group operates in the neutral instruction-salient condition from the beginning, whereas the COG group initially operates in the neutral instruction-nonsalient condition, which, due to gains in explicit knowledge, changes to the neutral instruction-salient condition, whereby the degree of salience is at a relative low level.

The differences of the degrees of salience, however, develop further in that the MOG group is provided with extended opportunities for practice and implicit learning, complemented by extra measures of induced salience. Doughty (1991) stresses the contribution of induced salience and redundancy to the relative high level of performance of the MOG group compared to the COG group, but no quantitative data are available. Nevertheless, it can be plausibly assumed that extended practice and extended input for implicit learning through considerable redundancy measures of repeated exposure to target structures are significant contributors to the acquisition of implicit knowledge by the MOG group, leading to the far superior performance level of the MOG group during posttesting.
Doughty’s (1991) study also illuminates the need to distinguish between practice phases and phases of implicit learning in an instructional setting. This applies to further research aiming to obtain quantitative data regarding their respective contribution to gains of implicit knowledge, but also applies to the effective organisation of the second language acquisition process.

In regard to the latter, the planful manipulation of the degree of salience through practice requires that phases of practice are independent of phases of predominantly implicit learning, thus avoiding the simultaneous engagement of implicit and explicit learning processes that would negatively affect implicit learning. However, both phases need to operate in succession in order for predominantly implicit learning phases to benefit from the increase of the degree of salience provided by the transfer of gains of explicit knowledge during practice phases.

The above evidence in support of the third and fourth conclusion illuminates the need for planful manipulations of the degree of salience in order to effectively organise the second language acquisition process, that is, to optimally increase learners’ implicit knowledge base.

Performance results derived from the above presented studies are typically obtained after a relatively short period of time for learning. They usually demonstrate performance levels based on predominantly implicit knowledge that are above chance level, but, at the same time, are well below ceiling level, thus, suggesting that there is still scope for an increase of the implicit knowledge base. Such scope is a reflection of the fact that complex rule-governed structures, such as artificial grammars, production and social systems, as well as grammars of artificial and natural languages are not acquired in one step but rather gradually.

In the context of the acquisition of the speech production skills of a second language, such gradual acquisition is twofold.

On the one hand, there is the acquisition of the language specific knowledge underlying the hierarchy of processing procedures, consisting of the procedural knowledge of the grammatical processor and knowledge constituting the processing resources of the mental lexicon, which permits the emergence
of particular structures only within the confines of the current stage of the hierarchical development of the processing procedures, thus reflecting a gradual, i.e. sequential acquisition process.

On the other hand, the acquisition of all grammatical structures processable at a current stage of development of the processing procedures and their application in all obligatory contexts occurs gradually, too, though not in the sense of sequential acquisition, but in the sense that the acquisition of particular grammatical structures does not occur simultaneously, since, for instance, particular knowledge underlying the processing of particular structures is still to be acquired.118

The below-ceiling performance of 12 out of 20 subjects in Doughty’s (1991) study, in that they only show the acquisition of a limited number of relative clause types, although the necessary processing procedure (S’ Procedure) is, in principle, acquired, is a case in point, demonstrating that the acquisition process of the knowledge underlying the regularities of relativisation is not yet concluded.

Hence, it is in the context of the above described twofold acquisition process of the knowledge underlying the grammatical encoding procedures that prior measures, such as explicit training phases and practice phases, to increase the degree of salience during successive implicit learning phases, become important contributors to the effective organisation of the second language acquisition process.

Evidence in support of the fifth conclusion consists of findings drawn from memory studies, from studies investigating the nature of the acquisition process of rule-governed structures, as well as from studies investigating the acquisition of artificial and natural languages as second languages.

Studies investigating procedural skill learning by amnesic patients and normal subjects under dual-task conditions unequivocally demonstrate significant decrements in performance, due to the division of attention, compared to skill learning under single-task conditions, permitting the undivided allocation of attentional resources, reflected in significantly higher performance levels.

These findings are corroborated by Van Patten’s (1990a) results showing, that by dividing learners’ attention between comprehending a text read to them and
simultaneously detecting a particular grammatical feature in the text, comprehension is negatively affected, reflected in a lower recall performance. Van Patten’s (1990a) results suggest that the allocation of attentional resources is necessary for the detection of grammatical features in the input and, thus, for the acquisition of underlying rules and regularities as well as for the comprehension of the input.

The above studies of procedural skill learning involving amnesic patients also reveal that implicit and explicit memory dissociate, reflected in amnesic patients’ lack of awareness, due to their deficient explicit memory, and their successful learning comparable to normal subjects. That is, the amnesic patients’ lack of awareness of the acquired knowledge underlying their performance comparable to normal subjects shows that although attention is needed for procedural skill learning, awareness is not required.

However, findings from the above investigation of the implicit learning of complex rule-governed structures reveal that awareness is not only unnecessary, but must not be involved in order to acquire predominantly implicit knowledge. Since the acquisition of predominantly implicit knowledge requires an implicit learning process operating in the neutral instruction-salient condition, it is the neutral instruction condition that excludes the simultaneous occurrence of explicit learning processes, requiring attention and involving awareness. Hence, awareness as a manifestation of simultaneous explicit learning processes that also require attention leads to detrimental effects on the implicit acquisition process, firstly, by disrupting the neutral instruction condition and, secondly, be generating a dual-task condition of learning that leads to a division of attention.

These findings are corroborated by the results from DeKeyser’s (1993) study investigating the effectiveness of frequent explicit error corrections during meaning-focused oral interactions that can be characterised as implicit learning phases predominantly operating in the neutral instruction-salient condition. The lack of any significant differences between the two experimental groups, one receiving frequent explicit error corrections over a period of one year and the other receiving almost no error corrections at all, demonstrates the ineffectiveness
of explicit error corrections during oral interactions, providing input for learning. In other words, implicit learning processes are disrupted by the violation of the neutral instruction condition through the concurrent engagement of explicit learning processes involving awareness and are negatively affected by the generation of a dual-task condition, which leads to a division of attention between the implicit learning task and the explicit learning task.

5. CONFIRMATION OF THE RESEARCH HYPOTHESES AND EVALUATION OF THE THEORETICAL CONCEPTS FOR INSTRUCTION REFLECTING POTENTIALLY CRITICAL PROCESSES FOR SECOND LANGUAGE ACQUISITION

Findings from the above investigation of the nature of the knowledge underlying the different processing resources involved in the grammatical encoding processes, based on cognitive and neuropsychological research on distinct kinds of memory, knowledge and knowledge acquisition in conjunction with pertinent studies of the acquisition of artificial and natural languages as second languages confirm all five hypotheses guiding this thesis. The discussion of the confirmation of each hypothesis below provides the basis for the following evaluation of theoretical concepts for instruction reflecting potentially critical processes, which have been identified in SLA research as being closely linked to the acquisition process of any second language. Hence, these processes are considered to be closely linked to the acquisition of the language-specific knowledge underlying the hierarchy of processing procedures, consisting of the procedural knowledge of the grammatical processor and the knowledge constituting the processing resources of the mental lexicon.

Hypothesis 1 is confirmed by evidence showing that implicit and explicit grammatical knowledge of artificial and natural languages as second languages, underlying the grammatical performance on language tasks, can be dissociated. Implicit knowledge can be dissociated from explicit knowledge, firstly, by demonstrating that implicit knowledge does not involve awareness, but explicit knowledge does involve awareness and, secondly, by demonstrating that implicit knowledge permits the achievement of the highest performance levels under time
pressure, whereas explicit knowledge leads to inferior performance levels under time pressure.

Levelt’s (1989) and Pienemann’s (1998a) assumption concerning the implicitness of the procedural knowledge underlying the grammatical encoding processes is confirmed by demonstrating that the implicitness of the knowledge of complex rule-governed structures predominantly underlying procedural and cognitive skill performance generalises to the implicitness of the knowledge predominantly underlying the grammatical performance on language tasks in that superior performance levels under time pressure are achieved without involving awareness.

However, Levelt’s (1989) and Pienemann’s (1998a) assumption concerning the explicitness of the syntactical lemma information as well as the form-based information stored in the mental lexicon is not supported since evidence provided by priming studies and studies of the acquisition of artificial and natural languages as second languages suggests that such knowledge is of an implicit nature.

Levelt’s (1989) and Pienemann’s (1998a) assumption concerning the explicitness of meaning-based word knowledge, though, is supported by the evidence provided by priming studies.

The confirmation of Hypothesis 1 renders the still prevalent application of the instructional concept of ‘Focus on Forms’ untenable since it is partly based on the assumption that acquired explicit grammatical knowledge can be converted into implicit knowledge. However, the dissociation of implicit and explicit grammatical knowledge underlying the grammatical performance on language tasks provides strong counter evidence to the ‘Focus on Forms’ concept. These knowledge forms are independent, stored in different memories and cannot convert into each other.

Furthermore, the confirmation of Hypothesis 1 also renders untenable the claim by proponents of the ‘Output Hypothesis’ that output facilitates second language acquisition in that learners ‘noticing a gap’ in their output will explicitly analyse their current ‘internal linguistic knowledge’. The confirmation that the procedural knowledge, underlying the grammatical encoding processes predominantly is implicit knowledge is irreconcilable with the above claim’s
implied explicitness of the ‘internal linguistic knowledge’ that, due to its explicit nature, can be explicitly analysed.

Hypothesis 2 is confirmed by evidence showing that the acquisition processes of implicit and explicit knowledge of artificial and natural languages as second languages can be dissociated.

The implicit acquisition process can be dissociated from the explicit acquisition process by demonstrating that learning phases operating in the combined neutral instruction-salient condition lead to the acquisition of predominantly implicit knowledge, whereas learning phases operating in the combined rule search–nonsalient condition or in the explicit training condition lead to the acquisition of predominantly explicit knowledge.

Learning phases operating in the neutral instruction-nonsalient condition or in the rule-search-salient condition, though, lead to the acquisition of implicit and explicit knowledge.19

The confirmation of Hypothesis 2 has a profound impact on the organisation of learning phases in that it stipulates the operating conditions required for the implicit acquisition of predominantly implicit knowledge.

These operating conditions are the ‘neutral instruction’ condition and the ‘salient’ condition.

‘Neutral instruction’ only provides explanations as to the procedure of input presentation, but is neutral in regard to the underlying grammatical structures, rules and regularities to be acquired and in regard to future testing in order to avoid the engagement of explicit learning processes.

‘Salience’ is a variable quality of transparency of the grammatical structures, rules and regularities to be acquired underlying the input presented.

None of the theoretical concepts for instruction reflecting potentially critical processes for second language acquisition elaborates on the nature of implicit learning processes and, thus, lack the potential to effectively organise the second language acquisition process.

Hypothesis 3 is confirmed by evidence showing that explicit knowledge of artificial and natural languages as second languages can optimally
contribute to the implicit acquisition process leading to predominantly implicit knowledge. This optimal contribution is achieved by increasing the degree of salience in learning phases operating in the combined neutral instruction-salient condition without disrupting the neutral instruction condition and without generating a dual-task condition of learning which leads to a division of attention. As the evidence confirming Hypothesis 2 shows, predominantly explicit knowledge can be gained in learning phases operating in the combined rule search-nonsalient condition or in the explicit training condition and some explicit knowledge can be gained in learning phases operating in the neutral instruction-nonsalient condition, in the rule search-salient condition, or even in the neutral instruction-salient condition due to extended practice. Such explicit knowledge can be transferred across successive learning phases, providing learners with the means to render input salient. Based on Posner and Petersen’s (1990) outline of the human attention system of interrelated attentional functions, identifying the attentional function of orientation to incoming sensory stimuli as facilitative in regard to detection, salience can be understood as the means by which learners’ attention is oriented towards the information to be detected. Since there are degrees of salience, evidence shows that changes to the salient condition of a learning phase through the transfer of explicit knowledge from a prior learning phase differ according to the weight of the knowledge transferred. Hence, learning phases succeeding phases of explicit learning are preferably phases operating in the neutral instruction-salient condition, whereby the degree of salience is induced independently of any gain in salience due to explicit knowledge transfer, but may also be phases operating in the neutral instruction-nonsalient condition. Phases of explicit learning have to be sufficiently distanced from successive implicit learning phases operating in the neutral instruction-salient condition in order to avoid the concurrent engagement of explicit learning and implicit learning processes and, thus, avoid the disruption of the neutral instruction condition and the generation of a dual-task condition, which leads to a division of attention between the implicit learning task and the explicit learning task. In both
cases, significant negative effects on the implicit learning process would be caused.

The confirmation of Hypothesis 3 and the establishment of the conditions under which explicit knowledge can contribute to the implicit learning process revises the current unitary concept of ‘Focus on Form’ and strengthens its effectiveness in that it defines two distinct kinds of form-focused input. The distinct kinds of form-focused input are, firstly, input that engages explicit learning processes, such as metalinguistic input, and, secondly, input that does not disrupt implicit learning processes, such as paralinguistic or extended linguistic input consisting, for instance of input repetition and modifications. The former needs to be distanced from implicit learning phases and the latter can be integrated in such implicit learning phases.

Hence, the currently undifferentiated, unitary concept of ‘Focus on Form’ has to be differentiated in order to optimally contribute to implicit learning processes.

Hypothesis 4 is confirmed by evidence showing that practice contributes to the acquisition of implicit knowledge of artificial and natural languages in that extended practice phases, preferably operating in the neutral instruction-salient condition, lead to gains in explicit knowledge which, transferred to successive phases of implicit learning, again, preferably operating in the neutral instruction-salient condition, increase the degree of salience.

The confirmation of Hypothesis 4, thus, concurs with the confirmation of Hypothesis 3.

The confirmation of Hypothesis 4 revises the current unitary concept of ‘Negotiation for Meaning’ (‘Interaction Hypothesis’) as an instructional concept and strengthens its effectiveness in that it distinguishes practice phases and implicit learning phases, though stressing their interconnectedness. The distinction is required since practice phases’ contribution to the implicit learning phases, preferably operating in the neutral instruction-salient condition or operating in the neutral instruction-nonsalient condition, lies in the generation of explicit knowledge that, transferred to successive implicit learning phases, increases the degree of salience. Implicit learning phases, though, need to avoid the simultaneous engagement of explicit learning processes that would disrupt
the neutral instruction condition and would generate a dual-task condition of learning leading to a division of attention. In both cases, significant negative effects on the implicit learning process would be caused. Hence, the currently undifferentiated, unitary concept of ‘Negotiation for Meaning’ as the manifestation of the ‘Interaction Hypothesis’ has to be differentiated in that ‘Negotiation for Meaning’ serving as a means for practice, potentially generating explicit knowledge, has to be distinguished from ‘Negotiation for Meaning’ serving as a means for implicit learning in order to render the interconnectedness of practice and implicit learning most effective.

Hypothesis 5 is confirmed by evidence showing that the allocation of attentional resources is a necessary condition for the acquisition of implicit and explicit knowledge of natural languages, but that awareness is not only unnecessary, but must not be involved during implicit learning, since it disrupts the neutral instruction condition and generates a dual-task condition of learning leading to a division of attention. The confirmation of the first part of Hypothesis 5 supports pervasive claims made by proponents of the ‘Interaction Hypothesis’, ‘Output Hypothesis’ and the concepts of ‘Focus on Form’ and ‘Focus on Forms’ that attention to grammatical information in the input is a necessary prerequisite for the acquisition of grammatical knowledge to occur. The confirmation of the second part of Hypothesis 5 concurs with the confirmation of Hypothesis 3 in that explicit learning processes must not disrupt the implicit learning process. In other words, explicitly directing attention to particular grammatical structures, rules and regularities in the input during an implicit learning phase simultaneously engages explicit learning processes and, thus, violates the ‘neutral instruction’ condition requiring the absence of explicit learning processes and, subsequently, the absence of awareness. At the same time, the concurrent engagement of implicit and explicit learning processes generates a dual-task condition of learning, which leads to a division of attention between the two learning processes. Both, the violation of the ‘neutral instruction’ condition and the generation of a dual-task condition significantly affect the implicit learning process.
The confirmation of the second part of Hypothesis 5 in conjunction with the confirmation of Hypothesis 3 revises the current unitary concept of ‘Focus on Form’ as outlined below in the context of the discussion of the confirmation of Hypothesis 3.

Furthermore, the confirmation of the second part of Hypothesis 5 also renders untenable the claim of proponents of the ‘Output Hypothesis’ that output facilitates second language acquisition in that learners ‘noticing a gap’ in their output will direct their attention towards input in order to fill the gap. That is, explicitly directing attention to particular grammatical structures, rules and regularities in the input, simultaneously engages explicit learning processes and, thus, negatively affects their implicit acquisition process.

6. SEQUENTIAL SECOND LANGUAGE ACQUISITION FOR SPEECH PRODUCTION: IMPLICATIONS FOR INSTRUCTION

Based on the above confirmation of the research hypotheses, the revised theoretical concepts for instruction, and in the context of Pienemann’s (1998a) Processability Theory, the following conclusions are formulated as instructional measures as well as measures in their support to effectively organise the sequential acquisition process of the knowledge underlying the grammatical encoding procedures for speech production. This knowledge, consisting of procedural knowledge of the grammatical processor and the knowledge constituting the processing resources of the mental lexicon, and entailing the automaticity of its use, is acquired sequentially according to the hierarchically ordered development of the grammatical encoding procedures. This acquisition process manifests itself in the sequential acquisition of the grammatical structures, rules and regularities of the target language.

The instructional measures and the measures in their support are:

1. The provision of input that is processable, containing the grammatical structures and/or word forms to be acquired. Processable input is selected from the speech production options learners have, in principle, at their respective current stages of development of speech
processing procedures and at their respective next stages of development. Learners’ respective current stages of development of speech processing procedures, manifested in the sequential acquisition of grammatical structures, rules and regularities, are established on the basis of regular assessments.

2. The provision of comprehensible and processable input, for instance, through the application of the concept of ‘Negotiation for Meaning’.

3. The provision of implicitly form-focused, processable and comprehensible input, for instance, through the application of the concept of ‘Focus on Form’ involving paralinguistic and/or linguistic measures to induce salience of the forms in focus, thus, implicitly directing learners’ attention towards these forms, but avoiding metalinguistic measures in order to prevent the engagement of explicit learning processes.

4. The provision of explicitly form-focused, processable and comprehensible input, for instance, through the application of the concept ‘Focus on Form’ involving metalinguistic measures to induce salience of the forms in focus, thus, explicitly directing learners’ attention towards these forms. Such explicit knowledge, transferred to successive implicit learning phases, sufficiently distanced from the phase(s) of explicit learning, may induce salience of the forms in focus.

5. The provision of opportunities for practice in conjunction with successive implicit learning phases in order to gain explicit knowledge through extended exposure to forms in focus and extended application of acquired implicit knowledge.

Such explicit knowledge gained, for instance, through the application of the concept of ‘Negotiation for Meaning’, transferred to successive implicit learning phases, sufficiently distanced from the phase(s) of practice, may induce salience of the forms in focus.
6. The provision of processable, comprehensible and form-focused input in implicit learning phases operating in the combined neutral instruction-salient condition in order to predominantly engage implicit learning processes leading to the acquisition of predominantly implicit knowledge. For instance, through the integration of the concepts of ‘Negotiation for Meaning’ and ‘Focus on Form’, involving implicitly form-focused input in successive learning phases, with phases of explicitly form-focused input and phases of practice sufficiently distanced from the phase(s) of implicit learning, but contributing to the implicit learning processes by increasing the degree of salience of the forms in focus.

7. SEQUENTIAL SECOND LANGUAGE ACQUISITION FOR SPEECH PRODUCTION: EXEMPLIFICATION OF THE IMPLEMENTATION OF INSTRUCTIONAL MEASURES FOR THE INITIAL STAGES OF THE ACQUISITION OF GERMAN AS A SECOND LANGUAGE WITHIN THE CONCEPTUAL FRAMEWORK OF ‘NEGOTIATION FOR MEANING’

7.1 ‘Negotiation for Meaning’, a conceptual framework for the implementation of the instructional measures and measures in their support and the effective organisation of the sequential second language acquisition process

In order to elaborate on and to exemplify the above formulated instructional measures as well as measures in their support, the instructional measures are implemented within the conceptual framework of ‘Negotiation for Meaning’ and exemplified for the acquisition of selected grammatical structures of German as a second language. These measures provide the basis for an effective organisation of the acquisition of the knowledge underlying the hierarchy of processing procedures, entailing the automaticity of its use, and manifested in the sequential acquisition process of the grammatical structures of the target language. The revised conceptual framework of ‘Negotiation for Meaning’, also drawing on Long’s (1996) updated ‘Interaction Hypothesis’ presented above, is considered to provide an acquisition-rich learning environment that can be aligned with all
the above formulated instructional measures of providing processable input, comprehensible input, form-focused input and practice. Hence, this constitutes an instructional approach of the highest facilitative calibre regarding the sequential acquisition process of the grammatical structures of the target language. However, before the above alignment can be demonstrated, the variables affecting meaning negotiation have to be identified.

The concept of ‘Negotiation for Meaning’ is inextricably linked to tasks that have the potential to generate meaning negotiation.

Pica, Kanagy and Falodun’s (1993) review of task-based research suggest that tasks’ meaning-negotiation potential, i.e. tasks’ potential to generate interactionally modified input, feedback on learner production and interactionally modified learner output, is greatest under task conditions which require that information has to be exchanged between all interactants, that all interactants have convergent goals, and that in order for interactants to meet their convergent goals, outcome options are restricted to one acceptable outcome.

In other words, these task conditions are the prerequisites for the generation of input for implicit learning and for the provision of extended opportunities for practice.

These task-design qualities are, for instance, met by jigsaw tasks and information gap tasks with role reversal.

Subsequently, any change to the particular qualities, (i) ‘interactant relationship’, defining who holds, requests, supplies information and the direction of the flow of information (one-way/two-way), (ii) ‘interaction requirement’, defining who is required or only expected to request or supply information, (iii) ‘goal orientation’, defining the goals of interactants as either convergent or divergent, and (iv) ‘outcome options’, defining whether there is only one outcome possible (‘closed’ task) or more than one outcome is possible (‘open’ task), potentially reduces the negotiation potential of that task (cf. Pica, Kanagy and Falodun, 1993).

Furthermore, the realisation of the task-inherent negotiation potential can be seriously affected by variables, such as task difficulty, task-attention-generating potential, task-elicitation potential, participation patterns, group makeups and participant qualities.
In order to present or to refer to evidence, supporting the relevance of the above variables, it is necessary to differentiate certain aspects of the variables. Firstly, task difficulty is determined by the linguistic, cognitive and social-cognitive demands placed on learners that learners have to manage in order to perform a particular task (cf. Nunan, 1989).

The linguistic demands are the speech processing demands to be met by the learners within the constraints of their respective stages of grammatical development (see chapter 2.2) and their acquired meaning potential (see ‘participant qualities’ below).

Modelled on the systemic functional model of language and applied to the SLA context, the meaning potential is at the semantic level the learners’ current scope of meaning options to interpret their experience of the world (ideational metafunction), to interact in the world (interpersonal metafunction) and to build up texts that are coherent and cohesive (textual metafunction), and at the grammatical level the processing resources to grammatically encode the currently available meaning options. (cf. Jones, Gollin, Drury and Economou, 1989; Halliday, 1985, 1994; Hasan and Perrett, 1994; Painter, 1989; Rothery, 1989).

Taking into account children as second language learners in a formal setting the cognitive demands are, firstly, the task demands in regard to particular knowledge or prior experiences to be met by learners within the constraints of their respective stages of cognitive development (cf. Ginsburg and Opper, 1979; Piaget, 1970; Shaffer, 1985, 1993; Singer and Revenson, 1978), reflected in levels of learners’ ‘conceptual range’ (cf. Billows, 1961; Mohan, 1986; Scarino, Vales, McKay and Clark, 1988).

In order to establish the compatibility between task difficulty and children’s respective stages of cognitive development, Piaget’s (1970) proposed sequence of cognitive development may serve as reference point. Although some developmental psychologists might not agree with all aspects of Piaget’s (1970) theory of cognitive development, there seems to be a general agreement that “Piaget has adequately described the general sequencing of intellectual development” (Shaffer, 1993, p.271).

It is in this sense that Piaget’s (1970) ‘Preoperational Stage’ (‘Intuitive Period’), ‘Concrete Operational Stage’ and ‘Formal Operational Stage’ become
productive in providing reference points in order to determine whether the
cognitive demands of a given task can be met by particular learners, or in order to
plan tasks that synchronise second language learning and content learning
consistent with learners’ respective cognitive development stages, reflected in
their respective conceptual range or ‘spheres’ (cf. Billows, 1961; Mohan, 1986),
as suggested by Scarino, Vale, McKay and Clark (1988), and secondly, the
cognitive demands are the task demands in regard to attentional demands to be
met by learners within the constraints of their respective attention span (cf.
In other words, task difficulty has to be adapted to children’s maturationally
constrained ability to sustain attention over extended periods of time, though it
“…continues to improve throughout childhood and early adolescence” (Shaffer,
Shaffer (1993) refers to Yendovitskaya (1971) who reports on the results of
various experimental studies, suggesting that, during preschool age, children's
attention span increases considerably. Yendovitskaya (1971), for instance, reports
on the results of Petukhova's (1955) study:

"...children were given a rather uninteresting task that required
placing pieces of colored paper into boxes according to color. The
data, in terms of the average time devoted to this type of activity
and the average time of being distracted from it, for children of
various age groups show considerable differences in the attention
stability [...] The older preschool children not only continue with
an uninteresting task (one assigned by an adult) for a longer period
of time, but they also turn away from the task less often than the
younger preschool children" (Yendovitskaya, 1971, p.68-69).

Petukhova's (1955) data show that children's average 'duration of activity'
increases with age from 37.4 minutes (3.5-4.5 years of age) to 51.4 minutes (4.5-
5.5 years of age), and finally to 62.8 minutes (5.5-6.5 years of age), however, the
average duration of distraction shows that only in the age group of 5.5-6.5 year
old the distraction time decreases considerably and, thus, demonstrate the
highest stability of attention and the longest attention span. Shaffer (1993) also refers to Ruff and Lawson’s (1990) study investigating the development of sustained, focused attention in children aged between 1 and 3.5 years of age (Experiment 1) and in children aged between 2.5 and 4.5 years of age (Experiment 2). Ruff and Lawson (1990) corroborate Petukhova’s (1955) results of an increase of sustained and focused attention with age.

Taking into account children as second language learners in a formal setting, the social-cognitive demands are the task demands in regard to social interaction skills to be met by learners within the constraints of their social-cognitive development, reflected in stages of social perspective taking (cf. Daehler and Bukatko, 1985; Damon, 1983; Hudson, Forman and Brion-Meisels, 1982; Krauss and Glucksberg, 1969; Mueller, 1972; Selman, 1976, 1980; Shaffer, 1985, 1993; Yeates and Selman, 1989).

There is general agreement that children’s social perspective taking skills develop sequentially. Selman’s (1976) longitudinal study of children’s role-taking skills reveals a series of stages of social perspective-taking, reflecting a gradual increase in role-taking skills. These findings are corroborated by a study by Gurucharri and Selman (1982), testing 41 children over a five year period. Shaffer (1993) summarises Selman’s (1980) and Yeates and Selman’s (1989) position based on the above findings:

“According to Selman (1980; Yeates and Selman, 1989), children will become much more proficient at understanding themselves and other people as they acquire the ability to discriminate their own perspectives from those of their companions and to see the relationship between these potentially discrepant points of view” (p.461).

However, Selman’s age range indications for each stage of development should not be considered as fixed but rather “...as a very rough guide” (Flavell, 1985, p.146). For instance, Daehler and Bukatko (1985) report on studies by Krauss and Glucksberg (1969) and Mueller (1972), finding that 4 and 5 year old
children can display egocentric as well as non-egocentric behaviour, whereby egocentric behaviour, which can be described as “…noncommunicativeness” (Damon, 1983, p.143) or as being “…unaware of any perspective than their own” (Shaffer, 1993, p.462), is the behaviour, reflecting a lack of role-taking skills, which children between 3 to 6 years of age display, according to Selman’s (1976) Stage O.

Another study by Hudson, Forman and Brion-Meisel (1982), investigating role-taking skills of second graders, finds skill levels in tutoring two Kindergarten children how to make caterpillars out of paper above the role-taking skill level that should be displayed by 6 to 8 year old children, according to Selman’s (1976) Stage 1.

However, these disparities between Selman’s (1976) age range indications for each stage of children’s development of role-taking skills and the evidence for above-stage role-taking skills by children can be explained by the finding that role-taking skill development can be accelerated by providing children with frequent opportunities to interact with their peers (cf. Bridgeman, 1981).

Secondly, the task-attention-generating potential is defined as the task’s potential contribution to the interactants’ state of alertness (cf. Posner and Peterson, 1990; Tomlin and Villa, 1994).

Posner and Petersen’s (1990) outline of the human attention system of interrelated attentional functions – alertness, orientation and detection – that can be linked to a network of anatomical areas in the brain (cf. Posner, 1988, 1992; Posner, Inhoff, Friedrich and Cohen, 1987; Posner, Petersen, Fox and Raichle, 1988; Posner and Rothbart, 1992) defines alertness as the readiness “…to process high priority signals” (p.35). Their findings suggest that alertness increases the rate of responding to signals, but often leads to an increase in errors. Furthermore, Posner (1993) and Posner and Rothbart (1992) report that alertness/arousal modulates the orientation function of attention in that increased levels of arousal lead to increased “efficiency of orienting” (Posner and Rothbart, 1992, p.91) towards incoming sensory signals, whereby the state of alertness is a reflection of the interactants’ respective level of arousal (cf. Posner, Inhoff, Friedrich and Cohen, 1987).
There is considerable evidence that over-arousal leads to subsequent task performance decrements (cf. Eysenck, 1982, 1984), which follows from the Yerkes-Dodson Law (cf. Yerkes and Dodson, 1908 stating an inverted U-shaped relationship between task performance and arousal and an inverse relationship between task complexity and the optimal level of arousal.

Easterbrook (1959) advances a theoretical explanation of the Yerkes-Dodson Law. He claims that arousal affects the utilisation of cues observed, whereby as arousal increases performance improves through the exclusion of irrelevant cues. However, with increasing levels of arousal more irrelevant cues and, subsequently, even relevant cues are being excluded, leading to decrements in task performance.

Hence, Easterbrook’s (1959) hypothesis

“...provides a potential explanation for the inverse relationship between the optimal level or arousal and task difficulty. If difficult tasks involve a greater number of relevant cues that do easy tasks, then attentional narrowing under high arousal will disrupt the performance of difficult tasks more readily than the performance of simple tasks” (Eysenck, 1982, p.49).

Eysenck’s (1982) review of studies investigating the effects of arousal on dual task performance\textsuperscript{128} shows that the evidence overwhelmingly supports Easterbrook’s hypothesis.\textsuperscript{129}

Subsequently, findings that, firstly, task difficulty is a source of arousal (cf. Kahneman, 1973), whereby task difficulty is considered to be determined by the attentional demands imposed by the tasks, that, secondly, motivation as a result of feedback on task performance, competition and task unfamiliarity is a source of arousal (cf. Hockey, 1984; Kahneman, 1973; Plough and Gass, 1993; Wilkinson, 1961, 1963), and, thirdly, that anxiety in relation to highly demanding tasks, such as speaking is a source of arousal (cf. Gardner and MacIntyre, 1993; MacIntyre and Gardner, 1989, 1994a; MacIntyre, Noels and Clément, 1997; Young, 1986, 1990) provide crucial variables that have to be taken into account in order to avoid over-arousal or in other words to avoid a decrease of the potential to generate learner intake.\textsuperscript{130}
Thirdly, the task-elicitation potential is defined as the potential of the task to elicit the spontaneous (oral) production of particular grammatical structures that are processable or are next in the processability. It is determined by the particular interactional goal of the task within a particular situational/cultural context, requiring particular structures or structural contexts to occur in order to realise certain meanings.

Fourthly, participation patterns, distinguished as either dyad/small group or whole class/large group, have a considerable effect on the realisation of the task-inherent negotiation potential. Doughty and Pica (1986), investigating the effect of participation patterns – teacher-fronted whole class versus dyad/small group – on interactional modifications, report, firstly, that “…there was virtually no difference between the group and dyad interaction patterns in the amount of modification” (p.316) and, secondly, that although

“...a required information exchange task will compel students to talk more in either a teacher fronted or a group situation this increase in total production will result in an increase of modified interaction only when students are working in groups” (p.321).

These findings are corroborated by Pica and Doughty’s (1988) follow-up study, again, investigating the effect of participation patterns – teacher fronted versus small group – on interactional modifications. However, evidence shows that learners can achieve comprehension in the teacher-fronted, whole-class participation pattern or in the small-group participation pattern without participating in negotiations themselves, as long as meaning negotiation occurs.

For instance, Ellis, Tanaka and Yamazaki (1994), investigating vocabulary acquisition by Japanese High-school students learning English as a second language, report:
“The Tokyo Study also (as the Saitama Study, D.P.H.) failed to demonstrate that active participation in negotiating meaning was advantageous for vocabulary acquisition. Those learners who listened to others negotiate achieved similar scores to those who engaged actively” (p.480).

In the same vein, Pica’s (1991) study, following up on Pica, Young and Doughty’s (1987) study, investigates the comprehension of directions given to three different groups of learners of English as a second language by a NS of English – one group of ‘Negotiators’ being encouraged to negotiate with the NS (teacher) for meaning, another group of ‘Observers’ being only permitted to observe the negotiation of the ‘Negotiators’, and a third group of ‘Listeners’ carrying out the task by listening to a text constructed similar to the text negotiated by the ‘Negotiators’. The study reveals that learners, observing other learners negotiate meaning of initially unmodified texts given to them or listening to a text of negotiated input, achieve comprehension of the directions as well as the actively negotiating learners do.¹³³

Fifthly, group makeups, distinguished as either NS (Teacher) (native speaker-teacher)¹³⁴ interacting with NNS (non-native speakers(s)) or NNS interacting with NNS, represent options with comparable results in regard to modifications of the interactional structure in order to achieve mutual comprehension (cf. Porter, 1986).

Porter (1986), investigating the kind of input non-native speakers provide to each other, compared to native speakers’ input to other native speakers or to non-native speakers when negotiating meaning, reports the comparability of interactional structure modifications, the comprehensibility of input, as well as the accuracy of production of non-native speakers when interacting with other non-native speakers or with native speakers. Porter’s (1986) findings reveal that NS and NNS do not significantly differ in their modifications of the interactional structure to repair breakdowns in comprehension, such as clarification requests, confirmation checks,
comprehension checks, verifications of meaning, definition requests and indications of lexical uncertainty, or to prompt the other speaker by continuing or completing the other speaker’s utterance. Subsequently, Porter (1986) concludes:

“...input from learners was just as comprehensible as that from native speakers, showing no clear advantage for a native speaker as an input provider” (p.219).

Concerning NNS accuracy in oral production, Porter (1986) concludes that the quantity of repair work and monitoring and the level of accuracy by learners does not significantly change when comparing learners’ interactions with other NNS or with NS. Furthermore, Porter (1986) allays teachers’ concerns of NNS/NNS interactions by pointing out that

“...teachers need not be concerned about learners picking up each other’s errors or miscorrecting each other: such miscorrections and error incorporations were extremely rare in the data” (p.219).

However, when considering the potential of ‘Negotiation for Meaning’ for providing input for the acquisition of grammatical structures of the target language, follow-on studies provide advantageous results for the NS/NNS group makeup due to the superior quality of native speakers’ modified input for comprehension as feedback focusing on form (cf. Pica, 1994; Pica, Hollliday, Lewis and Morgenthaler, 1989; Pica, Lincoln-Porter, Paninos and Linnell, 1996; Porter, 1986).

This superiority is demonstrated, for instance, by Pica, Lincoln-Porter, Paninos and Linnell’s (1996) study, showing that NNS’ predominant modification when interacting with NNS or NS is the segmentation of a part of the interlocuter’s prior utterance. Though mostly conforming to syntax and morphology of the target language, Pica et al. (1996) point out that

“...segmentation does not relate these (extracted, D.P.H.) content
words to new and alternate encodings. To accomplish that, lexical modifications such as paraphrase, description, and exemplification are needed. Learners appear to be more limited than NSs in producing new relationships between L2 form and meaning. Therefore, learners produce fewer modifications that can be revealed as input for learning” (p.65).

Pica et al.’s (1996) findings corroborate results reported by Pica (1994) using the data generated by Pica, Holliday, Lewis and Morgenthaler (1989) and Pica, Holliday, Lewis, Berducci and Newman (1991). Pica (1994) reports that out of 578 learner signals to NS, the majority (61%) consists of simple structural segmentations, whereas lexical modifications of preceding NS utterances account for 9% only and clarification requests account for 13%. On the other hand, Pica (1994) reports that out of 558 NS signals, approximately half of them (47%) are modifications to the sounds and structures as feedback to NNS utterances, consisting, for instance, of more complex segmentations focusing on form and of lexical modifications.

Finally, when considering the potential of ‘Negotiation for Meaning’ in regard to the stimulation of learners’ production of modified output, NNS/NNS and NS/NNS group makeups represent options with comparable quantitative results in modified output, as Pica et al.’s (1996) study shows. Pica et al. (1996) report that NNS receiving modified input from NNS or from NS generate comparable amounts of modified output.

However, when taking into account Pica et al.’s (1989) finding that the type of NS signal affects the frequency output modifications, with the NS signal type ‘clarification request’, such as open questions like ‘what’, leading to twice as many modifications of output by NNS compared to the NS signal type ‘confirmation check’, modelling what the NNS wants to say, there is the potential for the NS (Teacher) to exploit this finding by systematically increasing the conversational demands placed on learners through open-ended requests for clarification, thus, making the NS/NNS group makeup a more advantageous
option than the NNS/NNS group makeup (cf. Nuboyoshi and Ellis, 1993). Nuboyoshi and Ellis’ (1993) study, investigating form-focused communication tasks, which are communication tasks that have the potential to elicit a particular grammatical structure, in combination with the deliberate use of clarification requests by NS (Teacher) in order to stimulate modified output, exploits Pica et al.’s (1989) finding that the type of NS signal affects the likelihood of NNS output modifications and provide supportive evidence for the effectiveness of the NS/NNS group makeup in the stimulation of form-focused output by NNS.

Nuboyoshi and Ellis (1993) set up an experimental group of three learners of English as a second language and a control group of three learners of ESL. No pretesting on past tensing – the form focus of the study – is reported. Subjects are described as being at a low proficiency level, “…capable of using at least some past tense verb forms correctly” (Nuboyoshi and Ellis, 1993, p.206).

Individual members of the two groups interact with an NS (Teacher) to perform two one-way picture description tasks twice with a two-week interval between the two performances. The first task performance of members of the experimental group is characterised by the focused use of clarification requests by the NS (Teacher), in that each time the NNS produces an utterance with an incorrect tense form the NS (Teacher) asks for clarification, whereas during the second task performance, a week later, clarification requests are used only by the NS (Teacher) to solve breakdowns in comprehension. The members of the control group only receive the latter treatment of the experimental group.

The results show a significant increase of immediate modifications of the output by two members of the experimental group and a minimal increase by the third member of the experimental group. After one week, the two members of the experimental group who significantly improved their level of accuracy during the first performance sustain a high accuracy level in using the correct past tense forms of verbs. The third member of the experimental group does not sustain the gains achieved during the first performance.

Of the three members of the control group, two members show a high accuracy level which is comparable to the initial accuracy level of two of the members of the experimental group that achieved the highest accuracy level on the basis of their output modifications. The third member of the control group basically
achieved a zero accuracy level during both performances, which may be due to a still lacking knowledge base of morphological forms or to the consistent present tense marking of the conceptual specification since the description of a picture would normally occur in the present tense.

Nevertheless, the lack of improvement through modifications of the output of the third member of the experimental group does not speak against the effectiveness of the focused use of clarification requests in order to stimulate form-focused output, but may rather reflect possible shortcomings as outlined above in connection with the third member of the control group.\textsuperscript{136}

In a similar vein, Van den Branden’s (1997) study, investigating the effects of negotiation of meaning, content and form\textsuperscript{137} on learners’ output, reveals that modifications of output can be significantly increased by employing a “…pedagogical negotiation strategy” (p.616).

The group makeups used by Van den Branden (1997) are NS/NNS and NS(Teacher)/NNS-NS. Van den Branden’s subjects are 48 children, aged 11-12, consisting of non-native speaker of Dutch of low and very low proficiency levels and native speakers of Dutch of high to very high proficiency levels, and a native speaker (teacher). Peer interactions occur between a native speaker and a non-native speaker, whereas teacher-pupil interactions occur either between the native speaker (teacher) and a non-native speaker, or between the native speaker (teacher) and a native speaker.

The experimental task requires one interactant to describe a picture to a partner who cannot see the picture. In the peer interaction condition pupils take turns in describing 6 pictures each to their partners in order to solve a murder case. In the teacher-pupil interaction condition, the teacher is the listener at all times and the pupils always are the describers.

During negotiations for meaning with pupils NS(Teacher)/NNS or NS(Teacher)/NS, the teacher predominantly uses clarification requests and confirmation checks without any modifications and to a lesser extent uses confirmation checks with modifications, whereas the pupils, when interacting with each other (NS/NNS), almost exclusively use clarification requests and confirmation checks without modifications that basically shift the
initiative to repair an utterance back to the describer.
The quantity of output modifications by the describers is 25% higher in teacher-pupil interaction condition compared to the peer-interaction condition.
However, during negotiations for content the teacher streamlines his ‘pedagogical negotiation strategy’ by predominantly using clarification requests as ‘openers’ to stimulate the describers to modify their output themselves and by additionally using confirmation checks with modifications as a second step in case pupils are unsuccessful in their modifications after having received a clarification request. The teacher, thus, provides a correct model of what the describer was supposed to modify. As a result of this negotiation strategy, twice as many modifications of output are generated compared to the pupils’ approach when interacting with their peers, which Van den Branden (1997) describes as follows:

“Pupils in the peer interaction condition [...] did not worry about which negotiation strategy would yield most opportunities for the interactional modification of output or for language learning in general. They just organized negotiation of content so as to most efficiently and most quickly solve the problem” (p.618).

These results suggest that this two-step negotiation strategy is effective in stimulating output modifications by increasing the conversational demands placed on learners through open-ended requests for clarification and by aiding the accomplishment of modifications through the modelling of such modifications in the context of the whole utterance in focus.

Sixthly, participant qualities, affecting the realisation of the task-inherent negotiation potential, are the interaction skills of particular kinds of participants to provide processable, comprehensible, form-focused input and to stimulate form-focused output. The interaction skills of the distinct kinds of participants, native speakers (teacher) and non-native speakers are affected by various variables.
Firstly, non-native speakers’ interaction skills are affected by their linguistic skills, reflected in their respective stages of grammatical development (see
chapter 2.2) and their acquired meaning potential, which is taken to be synonymous with learners’ respective levels of proficiency.

The more the proficiency level differs between interactants, the more the quantity (total number of words) and quality (correctness) of input increases. However, the modification of the interactional structure by learners is greater with intermediate proficiency-level learners than with advanced proficiency-level learners (cf. Long and Porter, 1985, referring to Varonis and Gass, 1983; Porter, 1986; Takahashi, 1989; Van den Branden, 1997).

For instance, Porter’s (1986) study, investigating the effect of interlocutors’ proficiency level – intermediate or advanced, defined by TOEFL scores (Test of English as a Foreign Language) - on the provision of the quantity and quality of input to learners, reveals that:

"...learners made about one-third more repair (comprising confirmation check, clarification request, comprehension check, verification of meaning, definition request, lexical uncertainty, D.P.H.) with intermediates than with advanced learners. This expected finding suggests that talking with intermediates may be advantageous in that learners get more practice in negotiation for meaning than they get with advanced learners" (p.215).

Van den Branden’s (1997) study, investigating the effects of negotiation for meaning, content and form on learners’ output, corroborates the findings that interaction skills are affected by differing proficiency levels. Peer interactions between NS (Pupil)/NNS(Pupil), with the NS(Pupil) being at a high or very high level of proficiency and the NNS(Pupil) being at a low or very low level of proficiency, generate significantly more negotiation moves than peer interactions between NNS(Pupil)/NNS(Pupil) where both interactants are at a low or very low level of proficiency.

In addition, children’s interaction skills are affected by their cognitive skills, i.e. their thinking skills, reflected in their respective stages of cognitive development or Conceptual Range and their skill to sustain attention, as well as by their
social-cognitive skills, i.e. their role-taking skills, reflected in their respective stages of social perspective taking (see ‘task difficulty’ above.)

Secondly, non-native speakers' and native speaker's (teacher) interaction skills are affected by their unequal relationship as well as by their lack of awareness of the positive effects of meaning negotiation on the second language acquisition process, both impacting on the effective use of modifications of the interactional structure.

Various classroom-based studies reveal the unequal relationship between teacher and learner, reflected in the dominance of the teacher on various aspects of classroom interactions, such as the initiation of classroom interactions, the amount of teacher talk, the particular variety of language used, e.g. statements, imperatives and display questions, and the imposition of discourse structures, reflecting a uni-directional flow of information, thus, mostly restricting the learners' use of their interaction skills to small group work with peers (cf. Doughty and Pica, 1986; Hüllen, 1990; Long and Sato, 1983; Musumeci, 1996; Pica, 1987; Pica and Long, 1986).

For instance, Pica and Long (1986), investigating the interactional performance of experienced and inexperienced teachers of English as a second language in their regular classes, point out the dominant role of teachers regardless of their previous teaching experience:

"Certain conventions of classroom discourse, such as the centrality of the teacher's position and the communicative dominance this provides, appear to be present from the outset. Reflections of this power include the sheer quantity of teacher talk, the use of the solicit-response-react exchange as the dominant discourse structure, and the heavy reliance on display questions as a means of initiating such exchanges" (p.96).

Pica and Long (1986) conclude their study by pointing to the lack of opportunity for meaning negotiation in the lessons investigated due to the discourse structure, characterised by a predominantly unidirectional flow of information from
the teacher to the learner, imposed on the learners by the teacher, compared to interactions between native speakers and non-native speakers outside the classrooms.

Similarly, Hüllen (1990), reporting on classroom discourse investigations by Hüllen and Lörscher (1979) and Lörscher (1983), shows that teacher talk accounts for three quarters of all utterances, and Long and Sato’s (1983) exploratory study, comparing ESL teachers’ speech in classrooms with native speakers’ speech in NS/NNs interactions outside the classroom, reveals particular characteristics for the classroom situation: First, the distribution of sentence types differs significantly between NS informally interacting with NNS outside the classroom and NS(Teacher) interacting with NNS pupils in the classroom, with the NS(Teacher) using more statements and imperatives and fewer questions and, second, the questions consist of more display questions but fewer referential questions.

Furthermore, Musumeci (1996), investigating teacher/learner interactions in content-based classrooms, finds a lack of understanding by all participants – teachers and learners – as to the learning potential of meaning negotiations. She reports:

"Notwithstanding these teachers' exhortations to students, telling them to 'speak up' when they do not understand, their own behavior in the classroom reveals that they do not practice what they preach. Why not? When the teachers were asked why they did not simply tell the students they could not understand, all three instructors insisted that it is their responsibility as teachers to make sense of what the students say to ensure that communication is successful" (p.315-16).

Subsequently, NS(Teacher) tends to use confirmation checks entailing exact repetitions of learners’ responses or rewordings than clarification requests. Learners, on the other hand, indicate their non-understanding preferably through non-linguistic means, though learner initiated interactions occur, but “…almost
exclusively during small-group activities, not during whole-class activities” (Musumeci, 1996, p.307).139

Musumeci’s (1996) finding of minimal meaning negotiations between NS(Teacher) and NNS in whole class situations due to a lack of understanding by all interactants of the positive effects of meaning negotiation on the second language acquisition process is corroborated by Foster’s (1998) study investigating the concept of ‘Negotiation for Meaning’ in regard to interactions between non-native speakers, involving 21 adult intermediate ESL learners attending a municipal college in Britain three times a week for two hours each.

Foster (1998), using the participation patterns dyad and small group in a classroom setting, employs four tasks, two requiring information exchange and the other two where information exchange is optional. Foster (1998) reports that:

“...there was a discernible trend for dyads doing a two-way task to produce more negotiated interaction. However, it was noticeable that many students in the small groups did not speak at all, many more in both dyads and small groups did not initiate any negotiated interaction, and very few students in either setting produced any modified utterances” (p.1).

Although Foster (1998), subsequently, rejects ‘Negotiation for Meaning’ as a viable classroom concept, her description of students’ perception of group work as “…light-hearted and informal part of class” where one is “…relaxed enough about communication problems to let them pass” (p.19) leads Foster to draw the sensible conclusion:

“If we [...] would prefer our students to pursue communication breakdowns until they are resolved, it is probably necessary to show them how to do this and why” (p.19).

Finally, Pica (1987), stressing the importance of interactional modifications in the meaning negotiation process for the second language acquisition process, points out:
"The unequal status relationship between teacher and students which shapes and is shaped by most classroom activities provides minimal opportunity for the restructuring of social interaction [...] What is needed are activities whose outcome depends on information exchange and which emphasize collaboration and an equal share of responsibility among classroom participants”. (p.17).

Overall, the above studies suggest that the realisation of all participants' interactional skills is negatively affected if there is:

(i) a lack of understanding of the positive effects of meaning negotiation on the second language acquisition process, perpetuating dominant teacher behaviour in classroom interactions, as well as perpetuating negative or indifferent learner perceptions of meaning negotiations, and

(ii) a lack of modelling meaning negotiation and consequently a lack of application by learners and teachers.

Hence, it is proposed that, in order to redress these negative effects on participants’ interactional skills, all participants need to be empowered to modify the interactional structure effectively through a meaning negotiation-enhancement training, consisting of:

(i) participant-awareness raising as to the meaning negotiation potential of particular modifications of the interactional structure, manifested as listener and speaker requests (cf. Chamot, 1993; Dörnyei, 1995; Dörnyei and Scott, 1997; MacIntyre, 1994; O’Malley and Chamot, 1990; Oxford and Crookall, 1989; Oxford and Lavine, 1989; Yule and Powers, 1994; Yule, Powers and MacDonald, 1992),

(ii) the introduction of the linguistic means to realise the above modifications of the interactional structure, regardless of the learners’ respective stages of grammatical development, i.e. the introduction of particular formulae (cf. Nattinger and De Carrico, 1992; Nuboyoshi and Ellis, 1993; Pica, 1994; Pica, Holliday, Lewis and Morgenthaler, 1989; Pica, Lincoln-

(iii) participant encouragement to modify the interactional structure by providing opportunities to practise the negotiation for meaning (cf. Chamot, 1993; Dörnyei, 1995).

Although there is ample evidence that learners modify the interactional structure without being taught particular strategies (cf. Abraham and Vann, 1987; Chamot, 1987; Gaies, 1983), the above outlined empowerment training has the potential to accelerate the improvement of participants’ interactional skills.

Thirdly, non-native speakers' interaction skills are affected by their familiarity in that familiar learners interacting with each other use more listener requests – confirmation checks and clarification requests – when signalling non-understanding than unfamiliar learners interacting with each other (cf. Plough and Gass, 1993).

Plough and Gass (1993), investigating the effect of the familiarity of interlocutors in NNS/NNS (dyad) interactions when performing on problem-solving and decision-making tasks, find that five unfamiliar dyads use fewer confirmation checks and clarification requests compared to five familiar dyads. Plough and Gass (1993) suggest that interactants that are more familiar with each other may feel more secure in expressing non-comprehension.

And, fourthly, non-native speakers' interaction skills are affected by their differing first language backgrounds in that the greatest amount of modification occurs in interactions between learners with different first languages compared to learners with the same first language (cf. Long and Porter, 1985, referring to Varonis and Gass, 1983; Varonis and Gass, 1985; Takahashi, 1989).

In sum, the particular meaning-negotiation potential of a task, depending on the choices made in regard to the task design qualities 'interactant relationship', 'interactant requirement', 'goal orientation', and 'outcome options' (cf. Pica, Kanagy and Falodun 1993), can only be fully realised by taking into account particular task-related variables, identified as task difficulty, task-
attention-generating potential, task-elicitation potential, participation patterns, group makeups and participant qualities.

However, these variables have to be seen in their interconnectedness to each other. Such interconnections become apparent if the above task-related variables are divided into three basic categories, task design variables (TDV) interactant variables (IV) and organisation variables (OV), and links between variables in the three categories are established with the aim of identifying the optimal match of particular variables.

In order to make these links transparent between TDV and particular IV and OV, as well as between particular OV and IV and particular IV and TDV, a more detailed elaboration on the three basic categories of variables and their interconnections is necessary.

The first set of variables - TDV - encompass task difficulty, task-attention-generating potential and task-elicitation potential.

Task difficulty entails linguistic, cognitive and social-cognitive demands placed on second language learners. Briefly summarised, linguistic demands are the requirements in regard to the necessary grammatical structures and meaning potential to perform a particular task, i.e. the interactants' linguistic means, which are necessary to exchange information as a requester and/or as a supplier. Cognitive demands are the requirements in regard to children’s conceptual range and attention span to perform a particular task, i.e. the interactants' thinking skills that are necessary to hold, request and/or supply particular information, and the interactants' skills to sustain attention, which are necessary to achieve the task outcome. And social-cognitive demands are the requirements in regard to children’s social perspective-taking skills to perform a particular task, i.e. the interactants' role-taking skills, which are necessary to request and/or supply essential information to achieve the goal concerning the task outcome.

Task-attention-generating potential is the task-inherent potential to contribute to the interactants’ state of alertness, reflected in interactants’ reasonable level of arousal.

Task-elicitation potential is the task-inherent potential to elicit particular processable grammatical structures or grammatical structures that are either at
learners’ current level of development or the next level regarding the hierarchy of processability in order to realise certain meanings.

The second set of variables - IV - consists of participant qualities. Participant qualities are the participants' interaction skills to provide processable, comprehensible, form-focused input and to stimulate form-focused output. Interaction skills vary according to the kind of participant: native speaker, native speaker (teacher), and non-native speaker. Participants' interaction skills are affected by their linguistic skills, whereby children’s interaction skills are affected, in addition, by their cognitive and social-cognitive skills. Furthermore, participants’ interaction skills are affected by their unequal relationship (non-native speakers and native speakers as teachers), as well as by their familiarity and by their differing first language backgrounds.

The third set of variables - OV - consists of participation patterns and group makeups. Participation patterns encompass dyads or small groups (D/SG) and whole classes or large groups (WCL/LG). Group makeups consist of either NS(Teacher) (native speaker-teacher) interacting with NNS (non-native speaker(s)) or NNS interacting with NNS.

In order to realise the inherent meaning potential of a task, the following general links between the three categories of task-related variables have been established with the aim to optimally match particular variables that are interconnected:
All TDV have to match particular IV, some of which subsequently have to match particular OV or relate to them in a particular support capacity, which then have to match other particular IV. Some TDV relate to each other in a particular support capacity.
These interconnections are discussed in more detail below.
Firstly, the interconnections between the TDV task difficulty and particular IV and OV are discussed, as well as the interconnection between the TDV task difficulty and task-elicitation potential.
Task difficulty, reflected in the linguistic, cognitive and social-
cognitive demands placed on non-native speakers, has to be matched with the respective IV participant qualities, i.e. the non-native speakers' interaction skills, reflecting appropriate linguistic, cognitive and social-cognitive skills, as well as with the respective OV participation pattern and group makeup.

Concerning required linguistic skills, such a match can be achieved on the basis of regular assessments of learners’ respective stages of grammatical development to be elaborated on below, and through teachers’ professional judgement concerning the learners’ acquired meaning potential. The non-native speakers' linguistic skills, reflected in their respective stages of grammatical development and their acquired meaning potential, directly affect their interaction skills in that they limit the scope of language they can use when requesting and/or supplying information and when negotiating the meaning of such information towards mutual comprehension in order to achieve the task outcome, which is particularly relevant for learners who are at the beginning of their second language acquisition process.

Concerning the match between learners' linguistic skills and particular OV, one has to consider that, in order to avoid prolonged interactions that are fraught with an excessive amount of breakdowns in communication, bearing the risk of frequent occurrences of non-repair of such breakdowns, beginning learners should not negotiate meaning with other beginning learners until such time as their linguistic skill level allows them to successfully perform social interaction tasks in dyads or small groups with other non-native speakers, without teacher support. Concerning the required cognitive skills of children as non-native speakers, a match with the respective task demands can be achieved through professional judgement on the basis of Piaget's (1970) stages of cognitive development in conjunction with Scarino, Vale, McKay and Clark’s (1988) spheres of conceptual range, as well as on the basis of Selman's (1976) stages of social perspective taking. Since both developmental sequences are maturationally constrained, approximate, related age ranges of learners can be taken as rough guides for such professional judgements to be made.

In regard to children’s attention span, which is also maturationally constrained, professional judgement, based on learner performance, will provide the
basis for matching this particular cognitive skill of sustaining attention over extended periods of time with the respective task demands.

Children’s cognitive skills directly affect their interaction skills in that learners’ stages of cognitive development constrain the conceptual range of potential task content and learners’ attention span.

And there is a direct link between the constrained cognitive skills and particular IV and OV. That is, the superior interaction skills of the NS(Teacher) in conjunction with the participation pattern D/SG, potentially generating qualitatively and quantitatively superior interactions, are crucial in the provision of input that is at the children’s respective level of conceptual range as well as in regard to the systematic provision of processable, comprehensible and form-focused input and the systematic stimulation of learner output within the constraints of the children’s attention span.

Children’s social-cognitive skills, reflected in their role-taking skills, too, directly affect their interaction skills to various degrees throughout the years of schooling, but there is only an indirect link to particular OV.

Concerning social-cognitive skills, children have to be at least at the stage of 'social-informational role taking' (approximate age: 6-8 years) to potentially interact successfully with other learners or their teacher as a native speaker by requesting and/or supplying essential information and negotiating its meaning towards mutual comprehension in order to achieve the task outcome, i.e. they have to be beyond the first stage of social perspective taking, which Selman (1976) calls 'egocentric or undifferentiated perspective' (approximate age: 3-6 years), where interactants "…are unaware of any perspective other than their own" (Shaffer, 1993, p.462) since, only then, they can "…recognize that people can have perspectives that differ from their own" (Shaffer, 1993, p.462).

However, since the learner "…is still unable to think about the thinking of others" (Shaffer, 1993, p.462) in advance, he/she may not see the need to provide the other interactant(s) with particular information in order to aid the completion of the task.

A considerable improvement in learners' role-taking skills occurs, though, at the next stage of social perspective-taking, which Selman (1976) calls 'self-reflective role-taking' (approximate age: 8-10 years), where learners "…are now able
to consider the other person's viewpoint" (Shaffer, 1993, p.462) and, thus, increases the likelihood that information transferred to other interactants is focused on these interactants' needs.

But it is only at the following stage of 'mutual role taking' (approximate age: 10-12 years) that a learner "...can put the self in the other's place and view the self from that vantage point before deciding how to react" (Shaffer, 1993, p.462), i.e. simultaneity of consideration of one's own and the other interactant's viewpoint is achieved, allowing for true cooperation between interactants, performing a task, that is, allowing for effective information transfer that is focused on the informational needs of the respective interactants.

Hence, in order to provide optimal conditions for an effective information transfer between interactants at all stages of social perspective taking, particular care needs to be taken to insure that the information held by interactants that needs to be supplied to other interactants is made explicit as part of the task design quality 'interactant relationship' (cf. Pica, Kanagy and Falodun, 1993), thus, facilitating an effective information transfer between interactants, regardless of the particular group makeup or participation pattern.

Concerning the link between children’s social-cognitive skills and particular OV-participation patterns and group makeups - the developmental sequence of role-taking skills does not suggest any particular match between them.

However, an indirect link becomes apparent in the context of existing evidence that learner interactions should be considered from the earliest possible point in time to contribute to the acceleration of learners' development of role-taking skills.

Evidence, referred to above suggests that learners' social-cognitive development, reflected in their role-taking skills, can be accelerated by providing them with frequent opportunities to interact with their peers.

Thus, in the context of accelerating learners' role-taking skills through frequent peer interactions, the NNS/NNS group makeup is required and the D/SG participation is preferable to the WCL/LG participation pattern, since the task-based research clearly suggests that the negotiation of meaning is quantitatively and qualitatively superior in small group work compared to whole class work if the tasks compels the interactants to exchange information.
As foreshadowed above, interconnections between the different TDV and particular IV and OV are to be analysed in due course. Next to be analysed are the interconnections between TDV task-elicitation potential and particular IV and OV.

In order to realise the inherent potential of a task to elicit particular processable grammatical structures or grammatical structures that are next in the processability hierarchy in order to realise certain meanings, the TDV task-elicitation potential has to match the IV interaction skills, taking into account participants linguistic skills.

Other variables affecting children’s interaction skills such as cognitive and social-cognitive skills, and variables, such as unequal relationship between interactants, familiarity as well as differing first language backgrounds of interactants, which affect children as well as adults as interactants, are not considered here since they are not directly related to the TDV task-elicitation potential in focus. That is, only if the grammatical structures to be elicited through the exchange of necessary information as a requester and/or as a supplier are, in principle, processable and only if the learners’ meaning potential is sufficiently developed, can the elicitation potential of the particular task be realised.

Such a match between IV interaction skills, taking into account learners’ linguistic skills, and the TDV task-elicitation potential can be achieved on the basis of regular assessments of learners’ respective stages of development and through teachers’ professional judgement as to learners’ acquired meaning potential.

Since there is a direct link between the matched TDV and IV and the OV group makeup, as already argued in the context of the above analysis of the interconnections between the TDV task difficulty and particular IV and OV, the option of NNS/NNS interaction is being excluded until such time that learners’ linguistic skill level allows them to successfully negotiate meaning without teacher support.

Hence, the remaining OV options for such beginning learners lacking the necessary linguistic skills are the participation patterns WCL/LG or D/SG
and the group makeup NS (Teacher)/NNS.

Finally, interconnections between the TDV task-attention-generating potential and particular IV and OV are analysed. In order for the task-inherent attention-generating potential to contribute to the interactants’ state of alertness without causing overarousal the TDV task-attention-generating potential has to match the IV interaction skills, taking into account the unequal relationship between interactants and their familiarity in order to avoid anxiety, and has to match the TDV task difficulty in order to avoid unreasonable task difficulty, thus, subsequently avoiding over-arousal, entailing a potential decrease in implicit learning during interaction.

Other variables affecting ‘interactants’ interaction skills, such as differing first language backgrounds of participants, are not considered here since they are not directly related to the TDV task-attention-generating potential in focus. A match between the TDV task-attention-generating potential and the IV interaction skills, taking into account interactants’ unequal relationship as well as their familiarity, can be achieved. Regarding the unequal relationship, such match can be achieved on the basis of tasks imposing a more equal relationship on participants through task conditions requiring an information exchange between all interactants and requiring interactants to have a common goal as well as on the basis of an enhancement of interactants’ meaning negotiation skills achieved through meaning negotiation-enhancement training proposed above.

A match between the above TDV and IV, regarding the familiarity of interactants can be achieved on the basis of a professional questionnaire to be answered by the interactants. Since there is no direct link between the matched TDV task-attention-generating potential and IV interaction skills, taking into account interactants’ unequal relationships as well as their familiarity, and the OV participation pattern and group makeup, all OV options are available to the interactants.

Finally, the match between the TDV task difficulty and the TDV task-attention-generating potential is generally achieved by matching the TDV task difficulty with the relevant IV interaction skills, taking into account all learners’
linguistic skills and children’s cognitive and social-cognitive skills. This avoids the imposition of an unreasonable level of task difficulty on learners, be they adults or children, and at the same time constituting the same direct link between the two matched TDV task difficulty and task-attention-generating potential and the OV ‘group makeup’ that has been established above between the matched TDV task difficulty and IV interaction skills. Subsequently, the OV options available to beginning learners lacking the necessary linguistic skills are the participation patterns WCL/LG or D/SG and the group makeup NS(Teacher)/NNs, excluding the group makeup NNS/NNS.

In sum, the above analysis reveals that, after matching the TDV task difficulty with particular IV participant qualities, a low level of linguistic skills is the only variable constraining the OV options concerning group makeup, with the NS(Teacher)/NNS the only option reasonably available. In all other cases, all OV options concerning participation pattern and group makeup are available to all learners, be they adults or children. This finding augurs well for the use of particular OV options in order to exploit the framework of negotiation for meaning as a rich source of implicit learning, to be exemplified below.

7.2 Exemplification of the implementation of instructional measures for the initial stages of the acquisition of German as a second language within the conceptual framework of ‘Negotiation for Meaning’

The above formulated instructional measures will be implemented within the conceptual framework of ‘Negotiation for Meaning’ and exemplified for the acquisition of selected grammatical structures of German as a second language by adults and children as beginning learners, being at the second stage of the hierarchically ordered development of the processing procedures.

The instructional measures to be implemented are:

(i) the provision of input that is processable, containing the grammatical structures and/or word forms to be acquired,
(ii) the provision of comprehensible, processable input,  

(iii) the provision of implicitly form-focused, processable, comprehensible input,  

(iv) the provision of explicitly form-focused, processable, comprehensible input,  

(v) the provision of opportunities for practice in conjunction with successive implicit learning phases, and  

(vi) the provision of processable, comprehensible, form-focused input in learning phases operating in the combined neutral instruction-salient condition  

Firstly, the provision of processable input facilitates the acquisition of grammatical structures that are, in principle, already processable or become processable at the next stage of the development of processing procedures, as well as the growth of meaning potential.\textsuperscript{141}  

Since the hierarchically ordered development of the grammatical encoding procedures manifests itself in the sequential acquisition of the grammatical structures, rules and regularities of the target language, processable input focuses on structures that learners can, in principle, already process as well as on the processing resources necessary to process the grammatical structures at the next stage of development. That is, by systematically exposing learners to the surface structures of the target language, they can, in principle, already process, whereby the input for learning also contains processing resources needed for the next stage of development, they not only acquire the stage-appropriate knowledge to grammatically encode conceptual information for oral production but also acquire processing resources for the next stage of development of the processing procedures.  

Such systematic input clearly favours the ‘group makeup’ NS(Teacher)NNS
with the NS(Teacher) being the supplier of input in conjunction with task designs that inherently allocate an information supplier or requester function to each interactant, such as information gap tasks with role reversal (see footnote 120).

In order to provide processable input, one needs to know what learners can, in principle, produce at each level of the hierarchy of processing procedures. For German as a second language (GSL), the stages of grammatical development, as the manifestation of the hierarchically ordered development of the processing procedures are already mapped out on the basis of research findings reported on above.

Since the exemplification of the implementation of the above instructional measures assumes that the fictitious learners of GSL are at the second stage of the hierarchy of processing procedures, the first two stages define, in principle, what learners can already process, whereas the third stage defines what is becoming processable next.

Hence, it has to be established what learners can, in principle, produce at each of the three stages in focus and, thus, what processable input is needed for the respective current stage of development as well as for the facilitation of further development towards the next stage.

The first stage is characterised by the entry of lexical items into the mental lexicon, minimally entailing their conceptual specification, whereas the specification of their conceptual arguments can be expected to be gradually acquired, as, for instance, Braine (1988) and de Bot, Paribakht and Wesche (1997) propose.

Braine (1988), elaborating on the acquisition of linguistic structure, suggests that a new verb, most likely, is initially encoded as a lexical item “…representing a kind of action, without restricting it to a particular set of arguments” (p.248) and that “…it takes more exposure to the verb to register its argument structure than to register the kind of action it represents” (p.248). In the same vein, de Bot et al. (1997), aiming to model the processes leading from an encounter of a word to its entry into the mental lexicon by adapting Levelt’s (1989) model of speech
production and LeveI’t’s (1993) update in regard to the ‘Comprehension System’ argue:

“The process of learning the meaning of a lexical item must...involve the copying of semantic information from the (learner’s, D.P.H.) conceptual system to the lemma. Once a lexical item has been added to the lexicon in a more or less primitive form...its continued use will gradually specify additional information” (p.317).

These arguments are in line with the hierarchy of processing procedures in that the specification of a lexical entry’s conceptual arguments only becomes relevant at the fourth stage when interphrasal exchange of grammatical information can occur, whereby grammatical functions are assigned to conceptual arguments. This stage is characterised by the availability of Appointment Rules and S-Procedure as well as Word Order Rules.

At the first stage, in the absence of language-specific syntactic procedures, learners have to map conceptual structures onto single words and/or formulae. Single word ellipses, such as nouns, lexical verbs, adjectives, adverbs, numerals, or particles can be used as equivalent to main sentences as a statement, a direct question (intonation question) or an imperative.

Pienemann (1981), for instance, reports that mostly ellipses are used by children as responses in dialogue situations. Clyne (1986) and Clyne, Jenkins, Chen, Tsokalidou and Wallner (1995) reporting on results from studies of second language acquisition, carried out at various primary schools in Victoria (Australia) teaching German, but also Chinese, Italian and Greek as second languages, corroborate and add to Pienemann’s (1981) findings by showing that during the first phase of development children use one-word or two-word utterances and formulaic responses, such as: ‘Ich bin acht Jahre alt. Ich heiße [...] Gut, danke!” (Clyne, 1986, p.58).

Similar results are reported by Skiba and Dittmar (1992). Their study of the acquisition of German by three adult Poles in Germany describes the first stage of their learners:
The first three recordings (4th, 5th and 6th months of their stay) show the following inventory:

1st recording: bitte ('please'), gut ('good'), klein ('small', 'little'), kaputt ('broken'), verstehen ('understand'), sprechen ('speak')

2nd recording: weg ('away', 'out'), komm ('come', imperative), gehen ('go'), fertig ('finished, 'ready-made'), egal ('the same'), groß ('big')...

3rd recording: platz ('place', in German only a noun), schlagen ('beat'), guck mal ('look', imperative") (p.331).

However, learners also use formulaic sentences – everyday stereotypes, such as “hier sprechen sie deutsch” (p.333) to express ‘she speaks German here’.

Hence, the use of single-word ellipses, mostly as responses in interactions and the use of formulae by children and adults as beginning learners, which is well documented (cf. Hakuta, 1974; Weinert, 1995; Wong-Fillmore, 1976), augurs well for expanding learners’ lexical basis through processable input that systematically exposes learners to the target-like use of single-word ellipses and selected formulae, permitting the mapping conceptual structures onto single words and/or formulae.

Useful words to be entered into the mental lexicon are words, such as nouns, lexical verbs, adjectives, adverbs, numerals and particles, which enhance learners’ capabilities to participate in oral interactions and increase their meaning potential. Furthermore, such processable input facilitates the developmental process towards the next two levels of the hierarchy of processing procedures. By focusing on the acquisition of the meanings of particular words – nouns and verbs or adjectives, numerals and adverbs – that are essential constituents for oral language production at the second and third stage respectively, the developmental process towards mappings of conceptual structures onto surface form at both stages and the formation of phrasal structures at the third stage is facilitated.

Regarding the provision of processable input, focusing on selected formulae, a two-pronged approach is proposed. Firstly, selected formulae facilitating social interactions in the particular learning environment are to be introduced for
acquisition in order to encourage learners to engage in recurring oral interactions, which are necessary for the functioning in the learning environment. 

Such formulae may consist of ‘lexical phrases’ that Nattinger and De Carrico (1992) term ‘interaction markers’ and ‘topic markers’ and ‘discourse devices’, such as greetings, leave-takings, asking how someone is, expressing sympathy, changing a topic, obtaining a turn, thanking, apologising, stating not to know something, expressing wishes. 

These formulae permit learners to take on a more active role in oral interactions and, thus, will facilitate learners’ engagement in negotiations for meaning, once pertinent formulaic expressions have been acquired. Such formulae for meaning negotiations make up the second strand of ‘lexical phrases’ to be introduced for acquisition, consisting of listener requests (confirmation checks and clarifications checks) and speaker requests (comprehension checks) that are essential modifications of the interactional structure in order to achieve mutual comprehension, which, subsequently, facilitates the acquisition of word meanings. 

Based on Long’s (1981, 1983b, 1983c, 1983d) findings, Pica, Young and Doughty (1987) define the three modifications of the interactional structure as follows: 

(i) Confirmation checks: “Moves by which one speaker seeks confirmation of the other’s preceding utterance” (p. 740). 

Applied to GSL, a learner hearing the sentence: “Der Mann singt ein Lied” (The man sings a song) may repeat incorrectly: “sink?” 

An interlocutor’s response may than be: “singt!” (sings). 

In case of the assumption of non-understanding, the interlocutor may repeat part of the sentence: “Der Mann singt”, stressing the word ‘singt’ and may mime singing. 

(ii) Clarification requests: “Moves by which one speaker seeks assistance in understanding the other speaker’s preceding utterance” (p.740) 

Applied to GSL, a learner hearing the sentence:
“Der Mann singt ein Lied” (The man sings a song) may ask:
“Wie bitte?” (I beg your pardon) or “Ich verstehe es nicht” (I do not understand), indicating non-understanding of the preceding utterance.
Hence, an interlocutor may respond:
“Der Mann” – “Peter” (pointing to Peter) “singt ‘Rock around the clock’”.
The learner may ask: “singt?” (sings)
The interlocutor, assuming non-understanding of the word “singt” may repeat part of the sentence:
“Der Mann singt”, stressing the word “singt” and may mime singing.

(iii) Comprehension checks: “Moves by which one speaker attempts to determine whether the other speaker has understood a preceding utterance” (p. 740).

Applied to GSL, an interlocutor saying the sentence:
“Der Mann singt ein Lied” (The man sings a song) may check the comprehension of the learner by asking: “Verstanden?” or “Alles klar?”
If the learners response is: “Nein” (No), the interlocutor may respond as outlined under clarification requests.

In short, at the first stage, processable input systematically exposes learners to as many useful words as possible for entering into the mental lexicon, minimally entailing their conceptual specifications – meanings – as well as to a selection of formulaic expressions to improve learners’ interaction skills. The explicit nature of the learning of meaning-based word knowledge will be discussed below in the context of the provision of comprehensible, processable input.
Firstly, useful words to be entered into the mental lexicon are words, such as nouns, verbs, adjectives, adverbs, numerals and particles, which enhance learners’ capabilities to participate in oral interactions and increase their meaning potential.
Secondly, useful words to be entered into the mental lexicon are particularly nouns and verbs that are essential for the next stage of development, permitting mappings of conceptual structures onto surface form, applying NVN serial word order.
The input of formulaic expressions to improve learners’ interaction skills will be discussed below in the context of the provision of comprehensible input.

The second stage in the development of the grammatical processor is characterised by the development of the Category Procedure, once syntactic categories have been assigned to lexical entries. Since the syntactic formation of sentences is not yet possible, learners revert to mapping conceptual structures directly onto surface form applying serial word order. That is, as soon as the lemma of a lexical entry is retrieved, because its semantic properties – minimally entailing their conceptual specification – match the concept of the preverbal message fragment, the syntactic category becomes available, which is the precondition for mapping conceptual structures onto surface form.

Data, reported by Pienemann (1981) and Clahsen, Meisel and Pienemann (1983), show that learners at the second stage may already use phrases, such as noun phrases (Det + N) and, thus, produce target-like sentences. Hence, learners may acquire the meanings of determiners from the non-deviant input provided by the teacher, but such phrases have to be considered to be formulae since the Phrasal Procedure to build phrase structures is not acquired yet. Subsequently, the following exemplifications of mappings of conceptual structures onto surface display determiners in brackets, but at the same time highlight the kind of input essential for the next stage of development characterised by the development of the Phrasal Procedure.

Based on Halliday’s (1994) systematic account of the clause in English as a representation of patterns of experience, the following conceptual structures, without claiming to provide an exhaustive list, could be mapped onto surface form in German, applying N V N serial word order:

(i) actor doing patient
N V N
(der) Mann singt (ein) Lied
(The) man sings (a) song

actor doing
(Die) Frau singt
(The) woman
sings

(ii) behaver behaving
N V
(Das) Kind träumt
(The) child dreams

(iii) senser seeing phenomenon
N V N
Peter sieht (einen) Fisch
Peter sees (a) fish

senser feeling phenomenon
N V N
Maria mag Kaffee
Maria likes coffee

senser thinking phenomenon
N V N
(Die) Mutter glaubt Peter
(The) mother believes Peter

(iv) sayer saying target
N V N
(Der) Vater lobt Peter
(The) father praises Peter

(v) carrier attributing attribute
N V N
Maria hat (ein) Auto
Maria has (a) car
Extensions of the above mappings of conceptual structures onto surface form are, firstly, the use of pronouns, such as personal pronouns and demonstrative pronouns instead of nouns, shown by Pienemann (1981) to be acquired later during the second stage of development, which is in harmony with the processing procedures developed at this stage, and, secondly, the use of negators, such as ‘kein’ (article word) and ‘nicht’ (adverb).

As data, reported on by Clahsen (1984, 1985, 1988b), Clahsen, Meisel and Pienemann (1983), Meisel (1997), show, learners variably place negators pre-verbally or post-verbally, whereby preverbal placements of the negator are considered to be mappings of conceptual structure onto surface form and postverbal placements of the negator are considered to be formulaic applications (see chapter 2.1).

These conclusions drawn by Clahsen (1988b) and Meisel (1997) are in harmony with the Processability Theory:

‘Kein’ as an article word can only be used correctly in the position in front of the negated noun constituting part of a noun phrase, which is developmentally impossible due to the unavailability of the Phrasal Procedure at the second stage. Hence, the correct post-verbal placement of ‘kein’ in a NVN sequence – N V NEG N - may constitute a correct negation of the following noun by chance, or may constitute the correct application of a formulaic expression.

‘Nicht’ as an adverb may be used correctly in the post-verbal position as constituent (noun) negation – N V NEGN - or sentence negation – N V N NEG - by chance or as an application of a formulaic expression due to the unavailability of the S-Procedure entailing, for instance, the target language-specific Word Order Rules.

Hence, it is suggested to frequently expose learners to exemplars of such processable serial word order sequences in order to increase the number of useful lexical entries, (see also first stage), minimally entailing their conceptual
specifications (meanings). In case of determiners (definite and indefinite articles), though, such exposure provides input for learning meaning-based word knowledge for the third stage of development that requires determiners for the building of phrase structures.

However, in order to facilitate the acquisition of lexical entries’ respective syntactic categories such facilitation is achieved by rendering transparent the mappings of conceptual structures onto surface forms, whereby surface forms concerned are nouns, pronouns, such as personal and demonstrative pronouns, and lexical verbs including ‘haben’ (to have) and ‘sein’ (to be), and some modal verbs that are frequently used elliptically as well as the negators ‘kein’ (no) and ‘nicht’ (not).

The acquisition of the meaning and syntactic category of the article word ‘kein’ also provides input for the third stage of development, permitting the building of phrase structures, such as NEG(‘kein’) + N.

Although the developmentally correct use of ‘nicht’ in the post-verbal position becomes possible only at the fourth stage of development of the grammatical processor, as pointed out below, the acquisition of its meaning and syntactic category, based on frequent exposures to correct constituent negations, will add to learners’ expressiveness in that it permits additional applications of mappings of conceptual structures onto surface form.

Furthermore, the above suggested exposure to exemplars of processable serial word order sequences will facilitate the acquisition of morphological word form knowledge.

Given that the respective morphological forms have been entered into the mental lexicon, lexical morphemes can be produced since they do not involve the exchange of grammatical information between constituents. That is, if conceptual information in the preverbal message fragment provides a value for a diacritic parameter, the particular morphological form of that parameter is activated.

In German, this concerns particularly mood, tense and number information, permitting learners to produce certain lexical morphemes:
(i) verbs marked for present tense (indicative):
(Das) Kind singt (ein) Lied
(The) child sings (a) song
(for other examples, see the above mappings of conceptual structures onto surface form)

(ii) some modal verbs marked for present tense (subjunctive) that frequently are used elliptically, i.e. without non-finite part of complex verb group:
Peter möchte Kaffee (trinken)
Peter would like coffee (to drink)

(iii) verbs marked for past tense (preterite):
(Der) Mann sang (ein) Lied
(The) man sang (a) song

(iv) nouns marked for plural without article:\(^{145}\)
(Die) Frau liebt Bücher
(The) woman loves books

They also provide input for the third stage of development, permitting the production of phrasal morphemes, such as ‘die Häuser’ (the houses), whereby, for instance the head noun ‘Häuser’ agrees with the determiner ‘die’.

However, one must not forget that the morphological word form of a determiner also is determined by gender information and by case information (see footnote 18), which may not be available. That is, gender information may not have been acquired yet, or in regard to case information, which depends on the grammatical function of the noun phrase it is a constituent of, Appointment Rules have not been acquired.
yet. They only become available at the fourth stage of development. Hence, the target-like production of a determiner as a constituent of a noun phrase at the third stage of development still has to be considered formulaic.

Learners gradually build up morphological form knowledge for each lexical entry – lexical items, such as ‘singe’, ‘singst’, ‘singen’, ‘singt’, ‘sang’, ‘sangst’, ‘sangen’, ‘sangt’ – as they hear and begin to use personal pronouns, but lack the processing procedures to correctly produce inter-phrasal morphemes by matching diacritic features between the subject and the verb (subject-verb agreement). Subsequently, lexical morphemes may not be target-like since the selection mechanism of the correct morphological form is not in place, but they can be ‘target like’, firstly, in that they represent formulae and, secondly, in that they either represent the present tense or the past-tense (preterite).

In short, at the second stage, processable input that systematically exposes learners to old and new lexical items in the context of processable serial word order sequences, reflecting a wide range of possible mappings of conceptual structures onto surface form, needs to focus on, firstly, the acquisition of syntactic categories of already existent lexical entries, secondly, the acquisition of meanings and respective syntactic categories of new words encompassing nouns, pronouns, such as personal and demonstrative pronouns, lexical verbs including ‘haben’ (to have) and ‘sein’ (to be), and some modal verbs that are frequently used elliptically as well as the negators ‘kein’ and ‘nicht’, thirdly, the acquisition of the meanings of determiners (definite and indefinite articles) and, fourthly, the acquisition of morphological word form knowledge concerning mood and tense (indicative/present tense, past tense (preterite) of verbs, subjunctive/present tense of some modal verbs) and concerning number (plural of nouns).

The explicit nature of the acquisition process of the meaning-based word knowledge and the implicit nature of the acquisition of morphological word form knowledge and knowledge of the syntactic categories of lexical entries will be discussed below in the context of the provision of comprehensible input and of particular respective learning phases.
The third stage in the development of the grammatical processor is characterised by the development of the Phrasal Procedure that can build phrase structures and permits the exchange of grammatical information between the head of the phrase and other phrasal constituents. Since the syntactic formation of sentences is not yet possible due to the unavailability of the S-Procedure, Appointment Rules and Word Order Rules, learners still revert to mapping conceptual structures directly onto surface form, applying serial word order. However learners are able to extend the serial word order sequence by identifying the positions external to the sequence and mapping conceptual information onto surface form occupying theses positions – adverb (ADV) or (adverbial) prepositional phrases (PP): INITIAL] NP V NP [ FINAL

Within the constraints of the mappings outlined above, GSL learners would be able to build the following noun-phrase structures and prepositional-phrase structures:

(i) noun (N), pronouns (PRD) – personal, demonstrative, interrogative, determiner + noun (DET+N), adjective + noun (ADJ + N), determiner + adjective + noun (DET + ADJ + N), possessive pronoun + noun (PRO + N), possessive pronoun + adjective + noun (PRO + ADJ + N), and

(ii) preposition + noun (PREP + N), preposition + determiner + noun (PREP + DET + N), preposition + adjective + noun (PREP + ADJ + N), preposition + possessive pronoun + noun (PREP + PRO + N), preposition + determiner + adjective + noun (PREP + DET + ADJ + N).

In short, at the third stage processable input that systematically exposes learners to serial word order sequences, using noun phrases, and to extended word order sequences, using adverbs or (adverbial) prepositional phrases in the positions external to the sequence and noun phrases internally, needs to focus on:

(i) the acquisition of the meanings and the syntactic categories of pronouns, determiners including the negator ‘kein’ (article word) and adjectives as input for the formation of noun-phrase structures,
(ii) the acquisition of the meanings and the syntactic categories of prepositions as input for the formation of prepositional-phrase structures that can be placed into the two positions external to the serial word order sequence, and

(iii) the acquisition of the meanings and the syntactic categories of adverbs as input for their placement into the two positions external to the serial word order sequence.

The provision of processable input, appropriate for learners’ respective current stages of development of speech processing procedures as well as for the facilitation of the development of the speech processing procedures of the respective stages to follow, requires regular assessments of each learner’s current stage of development.

In order to evaluate available options, pertinent proposals for assessment are briefly outlined below.

The assessment of a learner's current development stage as a necessary prerequisite for the provision of stage-appropriate input is the focus of Clahsen's profiling concept (cf. Clahsen, 1985) for German as a second language as well as of Pienemann and his associates' assessment procedure for English as a second language (cf. Mackey, Pienemann and Thornton, 1991; Pienemann, 1990; Pienemann and Johnston, 1986; Pienemann, Johnston and Brindley, 1988). Both concepts draw on Crystal, Fletcher and Garman's (1976) profiling approach LARSP (Language Assessment Remediation and Screening Procedure) that provides a descriptive framework of grammatical structures and developmentally graded linguistic categories for the analysis of samples of spontaneous, interactional speech production.

Clahsen's proposal, focusing on syntactical development and sharing most of the characteristics of Crystal et al.'s LARSP, is, however, rightfully seen as impracticable (cf. Pienemann and Johnston, 1986) since it requires the teacher/analyst to transcribe an elicited speech sample of a learner of approximately 30 minutes duration and then to analyse in detail this sample on the basis of a developmental profile chart.
Pienemann and his associates' initial approach (cf. Pienemann and Johnston, 1986; Pienemann, Johnston and Brindley, 1988), on the other hand, does not need a transcription but an observation instead, focusing on particular developmental features of syntax and morphology - index features\textsuperscript{148} - of each stage that are immediately recorded on a standardised observation form and then interpreted as to the learners' achieved stage of development.

Testing of the assessment procedure and further improvements, in particular, in regard to the training of assessors and the list of 'index features' to be observed,\textsuperscript{149} lead to 'Rapid Profile',\textsuperscript{150} a computer-assisted screening procedure for English as a second language and a training facility called 'Rap Pro Trainer'\textsuperscript{151} (cf. Mackey, Pienemann and Thornton, 1991; Pienemann, 1990; Pienemann and Mackey, 1994).

'Rapid Profile', using an expert programme for on-line analysis of observed and recorded data in conjunction with the training instrument 'Rap Pro Trainer', represents a formidable development towards a reliable assessment of a learner's stage of development and the building of learner profiles of acquired developmental features.

Nevertheless, ‘Rapid Profile’ is a time-consuming procedure in that, even under the most favourable circumstances, it takes 15 or 20 minutes to assess one learner. In the context of formal acquisitional settings that are characterised by large numbers of learners and limited teaching or contact time, such as primary schools in Australia implementing LOTE programmes or Community Language programmes, or undergraduate, elementary courses at Australian universities, ‘Rapid Profile’ as a regular, recurring assessment procedure would be prohibitive. For example, the acquisitional setting of an Australian primary school, which is characterised by large numbers of learners per class and school to be taught by one teacher, a limited time allocation per student (cf. Nicholas, Moore, Clyne and Pauwels, 1993; NSW Department of Education, 1989),\textsuperscript{152} flexible entry points into a second language course (cf. Board of Studies NSW, 1995b; Curriculum Corporation, 1994a),\textsuperscript{153} a range of learners with various degrees of experience in the target language (cf. Board of Studies NSW, 1995b; Curriculum Corporation, 1994a),\textsuperscript{154} and a considerable age range of learners (cf. Fernandez, Pauwels and Clyne, 1993; NSW Department of Education, 1989),\textsuperscript{155} would not be able
to implement an assessment procedure based on Rapid Profile. With an average class size of 30 students in a primary school\textsuperscript{156} to be expected and a maximum teaching time of 2 hrs per student per week, the assessment of 10 classes, equalling 300 students that might range from Kindergarten to Year 6,\textsuperscript{157} would take five weeks, which is half the teaching time of an average 10-week school term. This would create a significant imbalance as to the remaining time available for various kinds of teacher input. This imbalance is increased even further if the recurrence of the assessment procedure and extra assessments due to flexible entries of learners are taken into account.

However, a solution to the above assessment problem can be found in the context of Pienemann’s (1998a) ‘Procedural Skill Hypothesis’ and the above conclusions concerning the implicitness of most of the knowledge underlying the processing procedures of grammatical encoding and its availability under time pressure. Pienemann (1998a), measuring reaction times of learners at the fourth stage of development of the grammatical processor when performing a sentence matching task, shows that learners’ performance is comparatively as fast as native speakers’ performance under time pressure,\textsuperscript{158} thus, reflecting comparable implicit procedural knowledge underlying the matching task.

Hence, sentence matching tasks may be used to assess learners’ current stage of development by taking into account that Pienemann’s (1998) experiment does not straightforwardly transfer to learners at a stage below the fourth stage. Learners’ sentence formation at the third and second stage of development is not based on the S-Procedure, Appointment Rules and Word Order Rules. For instance, sentence formation at the second stage is based on the Category Procedure and on direct mappings of conceptual structures onto surface form. Hence, reaction times during the matching task performance cannot be compared with reaction times displayed by native speakers, but they can be compared with reaction times displayed by learners who are either at the second or third stage of development. In order to obtain such comparable reaction times, one has to reliably establish that learners are either at the second or at the third stage of development, which can be achieved through the ‘Rapid Profile’ assessment procedure. Once comparable reaction times from learners at stages two and three, as well as from native speakers concerning grammatical structures to be acquired at stages four
and five, are becoming available, they will constitute the data base for the comparison of reaction time data obtained from learner performances on matching tasks geared towards a particular stage of development. Hence, if these comparisons show similarity of response times, one can safely assume that learners have acquired the implicit knowledge underlying the respective level of the hierarchically ordered processing procedures. In short, the performance on sentence matching tasks under time pressure, geared towards a particular stage of development and comparisons with relevant reaction time data obtained from tests of learners and native speakers, will form an assessment procedure that can effectively be implemented in acquisitional settings characterised by large numbers of learners and limited teaching or contact time.

Its effectiveness is based on the following factors:

(i) the assessment procedure can be fully computerised including reaction time comparisons with data from the data base.
(ii) the assessment procedure can be implemented without direct involvement of the teacher concerned, once the matching procedure is being explained to a learner, and
(iii) the assessment procedure, testing for two successive stages of development can be achieved in less than 15 minutes, as Bley-Vroman and Masterson’s (1989) study shows that it is possible to obtain reliable results when testing 60-90 sentences, including distractor items, representing three to four grammaticality types within less than a quarter of an hour.

Following the above formulated implications for instruction, input for learning not only has to be processable, but has to be comprehensible, too. Levelt’s (1993) model of the ‘Comprehension System’ or ‘Parser’ shows that, in order to achieve comprehension, learners process the incoming auditory stream leading to word recognition (cf. Marslen-Wilson, 1987, 1989: Marslen-Wilson and Tyler, 1980) and, subsequently, make use of the grammatical information and semantic information of each lexical entry, and interpret the resulting ‘derived message’, “…a conceptual structure, akin to the speaker’s message” (Levelt, 1993, p.11), in the context of the discourse. That is, the grammatical and
semantic information stored in the mental lexicon is pivotal to arrive at the ‘derived message’.

Applied to the first stage of development, this implies that the meaning-based knowledge of words and formulae has to be acquired. Applied to the second and third stage of development, this, again, implies that the meaning-based knowledge of words and formulae have to be acquired. But it also entails that the respective syntactic categories of words have to be acquired, since it is the identification of the syntactic categories of the constituents of serial word order sequences in conjunction with the meanings of the words leads to the ‘derived messages’ as an expression of conceptual structures mapped onto surface forms.

That is, in order to achieve comprehensibility, word meanings and their respective syntactic categories have to be acquired.

As foreshadowed above, the implicit nature of the acquisition of the knowledge of the syntactic categories of lexical entries will be discussed below in the context of the provision of particular learning phases predominantly engaging implicit learning processes, whereas the explicit nature of the acquisition of meaning-based word knowledge will be discussed in the context of the provision of comprehensible input to follow.

A recent review by Oxford and Scarcella (1994) concludes that the acquisition of meaning-based word knowledge is best achieved by fully contextualised learning tasks, supplemented by partially contextualised learning tasks. Oxford and Scarcella’s (1994) conclusions are in line with the above reported findings that the memorability of word meanings depends on the depth of processing (cf. Craik, 1973; Craik and Lockhart, 1972; Craik and Tulving, 1975).

Fully contextualised learning tasks in regard to the development of speaking skills would be meaning-focused oral interaction tasks.

Studies by Ellis, Tanaka and Yamazaki (1994) and by Ellis (1995a) show that interactionally modified input leads to the highest increase in acquired word meanings compared to premodeled input or baseline input, if learners are not swamped with information when negotiating for meaning (cf. Ellis,
Partially contextualised learning tasks that are referred to by Oxford and Scarcella (1994) consist of word groupings. That is, words are grouped together by the teacher, firstly, according to a particular attribute, word associations, whereby learners establish meaningful association between new words and already acquired words, secondly, visual imagery, whereby learners establish a link between visual images and new words, thirdly, aural imagery, whereby learners link new words to aural images created, for instance, by rhymes, rhythmical presentations and other auditory means, fourthly, according to the keyword method, whereby learners link new words to unusual visual and aural images created by themselves and, fifthly, according to the physical response method, whereby learners act out the meaning of new words.

The above learning approaches concur in that they provide some measure of elaboration by establishing certain measures of context. Such an increase in the depth of processing increases the memorability of new words encountered. Hence, these learning approaches dissociate from decontextualised learning tasks, such as word lists, flash cards or dictionary-lookup, if removed from meaningful contexts, since they lack a comparable depth of processing and, thus, do not provide the same degree of memorability (cf. Cohen, 1990; Swaffar, 1988).

In short, processable, comprehensible input requires the acquisition of word meanings and their respective syntactic categories. The acquisition of word meanings can be effectively achieved through an array of learning tasks that provide for an increased depth of processing, ranging from fully contextualised to partly contextualised approaches. Learning approaches typically considered to be decontextualised may be transformed into partly contextualised approaches. The acquisition of the syntactic categories of words whose meanings have been acquired will be discussed below in the context of the provision of particular learning phases predominantly engaging implicit learning processes. Explicit meaning-based knowledge of words does not necessarily need to be taught in an interactive context, but rather can combine an array of approaches ranging from decontextualised, partially decontextualised to fully contextualised
instructional approaches (cf. Oxford and Scarcella, 1994), such as tasks involving negotiations for meaning.

Following the above formulated implications for instruction further, the provision of form-focused input, since directly linked to the operating conditions of learning phases, will be discussed in the context of the provision of learning phases operating in the combined neutral instruction-salient condition to follow. Learning phases operating in a combination of these two conditions predominantly engage implicit learning processes, which lead to the acquisition of predominantly implicit knowledge. The discussion of the provision of learning phases of predominantly implicit learning in turn will then consider the provision of opportunities for practice.

Across the first two stages of development of the grammatical processor, the implicit knowledge to be acquired concerns the syntactic categories of lexical entries and morphological word form knowledge.\(^{160}\)

Before the learning phases can be discussed, their optimal operating conditions – neutral instruction and salient presentation of stimuli – have to be considered. Neutral instruction means that the presentation of input for learning avoids the engagement of explicit learning processes by being neutral in regard to the grammatical structures, rules and regularities that underlie the input and are to be acquired as well as by being neutral in regard to future testing or applications. Salient presentation of stimuli means that the presentation of input for learning has a quality of transparency in regard to the grammatical structures, rules and regularities underlying the input. Such quality may vary due to an \textit{a priori}-induced salience of the presentation and/or due to salience induced by transfer effects of explicit knowledge gained during prior learning phases.

An \textit{a priori}-induced salience is achieved by the provision of implicitly form-focused input that is processable and comprehensible, involving paralinguistic measures, such as visually and/or physically highlighting particular parts of the input, or linguistic means, such as increasing the redundancy level of the input or parts thereof through repetition, or providing interactional modifications of particular parts of the input during negotiations for meaning.
Salience induced by transfer effects of explicit knowledge is optimally achieved by the prior provision of explicitly form-focused input that is processable and comprehensible, involving metalinguistic means, such as the explicit teaching of the grammatical structures, rules and regularities in focus. Transfer effects that are based on explicit knowledge gained during prior learning phases operating in the neutral instruction-nonsalient condition, the rule search-nonsalient condition or the rule search-salient condition may not be as optimal, since the knowledge may not pertain the structures, rules and regularities in focus and it may be less complete.

However, transfer effects that are based on practice phases, operating in the neutral instruction-salient condition and involving extended exposure to input for implicit learning and extended applications of acquired implicit knowledge, effectively contribute to successive implicit learning phases, again, operating in the neutral instruction-salient condition, by increasing the a priori-induced salience further.

Independently of how complete and focused the attained explicit knowledge is in regard to the structures, rules and regularities to be acquired, the acquisition process of explicit knowledge has to be sufficiently distanced from the learning phase(s) focusing on the acquisition of predominantly implicit knowledge to avoid the engagement of explicit learning processes. Such implicit learning phases have to operate in the combined neutral instruction-salient condition.

Nevertheless, both measures of induced salience – implicitly as well as explicitly form-focused input – potentially increase the likelihood of detecting the grammatical structures, rules and regularities in focus.

This is in line with Posner and Petersen’s (1990) outline of the human attention system of interrelated attentional functions – alertness, orientation and detection - that identifies the attentional function of orientation to incoming sensory stimuli as facilitative in regard to detection.

Tomlin and Villa (1994), discussing the interrelated functions of the human attention system, point out:

- “Attentional resources can be specifically directed to some type or class of sensory information at the exclusion of...
others” (p.191).\textsuperscript{161}

- “Stimuli not receiving attentional orientation (when other stimuli are receiving it) are thus inhibited such that their detection requires more than normal effort” (p.191).
- “In general, orienting attention facilitates detection” (p.191).
- “Detection is the process that selects, or engages, a particular and specific bit of information” (p.192).
- “Information detected (cognitive registration) exhausts more attentional resources than even orientation of attention” (p.192).
- “Detected information is available for other cognitive processing” (p.192).
- “None of the central components of attention – alertness, orientation, or detection – require awareness” (p.193).

In short, an \textit{a priori}-induced salience is achieved by modes of input delivery that render input transparent and a salience induced by transfer effects of explicit knowledge is achieved by providing learners with the means rendering input transparent. Both kinds of induced salience orient learners’ attention towards the structures, rules and regularities and, thus, facilitate their detection during implicit learning phases.

Applied to the acquisition of implicit knowledge of lexical entries’ morphological word forms and their syntactic categories second stage in the development of the grammatical processor, the realisation of the combined neutral instruction – salient condition is of utmost importance.

Firstly, in order to satisfy the neutral instruction condition, words need to be presented to learners in meaning-focused contexts, such as meaning-focused tasks, which avoid the engagement of explicit learning processes and, thus, are in harmony with the implicit nature of the acquisition process.

Secondly, in order to satisfy the salient condition, the provision of implicitly and/or explicitly form–focused input constitute options to render such input transparent or respectively to provide learners with the means rendering the input transparent, whereby the latter option is not available to all learners due to
children’s developmental constraints regarding metalinguistic awareness (see chapter 4.2.5). That is, although children below the age of six for instance, may, be aware of certain grammatical features, as shown by Birdsong (1989) in his chronology of children’s development of metalinguistic abilities, “The crucial datum is children’s inability before middle childhood to deal with language form in a disembedded or decontextualized manner, that is, separate from the communication of meaning” (Birdsong, 1989, p.35).

As discussed in chapter 4.2.5, awareness of the linguistic system begins to develop at age 6, but it is at about age 8 that this development accelerates (cf. Karmiloff-Smith, 1986), which renders explicit form–focused input an option, only, for learners at about age 8 and older, depending on their progress in developing metalinguistic awareness in their first and/or second language. Hence, it is suggested that for children that do not have the developmental prerequisites to make use of decontextualized metalinguistic input, implicitly form- focused input constitutes the only option to render such input salient. For all other learners both options – the provision of implicitly and explicitly form-focused input – are available.

In the context of the exemplification of the implementation of the above instructional measures with adults and children acquiring GSL in a formal acquisitional setting it will be assumed that children are approximately 6 years old and, therefore, only the option of receiving implicitly form-focused input is available to them in order to satisfy the salient condition, whereas adults, having both options available to them, will be provided with explicitly form-focused input during a prior explicit learning phase. Drawing on the above instructional measures entailing the provision of processable, comprehensible input, the provision of implicitly and explicitly form- focused input at the second stage in the development of the grammatical processor will build on the already acquired word meanings (stage 1) in order to focus on the morphological word forms and syntactic categories to be acquired and in order to avoid dual-task conditions in which learners are
distracted from attending to the structures, rules and regularities by the need to focus attention on the meaning of the input.

Taken together, learning phases during the second stage of development provide processable, comprehensible and form-focused (salient) input in a meaning-focused context (neutral instruction) to optimally facilitate the implicit acquisition process of implicit knowledge of morphological forms and syntactic categories of lexical entries.

These implicit learning phases constitute the basis for the provision of practice phases involving extended exposure to input for implicit learning and extended applications of acquired implicit learning during oral interactions, followed by implicit learning phases, all together focusing, again, on the morphological forms and syntactic categories of lexical entries that have been the focus of prior processable, comprehensible and form-focused input.

Such practice phases, however, not only lead to the acquisition of explicit knowledge that contributes to the acquisition of implicit knowledge during successive implicit learning phases through transfer effects increasing the degree of salience, but also contribute to the acquisition of implicit knowledge during the practice phases. For instance, during NS(Teacher)/NNS (or NNS / NNS) oral interactions further pertinent input for implicit learning is provided in the context of modifications of the interactional structure, such as confirmation checks modelling what learners have tried to say.

Hence, the sequence of a predominantly implicit learning phase, operating in the neutral instruction-salient condition, followed by a practice phase, operating in the neutral instruction-salient condition, followed, again, by a predominantly implicit learning phase effectively organises the acquisition of implicit knowledge of morphological forms and syntactic categories of a selection of words.

This gradual acquisition process at each stage of development and towards the next stage of development eventually will be maximally supported when learners become able to orally interact with other NNS at their level of linguistic skills, independently of a NS (Teacher), so that implicit learning phases of learners based on NS (Teacher) / NNS interactions can occur in parallel with practice phases involving NNS / NNS interactions.

However, practice phases should not be restricted to NNS / NNS interactions
since NS (Teacher) /NNS interactions provide valuable feedback to the NS (Teacher) for the planning of follow-up phases of implicit learning in that learners’ performance may point to the need to provide particular processable, comprehensible and form-focused input.

The delivery of input that is processable, comprehensible and form – focused, first and foremost, depends on learners’ current linguistic skills that are, in principle, defined by learners’ respective stages of development of the grammatical processor.

Learners’ current linguistic skills determine task difficulty and, thus, at the early stages, limit the OV group makeup to NS (Teacher)/NNS, whereby the NNS participation pattern may vary from D/SG to WCL/LG.

However, the OV group makeup NS (Teacher)/NNS is also clearly favoured in respect to the NS (T) being the supplier of processable input, systematically exposing learners to the surface structures of the target language that they can, in principle, process.

Learners’ limited interaction skills and the superiority of the OV group makeup NS (Teacher)/NNS for systematic input provision have to be aligned with the general task design. That is, the tasks’ inherent meaning-negotiation potential has to be adjusted in order to match learners’ abilities to negotiate for meaning and needs to receive particular input for learning. This concerns the ‘interactant relationship’, defining who holds, requests, supplies information and the direction of the flow of information (one-way/two-way) and the ‘interaction requirement’, defining who is required or only expected to request/supply information.

Although the above learner constraints obviously limit the maximal exploitation of the concept of ‘Negotiation for Meaning’ at the beginning stages of development, the suggested approach gradually builds up learners’ and teachers’ interaction skills commensurate with their developing linguistic skills and by removing negative effects on such skills through an understanding of the positive effects of meaning negotiating and through modelling and application of meaning negotiation (meaning negotiation-enhancement training).

Furthermore, the alignment between learners’ current linguistic skills and task difficulty helps to prevent the task- attention-generating potential from
leading to an overarousal of learners, negatively affecting their attentional orientation towards what has to be acquired, and helps to make sure that the task-elicitation potential can be fully exploited.

Subsequently, a succession of learning phases will be presented below as an exemplification of the effective organisation of the implicit acquisition process of the implicit knowledge of selected morphological word forms and syntactic categories of lexical entries, minimally entailing their meanings. Children and adults are at the second stage in their development of the grammatical encoding procedures:

**LEARNING PHASE 1:**
Implicit learning phase

**Learner group:**
Children (approximately six years of age) or adults – NNS

**Input provider:**
Teacher – NS (Teacher)

**Input and grammatical focus:**
Morphological word forms of selected nouns – singular and plural – and of selected lexical verbs – third person singular and third person plural

**Task:**
Identify a particular person or thing (singular or plural) or a particular action (third person singular or third person plural) when listening to a range of sentences (one at a time) following the N(P) V N(P) serial order sequence and mark its corresponding picture on a sheet displaying all the correct corresponding pictures

**General task design qualities:**
Interactant relationship:
NS (Teacher) holds the information and the information flow occurs from NS(Teacher) to NNS
Interaction requirement:
NS (Teacher) is required to supply information and
NNS are encouraged to signal non-understanding

Goal orientation:
Convergent goal

Outcome options:
Only one outcome possible

**Alignment between the interactant variables (IV) and the task design variables (TDV):**

Task difficulty:
Adapted to stage of development and in case of children adapted to their
cognitive and social-cognitive skills

Task-attention generating potential:
Medium level of alertness/arousal achieved through adaptation of task difficulty
to stage of development and avoidance of other factors that may increase learners’
level of alertness/arousal

Task-elicitation potential:
The potential is high, since the task builds on already acquired meaning-based
word knowledge

**Subsequent alignment with the organisation variables (OV):**

Group makeup:
NS(Teacher)/NNS

Participation patterns:
D/SG and/or WCL/LG

**Operating conditions of the implicit learning phase:**
Processable, comprehensible, form-focused input is presented in the combined neutral instruction-salient condition:
The neutral instruction condition is achieved through the meaning-focused task. The salient condition is achieved either by aurally highlighting the words presented in the context of a sentence or by explicitly teaching learners during a prior explicit learning phase - sufficiently distanced from the current implicit learning phase - the word forms to be acquired implicitly

**LEARNING PHASE 2:**
Practice phase consisting of two phases:
Phase 1:
As learning phase 1
Phase 2:
As learning phase 2

**Learner group:**
Children or adults

**Input provider:**
NS (Teacher)

**Input and grammatical focus:**
Phase 1:
Morphological word forms of selected nouns and lexical verbs presented orally as in learning phase 1
Phase 2:
As Phase 1, but only in case of learners’ inability to solve a particular meaning task

**Tasks:**
Phase 1:
As learning phase 1
Phase 2:
Identify the particular person(s) or thing(s) shown as a picture and name it/them or identify the particular action(s) shown as a picture and name it/them in the context of a N(P) V N(P) serial word order sequence.

**General task design qualities:**

Interactant relationship:

Phase 1:
As learning phase 1

Phase 2:
NS (Teacher) holds the information in case of inability of NNS to name and the information flow occurs from NS (Teacher) to NNS

Interaction requirement:
Phase 1:
As learning phase 1

Phase 2:
NS (Teacher) requests information and NNS are encouraged to signal inability to solve a particular naming task. NS (Teacher) is required to supply information in cases of inability to name. However, in order to avoid the disruption of the neutral instruction condition through the engagement of explicit learning processes as well as to avoid the generation of a dual-task condition, NS (Teacher) does not supply information in cases NNS provide incorrect morphological forms when naming.

Goal orientation:
Convergent goal

Outcome options:
Phase 1:
As learning phase 1

Phase 2:
In regard to nouns, only one outcome possible and in regard to lexical verbs, more than one outcome possible

**Alignment between the interactant variables (IV) and the task design variables (TDV):**
As learning phase 1

**Subsequent alignment with the organisation variables (OV):**
As learning phase 1

**Operating conditions of the implicit learning phase:**
Phase 1:
As learning phase 1
Phase 2:
Processable, comprehensible, form-focused input is presented in the combined neutral instruction-salient condition in cases where learners are unable to name the particular person(s), thing(s) or action(s):
The neutral instruction condition is achieved through the meaning-focused task. The disruption of the neutral instruction condition through the engagement of explicit learning processes is avoided by abstaining from correcting incorrect morphological forms.
The salient condition is achieved by the isolated visual depiction of the person(s), thing(s) or action(s) in conjunction with an orally highlighted presentation of the word in focus in the context of a sentence following the N (P) V serial word order sequence

**LEARNING PHASE 3:**
As learning phase 1, however, the same input is presented using a different range of sentences (task)

**LEARNING PHASE 4:**
Implicit learning phase
**Learner group:**
Children or adults

**Input provider:**
NS (Teacher)

**Input and grammatical focus:**
Syntactic categories of words: Selected nouns and verbs

**Task:**
Select particular pictures from a pool of pictures and place them in order, matching a range of sentences (one at a time) following the N(P) V N(P) serial word order sequence presented orally

**General task design qualities:**
As learning phase 1

**Alignment between the interactant variables (IV) and the task design variables (TDV):**
As learning phase 1

**Subsequent alignment with the organisation variables (OV):**
As learning phase 1

**Operating conditions of the implicit learning phase:**
Processable, comprehensible, form-focused input is presented in the combined neutral instruction-salient condition:
The neutral instruction condition is achieved through the meaning-focused task.
The salient condition is achieved either by depicting all pictures representing nouns in a particular colour different to the colour of the pictures representing all lexical verbs or by explicitly teaching learners (adults only) during a prior explicit learning phase explaining what nouns and verbs are and how they can be used to express conceptual information
LEARNING PHASE 5:
Practice phase consisting of two phases:
 Phase 1:
 As learning phase 4
 Phase 2:
 As learning phase 5

Learner group:
Children or adults

Input provider:
NS (Teacher)

Input and grammatical focus:
 Phase 1:
 As learning phase 4
 Phase 2:
 Mapping conceptual structures onto syntactic categories, using serial word order, but only in case of learners’ inability to solve a particular mapping task.

Tasks:
 Phase 1:
 As learning phase 4
 Phase 2:
 Express in German information given in a particular conceptual structure in English, using N(P) V N(P) serial word order

General task design qualities:
 Phase 1:
 As learning phase 4
 Phase 2:
 Interactant relationship:
 NS (Teacher) holds the information in case of inability of NNS to map the given information in a particular conceptual structure onto syntactic categories and
the information flow occurs from NS (Teacher) to NNS

Interaction requirement:
Phase 1:
As learning phase 4
Phase 2:
NS (Teacher) requests information and NNS are encouraged to signal inability to solve a particular mapping task. However, NS (Teacher) is required to supply information in cases of inability to solve a particular mapping task. However, in order to avoid the disruption of the neutral instruction condition through the engagement of explicit learning processes as well as to avoid the generation of a dual-task condition, NS (Teacher) does not supply information in cases NNS provide incorrect mappings.

Goal orientation:
Convergent goal

Outcome options:
Only one outcome possible

Alignment between the interactant variables (IV) and the task design variables (TDV):
Phase 1:
As learning phase 4
Phase 2:
As learning phase 1 except for:
Task-elicitation potential:
The potential is high since the task builds on already acquired meaning-based word knowledge and knowledge of words’ syntactic categories

Subsequent alignment with the organisation variables (OV):
As learning phase 1
Operating conditions of the implicit learning phase:
Phase 1:
As learning phase 4
Phase 2:
Processable, comprehensible, form-focused input is presented in the combined neutral instruction-salient condition in cases where learners are unable to solve particular mapping tasks:
The neutral instruction condition is achieved through the meaning-focused task. The disruption of the neutral instruction condition through the engagement of explicit learning processes is avoided by abstaining from correcting incorrect mappings. The salient condition in regard to the different syntactic categories and meanings of the words involved is achieved by the use of pictures depicting particular persons, things or actions accompanying the oral presentation of the particular mapping by the NS (Teacher), whereby pictures representing nouns are depicted in a particular colour different to the colour of the pictures representing lexical verbs.

LEARNING PHASE 6:
As learning phase 4, however the same input is provided using a different range of sentences (task).

8. CONCLUSION
The above investigation of the sequential acquisition process of the different types of knowledge constituting the processing resources underlying grammatical encoding for speech production and the nature of their respective acquisition processes demonstrates that general learning mechanisms can account for the attainment of linguistic competence.
The key to these learning mechanisms is, firstly, the investigation of the nature of the knowledge underlying grammatical encoding in the context of the Processability Theory, and, secondly, the investigation of the nature of its acquisition process.
This investigation highlights the interdependence between the nature of
the knowledge to be acquired and the nature of the acquisition process. It confirms Gregg’s (1996) claim that there is a strong link between the knowledge constituting linguistic competence and the learning mechanisms by demonstrating that the knowledge underlying grammatical encoding is predominantly implicit and, consequently, determines the implicit nature of its acquisition process. Such implicit knowledge is dissociated from explicit knowledge, which determines the explicit nature of its acquisition process. This investigation also demonstrates that explicit grammar teaching and practice in the context of the manipulation of the learners’ attentional orientation mediated by alertness may contribute to the implicit learning process under certain conditions.

Taken together, these results provide an understanding of the nature of the types of knowledge that constitute the processing resources, which underlie grammatical encoding for speech production and the nature of their respective acquisition processes. These results also permit the evaluation of the theoretical concepts for instruction advanced as the ‘Interaction Hypothesis’, ‘Output Hypothesis’ and the concept(s) of ‘Focus on Form(s)’.

Apart from the independent finding in the context of the investigation of the ‘Input Hypothesis’ that comprehensible input is needed in order for second language acquisition to occur, the evaluation provides strong counterevidence in regard to the claims made by proponents of the ‘Output Hypothesis’ and the concept of ‘Focus on Forms’, rendering them untenable. Moreover, the investigation suggests that the unitary concepts of ‘Negotiation for Meaning’ (‘Interaction Hypothesis’) and the concept of ‘Focus on Form’ have to be revised in order to accommodate the dissociation between implicit and explicit learning processes.

Therefore, it becomes apparent that the concepts of ‘Negotiation for Meaning’ and ‘Focus on Form’, though in line with the above findings, once revised, only contribute to a comprehensive framework for the development and implementation of instructional measures to effectively organise the second language acquisition process.

Such a comprehensive framework is primarily constituted by the findings of the predominantly implicit nature of the knowledge to be acquired and, subsequently, the predominantly implicit nature of its acquisition process in conjunction with
Processability Theory and the finding concerning the need for comprehensible input in order for acquisition to occur, and permits the formulation of a set of instructional measures and measures in their support.

However, the exemplified implementation of these measures for the initial stages of the acquisition of German as a second language demonstrates that the effective organisation of the second language acquisition process is more than the sum of the formulated set of instructional measures. It is invariantly bound to the provision of processable input for learning that matches learners’ sequentially acquired processing procedures and that is comprehensible, but, at the same time, open to deliberate or inadvertent manipulations of the implicit learning conditions, the neutral instruction and salience of processable and comprehensible input for learning as well as the allocation of attentional resources without involving awareness.

Hence, since these conditions can be manipulated to varying degrees, the realisation of their full potential through deliberate manipulation is pivotal to the effectiveness of the second language acquisition process.

In order for the neutral instruction condition to operate during implicit learning phases, the simultaneous engagement of explicit learning processes has to be avoided under all circumstances, requiring that instructions given prior to the provision of processable and comprehensible input for learning are neutral in regard to the grammatical structures, rules and regularities to be detected as well as in regard to future testing or applications. The neutral instruction condition can be optimally established if the provision of input for learning occurs in a meaning-focused context.

In order for the condition of salience to operate during implicit learning phases, one has to realise that salience can be achieved by different means and may vary accordingly, but may also affect the neutral instruction condition. The condition of salience requires that the processable and comprehensible input provided for learning has a quality of transparency in regard to the grammatical structures, rules and regularities to be detected.

First, salience may be achieved by the provision of implicitly form-focused input for learning involving paralinguistic measures, such as visually and/or physically highlighting particular parts of the input, or linguistic means, such as
increasing the redundancy level of the input or parts thereof through repetition, or providing interactional modifications of particular parts of the input during negotiations for meaning. Such *a priori*-induced salience is in harmony with the neutral instruction condition.

Second, salience may be achieved as a result of transfer effects of explicit knowledge gained during prior learning phases, for instance, through the provision of explicitly form-focused input for learning, such as the explicit teaching of grammatical structures, rules and regularities, or during extended practice phases based on prior implicit learning phases. Such transfer-induced salience is only in harmony with the neutral instruction condition if sufficiently distanced from successive implicit learning phases in order to avoid the simultaneous engagement of explicit learning processes.

Hence, in order to realise the full potential of salience, given that learners are not developmentally constrained in regard to metalinguistic awareness, *a priori*-induced salience is best complemented by transfer-induced salience generated through explicit learning phases providing explicitly form-focused input as well as through extended practice phases, which have to be sufficiently distanced from successive implicit learning phases.

Furthermore, the realisation of the full potential of salience is closely linked to the attentional function of orientation mediated by the attentional function of alertness, which, preferably, is at a medium level in order to avoid overarousal and subsequent decrements in detection. Both, *a priori*-induced salience and transfer-induced salience orient the learners’ attention towards the structures, rules and regularities to be detected during implicit learning phases and, thus, facilitate their detection.

Such an allocation of attentional resources is only in harmony with the neutral instruction condition if the orientation of the learners’ attention mediated by a medium level of alertness occurs without awareness. The absence of awareness is crucial in order to avoid the concurrent engagement of explicit learning processes, that would, firstly, disrupt the neutral instruction condition and, secondly, would constitute a dual-task condition leading to a division of attention between implicit and explicit learning tasks, thus, negatively affecting implicit learning.

Hence, the realisation of the full potential of the attentional function of
orientation is dependent on the achievement of the highest degree of salience without disrupting the neutral instruction condition and without generating a dual-task condition through the engagement of explicit learning processes.

The above conclusions concerning the nature of the knowledge constituting linguistic competence and the nature of the learning mechanisms demonstrate the predominance of the implicit and the subordination of the explicit. In other words, the above conclusions suggest that, in order to effectively organise the sequential second language acquisition process, instructional measures to predominantly acquire implicit linguistic knowledge have to integrate explicit learning processes.

However, these explicit learning processes have to be sufficiently distanced from implicit learning processes.

Such an instructional concept, in its most general form, distinguishes clearly defined successions of implicit and explicit learning phases, which provide processable and comprehensible input for learning, with explicit learning phases subserving implicit learning phases by increasing the degree of salience, and, subsequently, by improving the attentional orientation of the learners without the disruption of the neutral instruction condition and without the generation of attention-dividing dual-task conditions.

NOTES

1 ZISA stands for ‘Zweitsprachenerwerb italienischer (portugiesischer) und spanischer Arbeiter’.

2 Clahsen (1984):
“As far as syntax is concerned, processing complexity results from reorderings and restructurings of various levels of underlying linguistic units. This observation is, for example, reflected in Slobin’s operating principle D, according to which the interruption of basic linguistic units is avoided in the early stages of L1 acquisition (cf. Slobin, 1973: 199f). The results of research on sentence comprehension and production (cf. Fodor,
Bever and Garrett, 1974: 344f.; Osgood and Bock, 1977: 131f.; Kempen, 1977: 262ff.) suggest that the language processing system prefers a canonical order of underlying linguistic material to the extent that deep structure relations can be mapped directly onto surface strings” (p.221).

“Neisser (1967:222) mentions several experimental studies indicating that memorization depends, among other factors, upon the position of the stimulus:
‘the serial position curve is U-Shaped. That is, the beginning and end of a string of digits are both better remembered than the middle; there are both ‘primacy’ and ‘recency’ effects’ (Neisser 1967:222).
From this it may be concluded that, in regard to sentence processing, the results of permutations which move constituents into first or final position are perceptually more salient and easier to memorize than sentence-internal permutations. Parts of this claim are further supported by Slobin’s (1973) results for L1 acquisition. Slobin claims that there is:
‘a general early tendency on the part of the child to attend to the ends of words when scanning linguistic input in a search for cues to meaning’ (Slobin 1973:191) (Claussen, 1984, p.222).
This explanation, reflecting Claussen’s (1984) position, seems to underly Pienemann, Johnston and Brindley’s (1988) predicted canonical word order since no new specifications for non-linguistic processing devices at this stage are being advanced.

GSL stands for German as a Second Language.

Levelt (1989):
“… procedural knowledge […] has the format IF X THEN Y. For instance:
IF the intention is to commit oneself to the truth of p, THEN assert p.
Here p is some proposition the speaker wants to express as being the case, and the indicated procedure is to build an assertion of that proposition (for
instance: ‘New York is beautiful’ and not ‘Is New York beautiful?’
D.P.H.).
The Conceptualizer and its message generator can be thought of as a
structured system of such condition/action pairs” (p.9-10).

7 Levelt (1989):
“There are, probably, additional properties stored with an item. It may
have particular pragmatic, stylistic, and affective features that make it fit
one context of discourse better than another […] Certain so-called
registers […] seem to select for lexical items with particular connotational
properties. Whether such features should be considered as conceptual
conditions on the item’s use is a matter of much dispute” (p.183).

8 However, not all lexical items are lexical entries. Inflected forms of a
word constitute lexical items of the same lexical entry, whereas
derivations of a word are separate lexical entries.

9 Levelt (1989) stresses the time-constrained nature of speaking:
“Speech is normally produced at a rate of about two to three words per
second. These words are selected at that rate from the many tens of
thousands of words in the mental lexicon […] Articulation runs at a speed
of about fifteen phonemes per second” (p.22) (see also Levelt, 1989,
p.199).

10 Levelt (1989) explains the highly controlled nature of the
‘Conceptualiser’s’ processing:
“Speakers do not have a small, fixed set of intentions that they have
learned to realize in speech. Communicative intentions can vary in infinite
ways, and for each of these ways the speaker will have to find new means
of expression. This requires much attention. And introspection supports
this. When we speak, we are aware of considering alternatives, of being
reminded of relevant information, of developing a train of thought, and so
forth. Message construction is controlled processing, and so is monitoring [...] The speaker can attend to his own internal or overt speech. The limit-capacity resource in conceptualizing and monitoring is Working Memory. The system allows only a few concepts or bits of internal speech to be highly active, i.e., available for processing (Miller 1956, Broadbent 1975; Anderson 1983)” (p.21).

Levelt (1989) defines automatic processes in contrast to processes that are under executive control demanding attentional resources by referring to Flores d’Arcais (1987), La Berge and Samuels (1974), Posner and Snyder (1975), Schneider, Dumais and Shiffrin (1984), Schneider and Shiffrin (1977) and Shiffrin and Schneider (1977):

“Automatic processes are executed without intention or conscious awareness. They also run on their own resources, i.e., they do not share processing capacity with other processes. Also, automatic processing is usually quick, even reflex-like [...] it is hard to alter automatic processes. Since automatic processes do not share resources, they can run in parallel without mutual interference” (p.20-21).

Levelt (1989) concludes in regard to the automatic nature of formulating and articulatory procedures:

“Formulating and articulating are ‘underground processes’ (Seuren 1978) that are probably largely inpenetrable to executive control even when one wishes otherwise” (p.22).

A lexical entry’s ‘basic metrical pattern’ is to be distinguished from “…contextually determined metrical properties of the word” that “are generated by […] the Prosody Generator” (Levelt, 1989, p.323).

Levelt (1989) explains:

“Words participate in the overall metrical structure of the utterance; they are grouped in smaller or larger rhythmic phrases. This phrasal togetherness is realized by the manipulation of the loudness, the duration, and the pitch of successive syllables in the utterance, and by the insertion of pauses” (p.364).
Levëlt (1989):
“A syllable’s main constituents are ‘onset’ and ‘rime’. Each syllable has a
rime. The rime begins with the syllable peak […] A rime is naturally
partitioned into a ‘nucleus’ and a ‘coda’. The nucleus contains the peak
slot(s), the coda the remaining […] slot(s). The syllable ‘art’ has /a/ as
nucleus and /rt/ as coda.
The onset of a syllable is the string of C’s (consonants or ‘low-sonorous
segments of the syllable’, D.P.H.) preceding the peak. In ‘meter’, /m/ and
/t/ are syllable onsets” (p.293).

Levëlt (1989):
“The phonetic plan for a syllable specifies the articulatory gesture to be
executed by the Articulator. It can be characterized as a sequence of
phones” (p.326-27).

Pienemann (1998a), referring to the established differences between the
developmental sequences of German as a first and second language (cf.
Clahsen, 1982b; Clahsen, 1984; Clahsen, Meisel and Pienemann, 1983;
Mills, 1985; Pienemann, 1981), demonstrates that both sequences, though
different, can be accounted for by Processability Theory if one considers
the differing initial word order hypotheses in first language acquisition
(SOV) and second language acquisition (SVO).
That is, Pienemann (1998a) demonstrates that, once syntactical and
morphological phenomena of the first language acquisition process are
characterised within Lexical-Functional Grammar, the analysis of the
necessary transfer of grammatical information between constituents as a
prerequisite for the production of these phenomena can be related to the
hierarchy of processing procedures.
The occurrence of differing initial hypotheses in bilingual acquisition
processes of young children is, however, dependent on the particular
bilingual development.
In contrast to Meisel’s (1989) finding of ‘balanced’ bilinguals acquiring each of the two languages (French and German) like monolingual children, Schlyter (1993) finds that children’s stronger language (French or Swedish) develops according to the L1 sequence, whereas children’s weaker language develops according to the L2 sequence.

Kempen and Hoenkamp (1987) distinguish two kinds of procedures – ‘categorial procedures’ (CPROCs) and ‘functional procedures’ (FPROCs).

Concerning ‘functional procedures’, they state: “FPROCs take care of the grammatical (functional) relations between such structures (built by categorial procedures, D.P.H.) (e.g. subject, object, modifier)” (p.211).

Kempen and Hoenkamp (1987) “…propose the term ‘functorization’ to denote the process of inserting functors” (p.218), whereby functors entail function words, such as articles, prepositions, auxiliaries, etc., i.e. morphemes with word status as well as inflectional morphemes.

Subsequently, Pienemann (1998a) highlights the language-specificity of ‘Functorisation Rules’: “…Functorisation Rules instigate the activation of free and bound grammatical morphemes […] these are language-specific and therefore have to be acquired with the L2” (p.75-76).

Levelt (1989):

“In other languages, such as French and Dutch, DET will have to inspect the gender and number parameters of the NP-head and insert their values in the list of diacritic parameters of the article lemma […] In German and various other languages, the functional procedure DET also needs case information, since the word form of the article depends on the grammatical function of the NP by which it was called” (p.238), based on ‘Appointment Rules’.
Levelt (1989) explains that there are categorial procedures for building
different phrases: noun phrase (NP), verb phrase (VP), adjectival phrase
(AP) and prepositional phrase (PP) (see p.238).

Levelt (1989) points out that the assignment of the functional destination
‘subject of S’ would make available the value for the diacritic parameter
case ‘nominative’, “…which is then available for the procedures DET and
N when their lemmas require diacritic case values” (p.240), as, for
instance, in the case of German.

Levelt (1989):
“When there is a mood marker [...] this will lead to a diacritic feature on
the verb. Such a mood-marked verb calls the appropriate categorial
procedure for imperative or interrogative word order” (p.240).

Pienemann (1998a) consistently uses the term ‘processing procedures’
instead of the term ‘processing resources’ used in another recent
publication by him (Pienemann, 1998b).
I prefer to use both terms, whereby the term ‘processing procedures’ is
used in reference to the procedures making up the hierarchy of processing
procedures proposed by Pienemann (1998a) and the term ‘processing
resources’ is used in reference to the knowledge underlying the processing
procedures.

It is in this context that the grammatical functions of a lexical entry in the
mental lexicon becomes productive, as demonstrated by Levelt (1989) in
his description of the process generating the surface structure ‘the child
gave the mother the cat’.
Once the verb phrase (VP) ‘gave’ is established, it has accepted its
grammatical functions SUBJ (subj), DO (direct object), IO (indirect
object) ordered according to their assignment to conceptual arguments
SUBJ (agent), DO (theme) and IO (goal). Since the relationship to the
SUB (agent) (‘the child’) is already fixed, “…VP calls the functional
procedures direct object (DO) and indirect object (IO) to inspect the
message [...] This is done in order to find the ‘theme’ and the ‘goal’,
respectively, as required by the head verb.” Then “the lemma for ‘give’
d dictates the ‘theme’ to map onto a direct-object complement, and the
‘goal’ onto an indirect-object complement.
The functional procedures DO and IO [...] identify CAT and MOTHER
(respectively) in the message” (Levelt, 1989, p.242).

Kempen and Hoenkamp (1987, p.220) and Levelt (1989, p.239) point out
that all ‘categorial procedures’ have ‘holders’ with ‘slots’ to deposit
values returned from subprocedures called.

Kempen and Hoenkamp (1987) describe the ‘holders’ as follows:
“A procedure, we assume, creates a data structure, called ‘holder’,
containing a sequence of numbered positions P1, P2,...Pn. Each of these
slots can serve as a receptacle for subtrees delivered by a subprocedure”
(p.220).

Pienemann (1998a) makes recourse to the same general cognitive
principle as Clahsen (1984) who defines the ‘Initialisation/Finalisation
Strategy (IFS) in reference to research on perception and memorisation

It is not quite clear to me, whether Pienemann (1998a) considers the
mental lexicon of the bilingual speaker to be a single storage system or to
consist of two separate storage systems. On the one hand, Pienemann
(1998a, p.74) seems to agree with de Bot’s (1992) proposal of a unitary
bilingual lexicon, but on the other hand, he strongly argues for a language-
specific lexicon: “Sooner or later a language-specific structure has to be
created for the L2 lexicon” (Pienemann, 1998a, p.83).

Pienemann (1998a) obviously assumes that Levelt’s (1989) ‘Speech
Comprehension System’ can also account for written input.
A strong argument, advanced by de Bot, Paribakht and Wesche (1997), suggests that Levelt’s (1989, 1993) model can be adapted to account for oral and written input into the comprehension system, thus, supporting the validity of Pienemann’s (1998a) reaction time experiment.

Pienemann (1998a) defines emergence as follows:
“...emergence can be understood as the point in time at which certain skills have, in principle, been attained or at which certain operations can, in principle, be carried out. From a descriptive viewpoint one can say that this is the beginning of an acquisition process” (p.138).


Apart from the explication below, the aspect of variation is not pursued further, since the focus of the thesis is on the provision of appropriate input under conditions matching the nature of the knowledge to be acquired and the nature of its acquisition process in order to effectively organise the sequential second language acquisition process.

Clahsen, Meisel and Pienemann (1983) and Pienemann (1981) adduce evidence that the omission of such constituents does not mean that they have not been acquired yet, since they are not omitted at all times.
Pienemann (1984) provides data for one of the learners - Giovanni – only.

Pienemann (1984) reports:
“First, we know from several longitudinal studies (cf. Clahsen, 1981; Pienemann, 1981) that the acquisition of INVERSION is a protracted process in which it takes months before the relative frequency of rule application develops from figures around 0.2 to 0.7. With Giovanni this process has taken only several days” (p.197)

“Second, in natural acquisition INVERSION is usually not simultaneously acquired for all possible structural contexts (which are: preposed adverb/adverbial, preposed object-NP, wh-questions, yes/no-questions, preposed subordinate clause). Giovanni, however, immediately applies the rule to four out of five possible structural contexts” (p.197)

“And finally, there is a third learner in our study who learned INVERSION in a similar manner as Giovanni. It would be a fairly improbable coincidence if this exceptional natural learning process should have taken place in two individuals and just at the very point in time immediately after the crucial experiment was conducted” (p.197-98).

Larsen-Freeman and Long (1991), referring to Pienemann's (1984) 'Teachability Hypothesis', provide some evidence as to ineffectual instruction due to a choice of instructional items that were beyond the learners' level of development:

"The learnability/teachability hypotheses provide a potential post hoc explanation for the results of several other studies which have shown either no effect or no lasting effect for instruction in particular structures" (p.308). For instance "Schuman's efforts to raise Alberto's performance of ESL negation directly from stage 1, No V ('No like hamburger'), to stage 4, analysed don't ('He doesn't like hamburgers') through intensive practice in the target forms had no effect on Alberto's spontaneous speech, although brief improvements were obtained during the drills themselves (Schumann, 1978; Adamson and Kovac; 1981). Similarly, Ellis (1984b)
found no improvement in the spontaneously produced WH-questions of thirteen children following three hours of instruction in both the meaning of WH-pronouns (what, where, when and who) and inversion in WH-questions. The children's spontaneous speech prior to this part of Ellis's study showed that they were beginning to use uninverted WH-questions (of any kind) when instruction was provided"(p.308).

In Westmoreland’s (1983) cross-sectional study reported by Pienemann (1986), six of the eight learners acquired the word order rules in sequence from Stage X to Stage X+4. Two learners’ sequential acquisition was inconclusive. However, Pienemann (1986) argues:
“Nevertheless, the findings as reported are not without weight. If the stages for the acquisition of word order rules for natural and formal acquisition were different, we would expect there to be gaps in Westmoreland’s implicational scale – that is to say, cases of zero rule application for a non-zero number of obligatory context characterizing a developmental stage through which the learner should have already passed. Yet there is not a single gap of this kind!” (p.18).

NS stands for Native Speaker(s) and NNS stands for Non-Native Speaker(s).

Doughty (1991) refers to previous research by Pica, Doughty and Young (1986) and Pica, Young and Doughty (1987) that “…has pointed to the importance to comprehension of redundancy in the form of exact and semantic repetitions” (p.462) and elaborates on the present study:
“In the present study, only the MOG instructional treatment incorporated lexical and semantic rephrasings” and “only the MOG group was provided with instruction involving isolated semantic repetition via the dictionary assistance. Additionally, only the MOG group viewed integrated semantic rephrasing via the reformulations of the original sentences in the explanation portion of the instruction. Thus, the findings of the present
study support and reinforce earlier evidence that redundancy is important to comprehension” (p.462).

Ellis (1995a) refers to Ellis, Tanaka and Yamazaki’s (1994) study involving the same subjects and other subjects.

Swain (1985) raises the issue of comprehensible input provision in the Canadian immersion programmes:
“One might question, then, whether the immersion students have, in fact, been receiving comprehensible target language input. The evidence that they have, however, seems compelling” (p.246). Swain (1985) adduces the following evidence:
“The evidence comes from their performance on tests of subject matter achievement [...] In virtually all the comparisons, the French immersion students have obtained achievement scores equivalent to those obtained by students in the regular English program (Swain and Lapkin 1982). Furthermore, on tests of listening comprehension in French, the immersion students perform as well as native speakers of French by grade 6 (Swain, Lapkin, and Andrew 1981). This strongly suggests that the immersion students understood what they were being taught, that they focused on meaning. Yet, as we have seen, after 7 years of this comprehensible input, the target system has not been fully acquired” (p.246).

Long (1996) asserts that
“…there is clear evidence of an indirect causal relationship between conversation and acquisition, as proposed by Long (1983d)” (p.449).

Swain (1985) elaborates on the limitations in comprehensible output in the Canadian immersion programmes:
“First, the students are simply not given - especially in later grades - adequate opportunities to use the target language in the classroom context. Second, they are not being ‘pushed’ in their output. That is to say, the
immersion students have developed, in the early grades, strategies for getting their meaning across which are adequate for the situation they find themselves in: they are understood by their teachers and peers. There appears to be little social or cognitive pressure to produce language that reflects more appropriately or precisely their intended meaning: there is no push to be more comprehensible than they already are. That is, there is no push for them to analyse further the grammar of the target language because their current output appears to succeed in conveying their intended message. In other words, although the immersion students do receive comprehensible input, they no longer receive much negative input” (p.249).

Swain and Lapkin (1995) highlight the importance of the processes of output production for any modification toward the target language variety to occur:

“The ‘output hypothesis’ (stripped to its bare bones) is that even without implicit or explicit feedback provided from an interlocutor about the learners’ output, learners may still, on occasion, notice a gap in their own knowledge when they encounter a problem in trying to produce the L2” (p.373).

To ‘notice a gap’ is a term coined by Schmidt and Frota (1986), which means “…the comparison of nontarget forms produced by the learner with target forms that appear in input” (Schmidt and Frota, 1986, p.311). To ‘notice a gap’, thus, involves awareness.

Schmidt (1990), advancing his ‘Noticing Hypothesis’, claims that “…noticing is the necessary and sufficient condition for converting input to intake” (p.129). He defines ‘intake’ as “…the processes involved in converting speech input into stored data that can be used for the construction of language” (p.139).

Swain and Lapkin (1995) do not define the term ‘consolidating’. Hence, I take the term ‘consolidating’ existing grammatical knowledge to mean
increased accuracy through monitoring of one’s own production (cf. Levelt, 1983, 1989).

Concerning the sequential acquisition process, Ellis (1993) refers to Pienemann (1985b).

Levelt (1989) concedes:
“There may be marginal forms of executive control, however. They are evidenced, for instance, in the fact that a speaker can abruptly stop speaking when he detects an error (Levelt, 1983). The sentence or the phrase is then typically not completed. One can stop a word in the middle of its articulation, even ignoring syllable boundaries. It is apparently possible to send an executive ‘halt’ signal to the individual processing components. Maybe similar signals can be sent to control other global aspects of processing, such as speaking rate, loudness, and articulatory precision” (p.22).

Pienemann (1998a), seemingly shares Paradis’ (1994) view that “…at least some aspects of the lexicon would seem to be mainly within the purview of declarative memory” (Paradis, 1994, p.398), but does not advance any particular view regarding explicit, declarative and implicit, nondeclarative knowledge components of the lexicon.

Of the word form knowledge essential for the phonological encoding process, only the morphological word form knowledge is considered, since it constitutes an essential processing resource for the grammatical encoding process, which involves syntax and morphology.

Squire (1986), for instance, considers “…episodic memory (specific time-and-place events) as well as semantic memory (facts and general information gathered in the course of specific experiences)” (p.1614) (cf. Tulving, 1983, 1985a) as part of declarative memory.
Mayes (1988) points out in his glossary of terms that explicit and declarative memory “…can be indicated directly either through a verbal statement or through non-verbal means, such as pointing. In other words, explicit memory is indicated by recall and recognition” (p.273).

Squire (1992), for instance, considers “…skillful behavior or habits (perceptuo-motor, perceptual, and cognitive skills), simple conditioning (including emotional learning), the phenomenon of priming” (p.210) as instances of nondeclarative memory.

Repetition and direct priming are subsumed under the term priming to be used henceforth. Roediger and McDermott (1993) distinguish repetition priming and direct priming as follows:

Repetition priming occurs when “…both the stimulus presented and the response required during the study phase are equivalent to the stimulus” (p.66).

Direct priming refers “…to the more typical case in which the same type of item is presented at study and test, although the exact form changes (e.g., study a word and then later complete its fragmented form)” (p.66).

Roediger and McDermott (1993) point out:

“…priming experiments involve at least two phases. In the first phase, subjects are exposed to material (usually words or pictures); often, subjects are asked to perform some orienting task as they examine the material.

Following this first phase, subjects may be given various filler tasks before being given the critical task, the implicit memory test, which is presented as just another task the subject is to complete; no instruction is given for subjects to recollect or to remember information from the prior phase to aid in performing the current task” (p.66).

Knowlton and Squire (1995) differentiate between ‘remembering’ (R) and ‘knowing’ (K) as two experiences related to recall and recognition.
respectively (cf. Tulving 1985b, 1989, 1993), whereby recall involves episodic memory and recognition involves semantic memory, both being forms of declarative memory.

However, Knowlton and Squire (1995), reporting on the results of their study, investigating ‘remembering’ and ‘knowing’ of previously presented words in recognition tests involving normal subjects (Experiment 3), point out that the two may not be independent, since “…some items that initially elicited an R response later elicited a K response. By this account, the process underlying R responses is ‘redundant’ with the process underlying K responses. That is, recollection of an item as part of an episode necessarily implies the availability of semantic knowledge that the item itself was previously presented” (Knowlton and Squire, 1995, p.708).

As will be discussed below, morphological priming across modalities is possible (cf. Fowler, Napps and Feldman, 1985).

Roediger and McDermott (1993) suggest that word form overlaps between and L1 and L2 may produce intact priming:
“If words in the two languages are morphologically similar, then cross-language priming will occur” (p.81).

An earlier development study of picture completion by Parkin (1989), involving children aged three, five and seven as well as adults, indicates similar results. Parkin (1989) reports:
“These data indicate that implicit memory can function effectively at a point where explicit memory does not. Furthermore, the data indicate that explicit memory performance improves with age. What is less clear is whether the implicit function also shows age-related development. The raw savings scores show absolute differences in baseline performance but, when savings are calculated in proportional terms, there is no age trend at all with all groups showing savings of around 40% at one hour and 36% at two weeks” (p.235-36).
Feldman (1994) points out that the experiments with Serbian subjects avoid potential problems with English subjects when comparing the facilitation of lexical decisions with inflectional and derivational primes: “In English, inflectional formations tend to be more similar in form and meaning than are derivational formations” and “…the number of inflectional affixes, for English is severely limited relative to the number of derivational affixes” (p.445).

Rueckl, Mikolinski, Raveh, Miner and Mars (1997) highlight: “…whereas repetition priming has played an important role in the study of both memory and word recognition, investigations of morphological priming have been linked almost exclusively to the latter. As a result, the study of morphological priming has not benefited much from recent developments in the memory literature, including, in particular, the emphasis on gathering converging evidence across a variety of tasks to elucidate the nature of the processes that underlie priming effects” (p.386).

‘Formally related’ means orthographically or phonologically related. Since this investigation occurs in the visual domain, the focus is on orthographically related words.

Feldman (1994), distinguishing between inflectional and derivational primes and systematically controlling orthographical and phonological overlap between inflectional and derivational primes and their targets, reports (Experiment 3) equivalent priming in the repeated condition and in the morphologically related condition (inflectional primes): “…identical repetition and inflectional primes both produced significant and equivalent facilitation. Matched derivational primes produced significantly reduced facilitation relative to the inflectional condition and significant facilitation relative to the no prime condition” (p.455-56). Hence, Feldman (1994) concludes that “…morphemic structure is more transparent for inflectional than for derivational formations” (p.442).
This conclusion does not apply to the priming of new associations. Bowers and Schacter (1993) summarise pertinent research:

“...in contrast to priming effects with familiar words, which are generally insensitive to levels of processing manipulations (cf. Bowers and Schacter, 1990; Graf and Mandler, 1984; Jacoby and Dallas, 1981), priming of new associations tends to be observed only following some degree of elaborative study processing (Graf and Schacter, 1985; Schacter and Graf 1986; but see Micco and Masson, 1991)” (p.316).

Bowers and Schacter (1993) conclude that “…it is possible that the initial acquisition or setting up of novel associations depends on an episodic or declarative memory system” (p.318).

ERP’s permit precise measurements of the exact time course in which localised brain areas become active (cf. Posner and McCandliss, 1993).


Schacter (1987) explains conceptually driven processes and data-driven processes as follows:

“Conceptually driven processes reflect subject-initiated activities such as elaborating, organizing, and reconstructing; data-driven processes are initiated and guided by the information or data that is presented in test materials. Although both explicit and implicit tests can have data-driven and conceptually driven components, it is argued that explicit memory tests typically draw primarily on conceptually driven processes, whereas implicit tests typically draw primarily on data-driven processes” (p.511).

Based on the overall evidence on priming of familiar words and novel meaningless words (nonwords), it seems plausible to assume that if nonwords with particular meanings assigned to them or novel real words would/could be used in priming studies and levels of processing would be
manipulated in the study tasks, similar effects on implicit and explicit memory tests could be expected.

Unfortunately, to the best of my knowledge, no studies using nonwords with meanings assigned to them and manipulating the depth of processing during study investigated LOP effects on both implicit and explicit memory tests. There is, however, a study by Rueckl and Olds (1993) (Experiment 1), using nonwords with meanings assigned to them, that provides evidence for a lack of LOP effects on an implicit memory task (perceptual identification task).

Rueckl and Olds (1993), manipulating the depth of processing, provide two study-task conditions, the nonelaborative condition involving the naming aloud of each presented pronounceable nonword (‘pseudoword’) and the elaborative condition involving the generation of a meaning for each presented nonword. One presentation in each study condition produced a larger priming effect in the nonelaborative condition compared to the elaborative condition.

That does not preclude form-based knowledge acquired to become explicit, in particular, in the context of the acquisition of literacy skills.

N. Ellis’ (1994b) review entails:
“(i) incidental vocabulary learning, (ii) the associations between vocabulary and academic intelligence, (iii) priming studies of implicit memory, and (iv) neuropsychological evidence from human global amnesia” (p.11-12).

However, the conclusions drawn in regard to the implicitness or explicitness of learning are solely based on (iii) and (iv).

Braine (1987) explains ‘distributional approach’ as follows:
“The distributional approach [...] emphasizes the privileges of occurrence of the words of the class, e.g., they occur in particular positions in phrases or sentences, are marked in particular morphophonemic way, or co-occur (agree) with particular morphemes. Thus, in the distributional approach,
the common property shared by the words of a class is distributional, not semantic, and it would be this property that children discover in acquiring word classes (e.g., Maratsos and Chalkley, 1980)” (p.65).

The above terminology is the result of findings from recent studies investigating the dissociation between implicit, nondeclarative and explicit, declarative memory, leading to more fine-grained distinctions in the domain of implicit memory (cf. Schacter and Tulving, 1994; Squire, 1994), thus, going beyond the initially used collective term ‘procedural memory’ for implicit memory. As Squire (1994) points out:

“Nondeclarative memory includes information that is acquired during skill learning (motor skills, perceptual skills, and cognitive skills), habit formation, simple classical conditioning (including some emotional learning), priming, and other knowledge expressed through performance rather than recollection” (p.205).

Hence, in the context of the argument explicated below, based on the evidence in support of the implicit nature of memory holding the knowledge acquired during skill learning, the interspersed use of the term procedural memory is synonymous with the term implicit, nondeclarative memory and the term procedural knowledge is synonymous with the term implicit, nondeclarative knowledge.

Patients with anterograde amnesia have “…very poor recall and recognition (explicit memory) […] of recently presented information” (Mayes, 1988, p.271).

Willingham, Nissen and Bullemer (1989) distinguish groups of subjects ‘with no explicit knowledge’, ‘with some explicit knowledge’ and ‘with full explicit knowledge’ as follows:

“Those with no explicit knowledge (n=19) included 12 subjects who said they had not noticed a sequence and 7 subjects who said they had but were unable to indicate more than three consecutive positions in it. Those with some explicit knowledge (n=29) included subjects who said that they had
noticed a sequence and successfully identified between four and nine consecutive positions. Those with full explicit knowledge (n=12) said they had noticed a sequence and specified all of it” (p.1049).

Willingham, Nissen and Bullemer (1989) refer to the instructions given: “Subjects were also told that we were more concerned with which response was made than with the speed of responses in this task” (p.1049).

Willingham, Nissen and Bullemer (1989) refer to Luce’s (1986) findings: “Simple visual reaction times average between 185 and 200ms, with a variance typically under 10ms (Luce, 1986)” (p.1050).

Willingham, Nissen and Bullemer (1989) point out that the generate task has such a quality: “...subjects were required to predict the next asterisk position. Thus subjects could demonstrate explicit knowledge of the sequence acquired during the preceding reaction time task, and because there was feedback about accuracy in this task (the next asterisk appeared only when its correct position was predicted, subjects could gain explicit knowledge of the sequence during this task” (P.1050-51).

This obviously implies that the reaction time task where subjects have “…to respond as fast as possible without making errors” (Willingham et al., 1989, p.1048) without receiving feedback, does not typically engage explicit knowledge, although it does not prevent the acquisition of such knowledge.

Willingham, Nissen and Bullemer (1989) report on the results from the first block of trials: “Results from the first block are of most interest because they reflect subjects’ knowledge of the sequence after training on the reaction time task but before the feedback that was intrinsic to the generate task provided new opportunities to learn the sequence” (p.1051).
Reber (1976) restates the instruction as follows:
“This is a simple memory experiment. You will see items made up of the letters PSTVX. They will run from three to eight letters in length and will be shown to you in groups of three items each. After seeing each set of three items I will give you a card and your task will be to try to reproduce all three items. I will tell you which ones you reproduced correctly. After you have reproduced all three correctly two times in a row we will go on to a new set of three items” (p.89).

Knowlton, Ramus and Squire (1992) describe the instructions given as follows:
“... we asked subjects to judge whether the new items were similar to, or reminded them of, the items they had just been shown. Subjects were instructed to say ‘yes’ if an item seemed familiar or if it reminded them of one that they had seen, and they were instructed to say ‘no’ if the item was unfamiliar or if it did not remind them of an item that they had just seen” (p.175).

Knowlton, Ramus and Squire (1992) report on the recognition task:
“Although the amnesic patients did score significantly above chance [...] this level of retention is consistent with previous findings for amnesic study patients that recognition tests provide a very sensitive method for detecting residual memory, especially when the retention interval is short (Hirst, Johnson, Phelps and Volpe, 1988; Mayes, Meudell and Neary, 1980; Musen and Squire, 1991; Schacter et al. 1991)” (p.176).

Knowlton and Squire (1994) point out that these lower scores compared to the scores obtained in the study by Knowlton, Ramus and Squire – 63.2% correct classifications by amnesic patients and 66.9% correct classifications by normal control subjects – may be “…due to the different grammars and letter sets used in two studies” (p.83).
The poorer classification performance in the different letter set condition may already reflect a further decreased performance level, at least for the normal control subjects, due to a lack of feedback given during classification performance.

This conclusion can be drawn from Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan’s (1989) results (Experiment 3 in conjunction with Experiment 1 and Experiment 2).

Mathews et al. (1989) report that, although the classification performance of all (normal) subjects in the different letter set condition is at above-chance level, their performance is markedly poorer than subjects’ performance in the previous experiments of their study since, contrary to Experiment 1 and Experiment 2, no feedback is given in Experiment 3 during the first 70 trials of classification performance in the different letter set condition. Moreover, the introduction of feedback after the 70th trial for another 30 trials does not lead to any improvement in the classification performance. Hence, Mathews et al. (1989) draw the following plausible conclusions:

“The results of Experiment 3 indicate that feedback during transfer is necessary for effective transfer to a new letter set” (p.1097).

“Additionally, the lack of improvement in performance in the final three blocks of trials in Experiment 3 when feedback was given, suggests that transfer trials without feedback […] might strengthen inappropriate rules that become resistant to extinction when feedback is introduced” (p.1097).

The slightly lower performance level of the amnesic patients compared to the normal subjects in both conditions may have been due to the experimental design. Knowlton and Squire (1996) discuss this point:

“One possibility is that the performance of the amnesic patients was adversely affected by interference from their earlier experience with the artificial grammars (in Experiment 2 and also in the first two sessions of Experiment 3). Interference could have occurred because some of the
same letters appeared in Grammars A and B (which were used in Experiment 2 and in the final two sessions of Experiment 3) and in Grammars C and D (which were used in the first two sessions of Experiment 3). In addition, the possibility for interference in the amnesic patient group was greater than in the control group. For the amnesic patients in Experiment 3, the interval between the first two sessions and the final two sessions (M=1.4 months) was shorter than for the controls (10.2 months). Also, the controls in Experiment 3 did not participate in Experiment 2 and would not be susceptible to interference; whereas the amnesic patients in Experiment 3 had participated in Experiment 2 2.5 months earlier. The possibility of interference seems a real one because individuals have been shown to retain grammatical knowledge for as long as 2 years (Allen and Reber, 1980)” (p.178).

Since I am not aware of any further studies that could provide new findings in regard to constraints on the transfer of exemplar-specific knowledge, this aspect will not be investigated further, but will be considered in the context of the demonstration of the generalisability of several findings derived from the studies under investigation here to the acquisition of artificial and natural languages as second languages.

‘Neutral’ means that subjects are indirectly encouraged during the presentation of stimuli not to engage in explicit learning, such as formulating and testing hypotheses, through instructions to memorise the letter strings presented, without mentioning the rule-governed nature of these strings.

Because of its widespread use in many artificial grammar learning studies, this task is referred to as ‘standard classification task’. Sometimes, however, latencies of subjects’ grammaticality judgements are recorded.
In addition to the ‘standard classification task’ described above, “Subjects were encouraged to give reasons for their responses whenever they could” (Reber and Lewis, 1977, p.338).

In view of Berry and Broadbent’s (1984) results, showing that concurrent verbalisations do not significantly affect task performance, but that practice does, one can safely assume that the exceptionally high performance level of subjects in Reber and Lewis’ (1977) study is due to practice effects, only, as pointed out by Reber and Lewis (1977).

Reber and Lewis (1977) describe what these essays entail:
“After the completion of the discrimination test, subjects were given a sheet of paper and asked to introspect and write freely about the experiment. They were requested to try to provide as much details as possible about, (a) what they knew of the rules for letter order, (b) what they thought they were doing, specifically the rules they were using whether or not they were sure that they corresponded to the actual ones, and, (c) any other mnemonics, strategies [...] they used” (p.338).

Since I am not aware of any further studies that could provide new findings pertaining the effects of ungrammatical input during the study task on classification performance, this aspect will not be investigated further, but will be considered in the context of the demonstration of the generalisability of several findings derived from the studies under investigation here to the acquisition of artificial and natural languages as second languages.

Mathews, Buss, Stanley, Blanchard-Fields, Cho and Druhan (1989) report: “Yoked subjects were given transcripts from an experimental subject to use in selecting their choices. They were given an exact, unedited transcript of the experimental subject’s instructions corresponding to each block of trials” (p.1087).

Dienes, Broadbent and Berry (1991):
“Rules were statements that could be used to either assign grammatical or nongrammatical status to an exemplar” (p.879).

Dienes, Broadbent and Berry (1991) describe the free-report test as follows:
“...subjects were asked to indicate how they decided whether an item followed the rules, any strategies they used, and any rules that they thought the [...] items followed, even if they were not confident as to the correctness of the rules. Subjects were also asked to indicate any specific exemplars they could recall. Subjects were urged to be as complete as possible” (p.877).

Reber, Kassin, Lewis and Cantor (1980) employ two formats of displays differing in the degree of salience of the pattern underlying the letter strings presented. They distinguish a ‘high-salience format’ and a ‘low-salience format’. The latter is a random display of the letter strings and the former is a structured display, that is, letter strings are arranged in columns, each representing one underlying pattern.

Berry and Broadbent (1988) elaborate on the saliency of the response characteristics:
“In the person control task, for example, both the subject and the computer person choose their responses from a fixed set of 12 adjectives ranging in intimacy from ‘very rude’ to ‘loving’ [...] For the ‘salient person’ [...] the critical input behaviour is the subject’s immediately preceding response. For the ‘non-salient person’ [...] the critical input behaviour is not the subject’s immediately preceding response, but the response on the trial before” (p.255).

Turner and Fischler (1993) do not elaborate on this rather intriguing piece of evidence for a lack of synergistic performance effects and, subsequently, do not consider it in their conclusions.
A predominant engagement of either an implicit or explicit learning mode does not totally exclude the activation of both learning modes in a particular instructional set or saliency condition, as demonstrated, for instance, by Mathews et al. (1989) and Reber and Lewis (1977).

These conclusions concerning the engagement of implicit and explicit learning modes and the acquisition of respective knowledge bases concur with Turner and Fischler’s (1993) conclusions, although Turner and Fischler focus on the data from paired comparisons and, thus, neglect the supportive evidence provided by the data from the combined conditions – instructional set and saliency of presentation of stimuli – under long and short response deadlines. Furthermore, Turner and Fischler (1993) do not elaborate on the nexus between the nonsalient presentation condition and the explicit learning mode.

Mathews, Buss, Stanley, Blanchard-Fields, Cho, Druhan (1989) describe the two tasks as follows:

The implicit task, a “...match task, is a short-term memory task. On each trial subjects are presented with a single string (a valid string from the grammar) that they are to hold in memory for a few seconds until five choices appear on the screen. Then they select the identical string from the choices and press the number of that choice on the keyboard. In this condition subjects do not know the items are generated by a grammar during training, and there is no incentive for explicit abstraction of similarities among the items. In fact, thinking about similarities among the items across trials would be likely to interfere with the task of matching the correct string that was presented on a given trial” (p.1092-93).

“In the explicit [...] task, the edit task, subjects were exposed to the same set of items used in the match task. However, these items were presented initially in altered form, having one to four letters changed to create invalid strings. Subjects were told that the items they would see were ‘flawed’ strings generated by a grammar. Their task was to figure out the rules of the grammar so that they could learn to identify and mark the
incorrect letters in each string. On each trial the subject marked one to four letters in the displayed string that he or she thought were incorrect. Then the correct string was displayed as feedback. Thus, the edit task requires continuous generation and testing of possible rules for letters occurring in various positions in the strings” (p.1093).

The term ‘salient condition’ entails the notion of a variable quality of transparency of the rule system underlying a complex system, such as an artificial grammar, a production or a social system.

The design of the learning task to control a complex production system following Berry and Broadbent (1984) does not distinguish a learning from a testing phase, but rather subjects learn to control the system through performance on the control task. Their performance is measured in intervals. However, this performance on the control task does not imply that implicit and explicit learning processes occur concurrently (see chapter 4.2.3).

Squire and Frambach (1990) determine the chance-level value to be at 20%.

Squire and Frambach (1990) use Berry and Broadbent’s (1984) calculated chance level of 3.4 trials out of 30 trials correct.

Delays do not invalidate the concept of successive learning phases, as concluded from Squire and Frambach’s (1990) findings, in that the transfer of explicit knowledge to the second learning phase occurring after 27 days still accounts for an above-chance control performance. This is also demonstrated by Allen and Reber (1980) who test the same subjects from a previous study (cf. Reber and Allen, 1978) after two years on a classification task and find subjects’ implicit knowledge underlying their classification performance still being at an above-chance level, though significantly lower.
Based on Turner and Fischler’s (1993) findings and the conclusions drawn from their results, one cannot deny that data from Reber et al’s (1980) study may have been contaminated due to a lack of control in regard to response time, as has already been pointed out above. Thus, comparisons of data are limited to the E-I- experimental group and the I-control group, which, regardless of possible effects in regard to response time limitations, reveal the effect of explicit training.

Performance values are “…the proportions of test items whose grammatical status has been correctly assigned on the ‘wellformedness’ task (Reber et al. 1980, p.495).

Performance levels are expressed as a percentage of correct classifications.

This distinct difference is larger than in Turner and Fischler’s (1993) Experiment 1 and may be due to the longer response deadline – 10 seconds in Experiment 3 compared to 6 seconds in Experiment 1.

Green and Hecht (1992) obviously expected even a lower percentage since native speakers are not necessarily taught the grammar of their native language. However, Green and Hecht (1992) point out: “The metalinguistic awareness of the English pupils may, of course, have profited from their experience of foreign language learning” (p.177).

De Graaff (1997) distinguishes two simple and two complex rules, whereby complexity is defined “…as the number of grammatical concepts that have to be taken into account for correctly processing or producing the specific structure” (p.255-56).

De Graaff (1997) explains:
“Participants were instructed to carry out this task as quickly as possible. This direction appeared on the screen for every item” (p.259).

The differential treatment in regard to time pressure is motivated by De Graaff’s assumption that “Under time pressure, on the other hand, explicit knowledge is less accessible, and participants will rely more on implicit knowledge” (p.254).

This task contains 30 items identical to the grammaticality judgement task operating under time pressure and 15 new items.

De Graaff (1997) reports that the delayed posttest was administered 5 weeks after the immediate posttest.

The difference is maximally in the vicinity of 0.05. However, when considering Graaff’s (1997) reported performance scores for each of the four structures to be acquired, the differences in both groups between the two response time conditions vary from structure to structure from 0.0 to 1.3, with the largest difference of 1.3 in the “explicit” group, concerning the morphological/simple rule, and the second largest difference of 0.7 in the “implicit” group, concerning the same morphological rule, thus, revealing that explicit knowledge may have contributed to the performance in the ‘no time pressure’ condition. Nevertheless, the overall consistency of all the other scores in both response time conditions does support the conclusions drawn below that the knowledge materially underlying the respective performance of each group is implicit knowledge.

DeKeyser (1995) defines these terms as follows:

“Explicit learning occurs with concurrent awareness of what is being learned” (p.380).

“Implicit learning occurs without concurrent awareness of what is being learned” (p. 380).
Inductive learning means that examples are encountered before rules are inferred; deductive learning means that rules are presented before examples are encountered. Whereas induction can be either implicit or explicit [...] deductive learning is necessarily explicit” (p.380).

DeKeyser (1995), referring to retrospective data obtained from structured interviews with subjects, comments on the effect of the ‘implicit-inductive’ group’s (which I consider to be an ‘explicit-inductive’ group) effort to figure out the grammatical rules underlying the sentences presented on the implicit character of their learning:

“...the implicit/explicit distinction was sometimes overridden by their learning strategies. Difficulties in making subjects stick to the implicit and explicit strategies by means of instructional set have also been reported by Reber (personal communication, May 1993)” (p.398).

DeKeyser’s (1995) concludes:

“In all likelihood, the difference between the two treatment groups would have been even larger if the subjects’ strategies had been more in line with the intended treatments” (p.398).

However, this conclusion is speculative and without substance in the light of the evidence I have adduced above in regard to the superiority of implicit knowledge when performing under limited response time, compared to explicit knowledge.

If one considers the longest sentence from Appendix C (DeKeyser, 1995, p.406) with 27 letters, even with modest typing skills, two letters can be typed per second, which would mean that the 27 characters can be typed in about 4 seconds. After allocating a few seconds for looking at the picture, one can plausibly assume that the response time available is at least 10 seconds.

This conclusion is in line with DeKeyser’s (1995) view:

“... the task (the production task, D.P.H.) was to some extent speeded (30 seconds/sentence is not as long as it sounds when one has to come up with a sentence in Implexan and type it in). Therefore, the production task in
this study can probably be characterized as somewhat more toward the monitored end of the monitored/nonmonitored continuum” (p.399).

The relatively lower score (33.3) from the final production test compared to the score (49.46) from the final grammaticality judgement test may be due to subjects’ extended rule search effort in the less constrained response time condition of the production test, consuming valuable time in their futile effort to discover the rules, as revealed by the subjective, retrospective reports referred to by DeKeyser (1995):

“... a majority of I-I (Implicit Inductive, which I now consider to be Explicit-Inductive, D.P.H.) subjects suspected the existence of grammar rules underlying the sentences they were presented with, and most of them had tried to figure them out, even though apparently with little success” (p.398).

Doughty (1991) states:

“...all subjects were instructed to read the material for the purpose of understanding as much of the information in the text as possible, were encouraged to use all resources presented to them on the screen to aid in their comprehension, and were notified in advance that they would be expected to answer questions and write a recall summary later on in the session” (p.447-48).

In the context of Knowlton and Squire’s (1996) findings, such implicit knowledge is abstract knowledge in that it permits, for instance, in case of artificial grammar learning, classification performance at an above-chance level of new letter strings generated by the same artificial grammar as the exemplars presented during the learning phase, or even of new letter strings, based on a new letter set, again, generated by the same artificial grammar.

However, in the latter case, lower performance levels, though still above chance, are to be expected since the transfer of exemplar-specific, implicit
knowledge that may have been acquired cannot occur (cf. Knowlton and Squire, 1996).

118 Pienemann (1998a) gives gender marking in Italian or German as an example:
“...gender marking does not occur in the presence of other phrasal morphemes even though gender marking itself also constitutes phrasal morphemes. The reason for this is that for gender marking to occur the corresponding diacritic feature has to be acquired for all nouns, and this is filtered through complex form-function relationships” (p.251).

119 The ‘rule search-salient’ condition is only observed in studies investigating the learning of complex rule-governed structures. It is assumed that the finding of the acquisition of implicit and explicit knowledge during learning phases operating in the rule search-salient condition generalises to the acquisition of artificial and natural languages as second languages since all other combinations of operating conditions do.

120 Pica, Kanagy and Falodun (1993) point out that information gap tasks’ one-way flow of information, due to the fact that only one interactant holds the information required to successfully complete the task, limits “…mutual opportunities for working toward comprehension, feedback, and interlanguage modification [...] since the task assigns each interactant a fixed role” (p. 21) as either a supplier or a requester of information. Pica et al. (1993) suggest a change of task design that would give the information gap task the same qualities as a jigsaw task concerning the two-way flow of information, i.e. interactants are both supplier and requester of information:
“...were interactants asked to complete two parts of an information gap task, alternating roles as information suppliers and requesters, this would give them opportunities to exchange information in two directions as their roles reversed” (p.22).
Piaget’s (1970) 'Intuitive Period', the later substage of the 'Pre-operational Stage' (from age 4 to age 7), can be described as that phase of cognitive development where the "...child is still dependent on what it sees" (Singer and Revenson, 1978, p.32); "...the child's thinking is called 'intuitive' because his understanding of objects and events is still largely based, or 'centered', on their single most salient perceptual feature – the way things appear to be – rather than on logical or rational thought processes" (Shaffer, 1993, p.251).

The 'Concrete Operational Stage' (from age 7 to age 11) can be described as that phase of cognitive development where "...children are rapidly acquiring cognitive operations and applying these important new skills when thinking about objects, situations, and events that they have seen, heard, or otherwise experienced", whereby “...a cognitive operation is an internal mental scheme that enables the child to modify and reorganize her images and symbols to reach a logical conclusion (Flavell, 1985)". (Shaffer, 1993, p.256). In short, "... children at this stage can apply their operational schemes only to objects, situations, and events that are real or imaginable" (Shaffer, 1993, p.256).

The 'Formal Operational Stage' (from age 11, 12 and beyond) can be described as that phase of cognitive development where children perform formal operations, that is, "...mental actions performed on ideas and propositions. No longer is thinking tied to the factual or observable, for formal operators can reason quite logically about hypothetical processes and events that may have no basis in reality" (Shaffer, 1993, p.260).

Scarino, Vale, McKay and Clark (1988), based on Billows (1961) cited in Mohan (1986), propose four conceptual spheres as a framework for a principled provision of learning experiences that synchronises language learning and content learning, the latter constrained by the learners' respective 'conceptual range' (sphere). Scarino et al. (1988) describe the four spheres as follows:
"Sphere 1 The first and innermost sphere represents what learners can see,
hear and touch directly. In practice, this is the classroom situation. Here, words are merely an accompaniment of action.

Sphere 2 The second sphere represents what the learners know from their own experience, their daily life, what they have seen and heard directly but cannot see or hear at the moment. This can be brought to mind by the use of words together with the classroom situation. Examples of themes and topics within this sphere include self, family and friends, home, school, free time, holidays, and pets.

Sphere 3 The third sphere represents what the learners have not yet experienced directly, but what they can call to mind with an effort of the imagination, with the help of pictures, dramatisation, charts and plans. Examples of themes and topics within this sphere include literature, events of general interest, and topics related to other subject areas.

Sphere 4 The fourth sphere represents what is brought into learners' minds through the spoken, written, or printed word alone. Examples of themes and topics within this sphere include social issues, environmental issues, jobs and careers, comparisons between Australia and the target country, relationships with others, and current events" (Book 2, p.8).

Scarino et al.’s (1988) proposal seems psychologically plausible, since the four spheres correspond to Piaget’s (1970) ‘Preoperational Stage’ (‘Intuitive Period’) (Sphere 1), ‘Concrete Operational Stage’ (Spheres 2 and 3) and ‘Formal Operational Stage’ (Sphere 4).

Shaffer's (1993) overview of the stages of social perspective taking, adapted from Selman (1976), can be summarised as follows:

Stage 0: "Egocentric or undifferentiated perspective (roughly 3 to 6 years)
Children are unaware of any perspective other than their own" (p.462).

Stage 1: "Social-informational role taking (roughly 6 to 8 years)
Children now recognize that people can have perspectives that differ from their own but believe that this happens ‘only’ because these individuals have received different
Stage 2: "Self-reflective role taking (roughly 8 to 10 years)
Children now know that their own and others' points of view may conflict even if they have received the same information. However, the child cannot consider his (sic) own perspective and that of another person at the same time" (p.462).

Stage 3: “Mutual role taking (roughly 10 to12 years)
The child can now simultaneously consider her (sic) own and another person's points of view and recognize that the other person can do the same" (p.462).

Stage 4: "Social and conventional system role taking (roughly 12 to 15 years and older)
The young adolescent now attempts to understand another person's perspective by comparing it with that of the social system in which he (sic) operates" (p.462).

Shaffer (1993) discusses Gurucharri and Selman’s (1982) findings:
"Apparently these role-taking skills represent a true developmental sequence, for 40 of 41 boys who were repeatedly tested over a five-year period showed a steady forward progression from stage to stage with no skipping of stages (Gurucharri and Selman, 1982). Perhaps the reason why these stages develop in one particular order is that they are closely related to Piaget's invariant sequence of cognitive stages (Keating and Clark, 1980) [...] As we see [...] preoperational children are at Selman's first or second level of role taking (stage 0 or 1), whereas most concrete operators are at the third or fourth level (stage 2 or 3) and many formal operators have reached the fifth and final level of role taking (stage 4)" (p.462-63).

Daehler and Bukatko (1985) report on studies by Krauss and Glucksberg (1969) and Mueller (1972):
“R. H. Krauss and S. Glucksberg (1969) asked 4- and 5-year-olds to describe a series of abstract geometric forms printed on wooden blocks to
another child seated behind a barrier [...] A speaker had to provide enough information so that a listener could duplicate an array. The children in this study often relied on personal, self-based descriptions of these stimuli (e.g., ‘It looks like Daddy’s shirt’); hence, the listener was usually unable to identify the described figure” (p.351-52).

On the other hand,

“E. Mueller (1972) [...] observed pairs of 4-year-olds as they interacted in a playroom. He found that 62 percent of the verbalizations made by children resulted in an adequate response from the listener, indicating that subjects who spoke knew what the listener needed to hear in order to understand the communication” (p.352).

Shaffer (1985) reports on Bridgeman’s (1981) study, involving fifthgraders developing their social perspective taking through peer interaction:

“Students in a cooperative interdependence condition were divided into six-person study groups. Each person in each group was assigned various lessons that he or she was required to learn and then teach to the other group members. Since each student had access only to his or her own materials, the members of each group were clearly dependent on one another. Indeed, the tutors had to be good listeners and recognize what their pupils didn’t understand and would need to know (a form of perspective taking) in order for the group members to learn all the material for which they were ultimately responsible. Students assigned to the control condition were required to learn exactly the same material, which was taught in the classroom by their teachers. When tested before the experiment, students in the control condition were found to be comparable in role-taking abilities to their counterparts in cooperative interdependence groups. But by the end of the eight-week experiment, children in the cooperative learning groups had typically become better role takers while those in the control condition had not” (p.481-82).
Tomlin and Villa (1994) comment on Posner’s (1978) findings, reported by Posner and Petersen (1990) in footnote 6:

“Perhaps this gives an explanation to why optimal performance occurs at medium levels of arousal and degrades at higher levels: that is, this type of result suggests that if a person is already in a state of alertness (e.g. eyes fixated at center of screen, under instructions to respond as quickly as possible in identifying vowel etc.), and alertness is further increased (e.g. tones, visual cues), then accuracy will drop off perhaps because not all information pertinent to making the decision has been fully processed at the time of response” (p.199).

Eysenck (1984) discusses Easterbrook’s (1959) hypothesis:

“Easterbrook’s hypothesis has been tested by using a paradigm in which a main or primary task and a secondary or incidental task are performed concurrently. The general expectation is that high arousal will have a relatively greater adverse effect on the subsidiary task than on the primary task, because the reduced range of cue utilisation excludes cues from the subsidiary task before those from the primary task. In other words, Easterbrook’s hypothesis assumes that there is a reallocation of attention from less important to more important sources of information as arousal increases’ (p.333).

Posner (1993) reports on findings by Robbins and Everitt (1987) involving studies with rats having lesions that affect the modulation of the attentional function of orientation by the attentional function of alertness/arousal that clearly support Easterbrook’s (1959) hypothesis of “…attentional narrowing under high arousal” (Eysenck, 1982, p.49).

Intake is the implicit acquisition of knowledge underlying the hierarchy of processing procedures, consisting of procedural knowledge of the grammatical processor and/or the knowledge constituting the processing resources of the mental lexicon, manifested in the sequential acquisition of grammatical structures of the target language.
Doughty and Pica (1986) report on the results based on the use of a task requiring the exchange of information:

“In the teacher-fronted situation, there was an increase of 14% in the area of unmodified interaction, as compared with a decrease of 5% in the utterances which contained features of modification. In the group situation, however, there was a substantial increase in the amount of modification – 122% – and a decrease of 13% in the amount of unmodified interaction” (p.320-21).

Pica and Doughty (1988):

“While the amount of total speech increased in both participation patterns when information exchange was required, there were differences in the type of interaction which accounted for the increase. In the teacher-fronted situation, the entire increase in speech was in the area of unmodified interaction [...] In striking contrast, all of the additional speech generated by the requirement for information exchange was in the form of modified interaction. In fact, there was a real decrease in the amount of conversational interaction which was unmodified and this portion of the total speech was, in a sense, ‘replaced’ by the more desirable modified interaction” (p.52-53).

Pica (1991) concludes:

“As so many studies of input comprehension have shown, and as the present results suggest, repetition and rewording of input are keys to its comprehensibility. Negotiation moves seem to be a vehicle or trigger for redundancy, rather than, in themselves, comprehension facilitators” (p.448).

If reference is made to native speakers that are not teachers, explicit indications are made in the text.

Furthermore, no distinctions are made between native speakers, and near-native speakers (non-native speakers with near-native linguistic skills),
since studies investigating different group makeups do not make, to the best of my knowledge, such distinctions. This does not imply that NS (Teacher) cannot be a near-native non-native speakers.

Pica (1994), referring to evidence provided by Pica, Holliday, Lewis and Morgenthaler (1989) and Pica, Holliday, Lewis, Berducci and Newman (1991), highlights the nexus between ‘meaning negotiation’ and 'input for learning' provided by native speakers to non-native speakers:

"For each task, the data reveal numerous opportunities for learners to attend to L2 form in their negotiations with the NSs. For example, when the learners signaled difficulty in understanding the NSs, the NSs often repeated and reformulated their original utterance for the learners. Similarly, when the NSs signaled that they could not understand the learners, the latter often gave these signals back as L2 reformulations of their own interlanguage utterances. Opportunities for the learners to attend to their own interlanguage form were also abundant: for example, when portions of their interlanguage utterances were repeated back to them in the NSs' signals. Such opportunities also arose when the learners signaled the NSs and responded to them, particularly with signals that provided interlanguage versions of the NS utterances and with responses that modified their own original productions" (p.509-10).

Nuboyoshi and Ellis’ (1993) explanation of the poor performance of the third member of the experimental group, as possibly being due to a ‘functional’ learner orientation compared to a ‘structural’ learner orientation of the other two members of the experimental group, is not satisfying since one can plausibly assume that this beginning learners’ interlanguage has not yet reached a plateau. It seems much more likely to me that the lack of a comparable improvement reflected in successful modifications of the initial output is either due to a deficit of form knowledge underlying the speech production process or due to a lack of encoding into the conceptual preverbal message the event information ‘past’.
Van den Branden (1997) distinguishes between the three kinds of negotiation, defining them as follows:

“1. Negotiation of meaning: side-sequences to the main flow of conversation aimed at signalling and solving problems of message comprehensibility [...]”

2. Negotiation of form: side-sequences to the main flow of conversation aimed at drawing the Describer’s attention to formal aspects of the description, and encouraging ‘self-repair’ [...]”

3. Negotiation of content: stretches of interaction aimed at pushing the Describer to provide more information than spontaneously offered in the description” (p.604-05).

Display questions are ‘Yes/No questions’ compared to referential ‘Wh questions’.

Musumeci (1996):
“The data for all three teachers show that immediately before conceding the floor to small group or individual tasks, the teachers follow a set routine: they ask students if they have any question; they pause and scan the room; and when no questions are forthcoming, they again remind the students to ask if they have any questions. Since no questions are asked until the students have settled into their groups or have begun their individual assignments” (p.318).

There are, however, other variables that can be a source of arousal, such as feedback on task performance, competition and task unfamiliarity, mentioned above, that are not considered in the analysis below, but should be accounted for within the overall task design.

Since the instructional measures to be elaborated on are in line with the focus of this thesis on acquiring the knowledge to grammatically encode conceptual information in order to be able to speak spontaneously in the
target language, the aspect of growth of meaning potential will not be considered in any detail.

Nattinger and De Carrico (1992) define lexical phrases as: "…lexico-grammatical units that occupy a position somewhere between the traditional poles of lexicon and syntax: they are similar to lexicon in being treated as units, yet most of them consist of more than one word, and many of them can, at the same time, be derived from the regular rules of syntax, just like other sentences" (p.36).

Nattinger and De Carrico (1992) make "…an attempt to group lexical phrases according to function in a way that will reflect the requirements of spoken and written language and, at the same time, be pedagogically useful" (p.59). They distinguish three categories: social interactions, necessary topics and discourse devices:

"Under social interactions we list lexical phrases that are markers describing social relations. Necessary topics are those topics about which learners will be asked, or ones they will need to talk about frequently. The third group discourse devices are types of lexical phrases that connect the meaning and structure of the discourse" (p.60).

As a result of the above analysis of the variables affecting meaning negotiations, it was concluded that after matching task difficulty with participant qualities, a low level of linguistic skills is the only variable that constrains the group makeup, with the NS (Teacher)/NNS the only option reasonably available. That is, as pointed out in the same context above, one has to consider that in order to avoid prolonged interactions that are fraught with an excessive amount of breakdowns in communication, bearing the risk of frequent occurrences of non-repair of such breakdowns, beginning learners should not negotiate meaning with other beginning learners until such time that their linguistic skill level allows them to do so. Hence, one can assume that at least at the first and second stage of development negotiation of meaning predominantly occurs and develops within the group makeup NS(Teacher)/NNS.
It is strongly recommended that input provided by teachers is non-deviant input. Since learners in any group or class are to be expected to be at different stages of the development of the grammatical processor, due to an individual rate of progression through the stages, or due to learners entering the course at a later point in time, or entering the course with a different degree of experience, learners would be confused by the fact that a (deviant) structure introduced by a teacher is correct for one learner (at a lower stage of development) and incorrect for another learner (at a higher stage of development). It also contradicts the general perception of teachers by learners as authorities who always model what has to be learnt in the best possible, correct way.

Helbig and Buscha (1993) formulate the rules for marking nouns for plural without article as follows:

“1. Der Nullartikel steht im Plural, wenn im Singular der unbestimmte Artikel steht [...]  
2. Der Nullartikel steht zur Bezeichnung einer Klasse im Plural” (p.377).

An example for the former rule is: 
Die Frau liebt Kinder 
An example for the latter rule is: 
Autos sind Fahrzeuge 

LARSP was developed for the assessment of speech impairment.

Pienemann and Johnston (1986) conclude:  
"From the perspective of the teaching of English as a second language, testing procedures like those of Crystal and Clahsen have a serious defect, which is that they require a detailed linguistic analysis of the given speech sample. This means that the teacher would have to transcribe the elicited speech sample and to analyze it according to a fixed and detailed procedure" (p.106-107). 

Pienemann and Mackey (1993) point out that the original procedure
(Crystal, Fletcher and Garman, 1976) took between 20 to 40 hours per subject.

Pienemann and Johnston (1986) describe their approach:
"...we were concerned about the number of structures we could reasonably expect a typical rater to pay attention to" (p.110).
Therefore, "...on the observation form a selection of those features which are actually available for each stage and each path of acquisition will appear. This can be theoretically justified, since we can show that all items at one given stage require the same degree of processing complexity and that consequently a learner can – in principle – produce all these items" (p.107).

Pienemann, Johnston and Brindley (1988) discuss the test results concerning the inclusion of optional structures on the observation forms:
"... some of the structures that were included on the observation forms as evidence for a particular stage of acquisition are infrequent in the data. […] the use of infrequent structures […] as indicators for stages of acquisition is a particular problem if these structures are optional in the target language, because this excludes negative evidence as an additional source of information" (p.239).
Hence, they conclude:
"...the most infrequent optional structures will be replaced by obligatory structures" (p.240).

Mackey, Pienemann and Thornton (1991) briefly describe 'Rapid Profile':
'Rapid Profile' "...involves spontaneous speech data, which, however, is not a free conversation, and does not need to be transcribed. Instead, the learner participates in communicative tasks which trigger the production of grammatical structures which are crucial to determining the student's developmental stage. These structures are recorded by the analyst by clicking in boxes on the computer screen. The tester does not need to analyse these data, only to listen to them and record them. […] the sample
is analysed 'on-line', i.e. while the learner speaks [...] using a computer program containing an expert system which is able to objectively interpret the observations entered into the program in terms of developmental level: the program can provide such interpretations as feedback to the analyst while the assessment is carried out. This allows the analyst to adjust the selection of elicitation tasks to the current state of the assessment. Different tasks were designed by LARC (Language Acquisition Research Centre, University of Sydney, D.P.H.) to elicit structures indicative of different developmental stages" (p.62).

Mackey et al. (1991) propose to ideally have two people being involved in the assessment procedure, an 'analyst' observing and recording data as well as a 'facilitator' administering the task and eliciting the data:
"These features – backed by a thorough training – condense the procedure to approximately (15–20 minutes, D.P.H.) per informant" (p.62).

151 Mackey, Pienemann and Thornton (1991) describe the ‘Rap Pro Trainer’ as follows:
The training instrument "Rap Pro Trainer [...] uses the same observation interface as the actual Rapid Profile procedure" and is complemented by a CD "…containing high quality recordings of learner speech. Rap Pro Trainer is able to control the CD and can identify every single grammatical structure in the learner data which is relevant to the Rapid Profile observation procedure. This ability is the basis for a wide range of interactive training modes from which the Rap Pro trainee can choose." Rap Pro Trainer "…evaluates the training session and can pinpoint areas which need further attention" (p.63).

152 Nicholas, Moore, Clyne and Pauwels (1993) provide data based on the National Survey of Language Learning in Australian Schools 1988 that indicate:
"…it is only in some systems in South Australia and Victoria that the majority of students in primary school language programs receive more than one hour per week of language instruction" (p.176).
The NSW Department of Education's (1989) Community Language Program Guidelines stipulate:
"The minimum time allocation for Community Language Programs [...] is 2 hours per week per student/group" (p.1).
Concerning the 'group structure' the same guidelines stipulate:
"Schools [...] are able to form a maximum of 10 classes" (p.2) and the class size can range from 15 to 30 students.

The Board of Studies NSW (1995b) points out:
"In school LOTE (Languages Other Than English, D.P.H.) learning, a range of entry and exit points for students is possible" (p.53).
The Curriculum Corporation (1994a) states:
"It is also desirable that students should be able to enter LOTE study at various points in their schooling. Students transferring to schools which do not offer the language they have been learning will need to be able to begin the study of others" (p.5).

The Board of Studies NSW (1995b) stipulates:
"Learners will bring a range of prior LOTE experiences to the classroom. This linguistic diversity of learners needs to be acknowledged and provided for in the organisation of LOTE programs" (p.8) and the Curriculum Corporation (1994a) considers:
"There is great diversity within these groups (LOTE learners, D.P.H.) and also a degree of overlap among them. All years of schooling will have learners from any or all of the groups (ranging from 'little or no experience' to 'a strong background in the language', D.P.H.). Systems, schools and teachers will thus need to provide for the needs of individual students" (p.3).

Fernandez, Pauwels and Clyne (1993) report on a draft survey of NSW independent schools in which German is taught as a second language from Kindergarten to Year 6.
Program Guidelines suggests group structures, consisting of students ranging from Kindergarten to Year 6.

Simpson and Cavenagh (1992) of the NSW Teachers Federation describe the situation concerning class sizes in NSW:
"The New South Wales Teachers Federation adopted the 30 maximum policy in 1938, arguing at the time that children in smaller classes would benefit by more individualised attention and a more caring atmosphere. That a half century later a class size of 30 could still be seen as average is indicative of the degree to which the staffing of our schools is wildly out of date" (p.3).

Mackey (1994) mentions that “The tasks used for 'Rapid Profile' have been tested with groups of both adult and child learners of English as a Second Language (ESL)” (p.4), but no indication is given as to the age of the children tested.

Pienemann and Mackey's (1993) study of children's ESL development and Rapid Profile reports the successful use of 'Rapid Profile' tasks with children age 8 to 10, however, the social-cognitive development of very young learners at the beginning of the primary school years imposes further constraints on the suitability of ‘Rapid Profile’ since it is using communicative tasks to generate spontaneous speech for assessment.

Pienemann (1998a) introduces a kind of response deadline that forces learners to perform the task under time pressure:
“The task of the subject was to judge if two sentences that appeared on a computer screen with a short time interval (360 msec.) were identical or not. A computer program was used for the purpose of managing this experiment” (p.224)
“The program recorded the subject’s response time to each of the test items starting from the moment at which the second item first appeared on the screen. If no response was given within 5 seconds [...] a warning was given” (p. 224).
Ellis, Tanaka and Yamazaki (1994) report two studies involving Japanese high school students acquiring English word meanings. Both studies investigate the effects of three different input conditions, unmodified input, premodified input and interactionally modified input, on the acquisition of vocabulary.

Interactionally, modified input is the same as premodified input, but differs from premodified and unmodified input in that learners receiving the former kind of input are permitted to negotiate meaning with the teacher and are encouraged to use a number of formulaic phrases written on the board requesting clarification.

Premodified input differs from unmodified input in that the redundancy of words in focus is increased.

Ellis (1995a) report one study involving Japanese high school students acquiring English word meanings. This study only considers the effects of interactionally modified input and premodified input on the acquisition of vocabulary. The differences between the two kinds of input are the same as in the above mentioned study by Ellis, Tanaka and Yamazaki (1994).

The acquisition of implicit phonological word form knowledge will not be considered here, since the focus of the thesis is on syntactical and morphological development.

However, the acquisition of the phonological specifications of words, entailing their sequences of syllables, follows the same principles of implicit learning as morphological word form knowledge.

Posner and Rothbart (1992) exemplify the process of orienting attention in regard to visual stimuli:

“When one attends to a location in visual space, not only is information at that location increased in processing efficiency, but information at other
locations is reduced over what it would be if attention had not been paid to the selected location (Posner and Presti, 1987)” (p. 93).

As has been pointed out above, based on the learners’ low level of linguistic skills, one can assume that, at least at the first and second stage of development, negotiation for meaning predominantly occurs and develops within the group makeup NS (Teacher) / NNS.

If learners are unable to name the particular person(s), thing(s) or action(s) shown as a picture, one can assume that the respective words have not been entered into the mental lexicon. Hence, the input serves to enter the respective words’ meanings as well as their morphological forms into the mental lexicon.

The supply of incorrect morphological forms by NNS provides feedback to the NS (Teacher) for the planning of follow-up phases of learning, but is not corrected by the NS (Teacher) during a predominantly implicit learning phase. Corrections are only made during separate explicit training phases.

If learners are unable to map the given information in a particular conceptual structure onto syntactic categories, one can assume that all or some of the respective words have not been entered into the mental lexicon or the categories of all or some of the respective words have not been entered into the mental lexicon. Hence, the input serves to enter the meanings as well as the categories of the respective words.
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