Methodological Problems in UG/LM-accessibility Research
in Second Language Acquisition

by

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Abstract

Methodological Problems in UG/LM-accessibility
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The thesis discusses metatheoretical and methodological problems in second language (L2) acquisition research on the issue of UG-accessibility.

It is argued that claims made by some proponents of the position that UG constrains L2 acquisition are unfalsifiable, due to the lack of a clear formulation of UG constraints or the associated learning mechanism (LM), from which specific predictions on L2 are made, and the appeal to general cognitive learning measures for the explanation of data not conforming to the UG/LM predictions. Some claims also lack appropriate motivation for an appeal to UG/LM in the explanation of L2 acquisition.

While most researchers have investigated whether L2 learners' interlanguage conforms to UG predictions, this approach, in principle, cannot provide evidence against UG-accessibility, if alleged UG violations at a given stage in the interlanguage development are dismissed on the basis

that the theory of UG specifies the properties of the steady state of natural language grammar and not the properties of intermediate stages of development. The thesis proposes an alternative approach to test whether adult L2 learners' hypotheses about L2 structure are in fact constrained by UG, by investigating the acquisition of an artificial language that is designed to violate the Empty Category Principle, one of the UG constraints that have been tested in L2 acquisition research on UG-accessibility. It is argued that if L2 learners successfully learn ECP violations through exposure to the primary linguistic data of the artificial language, it will constitute evidence against UG-accessibility in L2 acquisition.

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0. Introduction

In recent years, the question of whether second language (L2) acquisition is constrained by Universal Grammar (UG) has been a major concern in the study of L2 acquisition. A considerable number of empirical studies has been conducted with respect to whether L2 learners' performance respects the predictions made by UG constraints, in order to provide evidence for or against the claim, and different conclusions have been reached by different researchers on this issue.

There have been discussions on the validity of the research methods that those researchers used and suggestions with respect to the possible sources of non-conclusive or contradictory research results. While those questions on the details of empirical studies are important in evaluating claims made by different researchers, I find a necessity for carefully examining the claims from an *a priori* perspective before scrutinizing the details of empirical studies. The issues are a) whether the construct of UG was applied in a meaningful way in explaining L2 acquisition, b) whether the research questions were formulated in a testable way at the onset of research, and c) whether the conclusions were made on the basis of data gained through empirical studies.

In the following discussion, I will review the validity of the UG-based explanation of L2 acquisition from an *a priori* perspective, and propose an approach that is different from the one that has been pursued by researchers with respect to UG-accessibility in L2 acquisition.

The thesis is organized as follows. In Chapter 1, I will present my assumptions on the nature and the methodological requirements of empirical science in general and of the L2 acquisition research as an empirical science. In Chapter 2, I will review the role of the innate learning mechanism (LM) in the test of UG-accessibility claims, and argue for the necessity of learnability considerations for making UG-based predictions on L2 acquisition. In Chapter 3, I will review the motivation for appealing to the construct of UG in the explanation of L2 acquisition, and discuss certain problems of UG-accessibility claims in L2 research. In Chapter 4, I will discuss the conditions that must be met in order for L2 data to be evidence for or against UG-accessibility claims, and present motivations for using an artificial language for testing UG-accessibility. In Chapter 5, I will present the framework of the proposed study. In Chapter 6, I will discuss different formulations of the tested UG constraint, the Empty Category Principle, and present the hypothesis tested in the proposed study, which is based on one of the reviewed formulations. In Chapter 7, I will review preceding studies on wh-movement in L2 acquisition. In Chapter 8, I will review preceding L2 acquisition studies that used an artificial language. In Chapter 9, I will discuss the motivation for and the problems with 3 different measures of L2 performance, and present justification of my selection of L2 measures in the proposed study. In Chapter 10, I will present the design of the proposed study. In Chapter 11, I will summarize my arguments and conclusions.

1. Metatheory

Evaluation of claims made in empirical science requires a commitment to a particular metatheory of empirical science. While there could not be any single metatheory that all scientists would agree upon, one must assume a particular position in his approach to theory construction. In this chapter, I will present the metatheory that I assume in the evaluation of claims made by researchers with respect to the accessibility of Universal Grammar and the learning mechanism in L2 acquisition.

1.1. Falsifiability

I assume that the inquiry into the accessibility of innate language acquisition mechanism (or Universal Grammar + learning mechanism (UG/LM)) in L2 acquisition is one of empirical science; i.e., the UG/LM-accessibility claim must satisfy the requirement for any hypotheses in empirical science: falsifiability (Popper, 1968).

Popper (1968) presented 4 conditions that statements in empirical science must satisfy.

a). The statements deduced from hypotheses of a theory must be consistent among themselves. They must represent a logically possible world.

b). The theory must constitute a scientific advance, i.e., must achieve the goals of science better than other competing theories.

c). The statements in a theory of empirical science must be empirical in character, by being synthetic statements (derived from axioms and non-axiomatic statements), not just tautological deductions from axioms, so that singular statements (predictions) deduced from universal statements of the theory (hypotheses) can be contradicted by facts. They must represent a world of possible experience.

d). The singular statements deduced from a hypothesis must be corroborated by the facts. They must represent <u>the</u> real world.

Condition (c) is the principle of falsifiability. Falsifiability is the demarcation criterion that distinguishes between empirical science and metaphysics. Popper claimed that the goal of empirical science is to elucidate the problems of the current theory to make ever lasting revisions of the theory of the real world, and not to achieve some conclusively verified true statements, as positivists envisaged. Universal statements about the real world do not need to be, and in principle, cannot be both verifiable and falsifiable, because only singular statements about specific events can be verified by facts, and because an accumulation of singular statements cannot deduce a universal statement. However, universal statements can be falsified, if a derived singular statement that contradicts them is accepted as true. While there is no logical method of conceiving a hypothesis, there is a way to test a hypothesis, once it has been conceived. Thus, universal statements in empirical science can be refuted by facts.

Strictly universal statements (hypotheses) of a theory of empirical science can be expressed in the form of negations of strictly existential statements. The statement "For all X, X has property Y" is equivalent to "It is not that case that for some X, X has property not-Y." Strictly universal statements in a theory of empirical science do not assert that something exists or something is the case. Instead, they insist on the non-existence of certain things or events. Since a singular statement of the non-existence of certain things or events can be contradicted by a singular observation of such a thing or such an event, this provides a hypothesis with falsifiability.

Strictly existential statements are unfalsifiable, because only a universal statement can contradict them, and because a universal statement can never be verified. Therefore, strictly existential statements are not statements in empirical science.

Scientific statements can be corroborated, or not contradicted, by facts, while they cannot be verified. The method of empirical science requires that a hypothesis be testable (falsifiable), and that the hypothesis undergo repeated tests, once it has been posited, until it is falsified or otherwise superseded by another hypothesis that is better falsifiable.

Thus, in order for the claim of UG/LM-accessibility or UG/LM inaccessibility to be an empirical question, empirical evidence (and not the considerations of theoretical parsimony or restrictiveness) must be able settle the issue of whether L2 acquisition is in _fact_ constrained by UG/LM or not. In order for those claims to be testable, the claims on L2 facts must be deduced from hypotheses of the theory of L2 acquisition, and the claims must be stated in strictly existential statements insisting on non-existence of certain properties in L2.

Thus, testing out UG/LM-accessibility or UG/LM-inaccessibility in L2 acquisition implies a commitment to a particular formulation of UG and learning mechanism which allows for the operational definition of UG/LM effects on the L2 learner's behavior.

A particular formulation of UG/LM which gains considerable support of linguists/learnability theorists at one time may turn out later to be untenable with incompatible data made available, or by internal problems that are realized only later, or by the emergence of a new formulation that is more parsimonious or restrictive. However, since the theory of UG is a model of the _allegedly_ universal properties of natural languages, and since the learning mechanism is a complementary device to allow for the explanation of L1 acquisition on the basis of a given formulation of UG and positive evidence, there cannot be any ultimately correct formulation of UG/LM (or the assumed innate language acquisition mechanism) that represents the truth. Therefore, one cannot require an absolutely true formulation of UG/LM as a prerequisite for testing UG/LM-accessibility or UG/LM-inaccessibility in L2 acquisition. Thus, as Smith & Tsimpli (1995) note, it is axiomatic that UG is defined in terms of the current linguistic theory, and that the learning mechanism is defined in terms of the current learning theory associated with the formulation of UG in question, for the claim of UG/LM-accessibility to be tested. Thus, the conclusions drawn on the basis of data must be stated in term of the particular formulation of UG and the associated learning mechanism.

I further assume that the burden of demonstrating a given claim is on those who would like to make that claim. One cannot take, as evidence for a given claim, a failure to show that the facts are incompatible with that claim. If one wishes to demonstrate UG/LM-accessibility in L2 acquisition, then one must present evidence that is irreconcilable to the UG/LM-inaccessibility claim. If one wishes to demonstrate UG/LM-inaccessibility, then one must present evidence that is irreconcilable to the UG/LM-accessibility claim.

1.2. Confusion about the method of science

There has been some confusion among L2 researchers about how a hypothesis is conceived and how it is tested. There is no logical method of conceiving a hypothesis. A hypothesis in empirical science can be conceived without any justification, as long as it does not create a contradiction inside the theory, and as long as it is testable. A hypothesis must be posited before it can be tested.

1.2.1. The problem of circular arguments of UG/LM as explananda

It is important to clarify that in <u>testing</u> UG/LM-accessibility or UG/LM-inaccessibility in L2, linguistic theory and its associated learning theory must provide predictions independent of L2 data, by specifying properties of UG and the learning mechanism. In other words, the relationship between linguistic theory/learning theory and L2 research is unidirectional and cannot be bidirectional. What is tested is whether UG/LM is accessible in L2 acquisition, and given formulations of UG and LM are the premises of the theory.

However, some researchers claimed that L2 data can be used to test linguistic theory.

For example, White (1988) claimed that if it turns out to be the case that UG mediates L2 acquisition; i.e., if the interlanguages of L2 learners conform to UG-related properties, then L2 data will be relevant to testing linguistic theories. White (1988) tested Canadian French speakers learning L2 English in terms of 4 structures relevant to Subjacency (extraction from a relative clause following an NP, a wh-island, an object NP, and a subject NP) and 2 structures relevant to the Empty Category Principle (ECP) (extraction from a subject NP and that-trace sequences), and gained consistent results supporting the observation of Subjacency only in 2 of the structures relevant to Subjacency (extraction from a relative clause following an NP and from a subject NP) and in one structure relevant to the ECP (extraction from a subject NP). White then claimed that the discrepancy between the relatively consistent rejection of extraction from subject NPs and their variable judgement of that-trace violations suggested that that-trace effects should be treated separately from other ECP effects, appealing to the above argument that L2 data can be a basis of testing linguistic theory.

There is a circularity problem in such claims. In order for L2 data to be a basis for testing UG constraints, L2 data must be shown to conform to UG constraints. If the data does conform to UG constraints, then the data does not provide any discriminatory power in testing UG constraints. If the data does contradict UG constraints, then the data cannot be a basis for testing UG constraints in the first place, because the data must conform to UG constraints in order for it to be able to be a basis of testing UG constraints.

This argument has been typically used to explain away L2 data systematically contradicting UG predictions, as in White's (1988) argument. White's study was conducted to test whether L2 data conformed to UG predictions, and the result was negative. Thus, according to White's own argument, the L2 data should have failed to be qualified as a testing base for linguistic theory. In spite of the fact, White concluded on UG-accessibility, and attributed L2 data contradicting the ECP predictions to the possible misformulation of the ECP.

Similarly, Felix (1988) tested German speakers learning L2 English with structures involving the ECP, Subjacency, Case Filter, control vs. ECM verb contrast, and subject specificity and gained relatively high accuracy in grammaticality judgement only in Case Filter sentences and in control vs. ECM verb sentences. Felix then claimed that the variable results across construction types suggested that different UG constraints become available to the learner at different times, in stead of questioning the availability of UG constraints.

Also, in response to Bley-Vroman & Chaudron's (1990) criticism that the relative order of the matrix clause and the adjunct clause, which Flynn (1983, 1987) used to argue for her Parameter Setting Model, could not be attributed to the head directionality parameter discussed in Travis (1984) or Koopman (1985), Flynn & Lust (1990) claimed that Flynn's (1983, 1987) studies were conducted to pursue the "true" formulation of the parameter at issue on the basis of empirical data from language acquisition. Flynn & Lust argued that they did not have a preconceived "true" definition of UG principles and parameters determined in the absence of language acquisition evidence.

As Flynn & Lust claimed, it is possible to take an approach under which UG/LM-accessibility in L2 is assumed, and linguistic theory and/or learning theory is constructed on that assumption. However, in that case, UG/LM-accessibility is an axiom or a premise of the theory, and empirical data is mute as to UG/LM-accessibility (since the data will be interpreted in the way such that it does not contradict the axioms as long as the analysis is made under this theory). In other words, it is in principle impossible to test UG/LM-accessibility under such an approach.

1.2.2. The problem of the absence of statistically significant difference between L2 learners and native speakers as evidence for UG/LM-accessibility

Another type of confusions related to the method of empirical science is the use of a statistically non-significant difference between L1 speakers and L2 speakers as evidence for UG/LM-accessibility (ex. White (1988; 1989)).

The significance level in tests of the significance of the difference between group means or the difference between expected and observed frequencies are determined in such a way that there will be a probability of making a type I error (accepting an incorrect hypothesis) far smaller than a probability of making a type II error (rejecting a correct hypothesis), where the prediction is that there is a difference. That is, the criterion is set so that it is difficult to interpret the observed fact as corroborating the hypothesis that predicts a difference between two means or between two frequencies. Thus, if one wants to claim that there is a difference between L1 speakers and L2 speakers, the claim will be falsified unless there is a significant difference between the two groups in some relevant measure, with a probability level of 0.05 or less in typical cases. Here, it is important to note that the significance level of 0.05 is set to make the claim of difference, not the claim of sameness, easy to falsify. If one is to make the test of the claim of sameness as stringent as the test of the claim of difference, then the probability level of 0.95 or greater should be required to claim the sameness of two groups, where there is a certain observed difference.

However, this is often not the case. The probability as low as 0.064 (White (1988), paced judgement on grammatical extraction from a relative clause) of the observed difference is taken as evidence of sameness. Thus, while it is legitimate to argue that the claim of UG/LM-inaccessibility is falsified by such data, it is unfounded to argue that the claim of UG/LM-accessibility is corroborated by such data. In fact, such data should be taken as evidence against UG/LM-accessibility as well in that it does not meet the 0.95 probability criterion.

1.2.3. The problem of appealing to a general cognitive mechanism

Another issue that directly relates to the arguments made in the subsequent chapters is whether one can argue that UG/LM is inaccessible in L2 acquisition if the L2 learner can achieve the knowledge of a wild grammar, a grammar that violates UG/LM constraints.

Some researchers claimed that the knowledge of a wild grammar cannot be evidence for UG/LM-inaccessibility, because one can learn non-linguistic symbolic systems by general cognitive learning mechanism, and because even if the learner has access to UG/LM, the learner can deploy the general cognitive learning mechanism to internalize the wild pattern in L2.

This claim would place the falsifiability of the UG/LM-accessibility claim in serious doubt. A hypothesis is falsifiable only if there can be a fact that contradicts its predictions. A wild grammar is precisely what contradicts the UG/LM-accessibility predictions. If one takes a position that UG violations in intermediate stages in the interlanguage development where a natural language is the target are not evidence against the claim because the UG conformity is expected only of the steady state of the interlanguage, and that successful achievement of a wild target grammar is not evidence against the claim because the learner can appeal to the general cognitive learning mechanism, then there can be no fact that can contradict the claim.

2. The role of learnability theory in testing UG/LM-accessibility

At the onset of generative linguistics, it was hoped that linguistic theory would provide an account for the problem of language acquisition, namely, why the child is able to acquire his first language within a limited amount of time in spite of the fact that the input he receives is degenerate, finite, and underdetermined, and with no negative evidence. The traditional assumption in generative linguistics has been that language acquisition is possible because the child is endowed with an innate knowledge of natural language structure which constrains the hypotheses he makes as to the structures of his target language. Chomsky (1965) claimed, while a linguistic theory must meet the condition for its descriptive adequacy (i.e., it provides a means to describe the intrinsic competence of the idealized hearer-speaker as represented by his intuitions on the well-formedness of linguistic structures of his language), the theory must also meet the condition for its explanatory adequacy (i.e., it provides a theory of the innate knowledge of linguistic structure that allows the child to acquire a language).

> A grammar can be regarded as a theory of a language; it is <u>descriptively adequate</u> to the extent that it correctly describes that intrinsic competence of the idealized native speaker. The structural descriptions assigned to sentences by the grammar, the distinctions that it makes between well-formed and

> deviant, and so on, must, for descriptive adequacy, correspond to the linguistic intuition of the native speaker (whether or not he may be immediately aware of this) in a substantial and significant class of crucial cases.
>
> A linguistic theory must contain a definition of "grammar", that is, a specification of the class of potential grammars. We may, correspondingly, say that a linguistic theory is descriptively adequate if it makes a descriptively adequate grammar available for each natural language [Chomsky, 1965:24].

> To learn a language, then, the child must have a method for devising an appropriate grammar, given, primary linguistic data. As a precondition for language learning, he must possess, first a linguistic theory that specifies the form of the grammar of a possible human language, and, second, a strategy for selecting a grammar of the appropriate form that is compatible with the primary linguistic data. ... To the extent that a linguistic theory succeeds in selecting a descriptively adequate grammar on the basis of primary linguistic data, we can say that it meets the condition of explanatory adequacy. That is, to the extent, it offers an explanation for the intuition of the native speaker on the basis of an empirical hypothesis concerning the innate predisposition of the child to develop a certain kind of theory to deal with the evidence presented to him [Chomsky, 1965:24-25].

The problem of language acquisition has been known as the projection problem. The primary linguistic data does not provide sufficient information for the child to construct the grammar of his target language. Thus, to account for the fact that the child achieves the linguistic competence of ideal hearer-speaker, one must postulate an innate knowledge that provides what is required for language acquisition but what is not given in the primary linguistic data. Under generative linguistics, this innate knowledge is assumed to be the initial state of the linguistic knowledge of language learner, while the grammar of the ideal hearer-speaker of a given language is assumed to be the final state (or steady state) of language learner. The theory of UG pursued under generative linguistics is devoted to the characterization of the innate knowledge of linguistic structures, which is supposed to account for the crosslinguistically shared properties represented in the description of specific languages.

However, in spite of Chomsky's initial equation of linguistic theory and theory of language acquisition, the theory of linguistic structures has evolved without much consideration of the problem of language acquisition. Apparently, various formal devices have been proposed to capture regularities in specific languages as well as those across languages in such a way that they allow for simplicity in description and restrictiveness in prediction of grammatical properties, regardless of their implications to the explanation of language acquisition. Though the consideration of simplicity and restrictiveness has been an important aspect of theory construction in any science, the theory-internal, _a priori_ consideration of simplicity and restrictiveness seems to have led linguistic theory to a different direction from the one that the consideration of language acquisition dictates. That is, linguistic theory has come to postulate, as a part of linguistic knowledge of specific languages, a knowledge that cannot be learned or achieved from the available linguistic data even if the child is endowed with what the theory assumes to be the innate knowledge of linguistic structure.

To the extent that linguistic theory postulates an unlearnable knowledge as a part of the competence of ideal hearer-speaker, the theory fails to explain language acquisition. A necessity for learnability theory has arisen from this gap between the innate knowledge of linguistic structure and the information available in the primary data on the one hand and the knowledge of the target language structure on the other hand.

As discussed above, under linguistically oriented modeling of language acquisition, linguistic theory has the role of defining the initial state, the innate knowledge of linguistic structure, and the final state, the knowledge of the structure of a given language shared by the ideal hearer-speaker. Meanwhile, linguistic theory does not make any claim as to how the knowledge is acquired (nor as to how it could possibly be acquired). Under such a situation, the learnability theory has a crucial role in filling the gap between linguistic theory and the language acquisition model. Learnability theory provides the logical possibility for inducing what is required to fill the gap between the initial state and the final state of language acquisition on the basis of positive evidence alone, and it also provides the feasibility (i.e., acquisition on the basis of a limited amount of data and within a short period of time) of the acquisition of non-innate linguistic knowledge. To the extent that linguistic theory is constructed without the consideration of learnability, only a combination of a linguistic theory and its associated learnability theory, not linguistic theory alone, can be a model of language acquisition.

Thus, in pursuing linguistically oriented modeling of language acquisition, learnability issues have a critical role. More precisely, learnability theory places bounds on the possible natural language grammars independently of bounds placed by linguistic theory, in that even if linguistic theory allows for certain kinds of grammars, if they are unlearnable, then they are not existent in natural languages. An empirically testable language acquisition model must therefore make predictions that are compatible with both linguistic predictions and learnability predictions. A language acquisition model can then be falsified on the basis of data that does not conform to either the linguistic predictions or the learnability predictions (or both the linguistic predictions and the learnability predictions).

The test of UG-accessibility or UG-inaccessibility in L2 is often discussed without a clear reference to the role that learnability theory plays in the prediction. However, it is not possible to make a testable prediction as to the effect of UG on L2 without a specific assumption as to the learning mechanism involved in L2 acquisition. In this chapter, I will review the innate learning mechanism proposed by Wexler & Manzini (1987), how it contributes to the predictions on L2 acquisition, and confusion as to the role of learning mechanism in testing UG-accessibility or UG-inaccessibility.

2.1. The Subset Principle

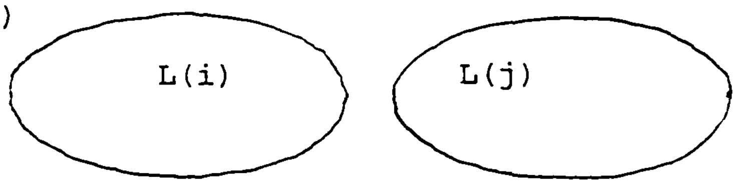
Pinker (1981) claimed that a context-free finite class of grammars that are determined by few parameters can be easily learned from the input, while context-sensitive rules cannot be learned easily even with the knowledge of possible rules. If the rules can be context-sensitive (A-->B / X_Y), then even if the phrase structure of an input sentence is known, the learner cannot determine which part of the structure is the context of rule application. Since the context-free rules are easier to deduce, it is easier to account for language acquisition if the grammar consists of a finite set of context-free rules. This observation has been the basis of the principles-and-parameter theory of syntactic structure, under which syntactic representations are constrained by X-bar theory (i.e., context-free phrase structure rules) and a few other constraints on syntactic representations, which may show small variation from one language to another according to the value of the associated parameters.

Under the principles-and-parameters approach, UG consists of a set of constraints on the well-formedness of representations (or derivations). Some UG constraints have their associated parameters, which are to be set by the language learner, to allow for certain crosslinguistic variations in structures related to UG. Under this theory, the task of the learner, with respect to the learning of UG-related properties in the target language, is the setting of parameters on the basis of positive evidence.

However, Wexler & Manzini (1987) claimed that the linguistic UG constraints do not ensure the acquisition of the core grammar and proposed learning principles independent of linguistic constraints that would prevent overgeneralization in language acquisition in terms of parameter setting.

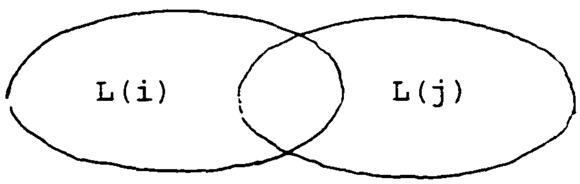
Wexler & Manzini presented the overgeneralization problem as follows. Where two hypothesized languages L(i) and L(j) resulting from fixing the parameter value for a given constraint as i and as j, respectively, are disjoint as in (1), any set of input data is either a subset of L(i) or a subset of L(j), and any relevant data can determine the appropriate parameter value without a problem.

(1)



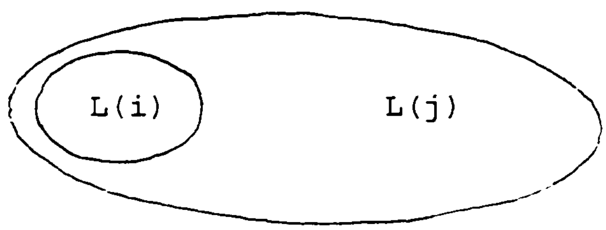
Where the languages L(i) and L(j) partially overlap, as in (2), input data can be either a subset of L(i) but not a subset of L(j), or a subset of L(j) but not a subset of L(i), or a subset of both L(i) and L(j). While in the last case, the data is indeterminate, the learner can determine the appropriate parameter value as far as the learner receives some data that is a subset of one language and not the other.

(2)



The problem occurs where one language is a proper subset of another as in (3).

(3)



If the input data is a subset of the larger language L(j) but not a subset of the smaller language L(i), the learner can determine the appropriate parameter value. However, if the data is a subset of both languages, then the data is compatible with either setting. If the learner selects the value that generates the larger language, when the target is in fact the smaller language, then there will be no data that will inform the learner that he has overgeneralized, because all the input data will then be compatible with his hypothesized parameter setting, if the learner receives no negative evidence. Thus, for the learner to correctly select the smaller language, where the two hypothetical languages that are compatible with data are in a subset relation, the learner must select the smaller language.

Thus, Wexler & Manzini formulated the learning principle, the Subset Principle, as in (4).

(4) Subset Principle

The learning function maps the input data to that value of a parameter which generates a language:

a). compatible with the input data; and

b). smallest among the languages compatible with the input data.

In order for the Subset Principle to work, the two hypothetical languages must meet the Subset Condition, as in (5).

(5) Subset Condition

For every parameter p and every two values i, j of p, the languages generated under the two values of the parameter are one a subset of the other, that is $L(p(i)) \subseteq L(p(j))$ or $L(p(j)) \subseteq L(p(i))$.

Also, the parameters must be independent of one another, in order for the subset relations of hypothetical languages generated by two values of a single parameter are to be determined, as in (5). Thus, the Independence Principle as in (6) is necessary.

(6) Independence Principle
The subset relation between languages generated under different values of a parameter remains constant whatever values of other parameters are taken to be.

Wexler & Manzini claimed that the governing category parameter and the proper antecedent parameter can be set by positive evidence alone without overgeneralization by following the three principles, and that the learning principles can provide a markedness hierarchy for parameter values independent of linguistic considerations.

2.2. Predictions on L2 acquisition and confusion over the role of the innate learning mechanism in testing UG-accessibility

As discussed before, it is not possible to make a testable prediction as to the effect of UG on L2 without a specific assumption as to the learning mechanism involved in L2 acquisition. UG alone cannot make a prediction. Only a combination of a specific formulation of UG and a specific formulation of learning mechanism can make a testable prediction on L2 acquisition.

There have been a few studies that relate to the issue of learning mechanism in L2 acquisition. However, there are some confusions about the role of learning mechanism in the theory of L2 acquisition.

The Subset Principle makes certain predictions on L2 acquisition. Under the Subset Principle, if the L2 learner assumes the L1 setting of a given parameter as its default value in L2 acquisition, where L2 is less marked than L1 in the parameter value (with the relative markedness defined in terms of the subset relation holding between grammars generated by different parameter settings), it should be impossible for the L2 learner to achieve the correct value of the parameter, because the learning mechanism is deterministic. Meanwhile, if L2 is more marked than L1 in the parameter value, or if the L2 learner assumes the most unmarked value as the default value of the parameter, then it should be possible for the L2 learner to achieve the correct value of the parameter. In neither case, should it be possible for the L2 learner to assume a value more marked than both of the value in L1 and the value in L2 at any stage of L2 acquisition, if the learning mechanism is operative.

White (1989) tested French speakers learning L2 English and English speakers learning L2 French with paced grammaticality judgement, non-paced multiple-choice grammaticality judgement, and paired comparison of sentences involving strict adjacency violations. In English, strict adjacency of the direct object to the verb is always observed, while in French, manner and frequency adjuncts can intervene between the verb and the direct object. Stowell (1981) claimed that in configurational languages where Case is assigned structurally, a direct object NP must be adjacent to the verb for the NP to receive Case, and attributed the difference between English and French, which are both configurational languages, to the difference in the level at which Case assignment takes place. In French, Case assignment takes place at a level where manner and frequency adjuncts can be ignored. Thus, with respect to the adjacency parameter, the [+strict adjacency] value generates a subset grammar (English) and [-strict adjacency] value generates a superset grammar (French). White found that French speakers learning L2 English allowed for adjacency violations in English where manner and frequency adjuncts intervened, and that many of English speakers learning L2 French failed to allow adjacency violations with manner and frequency adjuncts. White claimed that the results are explained if UG and the learning principles are distinct, and if the Subset Principle is not operative in L2 acquisition.

There is a problem in this conclusion. While it is true that the results were compatible with the claim that the Subset Principle does not constrain L2 acquisition, the results were compatible with three different positions, with the assumption that UG and the learning mechanism are distinct.

(7)

a). UG does not constrain L2, and the innate learning mechanism does not constrain L2 acquisition.

b). UG does not constrain L2, and the innate learning mechanism constrains L2 acquisition.

c). UG constrains L2, and the innate learning mechanism does not constrain L2 acquisition.

While White appears to assume position (7c), the results cannot determine which of the three was the case. Especially, with the failure of English speakers learning L2 French to acquire the superset French grammar, it is not clear whether L2 learners showed any evidence of UG; i.e., both English speakers and French speakers showed the L1 pattern in their L2s.

It should be clear that any argument that discusses exclusively either UG or the innate learning mechanism without a reference to the other fails to make a prediction in L2 acquisition. It is pointless to discuss which one of the three possibilities is the case, in that facts cannot determine it. What a fact can possibly show is that it is not the case that both UG and the innate learning mechanism (formulated in a certain way) constrain L2 acquisition.

Thus, only the claim that UG <u>and</u> the innate learning mechanism constrain L2 acquisition is falsifiable.

3. Motivation for appealing to UG/LM in the explanation of L2 acquisition

The interest in UG-based explanations of language acquisition derives from the fact there appears to be no alternative source for the learner's certain knowledge of linguistic structure. In L2 acquisition research, however, the UG-based explanations have been sometimes applied where there are alternative sources of the L2 learner's knowledge. In this chapter, I will discuss the problems of applying UG-based explanations to L2 acquisition where the appeal to UG is not required.

3.1. The projection problem

The motivation for appealing to the construct of UG in the explanation of L1 acquisition is the projection problem; i.e., the child achieves the knowledge of his L1 within a short period of time in spite of the fact that the input he receives is degenerate, finite, and underdetermined, and lacks negative evidence. In the tradition of generative linguistics, the child's ability to acquire his L1 is thus attributed to some innate knowledge of possible linguistic structures that allows the child to constrain the hypothesis that he makes as to the structure of his target language. Meanwhile, it has been shown, as discussed in Chapter 2, that under certain formulations of the innate linguistic knowledge, the primary linguistic data that lacks negative evidence was insufficient to block misformulation of the target linguistic knowledge, and the innate learning mechanisms have been proposed to complement given formulations of the innate linguistic knowledge to explain L1 acquisition (ex. Wexler & Manzini, 1987).

The interest in the UG/LM-based explanation of L2 acquisition comes from the question of whether the L2 learner also achieves the same abstract knowledge of the structure of the target language that is underdetermined by the input. In L2 acquisition, the projection problem requires an additional condition that the knowledge of the relevant L2 structures cannot be attributed to the learner's knowledge of his L1. If the L2 learner achieves the knowledge of the target language that cannot be induced from the input, and that cannot be attributed to L1, then the projection problem holds and provides motivation for appealing to UG/LM. If the L2 learner does not achieve the knowledge of the target language that cannot be induced from the input, and that cannot be attributed to L1, then the projection problem does not hold, and provides no motivation for appealing to UG/LM.

3.2. The problem of UG/LM-accessibility claims based on data in which the projection problem does not hold

There has been confusion among some L2 researchers about the motivation for appealing to UG/LM in the explanation of L2 acquisition. UG/LM has been invoked to explain L2 data that does not require an appeal to the innate language acquisition mechanism.

For example, Flynn & Martohardjono (1994) claimed, citing reports of Snow & Hoefnagel-Höhle (1982), Best, McRoberts, & Sithole (1988), Werker & Tees (1983), Neufeld (1978), and Flynn & Manuel (1991), that the fact that adult learners are capable of achieving segmental contrasts in L2 that do not exist in L1 both in perception and in production is evidence that the innate language acquisition mechanism is available to L2 learners, because L1 learners' ability construct a phonemic system from the primary linguistic data characterizes the operation of the innate language acquisition mechanism.

It is not clear how the ability of L2 learners to acquire segmental contrasts not existent in L1 relates to the question of whether UG/LM is accessible in L2 acquisition. There appears to be no theory of generative phonology that claims that segmental contrasts such as /l/ vs. /r/ in English should be unlearnable without the innate knowledge of linguistic structures and the innate learning mechanism.

3.3. Confusion over partial, indirect, and no access to UG

There has been confusion with respect to the motivation for appealing to UG/LM in the explanation of L2 acquisition concerning the difference between UG/LM-based predictions and predictions based on the surface properties of L1. Some researchers claimed that the L2 learner can access certain UG constraints in L2 acquisition through the knowledge of L1, if and only if those constraints are instantiated in L1. This claim can be interpreted in different ways. If it means that the L2 learner accesses a part of the innate knowledge of linguistic structure, as long as it is instantiated in L1, then the claim must be motivated by a projection problem in L2 acquisition. If it means that the L2 learner accesses a part of the knowledge of L1, which happens to instantiate a UG-related property, then the claim does not require a probjection problem in L2 acquisition as its motivation.

As far as the learnability of those UG-related properties instantiated in L1 is concerned, no projection problem can be raised in L2, since L1 can be the source of the relevant knowledge. Thus, it appears that it is unfounded to make a claim on UG-accessibility as in the first interpretation, and that a claim should be interpreted in terms of the access to L1 knowledge rather than UG.

For example, Yip (1995) classified the positions taken by different researchers with respect to the accessibility of UG as follows.

(8)

a). Full access to UG - back to UG position:
The original UG principles and parameters with their unspecified values are available to adult L2 acquisition.

b). Full access to UG - start from L1 position:
While UG still operates in L2, UG constraints operate with L1 parametric values as default in adult L2 acquisition.

c). Partial access to UG position:
A subcomponent of UG not instantiated in L1 and not invariable is inaccessible in adult L2 acquisition.

d). Indirect access to UG position:
Only the knowledge of L1 grammar and the general cognitive mechanisms are available to adult L2 acquisition.

In Yip's interpretation, (a) contrasts with (b), (c), and (d) in that it assumes that L2 acquisition starts from the same initial state from which L1 acquisition starts, and in that the former does not give an important role to L1 transfer in UG-related properties, while the latter does. (b) contrasts with (c) and (d) in that even though L2 acquisition starts from the properties instantiated in L1, UG constraints and parameters not instantiated in L1 are still available, and can be triggered by appropriate primary linguistic data in L2. None of the above positions claim that no UG constraints are available to adult L2 acquisition.

Yip's interpretation that no position claims that no UG constraints are available to adult L2 acquisition is unfounded for reasons discussed above. A claim of access to UG must be clearly differentiated from a claim of access to a part of L1 knowledge, which happens to instantiate a UG-related property. In fact, the indirect access position (d) claims no access to UG. Also, the partial access position (c) appears to have a problem in its motivation for appealing to the construct of UG, if the claim is concerned only about the UG-related properties in L2 that are instantiated in L1.

The problem with the partial access position (c) in its motivation for appealing to UG does not, however, necessarily invalidate the claim in favor of the indirect access position (d), if the claim is to be evaluated in terms of the effect of UG on learning a wild target. The 2 positions make different predictions.

The partial access position claims that the L2 learner has the knowledge of a given UG constraint, while the indirect access position claim that the L2 learner has only the knowledge of a structural pattern in L1 which happens to be effected by the UG constraint. The knowledge of a UG constraint constrains the hypotheses about possible natural language grammars, while the knowledge of a certain L1 structure does not. In other words, if a UG constraint is available to the L2 learner, the learner does not consider a grammar that violates the UG constraint as a possible target language grammar. If only a pattern in L1 is available to the L2 learner, the pattern in L1 effected by the UG constraint is not different from any other structural pattern in L1, including those effected by peripheral learning, in terms of whether it constrains the hypotheses that the L2 learner makes as to the grammar of the target language, and therefore, the learner may consider a grammar that is different from the L1 pattern (which violates the relevant UG constraint) as a possibility. Thus, (b) and (c) on the one hand and (d) on the other hand make different predictions, with respect to whether UG constraints instantiated in L1 still constrain the L2 grammar. If UG constraints in L1 are available to L2 acquisition, then the L2 learner should not be able to learn a structural property that violates the UG constraints. If UG constraints in L1 are not available to L2 acquisition, then the L2 learner should be able to learn a structural property that violates the UG constraints.

Even if the L2 learner fails to learn a structural property that violates UG constraints, the projection problem does not hold, since the constraint is instantiated in L1, and therefore, there is a problem in (c) as to the motivation for claiming that UG is accessible. However, (c) can be falsified by the successful learning of a structural property that violates UG constraints.

4. Motivation for studying a wild grammar

Under the principles-and-parameters approach to generative grammar, the innate knowledge of linguistic structures is assumed to be a set of well-formedness constraints on representations (or on derivations), with parameters whose values are set on the basis of the primary linguistic data, allowing for certain crosslinguistic variation. UG/LM-accessibility is a claim on the knowledge in this restricted domain, or the core grammar, which is governed by the UG constraints and the associated learning mechanism under the principles-and-parameters approach. To demonstrate UG/LM-accessibility, one must show evidence that the L2 learner's performance in L2 systematically conforms to the predictions made by UG constraints and the learning mechanism, and that such performance cannot be achieved on the basis of knowledge gained through the target language input or through the knowledge of his L1. To demonstrate UG/LM-inaccessibility, one must show evidence that the L2 learner's performance in L2 systematically deviates from the predictions made by UG constraints and the learning mechanism, and that the deviation is not just a failure to achieve the target pattern but is impossible in any natural language.

One may consider either (a) or (b) as evidence for UG/LM-accessibility, and one may consider (c) or (d) as evidence for UG/LM-inaccessibility:

(9)

a). The L2 learner achieves knowledge of linguistic structure that is compatible with UG/LM and underdetermined by the L2 primary linguistic data, and that cannot be attributed to the knowledge of L1.

b). The L2 learner does not achieve knowledge of linguistic structure that is incompatible with UG/LM.

c). The L2 learner does not achieve knowledge of linguistic structure that is compatible with UG/LM and underdetermined by the L2 primary linguistic data, and that cannot be attributed to the knowledge of L1.

d). The L2 learner achieves knowledge of linguistic structure that is incompatible with UG/LM.

In order for the UG/LM-accessibility claim to be falsifiable, one must be in principle able to show either (a) or (b) does not hold, on the basis of empirical evidence. In other words, one must be able to show that (c) or (d) holds. In order for the UG/LM-inaccessibility claim to be falsifiable, one must be in principle able to show either (c) or (d) does not hold, on the basis of empirical evidence. In other words, one must be able show that (a) or (b) holds.

However, in an empirical study, it is, in principle, impossible to demonstrate (b) or (c), because it is impossible to determine whether the performance of the learner at one stage is representative of the knowledge of the final state of the interlanguage.

One may claim that the L2 learner should never violate the predictions by UG/LM if UG/LM is accessible in L2 acquisition, and that if the L2 learner violates the predictions at any stage, then it should be evidence against UG/LM-accessibility. However, the claim is confounded by the fact that the L1 learner does violate some of the predictions made by UG/LM at some stage in the L1 development. For example, it has been claimed that the child language lacks tense or agreement features in early stages[1] and that the interpretations of pronouns and anaphors often do not follow the binding principles in the child language.[2] The child language almost always exhibits consonant harmony before the segmental contrasts are established in the developing L1, while consonant harmony is rare in adult languages, and some obligatory neutralizations in the child language are allegedly not observed in adult languages.[3] Thus, apparent violations of the predictions by UG/LM may not be a basis for claiming UG/LM-inaccessibility unless there is evidence that the L2 learner's performance represents the knowledge of interlanguage at the final, steady state. In short, if the L2 learner has not yet received enough primary linguistic data and an ample amount of time to internalize the structural regularities, it is not surprizing to see deviations from the predictions made by UG/LM, which is based on the knowledge of natural language at the steady state.[4]

In the same way, one may claim that the L2 learner should never achieve knowledge of linguistic structure that is compatible with UG/LM and underdetermined by the primary linguistic data and that cannot be attributed to the knowledge of L1, at any stage, if UG/LM is inaccessible in L2 acquisition. However, this claim is unfounded because the motivation for postulating such a construct as UG and devising the associated learning mechanism is in explaining the knowledge of linguistic structure at the steady state. If the L2 learner fails to converge upon the knowledge of the target language at the final stage of L2 acquisition, then there is no point in invoking UG/LM in the explanation of L2 acquisition. Moreover, the temporary conformity with the predictions made by UG/LM can be achieved by other means. For example, as Bley-Vroman (1986) noted, the learner may randomly seek for innovations in hypothesizing the target language structure; i.e., the learner discards the old hypothesis and creates a new one when it has been some time since the old hypothesis was made, regardless of whether the old hypothesis conforms to the data or not. Such random generation of hypotheses will never converge upon the target, but can generate, by chance, a hypothesis that may conform to the predictions made by UG/LM. Thus, it is not surprizing to see the L2 learner's performance which appears to be compatible with the predictions made by UG/LM at least temporarily in some structural domain, even if UG/LM is inaccessible in L2 acquisition.

The exclusion of 2 kinds of evidence, (b) and (c), leaves only the other 2 kinds of evidence as evidence that can be used to determine, empirically, whether UG/LM is accessible or not in L2 acquisition:

(10)

a) the evidence that the L2 learner does achieve knowledge of linguistic structure that is compatible with UG/LM and underdetermined by the L2 primary linguistic data and that cannot be attributed to the knowledge of L1 (at the final stage of L2 acquisition)

... evidence against UG/LM-inaccessibility

d) the evidence that the L2 learner does achieve knowledge of linguistic structure that is incompatible with UG/LM (at the final stage of L2 acquisition)

... evidence against UG/LM-accessibility

Type (a) evidence falsifies the UG/LM-inaccessibility claim. Type (d) evidence falsifies the UG/LM-accessibility claim.

To claim the achievement of knowledge compatible or incompatible with UG/LM at the final stage of acquisition, it is necessary that the relevant type of knowledge is achieved as convergence to the target. If the relevant type of knowledge achieved by the L2 learner is the type that the target language requires, then there will be no L2 data that is incompatible with the hypothesis that the learner has made, and thus there will be no change, if the L2 learner is using some learning mechanism that allows for convergence to the target (rather than some non-converging mechanism, such as the random generation discussed above). As for type (a) evidence, one can obtain it by testing the L2 learner's knowledge of a natural language of some kind that is learned as L2. As for type (d) evidence, one cannot obtain it by testing the L2 learner's knowledge of a natural language, because, by definition, there is no natural language which requires knowledge of linguistic structure that is incompatible with UG/LM. Thus, the target language must be an artificial language that is made deliberately incompatible with the predictions made by UG/LM, to obtain type (d) evidence.

Some researchers have conducted studies to gain type (a) evidence. For example, Schachter (1988a) studied Korean speakers' knowledge of Subjacency in L2 English, and White (1988) studied French speakers' knowledge of English bounding nodes for Subjacency in L2 English. Since the Korean language does not have overt movement, Subjacency is not instantiated in overt syntax of Korean speakers' L1. Also, Subjacency is considered to be underdetermined by the L2 primary linguistic data, in that the absence of wh-extraction from a wh-island or from a complex NP in English is insufficient to reach a conclusion that it is impossible, and also in that wh-extraction from other kinds of embedded clauses (as well as some kinds of NPs) is possible in

English. In French, while Subjacency is instantiated, S's and NPs count as bounding nodes, and the language allows for wh-extraction from a wh-island. Thus, the knowledge of Ss rather than S's as bounding nodes in L2 English cannot be attributed to the knowledge of L1, and also it is considered to be underdetermined by the L2 primary linguistic data, in that the absence of wh-island violation in English is insufficient to reach a conclusion that wh-extraction from an wh-island is impossible in English.

However, natural languages are highly crosslinguistically variable as well as intralinguistically irregular and often do not provide conclusive evidence as to UG/LM-accessibility or inaccessibility. In order to show evidence that the L2 learner's performance deviates systematically from the predictions made by UG, the interlanguage structures must be outside of the bounds of natural language structures;[5] i.e., the L2 learner's grammar must be a wild grammar. Nevertheless, UG-related studies in L2 acquisition have been designed in such a way that the testing measures cannot detect a wild grammar. For example, some researchers (ex. Schachter, 1989; White, 1988) looked at the L2 learner's performance with respect to Subjacency, and reported incompatible results. (Schachter (1989) rejected UG/LM-accessibility, while White (1988) supported UG/LM-accessibility.[6]) Aside from the problems of the research methods the researchers used, it is clear in the first place that any data with respect to certain Subjacency effects cannot provide evidence of a wild grammar because some languages, such as Norwegian, allow for wh-extraction that appears to violate Subjacency, such as extraction from a restrictive relative clause of an object NP (Taraldsen, 1981), and thus, such extraction must be allowed as a possibility in natural languages.[7] Then, if the L2 learner fails to reject Subjacency violations in some language that he is learning as L2, the data cannot be taken as evidence against UG/LM-accessibility as long as extraction out of all the tested structures is allowed in some natural language.[8] Thus, the UG/LM-accessibility is untestable with respect to Subjacency effects on extraction from a complex NP or from a wh-island, because there can be no evidence against it.

The difficulty of providing conclusive evidence against UG/LM-accessibility calls into question the validity of UG/LM-accessibility as a testable hypothesis. While conservative UG/LM-proponents use only type (a) evidence to claim UG/LM-accessibility (falsification of UG/LM-inaccessibility), they take a failure to show type (a) evidence as neutral as to UG/LM-accessibility. Other UG/LM-accessibility proponents often take the data showing the L2 learner's performance comparable to the native speaker's in any domain governed by UG/LM (regardless whether it is type (a) evidence or not), as evidence for UG/LM-accessibility, while they do not take the L2 learner's performance significantly different from the native speaker's as evidence against their claim, as long as the L2 learner's performance is compatible with some option allowed in natural languages. Often their testing measures can elicit only those options that are allowed in some natural language, and it is impossible for their testing measures to provide evidence against UG/LM-accessibility. Thus, the report of data conforming to the predictions made by UG/LM must be treated with a caution, even if it is based on type (a) evidence, in that the positive conclusions are coming from studies that could not have possibly provided a negative conclusion.

Therefore, there is a need to complement the claimed falsification of UG/LM-inaccessibility in L2 acquisition with the attempted but not achieved falsification of UG/LM-accessibility, in order to conservatively conclude that UG/LM constrains L2 acquisition.

One potential problem for an artificial language study is that there is no <u>native</u> speaker norm for any artificial language, and therefore, there is no reference point for the equivalent performance of the L2 learner to L1 acquisition results. However, since the performance of both the L2 learner and the L1 learner is instrumentally defined in any studies investigating UG/LM-accessibility, it is possible to show that the L2 learner has achieved the level of performance in an artificial language that can be considered to be an indication of mastery comparable to the mastery of UG/LM-related structural properties in L1, in the following way.

It is possible to design an artificial language whose structural properties conform to UG/LM, for example, with respect to Subjacency effects in wh-extraction. The artificial language can be modelled upon a given type of language, for example, Italian, in terms of this property; i.e., S's and NPs count as bounding nodes. Then, it is possible to test out native speakers of the modelled language, Italian in this example, with the artificial language as well as with the native language, Italian, in terms of Subjacency, to see whether the native speakers of the modelled language achieve a level of performance in the artificial language comparable to their performance in their native language. If they do achieve comparable performance in the artificial language, then the artificial language can be considered equivalent to a natural language in terms of Subjacency. Then, it is possible to design another artificial language, which share the same properties and the lexicon with the artificial language discussed above, but which is different in terms of the tested UG/LM-related structural properties, Subjacency in this case, with respect to the parameter setting; i.e., the second artificial language counts Ss and NPs as bounding nodes, as in English. Then, it is possible to expose adult Italian speakers to the second artificial language and test whether they can achieve a parameter setting different from their native language in the artificial language.

The above example is for using an artificial language for testing UG/LM-inaccessibility by a study that can gain type (a) evidence. Using an artificial language for testing UG/LM-accessibility by a study that can gain type (d) evidence requires a second artificial language which shows an option that is not allowed by UG/LM. It is not possible to design such an artificial language with respect to Subjacency effects on extraction from a complex NP or from a wh-island, because such extraction is allowed in some natural language, as discussed above. Thus, to gain type (d) evidence, one must choose a structural property in terms of which an option disallowed by UG/LM is clearly definable. One candidate UG/LM-related structural property that can provide type (d) evidence is the Empty Category Principle. The detail is discussed in Chapter 6.

Notes to Chapter 4

1. Radford (1990) claimed that early child grammars lack functional category systems (D, I, and C). Clauses in early child grammars closely resemble small clauses in adult grammars, which Radford analyzed as a maximal projection of a nonfinite predicative lexical category (a category capable of functioning as the head of a predicate phrase), with a subject DP in its specifier position.

(1)

```
     I can't imagine [a film [ having so much influence]]
                      VP      V'
     I've never found [the rich [kind to the poor]]
                       AP        A'
     I don't want [your feet [ on my table ]]
                   PP         P'
```

Radford analyzed the clause structure of early child grammars as the same structure except that the specifier position is filled by an NP, not a DP.

The structure of child clause lacks C projections, and therefore, in early child English, a) complement clauses are not introduced by an overt complementizer *that*, b) there is no subject-auxiliary inversion, and c) there is no fronting of wh-phrases, except for superficially wh-fronted formulaic utterances of the form *What's/where's NP*? or *Where NP go*? or *What NP doing*? or *How are you*? Radford claimed that the child analyzes *what/where* in *What's/where's NP*? utterances as the subject of the clause (instead of the NP), because the *'s* continues to surface even when the child has acquired the person/number agreement of the copula in *NP be NP* sentences, indicating that the copula in *What's/where's NP*? sentences is agreeing with the wh-phrase. Radford also claimed that while *what* and *where* in *What NP doing*? and *Where NP go*? may be analyzed as adjuncts to the clausal VP (thus, as being fronted), there is no evidence that the wh-fronting in these clauses involves a C projection.

The structure of child clause also lacks I projections, and therefore, in early child English, a) modals are absent, b) copula *be*, passive *be*, and aspectual verbs *be* and *have* are absent, c) there is no do-insertion for negation, and d) there is no inflectional person/number agreement marking on the verb by -*s*.

Radford (1990) assumed that the subject of a clause is base-generated in the spec of VP, because a theta-role is assigned to nominal arguments by lexical categories within their immediate maximal projection, and then it moves to the spec of IP in order to receive Case and to let the I discharge Tense and Agreement features, in the adult grammar of English. In child grammars, the subject stays within a VP, because there is no I projection in the clause. Thus, Radford analyzed the NP V sequence following the verb *want* in child utterance as a clause consisting of a VP, and attributed the absence of _to_ in the complement clause of _want_ to the absence of the I system.

Radford also analyzed modals, copula _be_, and auxiliary _be_ and _have_ as semantically contentless and to function only for the purpose of discharging Tense and Agreement features of I. Thus, Radford attributed the absence of those words in child utterances to the absence of the I system.

Radford assumed that the negation element _not_ intervenes the I position and its complement VP, and that the negation element blocks the discharge of Tense and Agreement features to V. Radford claimed that a modal or an auxiliary is required in a finite negative clause in the adult grammar to let the features discharged. Radford analyzed that in child grammars, the negation element is an adjunct to the V' in the NP _no_ V (NP) sequence, and that it is an adjunct to the VP clause in the _no_ NP V (NP) sequence.

2. Chomsky (1969) reported that children (mostly at age 5) allowed for coreference of the subject pronoun in (1) with the embedded clause subject R-expression, which is a violation of Principle C.

(1)

He$_i$ knew that Pluto$_i$ was sad.

Solan (1987) claimed that children start to overgeneralize Principle A (a prohibition against an intervening clause boundary between an anaphor and its antecedent) to pronouns and prefer coreference of a pronoun and an R-expression within a clause to coreference of a pronoun and an R-expression outside the clause in which the pronoun is in, where the pronoun precedes the antecedent in the linear order, as in (2).

(2)

a. After he$_i$ ran around, the horse hit the sheep$_i$.

b. After his$_i$ run, the horse hit the sheep$_i$.

Matthei (1987) claimed that children sometimes interpret the reciprocal in (3) as bound to the matrix subject, which is a violation of Principle A.

(3)

The horses said that the cows jumped over each other.

Matthei tested 4 complement types, a finite clause introduced by _that_, a finite clause without _that_, an infinitive, and a gerund (ACC-ing), and 2 types of NPs, conjoined NPs and plural NPs, and found no significant effect of complement type nor of NP type in the interpretation of the anaphor. Meanwhile, in single clause sentences, children preferred the closer of the 2 NPs in the sentence as the antecedent of the anaphor. Matthei claimed that children appeared to treat anaphors like pronouns in early stages, searching for the antecedent outside of the sentence determined by the discourse context.

Grimshaw & Rosen (1990) reported that children accepted 42.0% of Principle B violations as in (4a) and 37.5% of Principle C violations as in (4b), while they correctly accepted 83.3% of grammatical sentences for Principle B and Principle C.

(4)
a). Bert$_i$ patted him$_i$.
b). He$_i$ patted Bert$_i$.

3. Drachman (1978) claimed that in early stages of L1 acquisition, the child polarizes manner and place of articulation, so that a chain of sound shifts, such as x --> f, f --> p (or x --> k, k --> p), occurs, but that the context-free sound shifts do not remain into late childhood, much less into adult life. Also, vowel harmony is very strong in the earliest stages, when consonants are constrained by the polarization. When the manner/place polarization recedes at least to the extent that a variety of consonants can appear, vowel harmony is entirely suppressed, and the consonant harmony is seen at its strongest. Smith (1973) reported that vowel harmony was suppressed by 2;2 while consonant harmony continued until 3;9. Drachman (1978) provided the following as examples of harmony in child language.

(1) Vowel harmony
little [didi:], broken [bugu:] (Smith, 1973)
provatáki [povoáki], kókoras [kákaras] (Drachman, 1975)
baguette [bEjEt], poupée [pepEj] (Grégoire, 1937)
tire [tere] (Bar-Adon, 1971)

(2) Consonant harmony (place)
a. velar harmony
book [gUk], sock [gOk] (Menn, 1971)
b. dental harmony
meat [dit], boot [dut] (Menn, 1971)
kan.ta [tan.ta] (Chao, 1951)
madame [dadap] (Roussey, 1899)
c. labial harmony
twice [daif], queen [gi:m] (Smith, 1973)
kapélo [papélo] (Drachman, 1975)
chapeau [popo] (Roussey, 1899)

(3) Consonant harmony (manner/place)
a. nasal harmony
kamm [namm], kanone [nanone] (Preyer, n.d. cited in Drachman, 1978))
vilein [nEn], panier [meni], nourrice [nunis] (Roussey, 1899)

b. lateral harmony
sel:ka [lel.ka] (Vihman, 1971)
kliδí [lilí] (Drachman, 1975)

In contrast, in adult languages, the context-free process f --> p does not occur (while p --> f is frequently attested in historical changes). Vowel harmony is attested in many languages and language families (ex. Finno-Ugric, Altaic, Tibetan, West African languages, etc.), while consonant harmony is rare. Drachman (1978) gave Sanscrit s ... 's --> 's ... 's harmony as an example of consonant harmony, and cited Grammont (1956) on Sanscrit retroflex harmony, Arabic emphatic harmony, and Toba (Javanese) r-harmony, Beeler (1970) on sibilant harmony, and Lovins (1972) on Paiute palatal harmony.

4. Sharwood Smith (1988a; 1988b) presented, as the developmental conformist position (Sharwood Smith, 1988a) or as the intermittent reorganization view (Sharwood Smith, 1988b), the position that the fact that pre-steady-state intermediate interlanguage grammars may deviate from UG predictions does not constitute evidence against UG-accessibility. Under this position, the intermediate grammars may contain inconsistencies that would constitute UG violations when each such grammar is taken as a unified system, due to readjustments to the developing grammar, caused either by overgeneralization of newly acquired rules or intrusion from the grammar of L1. However, under this position, the non-conformity to UG is to be remedied on the attainment of an end-state.

5. It is possible to show UG/LM-inaccessibility by showing that the interlanguage properties cannot be achieved by the assumed learning mechanism, even if the interlanguage properties are within the options allowed by UG. For example, one can show that the interlanguage parameter setting cannot be explained if the Subset Principle (Wexler & Manzini, 1987) is in tact, regardless of whether the L2 learner starts from the L1 setting or the most unmarked setting, if the L1 setting is more marked than the interlanguage setting and the interlanguage setting is more marked than the target setting.

6. Taraldsen (1981) claimed that the following sentences are grammatical in Norwegian.

(1)
Hvore mange av dem fant du noen som kunne hjelpe?
How many of them did you find somebody who could help?

(2)
Her er en katt som vi leter efter noen som kan ta seg av.
Here is a cat that we are looking for somebody that can take care of.

(3)
    Per kjenner jeg ingen som liker.
    Peter I know nobody who likes.

(4)
    Der et Per vi skal finne noen som kan trøste.
    It is Peter we shall find somebody who console.

(5)
    Per er vanskelig å tenke seg noen som liker.
    Peter is difficult to imagine somebody that likes.

These sentences appear to violate Subjacency in that an NP is extracted over S' and NP. However, Taraldsen attributed this type of extraction to extraposition applying (string-vacuously) before extraction, because a) this type of extraction is possible only from a restrictive relative clause of an object NP, and not from a restrictive relative clause of a subject NP, and b) the semantic/pragmatic condition in Norwegian that the head noun of the NP to be extraposed must be nonspecific also holds of the head noun for the relative clause from which an NP is extracted.

Under Taraldsen's analysis, extraposition adjoins the relative clause to the VP whose complement the relative clause is a part of. Extraposition is string-vacuous in that its effect is invisible on the surface, since the relative clause is in the same position in the linear string. Then, an NP is extracted from the adjoined relative clause. Since the object NP no longer intervenes, extraction crosses only S' in the relevant substructure of the sentence.

7. Schachter (1988a) and White (1988, 1989) assumed that the UG(/LM)-accessibility claim can be falsified by the presence of a significant difference between the performance of L2 learners and the performance of native speakers with respect to some UG constraint. Their version of UG-accessibility claim is a more falsifiable claim than the version that I presented on page 40, which assumes that L2 learners' failure to conform to UG/LM predictions does not count as evidence against UG/LM-accessibility, because there is no way to confirm that L2 learners have achieved the steady state in the L2 interlanguage, and thus, their nonconformity to UG/LM predictions may not be representative of the steady-state of the interlanguage. Methodologically, the Schachter/White version of UG(/LM)-accessibility is more desirable than the version that I presented on page 40. However, in order to resolve the issue of UG/LM-accessibility in L2 acquisition unambiguously, the falsification of the version presented on page 40 will be a stronger argument against UG/LM-accessibility. I will pursue the relaxed version of UG/LM-accessibility in order to specify what could be evidence against UG/LM-accessibility under the less falsifiable framework that some UG/LM-accessibility proponents subscribe to.

8. As discussed in note 2, if there is a specific assumption as to what the learner's knowledge is in the initial state and what data the learner uses to change hypotheses, one may show that certain UG-compatible interlanguage properties are unachievable under the assumed learning mechanism. Then, it can be evidence against UG/LM-accessibility.

5. The framework of the proposed study

As discussed above, evidence that bears on the issue of whether UG/LM is accessible in L2 acquisition can be of either type (a) or type (b) (previously, type (a) and type (d) in (10)):

(11)

a). the evidence that the L2 learner achieves knowledge of linguistic structure that is compatible with UG/LM and underdetermined by the L2 primary linguistic data and that cannot be attributed to the knowledge of L1 at the final stage of L2 acquisition

b). the evidence that the L2 learner achieves knowledge of linguistic structure that is incompatible with UG/LM at the final stage of L2 acquisition

While there have been studies that sought for type (a) evidence (ex. Schachter, 1989; White, 1988: See Chapter 7.), the results have been non-conclusive. Though some studies concluded positively with respect to UG/LM-accessibility, such studies were designed not to be able to elicit evidence against UG/LM-accessibility. Therefore, it is necessary to complement the results of those studies confirming UG/LM-accessibility with the evidence that the L2 learner does not achieve knowledge incompatible with UG/LM through a study that is in principle possible to gain type (b) evidence.

While there have been at least one study that sought for type (b) evidence, reported in Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995), the results are non-conclusive due to the problems in the design of materials as well as the small number of subjects. (See Chapter 8 for details.) Thus, there is a need for further investigation of the adult L2 learner's ability to achieve knowledge of linguistic structure incompatible with UG/LM.

In this and following chapters, I will discuss a proposal of an artificial language study that could in principle provide evidence against UG/LM-accessibility in L2 acquisition.

5.1. Structural property

One syntactic structural property, the Empty Category Principle (ECP), is tested in the proposed study. The ECP constrains the distribution of non-pronominal empty categories in syntactic representations at certain levels of syntactic representations (SS and LF). (The specific formulations of the ECP and the effects of the constraint will be discussed in Chapter 6.) The ECP prohibits extraction of a wh-phrase from a finite adjunct clause (such as a temporal clause). Thus, if a language allows for extraction from a finite adjunct clause, then the language requires a wild grammar to explain its properties.

5.2. Use of artificial language

To ensure that the learner's performance is representative of the steady state of his knowledge, the knowledge of structural properties that are incompatible with UG/LM must be achieved by convergence to the target. This is because, if the learner is using a learning mechanism that allows him to converge upon the target grammar, and if they have reached the correct UG/LM-incompatible hypothesis, then there will be no data that disconfirms the learner's hypothesis, and therefore, there will be no subsequent change in the hypothesis, which ensures that the achieved correct hypothesis will be the steady state of the interlanguage. For this purpose, an artificial language must be used as the target language of the adult L2 learner to elicit type (b) evidence, since no natural language has UG/LM-incompatible structural properties.

There have been a considerable number of language learning studies which used an artificial language. While most of them did not address the issue of UG/LM-accessibility, they provide important models for designing an artificial language and training material and procedure for the proposed study. Some of these studies will be reviewed in Chapter 8.

5.3. Testing measures

The proposed study attempts to determine whether adult L2 learners are capable of learning structural properties that are allegedly disallowed by UG/LM to the extent that their performance with respect to the structural properties that are incompatible with UG/LM is indistinguishable from their performance with respect to the structural properties that are compatible with UG/LM, as measured by testing instruments that have been used by some researchers in their studies that they claimed to have shown evidence that adult L2 learners did achieve knowledge of linguistic structures that were compatible with UG/LM and underdetermined by the natural L2 primary linguistic data and that could not be attributed to the knowledge of L1.

There is always a controversy in the field as to data from which testing measures should be taken as evidence against UG/LM-accessibility or inaccessibility. The disagreement among researchers about the validity of testing measures is often the source of inconclusiveness of the debate on UG-accessibility in L2 acquisition. To avoid repeating the controversy on the validity of specific testing measures for eliciting evidence against UG/LM-accessibility, the proposed study uses the testing measures that have been used in L2 acquisition studies that claimed UG/LM-accessibilty.

The logic behind the use of these measures is the following. If the testing measures that were used to elicit type (a) data in preceding studies were a valid basis to make a claim on L2 learners' knowledge of UG/LM-related properties, then type (b) data that may be elicited by the same measures in the proposed study should be a valid basis to make a claim on L2 learners' knowledge of wild grammar. If type (b) data elicited by these measures is not a valid basis to make a claim of L2 learners' knowledge of wild grammar, then the type (a) data elicited the same measures in the preceding studies should not be taken as a valid basis to make a claim of L2 learner's knowledge of UG/LM-related structural properties. Thus, the use of the same measures adopted by the UG/LM-accessibility proponents who claimed to have shown the type (a) data will make it impossible for these UG/LM-accessibility proponents to question the testing measures, and thus it eliminates one major obstacle for demonstrating UG/LM-inaccessibility in L2 acquisition. Three testing measures that have been used by UG/LM-accessibility proponents will be reviewed in Chapter 9.

6. The Empty Categoy Principle and the research question

As I argued before, UG and LM must be defined in some way before one can test UG/LM-accessibility or inaccessibility, and therefore, testing UG/LM-accessibility or inaccessibility entails a commitment to a certain formulation of UG and LM. Thus, the understanding of particular formulation of UG constraints is important in evaluating preceding studies on UG/LM-accessibility and in designing a new one.

In this chapter, I will discuss different formulations of the ECP, the constraint tested in the proposed study. I will review the formulations that have been used in the preceding L2 acquisition studies and the one used in the proposed study. I will then present the research question based on one of the formaulations of the ECP, and discuss the problems of the interpretation of UG constraint violations in L2 acquisition proposed by White (1992).

6.1. The ECP

Some L2 researchers have tested L2 learners' knowledge of the ECP (Felix, 1988; White, 1988; Martohardjono, 1993;1994) in its different formulations, using different structures that were supposed to represent the ECP effects. As for the formulation of the ECP, Felix (1988) and White (1988) adopted the formulation of the ECP in Chomsky (1981), while Martohardjono (1993) partially adopted the formulation in Chomsky (1986b). As for the structures used, Felix (1988) used Superiority violations, that-trace violations, and the extraction of an object NP from an infinitival clausal subject. White (1988) used the extraction of a complement of a subject NP and that-trace violations. Martohardjono (1993, 1994) used the extraction of a subject NP from a relative clause, the extraction from an adjunct clause, the extraction from a sentential subject (gerund), and that-trace violations. Since different formulations of the ECP provide different predictions and different interpretations of these alleged ECP violations, it is important to clarify the differences of the available formulations of the ECP and their predictions. In this section, I will review the formulations of the ECP in Chomsky (1981), Chomsky (1986b), and Rizzi (1990), and how these formulations did or did not account for the ungrammaticality of 4 different structures: that-trace violations, Superiority violations, the extraction from a finite adjunct clause, and Super-raising.

6.1.1. The ECP in Chomsky (1981)

In Chomsky (1981), the ECP and the Subjacency Condition restrict the distance of wh-movement. The Subjacency Condition restricts the application of wh-movement, prohibiting movement across 2 or more bounding nodes, S' and

NP for English. The ECP constrains the distribution of wh-traces in the representation created by movement. The ECP is formulated as a disjunction of 2 conditions, one of which a non-pronominal empty category must satisfy, both at SS and LF.

(12) The ECP in Chomsky (1981)
A non-pronominal empty category must be:
a) lexically head-governed, or
b) antecedent-governed.

(13)
A head-governs B iff
a). A = X^0, and
b). A c-commands B, and
c). all maximal projections dominating B also dominate A.

A antecedent-governs B iff
a). A is conindexed with B, and
b). A c-commands B, and
c). all maximal projections dominating B also dominate A.

A c-commands B iff
a). A does not contain B, and
b). all categories (distinct or nondistinct from A) dominating A also dominate B.

The head of a maximal projection is accessible to an external governor, but peripheral positions are not.

Chomsky (1981) assumes the phrase structure of (14), in which COMP is considered to be the head of S' and Infl is considered to be the head of S.

(14) Phrase structure in Chomsky (1981)

```
        S'
       / \
COMP      S____
        / |    \
     NP  Infl   VP
```

Under this formulation of the ECP, 3 types of violations (that-trace, Superiority, and extraction from a finite adjunct clause) are explained in the following way.

(15) That-trace violations

```
a).   Who did John think (that) Bill saw?
      [who did [John think [t (that) [Bill saw t]]]]
      S'       S           S'        S

b).   Who did John think saw Bill?
      [who did [John think [t    [t saw Bill]]]]
      S'       S           S'    S

c).   * Who did John think that saw Bill?
      [who did [John think [t that [t saw Bill]]]]
      S'       S           S'      S
```

The extraction of an object NP from a finite compelement clause is grammatical with or without an overt complementizer. The extraction of a subject NP from a finite complement clause is grammatical when there is no overt complementizer, and ungrammatical when there is an overt complementizer. The extraction of an object is always grammatical, because the initial trace is lexically head-governed by the V of the complement clause, and the intermediate trace in the COMP of the complement clause is lexically head-governed by the V of the matrix clause. The extraction of a subject from a complement clause without an overt complementizer is grammatical, because the initial trace of the subject is antecedent-governed by the intermediate trace in the COMP of the complement clause, and the intermediate trace is lexically head-governed by the V of the matrix clause. The extraction of a subject NP from a complement clause with an overt complementizer is ungrammatical, because the initial trace is neither lexically head-governed nor antecedent-governed. The subject of S is not lexically head-governed (in languages without a rich agreement). The subject position is not antecedent-governed because it is not c-commanded by the intermediate trace in the COMP of the complement clause. The multiply filled COMP position is assumed to have the structure of (16).

(16)

```
     COMP
     /  \
    t    that
```

In (16), the intermediate trace cannot c-command the initial trace, in that the first branching node dominating the intermediate trace does not dominate the initial trace. Thus, the subject trace in (15c) violates the ECP.

(17) Superiority violations

a). Who saw what?

b). $[_{S'}\text{who}_i\ [_{S}\ t_i\ \text{saw what}_j]]$

c). $[_{S'}\ [_{COMP}\ \text{what}_j\ \text{who}_i]\ [_{S}\ t_i\ \text{saw}\ t_j]]$

d). * What did who see?

e). $[_{S'}\text{what}_j\ \text{did}\ [_{S}\text{who}_i\ \text{see}\ t_j]]$

f). $[_{S'}\ [_{COMP}\ \text{who}_i\ \text{what}_j]\ [_{S}\ t_i\ \text{see}\ t_j\ ]$

The extraction of a subject with an object wh-phrase in situ is grammatical, as in (17a), while the extraction of an object with a subject wh-phrase in situ is ungrammatical, as in (17d). The contrast is attributed to the representation of the sentences at LF. (17a) has the representation of (17b) at SS, and (17c) at LF, in which the object wh-phrase and the subject wh-phrase are in the COMP of the matrix clause. (17d) has the representation of (17e) at SS, and (17f) at LF. In (17c), the COMP of the matrix S' has the index of the subject wh-phrase, which is moved into it first, and in (17f), the COMP of the matrix S' has the index of the object wh-phrase. (17c) is grammatical, because the subject trace is antecedent-governed by the COMP in the matrix S', which has the index of the subject wh-phrase, and the object trace is lexically head-governed by the V. (17f) is ungrammatical, because the subject trace is neither lexically head-governed nor antecedent-governed, the COMP in the matrix S' having the index of the object wh-phrase, and the subject wh-phrase not c-commanding the subject trace, while the object trace is lexically head-governed.

This analysis could be applied to cases of extraction from an embedded clause.

(18)

a). Who did John think said what?

b). $[_{S'}$ who$_i$ did $[_{S}$ John think $[_{S'}$ t$_i$ $[_{S}$ t$_i$ said what$_j$]]]]

c). $[_{S'}$ $[_{COMP}$ what$_j$ who$_i$] did $[_{S}$ John think $[_{S'}$ [t$_j$ t$_i$] $[_{S}$ t$_i$ said t$_j$]]]]

d). * What did John think who said?

e). $[_{S'}$ what$_j$ did $[_{S}$ John think $[_{S'}$ t$_j$ $[_{S}$ who$_i$ said t$_j$]]]]

f). $[_{S'}$ $[_{COMP}$ who$_i$ what$_j$] did $[_{S}$ John think $[_{S'}$ [t$_i$ t$_j$] $[_{S}$ t$_i$ said t$_j$]]]]

(18a) has the representation of (18b) at SS and the representation of (18c) at LF. (18d) has the representation of (18e) at SS and the representation of (18f) at LF.

With the assumption that COMP assumes the index of the first wh-phrase that is moved into it, the COMP of the embedded S' has the index of the subject in (18c). Thus, the initial subject trace is antecedent-governed by the COMP of the embedded S', and the initial object trace is lexically head-governed by the V of the embedded clause.

The intermediate traces are lexically head-governed by the V of the matrix clause.

In (18f), the COMP of the embedded S' has the index of the object. Thus, the initial subject trace is not antecedent-governed, because the intermediate trace of the subject does not c-command the initial trace. The initial trace is not lexically head-governed, either. Thus, (18f) violates the ECP.

(19) Extraction from an adjunct

a). * What did John go to bed after he finished?

[$_{S'}$what$_i$ did [$_{S}$John go to bed] [$_{S'}$t$_i$ after [$_{S}$he finished t$_i$]]]

b). * How fast did John go to bed after he finished his homework?

[$_{S'}$how fast$_i$ did [$_{S}$John go to bed] [$_{S'}$t$_i$ after [$_{S}$he finished his homework t$_i$]]]

The extraction of a wh-phrase (both arguments and adjuncts) from a finite adjunct clause is ungrammatical. In (19a) the initial trace of the object is lexically head-governed by the V. However, the intermediate trace in the COMP of the adjunct S' is neither lexically head-governed by the matrix V nor antecedent-governed by the wh-phrase in the COMP of the matrix S'. Since the clause is an adjunct and not a complement, the matrix V cannot govern the COMP of the clause. Since the matrix S' node (S_1) does not dominate the adjunct S' node (S_2) in (20) while the matrix S' node dominates the COMP of the matrix S', the COMP of the matrix S' does not c-command the COMP of the adjunct S'.

(20)

```
            S'1
           /   \
        S'1     S'2
       /  \    /  \
   COMP    S COMP   S
```

Thus, (19a) is a violation of the ECP. In (19b), the initial adjunct trace is antecedent-governed by the intermediate trace in the COMP of the adjunct S'. However, the intermediate trace in the COMP of the adjunct S' is neither lexically head-governed by the matrix V nor antecedent-governed by the wh-phrase in the COMP of the matrix S'. Thus, (19b) is also a violation of the ECP.

6.1.2. The ECP in Chomsky (1986b)

In Chomsky (1986b), X-bar theory, theta theory, and the projection principle restrict movement of XP to XP positions and movement of X0 to X0 positions, and prohibit movement into a complement position.[1] Adjunction is possible only to a non-argument maximal projection, which is not an IP. The distance of wh-movement is constrained by the Subjacency Condition and the Empty Category Principle (ECP). The 2 constraints were defined in terms of the notion of <u>barrier</u>.

(21)

Theta-marking:
A directly Theta-marks B only if A and B are sisters.

Theta-government:
A Theta-governs B iff
a). A is a zero-level category, and
b). A Theta-marks B, and
c). A and B are sisters.

L-marking:
A L-marks B iff
a). A Theta-governs B, and
b). A is a lexical category.

BC (blocking category):
G is a BC for B iff
a). G is not L-marked, and
b). G dominates B
where G is a maximal projection.

Barrier in terms of domination:
G is a barrier for B iff (a) or (b):
a). G immediately dominates D, D a BC for B
b). G is a BC for B, and G =/= IP.
where G is a maximal projection.

Barrier in terms of Minimality:
G is a barrier for B if
a). G is (a projection, immediate projection) of D,
D a zero-level category distinct from B, and
b). G =/= IP, I'

Chomsky (1986b) assumes the phrase stucutre in (22), in which CP headed by C replaces S' headed by COMP, and IP headed by I replaces S headed by Infl of the phrase structure of Chomsky (1981).

(22) Phrase structure in Chomsky (1986b)

```
        CP
       /  \
           C'
          / \
         C   IP
            /  \
          NP    I'
               / \
              I   VP
                 /  \
                V    NP
```

Following Lasnik & Saito (1984), Chomsky (1986b) assumes that the ECP is violated if a non-pronominal empty category is not [+gamma] marked at LF. Gamma marking applies to argument non-pronominal empty categories at SS, and to non-argument non-pronominal empty categories at LF. If a non-pronominal empty category is antecedent-governed, it is [+gamma] marked at the relevant level of representation. If it is not, it is [-gamma] marked. Once a gamma mark is assigned, it cannot be changed at a later stage in derivation. If a barrier in terms of domination or in terms of Minimality intervenes between the non-pronominal empty category and the closest potential antecedent-governor in a representation, then antecedent-government is blocked.

The Subjacency Condition is violated if a chain involves a link that is intervened by a barrier in terms of domination. The Subjacency Condition allows for gradient violation. If a link is intervened by a barrier in terms of domination, then it results in slight decrement of acceptability. If a link is intervened by 2 barriers, then it results in significantly greater decrement of acceptability. Barriers in terms of Minimality do not count as barriers for Subjacency.[2]

Chomsky (1986b) revises the formulation of the ECP in Chomsky (1981) for the following reasons. In Chomsky (1981), the ECP consistes of 2 disjunct clauses, one for lexical head government and the other for antecedent-government. If either clause is satisfied, the ECP is satisfied. However, Chomsky (1986b) notices the following problem.

Where I is finite and does not host a modal, the lexical V moves from the head of VP to I, leaving a trace. The amalgamated V-I takes the index of V, and it is lexical, and therefore, it L-marks the VP so that the trace of V is properly antecedent-governed by V-I. In (23), therefore, <u>seem</u> moves to the I position of the matrix clause. The verb is a raising predicate taking an IP complement, and the subject in the spec of the complement IP must move to the matrix spec of IP to receive Nominative Case, leaving a trace.

(23)

a). John seems to be intelligent.

b). I $[_{VP}$ seem $[_{IP}$ John to be intelligent]]

c). $John_i$ $seem_j$-I $[_{VP}$ t_j $[_{IP}$ t_i to be intelligent]]

In this structure, t_i cannot be antecedent-governed by $\underline{John}_i$ due to a Minimality violation. In order to account for the grammaticality of (23a), Chomsky introduces spec-head agreement, index sharing between the head I and the NP in the spec of IP. By spec-head agreement, $\underline{John}_i$ and $\underline{seem}_j$-I share the same index j=i, and thus, the trace of $\underline{John}_i$ in the spec of complement IP is properly antecedent-governed by the trace of V.

However, Super-raising in (24a) is ungrammatical.

(24)

a). * A man seems there to be killed.

b). I $[_{VP}$ seem $[_{IP}$ there to $[_{VP}$ be killed a man]]]

c). a man_i $seem_j$-I $[_{VP}$ t_j $[_{IP}$ there to $[_{VP}$ be killed t_i]]]

Chomsky (1986b) attempts to explain the ungrammaticality of (24a) in terms of the ECP, on a par with the ungrammaticality of (25a).

(25)

a). * John seems that it appears to be intelligent.

b). $John_i$ seems $[_{CP}$that it appears $[_{IP}t_i$ to be intelligent]]

If the trace of a man is properly governed by lexical-government by the verb killed, then, (24a) should not be an

ECP violation. Thus, Chomsky eliminates the lexical-government clause from the ECP, and requires that a non-pronominal empty category be licensed by antecedent-government. In (24c), by spec-head agreement, j=i. However, the trace of <u>seem</u> is too far way from the trace of <u>a man</u> to antecedent-govern it, because the complement clause VP is a barrier both in terms of domination and in terms of Minimality, and IP also inherits barrierhood from the VP.

Under this formulation of the ECP, that-trace violations are explained as follows.

(26)

a). Who did John think (that) Bill saw?

$[_{CP}$ who$_j$ did $[_{IP}$ John $[_{VP}$ t$_j$ $[_{VP}$ think $[_{CP}$ t$_j$ (that) $[_{IP}$ Bill saw$_k$ $[_{VP}$ t$_j$ $[_{VP}$ t$_k$ t$_j$]

b). Who did John think saw Bill?

$[_{CP}$ who$_i$ did $[_{IP}$ John $[_{VP}$ t$_i$ $[_{VP}$ think $[_{CP}$ t$_i$ $[_{IP}$ t$_i$ saw Bill]

c). * Who did John think that saw Bill?

$[_{CP}$ who$_i$ did $[_{IP}$ John $[_{VP}$ t$_i$ $[_{VP}$ think $[_{CP}$ t$_i$ that $[_{IP}$ t$_i$ saw Bill]

In (26a), the finite complement clause V moves from V to I, and then V-I L-marks VP. Since the VP is L-marked, it is not a BC for the object NP, and therefore, the object NP can be extracted to the spec of the complement CP, without violating Subjacency, because neither IP nor VP is a barrier. However, the C' projection will be barrier in terms of Minimality, which blocks the antecedent-government of the initial trace of the object by the intermediate trace in the spec of the CP, if there is an overt complementizer. Thus, if there is an overt complementizer, then the object must first adjoin to the VP of the complement clause, and then move to the spec of the complement CP. Then, the object NP adjoins to the VP of the matrix clause, and moves to the spec of the matrix CP. The initial trace of the object is antecedent-governed by the intermediate trace in a segment of VP in the complement clause at SS. The intermediate trace in the segment of VP in the embedded clause is not antecedent-governed by the intermediate trace in the spec of the complement CP at SS, if there is an overt complementizer. However, at LF, the complementizer can be erased from the representation, because it does not affect interpretation. If the complementizer is erased, then intermediate trace in the segment of VP in the complement clause is antecedent-governed by the intermediate trace in the spec of the complement CP at LF. The intermediate trace in the spec of the complement CP is antecedent-governed by the intermediate trace in the segment of the VP in the matrix clause. The intermediate trace in the segment of VP in the matrix clause is antecedent-governed by the wh-phrase in the spec of the matrix CP. Thus, all nonargument traces are [+gamma] marked at LF. Thus, (26a) does not violate the ECP.

In (26b), the subject NP of the complement clause moves to the spec of the complement CP, then adjoins to the VP of the matrix clause, and then moves to the spec of the matrix CP. At SS, the initial trace is antecedent-governed by the intermediate trace in the spec of the complement CP, because the C' projection is not a barrier in terms of Minimality in this case, C being empty and thus non-distinct from the head N of the subject NP. At LF, the intermediate trace in the spec of the complement CP is antecedent-governed by the intermediate trace in the segment of the VP of the matrix clause, and the intermediate trace in the segment of VP of the matrix clause is antecedent-governed by the wh-phrase in the spec of the matrix CP. Thus, (26b) does not violate the ECP.

In (26c), the subject NP moves in the same way as in (26b). However, the initial trace is not antecedent-governed by the intermediate trace in the spec of the complement CP, because the C' projection is a barrier in terms of Minimality, C being overt and thus distinct from the head N of the subject NP. Thus, the initial trace is [-gamma] marked at SS. At LF, the overt complementizer can be erased from the representation, because it does not affect interpretation. However, the initial trace is already [-gamma] marked at SS, and therefore, the initial trace cannot be [+gamma] marked. Thus, (26c) is ungrammatical.[3]

The ungrammaticality of the extraction from an finite adjunct clause is explained as follows. An adjunct CP, such as a temporal clause, is not L-marked, and therefore, wh-extraction from an adjunct CP must cross at least one barrier defined in terms of domination. Thus, if a wh-phrase moves into the spec of the adjunct CP and then moves to an A' position in the matrix CP, then the intermediate trace in the spec of the adjunct CP is not antecedent-governed at LF. If the wh-phrase in the DS subject position in the adjunct clause moves directly to an A' position in the matrix CP, then the initial trace is not antecedent-governed at SS. If the wh-phrase in the DS object position moves to a segment of VP and then to an A' position in the matrix, then the intermediate trace in the segment of VP is not antecedent-governed at LF. Thus, extraction from an adjunct CP is a violation of the ECP.

There is a problem with Chomsky's (1986b) framework in accounting for the Superiority effects. (27a) is grammatical, while (28a) is ungrammatical.

(27)

a). Who said what?

b). $[_{CP}$ who$_i$ C $[_{IP}$ t_i say$_k$-I $[_{VP}$ t_k what$_j$]]]

c). $[$ $[_{NP}$ what$_j$ $[_{NP}$ who$_i$]] C $[_{IP}$ t_i say$_k$-I $[_{VP}$ t_j $[_{VP}$ t_k t_j]]]]

(28)

a). * What did who say?

b). $[_{CP}$ what$_j$ did$_k$ $[_{IP}$ who$_i$ t_k $[_{VP}$ t_j $[_{VP}$ say t_j]]]]

c). [$[_{NP}$ who$_i$ $[_{NP}$ what$_j$]] did$_k$ $[_{IP}$ t_i t_k $[_{VP}$ t_j $[_{VP}$ say t_j]]]]

At LF, all wh-phrases in double questions must move to the spec of the matrix CP. In (27a), who is moved to the spec of CP at SS as in (27b), and what is moved to the spec of CP, adjoining to who, at LF as in (27c). In (28a), what is moved to the spec of CP at SS as in (28b), and who is moved to the spec of CP, adjoining to what, at LF as in (28c).

In (27b), the trace of who is antecedent-governed by the wh-phrase in the spec of CP. In (27c), the initial trace of what is antecedent-governed by the intermediate trace in a segment of VP. However, the intermediate trace is not antecedent-governed by what in the spec of CP, because what does not c-command the intermediate trace. If what directly moves to the spec of CP because VP is L-marked by lexical V-I, then the initial trace of what is not c-commanded by what in the spec of CP. Thus, (27a) should be ungrammatical.

In (28b), the initial trace of what is antecedent-governed by the intermediate trace in a segment of VP, and in (27c), the intermediate trace is antecedent-governed by the wh-phrase in the spec of CP. In (27c), the trace of who is not antecedent-governed by who in the spec of CP, because who does not c-command its trace. However, by spec-head agreement, I and who share the same index, and therefore, i=k. Then, the moved did with index k can antecedent-govern the trace of who. Thus, (28a) should be grammatical.

6.1.3. The ECP in Rizzi (1990)

Rizzi (1990) solves the above problems by reformulating the ECP. While Rizzi assumes that Subjacency holds as formulated in Chomsky (1986b), Rizzi formulates the ECP as follows.

(29) ECP in Rizzi (1990) (to be revised later)
A non-pronominal empty category must be
a). properly head-governed (Formal licensing), and
b). theta-governed or antecedent-governed (Identification).

Head-government is formally defined as in (30).

(30) Head-government
X head-governs Y iff:
1). a. X is a head
b. X m-commands Y
2). X = { [+/-V +/-N], Agr, T }
3). a. no barrier intervenes
b. Relativized Minimality is respected.

Proper head-government is government by a head within its immediate projection, which requires that X c-command Y (rather than that X m-command Y). Theta-government is government by a theta-assigner. Antecedent-government is government by an antecedent, as defined in (31).

(31) Antecedent-government
X W-antecedent-governs Y (W = { A, A', X^0 } iff
1). a. X is in a W-position
b. X c-commands Y
2). X and Y are coindexed
3). a. no barrier intervenes
b. Relativized Minimality is respected.

W is a variable that ranges over A, A', and X^0, corresponding to cases of chains formed by NP-movement, wh-movement, and head-movement, respectively.

A barrier is defined as in (32).

(32)
XP is a barrier if it is not directly selected by X^0 not distinct from [+V].

Rizzi assumes that C^0, Agr^0, T^0, and V^0 are not distinct from [+V], and therefore, AgrP selected by C^0, TP selected by Agr^0, and VP selected by T^0 are not intrinsic barriers, while Rizzi leaves Chomsky's (1986b) approach as an alternative. CP is not a barrier when it is selected by a V^0.

M-command and c-command are defined as in (33) and (34).

(33) m-command
X m-commands Y iff
a). neither X dominates Y nor vice versa, and
b). the first maximal projection dominating X dominates Y.

(34) c-command
X c-commands Y iff
a). neither X dominates Y nor vice versa, and
b). the first projection dominating X dominates Y.

Relativized Minimality is defined as (35).

(35) Relativized Minimality
X alpha-governs Y only if there is no Z such that
a). Z is a base-generated position
b). Z is alpha-GTcompatible with Y
c). Z c-commands Y and does not c-command X.

Here, alpha is a variable that ranges over head, A, A', and X^0. An element Z is alpha-GTcompatible if it enters a configuration that is appropriate for the element to be a potential governor of the respective type, as defined in (36).

(36)
a). Z is a typical potential head-governor for Y. i.e., Z is a head m-commanding Y.
b). Z is a typical potential antecedent-governor for Y, Y in an A-chain. i.e., Z is an A-specifier c-commanding Y.
c). Z is a typical potential antecedent-governor for Y, Y in an A'-chain. i.e., Z is an A'-specifier c-commanding Y.
d). Z is a typical potential antecedent-governor for Y, Y in an X^0-chain. i.e, Z is a head c-commanding Y.

Rizzi assumes the phrase structure of Chomsky (1988) as in (37), in which AgrP and TP replaces IP of the phrase structure of Chomsky (1986b).

(37) Phrase structure in Chomsky (1988)

```
        CP
       /  \
           C'
          / \
         C   AgrP
            /    \
          NP      Agr'
                 /    \
              Agr      TP
                      /  \
                          T'
                         / \
                        T   VP
```

Rizzi explains the grammaticality of (27a) and ungrammaticality of (28a) as follows. In (37), the spec of AgrP is the position where the subject NP is base generated. Agr is a head-governor only if it is finite, and it is a head-governor for only an element that it agrees with. T is always a head-governor for VP, even if it is non-finite. While Agr can be an independent head with its own maximal projection, it can also be assigned to another head as a feature or a set of features. In English, C can be expanded to Agr or *that*, or not expanded. *that* and an unexpanded C are inert for government, while C expanded to Agr is a governor. Where C hosts Agr, the subject trace is properly head-governed, as in (38).

(38)

who Agr [t Agr [T [left]]]
AgrP TP VP

The trace is properly A'-antecedent-governed by the wh-phrase in the spec of CP. Thus, the head-government clause and the identity clause of the ECP are satisfied, and (38) is grammatical. However, where C hosts an inflected auxiliary, as in (39), the sentence is ungrammatical.

(39)

who did [t Agr [T [leave]]]
AgrP TP VP

Rizzi claimes that in this case, the inflected auxiliary is base-generated in Agr or T and then moved to C. This movement is substitution, and in order for substitution to be licensed, the hosting C must be radically empty, i.e., not expanded, under the Recoverability Principle. Thus, in (39), C is not a head-governor for the subject trace, and therefore, the sentence is ungrammatical.

In the same way, in (40b), C hosts Agr, and therefore, the trace of <u>who</u> is properly head-governed. The trace of <u>who</u> is also properly A'-antecedent-governed by <u>who</u> in the spec of CP. The initial trace of <u>what</u> is properly head-governed by the V, and it is properly Theta-governed by the V.

(40)

a). Who said what?

b). $[_{CP}\ [_{NP}\ what_j\ [_{NP}\ who_i\ ]]\ Agr\ [_{AgrP}\ t_i\ \ [_{TP}\ T\ [_{VP}\ said\ t_j\ ]]]$

In (41), C does not host Agr, since it hosts an inflected auxiliary. Thus, the subject trace is not head-governed by C. The subject trace is not A'-antecedent-governed by <u>who</u> in the spec of CP, because <u>who</u> does not c-command the trace.

(41)

a). * What did who say?

b). $[_{CP}\ [who_i\ [\ what_j\ ]]\ did_k\ [_{AgrP}\ t_i\ t^k\ [_{TP}\ t_k\ \ [_{VP}\ say\ t_j\ ]]]$

This analysis also predicts subject-object asymmetry in extraction from a complement clause, with the assumption that the complement clause C hosts Agr that agrees with the complement clause subject, only when the subject moves at SS.

(42)

a). Who did John think said what?

b). $[[_{CP}\ what_j\ [who_i]]\ did_k\ [_{AgrP}\ John\ t_k\ [_{VP}\ think$
$[[_{CP}\ t_j\ [t_i]]\ [_{C}\ Agr]\ [_{AgrP}\ t_i\ \ [_{VP}\ said\ t_j]]]]]]]]$

(43)

a). * What did John think who said?

b). $[_{CP}[\text{who}_i\ [\text{what}_j]]\ \text{did}_k\ [_{AgrP}\text{John}\ t_k\ [_{VP}\text{think}$
$[_{CP}[t_i[t_j]]\ [_{C}\text{Agr}]\ [_{AgrP}t_i\ [_{VP}\text{said}\ t_j]]]]]]]]$

(42) and (43) are counterparts of (40) and (41), respectively, involving extraction from a complement clause. The representations of (42a) and (43a) at LF are (42b) and (43b), respectively.

In (42b), the initial trace of the subject of the complement clause is properly head-governed by the Agr in the C of the complement CP, because the complement clause V is finite and shows the subject agreement. The initial trace of the subject is antecedent-governed by the intermediate trace in the spec of the complement CP. The intermediate trace of the subject is properly head-governed by the matrix V and antecedent-governed by the wh-phrase in the spec of matrix CP.

In (42b), the initial trace of the object of the complement clause is properly head-governed and theta-governed by the V in the embedded clause. The intermediate trace of the object adjoined to the intermediate trace of the subject is head-governed by the matrix V, because the intermediate trace of the subject does not count as the closer head-governor for the intermediate object trace, the head of the subject trace not m-commanding the adjoined object trace, and the embedded C not c-commanding its spec position, and because the subject trace NP is not a barrier for the object trace, not dominating the object trace NP in the adjunction structure of (44).

(44)

```
      NPi
     /    \
  NPj      NPi
   |        |
   tj       ti
```

The intermediate trace of the object adjoined to the intermediate trace of the subject is antecedent-governed by the object wh-phrase adjoined to the subject wh-phrase in the spec of the matrix CP, because under (44), the object wh-phrase c-commands its intermediate trace, the NP of the subject wh-phrase not dominating the object wh-phrase.

In (43b), the initial trace of the subject of the complement clause is not properly head-governed by Agr in the C of the complement CP. Though the complement clause V is finite and shows subject agreement, the intermediate trace of the object is in the spec of the complement clause C, and spec-head agreement cannot allow for the complement clause C to agree with the subject. The initial trace of the subject is antecedent-governed by the intermediate trace of the subject in the spec of the complement CP. The intermediate trace of the subject is properly head-governed by the matrix V, and antecedent-governed by the wh-phrase in the spec of the matrix CP.

In (43b), the initial trace of the object of the complement clause is properly head-governed and theta-governed by the V of the complement clause. The intermediate trace of the object adjoined to the intermediate trace of the subject in the spec of the complement CP is properly head-governed by the matrix V, and antecedent-governed by the object wh-phrase adjoined to the subject wh-phrase in the spec of the matrix CP.

A problem with this approach is that it does not explain the ungrammaitcality of Super-raising in (24). Since the raised (or passivized) object is head-governed and Theta-governed by the verb, it does not violate the ECP as formulated in (29).

Therefore, Rizzi revises the formulation of the ECP further. Rizzi separates the identity clause of the ECP and attributes the identity requirement to another constraint in the following way.

Rizzi claimes that an operator and a variable must be connected either by binding or by antecedent-government in order for the variable to be identified.

Binding requires identity of referential indices and the c-command relation. Rizzi restricts the assignment of referential indices to arguments that has a referential Theta role. While all elements selected by the verb are Theta-marked, only those selected elements that refer to participants in the event described by the verb have a referential Theta role. Other selected elements that do not refer to participants but rather qualify the event (measure, manner, etc.) do not have a referential Theta role. Every position that receives a referential Theta role is assigned a referential index at DS, and if the element is moved, it carries its index along. Rizzi defined the binding relation in terms of the referential index, restricting the binding relations to elements with referential Theta roles.

(45)
X binds Y iff
a). X c-commands Y, and
b). X and Y have the same referential index.

Antecedent-government is a chain of local government relations. Rizzi defined a chain as in (46).

(46)
$(a_1, \ldots, a_n)$ is a chain only if for $1 <= i < n$, a_i antecedent-governs a_{i+1}

Then, Rizzi redefined antecedent-government in such a way that the definition does not refer to referential indeces.

(47)
X antecedent-governs Y iff
a). X and Y are nondistinct
b). X c-commands Y
c). no barrier intervenes
d). Relativized Minimality is respected.

The identification by the binding relation can be long-distance, while the identification by antecedent-government is local in nature, in that the latter involves a chain of government, a local relation. This distinction effects the asymmetry between argument extraction and adjunct extraction in A'-chains.

In A-chains, the identification of argument traces is constrained by locality conditions similar to those of adjuncts in A'-chains, as shown in the ungrammaticality of long-distance raising in (24). Rizzi attributes the effect to Theta Criterion defined in terms of chain.

(48) Theta Criterion
a). Each Theta position belongs to a chain containing exactly one argument.
b). Each argument belongs to a chain containing exactly one Theta position.

Since a chain involves government, a local relation, (48) restricts identification of A-movement traces to local relations.

(48) explains the ungrammaticality of (24). Since non-tail elements in a chain must antecedent-govern the element that immediately follows it, the long-distance raising in (24) cannot form a well-formed chain. If <u>there</u> in the spec of IP in the complement of <u>seem</u> is included in the chain in some way, then the chain contains 2 arguments, and therefore, (48a) is violated. If the moved NP <u>a man</u> and its initial trace each become a vacuous chain containing only the moved NP or the trace, then the vacuous chain of the moved NP violates (48b), not having a Theta position, and

the vacuous chain of the trace violates the identity requirement though it satisfies the Theta Criterion.

Rizzi claims that the restriction of referential indeces to referential Theta role positions (arguments) and the Theta Criterion subsume the identification requirement clause (b) of (29). Thus, Rizzi simplifies the ECP to (49).

(49) ECP revised in Rizzi (1990)
A non-pronominal empty category must be properly head-governed.

There is a problem in this reduction. The restriction of referential indeces to referential Theta role positions and the Theta Criterion only capture the distinctions among argument extraction in an A'-chain, adjunct (and head) extraction in an A'-chain, and argument extraction in an A-chain, and do not specify the identity requirement. However, it must still be required that a non-pronominal empty category be identified either by binding or by antecedent-government. This restriction does not seem to be stated in Rizzi's revised formulation. Rizzi apparently assumes that this identity requirement is not a part of the ECP. In his analysis, a representation that violates only the identity requirement is not ungrammatical, but it is uninterpretable.

Under Rizzi's revised analysis, the ungrammaticality of the sentences that are considered ECP violations must be attributed to the lack of proper head-government. The ungrammaticality of 3 types of extractions (that-trace, Superiority, and extraction from a finite adjunct clause) are explained as follows under this revised analysis.

As for the that-trace effects, the extraction of a subject from a complement clause with an overt complementizer is violation of the ECP, because a) the initial trace is not properly head-governed, because the subject trace in the spec of AgrP is not properly head-governed by Agr, Agr not c-commanding the spec of AgrP, and b) it is not properly head-governed by C, because C not expanded to Agr is inert for head-government, though it is a potential head-governor for the spec of AgrP (a head m-commanding the spec of AgrP), and c) it is not properly head-governed by the matrix V, because C is a potential head-governor for the spec of AgrP and c-commands the spec of AgrP, while it does not c-command the matrix V, violating Relativized Minimality.[4]

The extraction of an object from a complement clause with an overt complementizer does not violate the ECP, because the object trace is properly head-governed by the complement clause V.

As for the Superiority effects, the extraction of an object with a subject wh-phrase in situ at SS is a violation of the ECP, if the C of the clause from which the subject is extracted hosts an overt auxiliary at SS, because at LF, a) the subject trace in the spec of AgrP is not properly head-governed by Agr because Agr does not c-command the spec of AgrP, and b) it is not properly head-governed by C, because C hosts an inflected auxiliary at SS, and therefore, must be radically empty and inert for head-government.

The extraction of an object of a complement clause with a subject wh-phrase in situ in the complement clause at SS is also a violation of the ECP, because the C of the complement clause cannot agree with the subject, the spec of the complement CP hosting the object intermediate trace, while the subject intermediate trace is adjoined to the object trace.

The extraction of a subject with an object wh-phrase in situ at SS is not a violation of the ECP, because at SS and LF, the trace of the subject is properly head-governed by C hosting Agr that agrees with the subject.[5]

As for the extraction of an argument or an adjunct from a finite adjunct clause, if all adjunct clause introducers are in C, then the intermediate trace in the spec of CP is not head-governed, because the C is not a proper head-governor, and the CP is a barrier for government from outside, not being selected by the V of the higher clause. Thus, extraction of from a finite adjunct clause is a violation of the ECP, if the wh-phrase is extracted through the spec of the adjunct CP.

Alternatively, the wh-phrase may directly move to the spec of the matrix CP from the position where it is base generated, though the movement may generate a representation that violates Subjacency. In this case, subject extraction is still a violation of the ECP, because the initial trace is not properly head-governed. However, object extraction and adjunct extraction are not a violation of the ECP, because the object trace and the adjunct trace are properly head-governed by the adjunct clause V and Agr/T, respectively. The identification requirement is violated in both object extraction and adjunct extraction, because the wh-phrase in the spec of the matrix CP does not c-command the initial trace in the adjunct CP.

Thus, under Rizzi's (1990) revised analysis, subject extraction from a finite adjunct clause is a violation of the ECP, and object and adjunct extraction from a finite adjunct clause can be either an ECP violation or a Subjacency violation plus the identification requirement violation.

6.1.4. Summary of the formulations of the ECP

As discussed above, different formulations of the ECP make different predictions as to the grammaitcality of certain wh-extractions.

Under Chomsky (1981), the ECP explains the ungrammaticality of the extraction of the subject from a complement clause with an overt complementizer (that-trace violations), the extraction (both from the matrix clause and from a complement clause) of a wh-object with a wh-subject in situ (Superiority violations), and the extraction of arguments and adjuncts from a finite adjunct clause. Meanwhile, it does not explain the ungrammaticality of Super-raising.

Under Chomsky (1986b), the ECP explains the ungrammaticality of that-trace violations, extraction from a finite adjunct clause, and Super-raising. It does not explain the ungrammaticality of Superiority violations.

Under Rizzi (1990), the ECP explains the ungrammaticality of that-trace violations, Superiority violations, and subject extraction from a finite adjunct clause. The ECP may also explain object and adjunct extraction from a finite adjunct clause if the wh-phrase is extracted from a spec of the adjunct CP. If the wh-phrase directly moves to the spec of the matrix CP, then Subjacency and the identification requirement explain the ungrammaticality and uniterpretability of object and adjunct extraction from a finite adjunct clause. Theta Criterion explains the uninterpretability (or unacceptability) of Super-raising.

6.2. The research question

Among the 3 approaches reviewed above, only Rizzi's (1990) formulation of the ECP, the identification requirement and the Theta Criterion appears to provide a consistent account of the 4 types of violations discussed (that-trace, Superiority, extraction from a finite adjunct clause, and Super-raising). Thus, the proposed research adopts Rizzi's formulation of the ECP in testing the L2 learner's knowledge of the ECP in the acquisition of an artificial language. Extraction from a finite adjunct clause is always either ungrammatical due to a violation of the ECP or uninterpretable due a violation of the identification requirement, while that-trace violations and Superiority violations depend on whether the language in question allows for C to host Agr that agrees with the subject or whether the language allows for the subject to be extracted from a position adjoined to the VP of the clause, which is properly head-governed by the V. Therefore, the most stringent test for the knowledge of the ECP/identity requirement appears to be whether the L2 learner rejects extraction from a finite adjunct clause, in that there could not be an explanation for the acceptance of such structures if UG were accessible to the L2 learner.

Meanwhile, that-trace violations and Superiority violations can be used to test whether the L2 learner is treating the artificial language on a par with a natural language. If the learner rejects that-trace violations and Superiority violations in spite of the fact that no information is given in the primary linguistic data as to whether these structure are ungrammatical in the artificial language, then one may claim that the artificial language is treated as a natural language. Even if the learner's L1 can be the source of the knowledge of that-trace violations and

Superiority violations, in order for the learner to project his knowledge of L1 to the artificial language, the learner must be treating the artificial language as a natural language, rather than a non-linguistic symbolic system.

If the L2 learner accepts extraction from a finite adjunct clause on the one hand, and rejects that-trace violations and Superiority violations on the other, then such a grammar is undescribable under the theory of Rizzi (1990).

Thus, the hypothesis tested in the proposed study is:

> If adult L2 learners' IL knowledge is constrained by the ECP (and the identity requirement), then the learners should not be able to achieve the knowledge of structures which allows for wh-extraction from an adjunct CP, as indicated by their consistent acceptance of such structures in grammaticality judgement, and at the same time, the knowledge of the ECP, as indicated by their consistent rejection of wh-extraction from the subject position of a complement CP with an overt C (that-trace effect) and wh-extraction from the object position of a complement CP with a wh-phrase in its subject position (Superiority) in grammaticality judgement.[6]

6.3. Interpretation of violations of UG constraints relevant to wh-movement

White (1992) suggested an interpretation of apparent Subjacency violations as base-generation of wh-phrase in the spec of CP and pro in the gap. This analysis is relevant to the interpretation of ECP violations, because this option generates an apparent wh-extraction construction without a trace, which is not constraint by the ECP, without violating UG constraints. Since it is important to construct tested structures in such a way that there is no alternative interpretation in the proposed study, White's proposal is reviewed in this section.

White (1992) claimed that L2 learners' failure to reject Subjacency violations can be explained by the option of base-generating a wh-phrase in the spec of CP and filling the gap position with a resumptive pro. Saito (1987) claimed that Japanese allows for 2 types of topicalization, one with a base-generated topic and a pro in the gap position, and the other with a topic base-generated in the gap position and moved to the surface topic position by scrambling, leaving a trace in the gap. Cole (1987) also claimed that Korean allows for either a pro or a variable as a null object. Therefore, if L2 learners posit a pro in the gap position, then the structure that appears to be an ECP violation does not violate a UG constraint, since the structure does not involve a non-pronominal empty category. White claimed that natural languages allow for a variety of possibilities with respect to typology of null objects, and that what L2 learners do is interpretable within this range.

White's account fails to explain why L2 learners sometimes reject Subjacency violations and sometimes accept them. White intended to claim that when they accept Subjacency violations, they are base-generating the wh-phrase in the spec of CP and positing a pro in the gap, and whey they reject Subjacency violations, they are base-generating the wh-phrase in the gap position and moving it to the spec of CP, leaving a trace. What this account does not explain is why the option of base-generating the wh-phrase in the spec of CP and positing a pro in the gap is not available when L2 learners reject Subjacency violations. As standardly assumed, if there is at least one way to generate a given structure in conformity with UG constraints, the structure should be well-formed.

Another problem is that White assumed that base-generating a wh-phrase in the spec of CP and positing a pro in the gap is available to Chinese, Korean, and Japanese speakers' L2 English, while the option is not available to Spanish, French, and Dutch speakers' L2 English. If UG allows for such an option, and if UG is accessible to L2 learners, then one must explain why it is not available to speakers of some languages.

Still another problem of White's analysis concerns learnability. If Chinese, Korean, and Japanese speakers assume that base-generating a wh-phrase in the spec of CP and positing a pro in the gap is allowed in English, then they should not be able to constrain their interlanguage grammar, if the Subset Principle is correct (Wexler & Manzini, 1987). White did not clarify what learning mechanism she assumed. If White assumes the Subset Principle, and if White assumes that the L2 learner whose L1 allows for base-generating a wh-phrase in the spec of CP and positing a pro in the gap starts from the assumption that the L1 option holds of the L2, then an interlanguage grammar that correctly does not allow for such an option should be considered a wild grammar, because such a grammar should be unachievable.

White's proposal also has a problem as an empirical claim. White's proposal cannot predict when L2 learners take which one of the options. If one is allowed to assume the movement analysis when L2 learners observe Subjacency and to assume the pro analysis when L2 learners do not observe Subjacency, any facts about Subjacency can be taken as compatible with UG constraints. The claim appears unfalsifiable. White however dismissed the alleged unfalsifiability of her claim by simply mentioning that her analysis was not more or less testable than the claim that Japanese or Korean allows for both a pro and a variable as a null object, and suggesting that more detailed investigation of interlanguage would be required. White did not specify how her claim can be in principle falsified.

I propose that one possible way to falsify White's claim is to test whether L2 learners allow for extraction of an adjunct from a finite adjunct clause. Even if base-generation of a wh-phrase in the spec of CP and of a pro in the gap is allowed by UG, pro is an NP and cannot fill the position of adjuncts (adverbials). Thus, extraction of an adjunct must involve a trace, and thus the structure must be subject to the ECP and the indentification requirement. The proposed study tests the extraction of an adjunct from a finite adjunct clause, and the pro analysis cannot be applied if the learners successfully learn the structure.

Also, even if the option proposed by White were availale, it would not be able to explain other structures to be learned in the proposed study. If the base-generation of pro in the apparent gap is allowed in a given grammar, then a pro should be able to appear in any argument position without a wh-phrase, as long as Binding Principle B is satisfied. Even if it were possible to formulate an additional constraint that a pro must be bound by some wh-operator, then the pro construction should be allowed both in an adjunct clause and in a complement clause. If the artificial language allows for the apparent violation of the ECP or the identification requirement by (argument) wh-extraction from an adjunct CP, while it prohibits that-trace violations and Superiority violations, then the base-generation of a wh-phrase in the spec of CP or base-generation of a pro in the gap must somehow be prohibited in the complement CP, and White's analysis cannot be applied. Thus, it must be a violation of the ECP or the identification requirement.

Notes for Chapter 6

1. Chomsky (1986b) classifies movement into substitution and adjunction. Substitution has the following characteristics:
a). There is no movement to complement position.
b). Only X^0 can move to the head position.
c). Only a maximal projection can move to the specifier position.
d). Only minimal and maximal projections (X^0 and X") are "visible" for the rule Move-alpha.
(a) follows from the theta-criterion. (b) follows from Emonds' (1976) Structure Preservation. (c) follows from the assumption of X-bar theory that heads cannot be base-generated without a maximal projection, which entails that a bare head cannot appear in the specifier to receive a moved X0 category.
Adjunction is possible only to a maximal projection that is a non-argument, and that is not an IP.

2. Subjacency shows a certain crosslinguistic variation. In English, wh-extraction from a finite wh-clause is ungrammatical as in (1), while in Italian, the counterpart of (1) is grammatical.

(1)
* What did John wonder whether he should fix?

Chomsky (1986b) attributed the difference between these languages to an extra barrier in a finite clause from which the wh-phrase is extracted. In English, the IP of the finite clause from which the wh-phrase is moved is an extra barrier effecting the wh-island, since movement from a segment of the complement clause VP to a segment of the matrix VP involves 2 barriers, the complement clause IP and the complement clause CP. In Italian, the CP of the finite clause from which the wh-phrase is moved is an extra barrier. Movement from a segment of the complement clause VP to a segment of the matrix VP involves only 1 barrier, the complement CP, in this case, and there is only a weak 1-Subjacency violation.

3. The construction in Italian comparable to extraction of a subject from a that-clause in English is allowed, because according to Rizzi (1990), the subject wh-phrase is not base-generated in the spec of complement IP, but in the post verbal position as an adjunct to VP, with an expletive pro in the spec of IP. The initial trace of the wh-phrase is a non-argument trace, and it can be antecedent-governed by the intermediate trace in a segment of the matrix VP at LF, where the complementizer of the complement clause can be deleted.

4. The intermediate trace in the spec of CP in the complement clause is properly head-governed by the matrix V, because the V m-commands the spec of CP, and C m-commands but does not c-command the spec of CP, not violating Relativized Minimality.

5. Under this analysis, the identification requirement is satisfied in all above types of Superiority sentences.

In the extraction of an object with a subject wh-phrase in situ at SS, the initial trace of the subject is c-commanded and antecedent-governed by the intermediate trace of the subject adjoined to the intermediate trace of the object in the spec of the complement CP at LF. The intermediate trace of the subject is c-commanded and antecedent-governed by the subject wh-phrase adjoined to the object wh-phrase in the spec of the matrix CP. The initial trace of the object is Theta-governed by the V of the complement clause, and the intermediate trace of the object in the spec of the complement CP is antecedent-governed by the object wh-phrase in the spec of the matrix CP.

In the extraction of a subject with an object wh-phrase in situ at SS, the initial trace of the object is theta-governed by the V of the complement clause at LF, and the intermediate trace of the object adjoined to the intermediate trace of the subject is c-commanded and antecedent-governed by the object wh-phrase adjoined to the subject wh-phrase in the spec of the matrix CP. The initial trace of the subject is antecedent-governed by the intermediate trace of the subject in the spec of the complement CP, and the intermediate trace of the subject is antecedent-governed by the subject wh-phrase in the spec of the matrix CP.

6. Under this hypothesis, I assume the Subset Principle (Wexler & Manzini, 1987) as the learning mechanism, because it is the only learning mechanism that have been seriously discussed in the UG-based research on L2 acquisition of syntax. The artificial language containing UG violations is a superset of L1 (English) and the artificial language containing no UG violations, and therefore, the successful learning of the wild artificial language is not a violation of the Subset Principle, if the learners are capable of successfully learning the artificial language that has no UG violations. The violation of UG/LM predictions in the learning of a wild artificial language is thus attributed only to the violation of the ECP.

7. Review of preceding studies on wh-extractions in L2 acquisition

There have been several studies in L2 acquisition that have dealt with the L2 learner's knowledge of UG constraints relevant to movement. While most of them have concluded that UG constrains L2 acquisition, these studies appear to have problems in the methods employed for data elicitation, the analyses of data, and/or the arguments leading to the conclusions. In this chapter, I will review these studies to clarify some of the problems in the preceding studies on natural L2 acquisition that are claimed to have supported UG-accessibility.

7.1. Felix (1988)

Felix (1988) tested 48 German college students learning L2 English and 23 English speakers with 28 sentences involving 7 structures, 4 of which violated either the ECP or Subjacency (or both).[1]

(50)

ECP violation:
1). Superiority
a. I don't know who did what
b. * I don't know what who did
c. my mother doesn't remember what happened here
d. * my mother doesn't remember where what happened

(50 continued.)

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2).   That-trace effects
a.    who do you believe that John gave a book to
b. *  who do you believe that will come
c.    who does John believe that he saw
d. *  who does John believe that saw him

ECP and Subjacency violation:
3).   Subject condition
a.    which piano is it fun to play
b. *  which piano is to play fun
c.    which girl is it a pleasure to love
d. *  which girl is to love a pleasure

Other constraints:
4).   Parasitic gaps
a.    a person that they spoke to because they admired
b. *  a person that they spoke to because admired them
c.    a person they spoke to because they admired
d. *  a person they spoke to because admired them

5).   Control (CP complement) vs. ECM (IP complement) verbs
a.    Jones was easy for Smith to persuade to come to the
      party
b. *  Jones was easy for Smith to expect to come to the party
c.    Bill is difficult for John to persuade to quit the job
d. *  Bill is difficult for John to expect to quit the job

6).   Specified subject
a.    who did the man see pictures of
b. *  who did the man see John's pictures of
c.    who did he hear stories about
d. *  who did he hear John's stories about

7).   Case filter effects
a.    John seems to love Mary
b. *  Mary seems John to love
c.    John seems to like Bavaria
d. *  Bavaria seems John to like
```

None of the contrasts in the test sentences is present in German. In German, both subject and object extractions are allowed at SS, and no extraction is allowed from a that-clause. No parasitic gap is allowed, while extraction from a clausal subject is allowed. ECM is restricted to a smaller class of verbs in German, and preposition stranding in (50.6) is impossible. There is no case filter violation in (50.7) because German is verb-second so that the preverbal COMP-position can be the landing site for any XP.

Subjects were presented with the 28 test sentences and 12 grammatical distractor sentences in a randomized order and were asked to judge sentence as either grammatical or ungrammatical.

Felix's results were as in Table 7.1.1 (Table 2 in Felix (1988: 283)).

Table 7.1.1 : Felix's (1988) results, percentage of judgements

	gr/ungr	experiment		control	
		gr	ungr	gr	ungr
Superiority					
a	gr	68.8	31.2	91.3	8.7
b	ungr	35.4	64.6	4.3	95.7
c	gr	66.7	33.3	87.0	13.0
d	ungr	33.3	66.7	4.3	95.7
Parasitic gap					
a	gr	31.3	68.7	0.0	100.0
b	ungr	8.4	91.6	0.0	100.0
c	gr	29.2	70.8	0.0	100.0
d	ungr	4.2	95.8	0.0	100.0
ECM/Control					
a	gr	37.5	62.5	21.5	78.5
b	ungr	22.9	77.1	0.0	100.0
c	gr	43.6	56.4	21.5	78.5
d	ungr	25.2	74.8	0.0	100.0
that-trace					
a	gr	52.1	47.9	82.7	17.3
b	ungr	37.5	62.5	0.0	100.0
c	gr	64.5	35.5	87.0	13.0
d	ungr	31.2	68.8	0.0	100.0

(Table 7.1.1 continued)

	gr/ungr	experiment gr	experiment ungr	control gr	control ungr
Subject Condition					
a	gr	47.9	52.1	100.0	0.0
b	ungr	20.8	79.2	0.0	100.0
c	gr	56.4	43.6	100.0	0.0
d	ungr	18.7	81.3	0.0	100.0
Case Filter					
a	gr	93.7	6.3	100.0	0.0
b	ungr	14.5	85.5	0.0	100.0
c	gr	91.6	8.4	100.0	0.0
d	ungr	6.3	93.7	0.0	100.0
Specified Subject					
a	gr	52.1	47.9	100.0	0.0
b	ungr	6.3	93.7	8.7	91.3
c	gr	68.6	31.4	100.0	0.0
d	ungr	8.4	91.6	4.3	95.7

The control group did not consistently reach a perfect score. The control group rejected all parasitic gap constructions, and Felix attributed it to the parasitic gap constructions' violation of Bijection Principle (Koopman & Sportiche, 1981). Some subjects in the control group rejected grammatical Control vs. ECM sentences, and Felix attributed it to the stylistic awkwardness of these sentences.

One subject in the control group accepted ungrammatical superiority sentences 1b and 1d and an ungrammatical specified subject sentence 6d in (50), and two accepted an ungrammatical Specified Subject sentence 6d in (50). Felix had no explanation for these cases, while he suggested that it might haven been due to dialectal differences, and contrastive judgement might have elicited the predicted pattern, if it had been used.

The experiment group judged less precisely and less consistently than the control group, while in the majority of cases, the experiment group showed the same general response pattern as the control group. In 3 sentences, 2a, 3a, 6a in (50), the experiment group gave chance-level responses.

In the parasitic gap construction, the experiment group performed better than the control group, while the experiment group tended to reject both grammatical and ungrammatical parasitic gap sentences. The experiment group never accepted ungrammatical ones, and 1/3 of the experiment group had correct intuition about the grammatical sentences. Felix claimed that L2 learners were less distracted by stylistic considerations than native speakers.

In control vs. ECM sentences, 3/4 of the experiment group judged correctly on ungrammatical sentences, while only a minority of the experiment group judged correctly on grammatical sentences. Felix suspected that the stylistic awkwardness somehow affected the judgement.

In that-trace sentences, 2/3 of the experiment group judged correctly on ungrammatical sentences. The result for grammatical sentences was less clear in that the experiment group responded at the chance-level to 2a while close to 2/3 of the experiment group accepted 2c. Felix claimed that considerations independent of UG constraints affected the L2 learners' judgement.

In Subject Condition sentences, more than 3/4 of the experiment group judged correctly on ungrammatical sentences, while roughly 1/2 of them judged correctly on grammatical sentences. Felix attributed it to considerations independent of UG constraints.

In Case Filter sentences, close to 90% of the experiment group judged correctly on both grammatical and ungrammatical sentences.

In Specified Subject sentences, more than 90% of the experiment group judged correctly on ungrammatical sentences. Two thirds of the experiment group also judged correctly on one grammatical sentence 6c, while they responded at the chance-level to 6a. Felix suspected that either preposition stranding or who as an object pronoun affected the judgement.

In spite of the difference between native speakers and L2 speakers in all constructions except for Case Filter and Specified Subject sentences, Felix concluded that in most cases the majority of test subjects gave correct responses in judging structural contrasts that can neither be learned from the primary linguistic data nor can be transferred from L1 German, and that adult L2 learners do have consistent intuitions about grammaticality contrasts involving principles of UG, supporting the view that adult learners have access to principles of UG.

Felix attributed all data not conforming to the UG prediction to stylistic or unknown reasons independent of UG. It was not clear how Felix was to explain relatively large differences between the experiment group and the control group, such as the experiment group's 33-35% incorrect judgements on ungrammatical Superiority sentences (the control group 4.3% incorrect), 23-25% incorrect judgements on ungrammatical control/ECM sentences (the control group 0% incorrect), 31-38% incorrect judgements on ungrammatical that-trace sentences (the control group 0% incorrect), 19-21% incorrect judgements on ungrammatical Subject Condition sentences (the control group 0% incorrect). If all non-conforming data is treated this way, then there cannot be any evidence against UG-accessibility.

Moreover, Felix reported only percentages of responses in each response type to the total number of items for each category (grammatical and ungrammatical) and each sentence type, and did not present results from a test of significance of the difference between group means or of the difference between the expected and observed frequencies. I performed chi-square tests on the percentages reported in Table 7.1.1, with the control group's performance as the expected ratio for the experiment group's performance. A chi-square was calculated for each sentence in which neither the experiment group nor the control group performed categorically. The results are presented in Table 7.1.2.

Table 7.1.2: Results of chi-square tests for the difference between the experiment group and the control group (one-tailed)

		chi-square	probability
Superiority			
a	gr	63.73 (df=1)	p < .001
b	ungr	235.04 (df=1)	p < .001
c	gr	36.44 (df=1)	p < .001
d	ungr	204.37 (df=1)	p < .001
Parasitic gap			
a	gr	-----	
b	ungr	-----	
c	gr	-----	
d	ungr	-----	
ECM/control			
a	gr	15.17 (df=1)	p < .001
b	ungr	-----	
c	gr	28.94 (df=1)	p < .001
d	ungr	-----	
That-trace			
a	gr	65.45 (df=1)	p < .001
b	ungr	-----	
c	gr	44.76 (df=1)	p < .001
d	ungr	-----	
Subject Condition			
a	gr	-----	
b	ungr	-----	
c	gr	-----	
d	ungr	-----	
Case Filter			
a	gr	-----	
b	ungr	-----	
c	gr	-----	
d	ungr	-----	
Specified Subject			
a	gr	-----	
b	ungr	.73 (df=1)	p < .50
c	gr	-----	
d	ungr	4.08 (df=1)	p < .05

All chi-squares except for one for a Specified Subject sentence reached a significance level.

Given the above results, Felix's conclusion that the performance of the experiment group reflected their consistent judgement on structural contrasts that could not be attributed to the primary linguistic data in L2 nor to the knowledge of L1 appears unjustified. If their judgement was consistent, then it must be said that the experiment group's judgement was consistent at a level significantly lower than the level at which the control group's judgement was.

The experiment group judged more correctly on ungrammatical structures than on grammatical structures. Felix claimed that this fact supported the view that adult learners have access to UG. If a sentence violates a UG principle, then other considerations such as stylistic or pragmatic factors will be immaterial for determining ungrammaticality. If a sentence does not violate any UG principle, then the sentence may still be unacceptable for reasons other than UG violation. Thus, judgements on grammatical sentences can be less accurate than judgements on ungrammatical sentences, if the learners have access to UG. If an ungrammatical sentence violating a UG principle is judged as grammatical, then this suggests that the learner has no access to UG, since other factors cannot override ungrammaticality determined by the UG violation. Thus, correct judgements on ungrammatical sentences are more important than correct judgements on grammatical sentences in determining whether learners have access to UG.

Birdsong (1989) argued against Felix's interpretation of more accurate judgements on ungrammatical sentences than on grammatical sentences. Birdsong claimed that the fact that the L2 learners tended to reject sentences could explain why they performed more correctly on ungrammatical sentences than on grammatical sentences. The details of Birdsong's argument is discussed in Section 9.1.3.

7.2. Schachter (1989)

Schachter (1989) tested 20 Indonesian speakers, 21 Chinese speakers, and 20 Korean speakers learning L2 English and 19 English speakers on their knowledge of Subjacency using 4 constructions: sentential subject, relative clause, NP complement, and embedded question.

Schachter claimed, citing personal communication with Müller-Gotama, that in Indonesian, Subjacency operates as it does in English, except that the wh-phrase must be moved to the clause initial position before it can be extracted from the clause, and citing personal communication with Saito, that in Korean, there is no movement to which Subjacency applies. Huang (1982) claimed that in Chinese, there is no wh-extraction, while relativization from a complex NP or from a sentential subject and topicalization are allowed.

Schachter claimed that if speakers of a language that does not show evidence of Subjacency (Korean) or speakers of a language that shows evidence of Subjacency in only certain constructions (Indonesian, Chinese) become proficient in English, and if UG principles are available to L2 learners, then it should be the case that L2 learners, who have acquired the relevant complex structures, should exhibit the knowledge of Subjacency, which constrains extraction from those structures.

Subjects were asked to judge 6 grammatical non-extraction sentences and 6 ungrammatical extraction sentences in each of the 4 constructions.

(51)

Grammatical sentences:
SS: That oil prices will rise again this year is nearly certain.
RC: The theory we discussed yesterday will be on the exam next week.
NC: There is a good possibility that we can obtain the information elsewhere.
EQ: The dorm manager asked me who I wanted to have as a roommate.

Ungrammatical sentences:
SS: * Which party did [for Sam to join t] shock his parents?
RC: * What did Susan visit the store [that had t in stock]?
NC: * What did the police have evidence [that the mayor murdered t]?
EQ: * Who did the Senator ask the President [where he would send t]?

where:
SS = sentential subject
RC = relative clause
NC = NP complement
EQ = embedded question

Subjects who correctly judged 5 sentences out of 6 grammatical sentences for each construction were considered to have passed the syntax construction test for that construction. Subjects who correctly judged 5 sentences out of 6 ungrammatical sentences for each construction were considered to have passed the Subjacency test for that construction.

It was predicted that if Subjacency is available to L2 learners, then most non-native speaker subjects should fall in either the A cell or the D cell, and if the test measure is valid, then most native speaker subjects should fall in the A cell in (52).

(52)

		Syntax test	
		pass	fail
Subjacency test	pass	A	B
	fail	C	D

The results are presented in Tables 7.2.1, 7.2.2, and 7.2.3 (Tables 3.2, 3.3, and 3.4 in Schachter (1989: 83, 84, 85), respectively).

Table 7.2.1: Schachter's (1989) results for native speakers

		SS		RC		NC		EQ	
		Syntax test							
		pass	fail	pass	fail	pass	fail	pass	fail
Subjacency test	pass	15	3	17	1	10	1	14	2
	fail	1	0	0	1	7	1	3	0

Table 7.2.2: Schachter's (1989) results for non-native speakers

Indonesian:

		SS (Syntax test)		RC		NC		EQ	
		pass	fail	pass	fail	pass	fail	pass	fail
Subjacency test	pass	6	1	6	1	8	0	8	1
	fail	11	2	9	4	11	1	6	5

Chinese:

		SS (Syntax test)		RC		NC		EQ	
		pass	fail	pass	fail	pass	fail	pass	fail
Subjacency test	pass	7	5	10	0	11	0	7	2
	fail	7	1	6	4	9	0	9	2

Korean:

		SS (Syntax test)		RC		NC		EQ	
		pass	fail	pass	fail	pass	fail	pass	fail
Subjacency test	pass	3	2	5	0	2	0	3	0
	fail	7	9	8	8	15	4	13	5

Table 7.2.3: Comparisons of native speakers with non-native speakers

		control (Syntax test)		Indonesian		Chinese		Korean	
		pass	fail	pass	fail	pass	fail	pass	fail
Subjacency test	pass	56	7	28	3	31	8	13	2
	fail	11	2	37	12	33	8	43	26

Indonesian df=3, chi-square = 237.196, $p < .001$
Chinese df=3, chi-square = 116.688, $p < .001$
Korean df=3, chi-square = 614.297, $p < .001$

The results showed that while non-native speakers could generally correctly accept grammatical sentences, only about one third of them could pass the syntax test and the Subjacency test. Since the native speaker control group performed as expected, the test measure was appropriate. Thus, Schachter claimed that many non-native speakers had knowledge of the tested constructions, while they did not necessarily have knowledge of Subjacency.

To compare the performance of non-native speakers with the performance of native speakers, the number of subjects in the 4 cells across 4 constructions were collapsed into a 2 x 2 matrix for each group, as in Table 7.2.3. Chi-square tests showed that the distribution of subjects among the 4 categories was significantly different between each of the non-native speaker groups and the control group. Schachter concluded, on the basis of the significant difference between each of the experiment groups and the control group, that the hypothesis that all UG principles are available to the adult L2 learner must be rejected.

There were some problems with the test sentences and the method of analysis in Schachter's study.

While Schachter used grammatical sentences without extraction for the test of the knowledge of relevant structures and ungrammatical sentences with extraction for the test of the knowledge of Subjacency, the grammatical sentences were not exact counterparts of the ungrammatical sentences.

In the sentential subject sentences, the grammatical sentence set contained 2 sentences with a finite clause as a sentential subject, 2 sentences with an infinitive (without for-subject), and 2 sentences with a PRO-ing gerund. Meanwhile, the ungrammatical sentence set contained 2 sentences with a finite clause as a sentential subject, 3 sentences with an infinitive with for-subject, and 1 sentence with a finite clause with a complex NP subject from which the wh-phrase was extracted.

Similarly, in the relative clause sentences, the grammatical sentence set contained 3 sentences with a relative clause modifying an object NP, 2 sentences with a relative clause modifying a subject NP, and 1 sentence with a relative clause modifying an NP within a complex subject NP. Meanwhile, the ungrammatical sentence set contained only sentences with a relative clause modifying an object NP.

In the embedded question sentences, the grammatical sentence set contained 3 sentences with the wh-phrase extracted from an object of a transitive verb and 3 sentences with the wh-phrase extracted from a be verb predicate. Meanwhile, the ungrammatical sentence set contained only sentences with the wh-phrase in the spec of matrix CP extracted from an object of a transitive verb, 3 of which had the other wh-phrase in the spec of the embedded CP extracted from a subject, and 3 others of which had the other wh-phrase in the spec of the embedded CP extracted from an adjunct position (adverb).

It was not clear why Schachter included, in the grammatical sentence set, structures that were not used in the test of the knowledge of Subjacency.

Moreover, some of the test sentences were invalid for the test of the knowledge of Subjacency. Some of the sentential subject sentences had a finite clause subject. The sentences with a finite clause subject were invalid for the test of the knowledge of Subjacency, in that subject-auxiliary inversion is impossible in a sentence with a finite clause subject in English, and therefore, an interrogative sentence with a finite clause subject is ungrammatical without extraction from a sentential subject.

There was also a problem in the chi-square test that Schachter performed on the distribution of subjects over the 4 categories in terms of pass/fail of the syntax test and the Subjacency test. While Schachter found a significant difference between each of the experiment group and the control group in the distribution of subjects over the 4 categories, part of the value of each chi-square was from the variation of the frequencies in the A cell and the D cell within the A-D cell cluster and from the variation of frequencies in the B cell and the C cell within the B-C cell cluster, rather than the variation between the A-D cell cluster and the B-C cell cluster. Since the tested UG-accessibility claim was that the L2 learner, who has acquired the relevant complex structures, should exhibit the knowledge of Subjacency, the subjects who fell in either the A cell or the D cell should have been considered to conform to the prediction, and the distribution of subjects in the A cell and the D cell within the A-D cell cluster should be irrelevant to the test of the hypothesis. In the same way, the subjects who fell in either the B cell or the C cell should have been considered to contradict the prediction, and the distribution in the B cell and the C cell within the B-C cell cluster should be irrelevant to the test of the hypothesis. Thus, appropriate chi-square tests should have been performed on the frequencies in the A-D cell cluster and in the B-C cell cluster across language groups.

I recalculated the chi-squares by collapsing the frequencies in the A and D cells and in the B and C cells, and comparing the 2 frequencies between each of the experiment groups and the control group. The results are presented in Table 7.2.4.

Table 7.2.4: Recalculation of chi-squares

	control	Indonesian	Chinese	Korean
conforming	58	40	39	39
non-conforming	18	40	41	45

Indonesian df=1, chi-square = 32.48, $p < .001$
Chinese df=1, chi-square = 35.61, $p < .001$
Korean df=1, chi-square = 46.72, $p < .001$

In spite of the problem discussed above, the recalculated chi-squares were significant.

7.3. White (1988)

White (1988) claimed that if interlanguages are constrained by UG, then violations of invariable UG constraints and options not allowed by parameterized UG constraints should be impossible in interlanguages, while options incorrect for the target language, which are allowed by parameterized UG constraints, may be possible. Also, White claimed that L1 parameter setting is transferred to the interlanguage in the initial stages of L2 acquisition.

White tested 3 groups of French speakers learning L2 English, the adult 1 group, who were 18 adult learners at a low intermediate level, the adult 2 group, who were 25 adult learners at a high intermediate or an advanced level, and the secondary IV group, who were 23 secondary students, and 1 group of 14 native speakers of English, on their knowledge of Subjacency and the ECP.

The structures tested included extraction from a complement of an object NP, extraction from a complement of a subject NP, extraction from a complex NP, extraction from a wh-clause, and subject extraction from a that-clause.

```
(53) object noun complement
a).  John likes [the people [in this office]]
                NP          PP
b).  * Which office does [John like [the people [in  t ]]]
                         IP         NP          PP

(54) subject noun complement
a).  [Your interest [in baseball]] surprised me
     NP
b).  * What did [  [your interest [in  t ] surprise me]
                IP NP              PP
(55) complex NP
a).  Mary believed [the claim [that John had won the race]]
                   NP         CP
b).  * What did [Mary believe [the claim [that
                IP            NP         CP
       John had won  t  ]]]
```

(56) wh-clause
a). John wondered [$_{CP}$ whether [$_{IP}$ Mary had chosen a good book]]
b). * Which book [did John wonder [$_{CP}$ whether [$_{IP}$ Mary had chosen t]]]

(57) that-clause
a). Who does John believe that Mary saw t ?
b). Who does John believe Mary saw t ?
c). * Who does John believe that t saw Mary?
d). Who does John believe t saw Mary?

The constraint against extraction from a complement of NP, extraction from a complex NP, and extraction from a wh-clause is Subjacency, and the constraint against subject extraction from a that-clause is the ECP.

In Chomsky (1981), Subjacency was formulated such that it rules out a derivation in which movement crosses 2 or more bounding nodes (S'(=CP), S(=IP), NP, and PP in English and S', NP, and PP in French in White's (1988) presentation).[2,3] Since S', NP and PP are bounding nodes both in English and French, White predicted that French speakers learning L2 English would correctly reject extraction from a complement of an object NP, extraction from a complement of a subject NP, and extraction from a complex NP in English. Meanwhile, since S is not a bounding node in French, White predicted that they would allow for extraction from a wh-clause.

In terms of the ECP, French and English are the same in that subject extraction from a that-clause is prohibited, except that in French, the subject NP can be extracted when the complementizer is *qui* rather than *que*. Thus, White predicted that French learners of L2 English would correctly reject extraction from a that-clause in English.

White (1988) attributed the ungrammaticality of extraction from a complement of a subject NP to both Subjacency and the ECP, using Kayne's (1981) revised ECP that attributed the stronger ungrammaticality of (58b) than that of (58a) to the lack of proper government of the trace inside a subject NP due to the lack of a path between the antecedent and the empty category.

(58)

a). * Who did Mary destroy a book about t ?

b). * Who did stories about t frighten Mary?

White predicted that French speakers would also correctly reject extraction from a complement of a subject NP, since it involves a Subjacency violation with NP and PP as bounding nodes and an ECP violation.

To test Subjacency or the ECP, the learner must have reached a stage at which he has mastered structures involving several bounding nodes. The assumption that constraints are triggered only when the learner reaches the appropriate level of complexity in the interlanguage made an additional prediction that there would not be gross discrepancies between subjects' treatment of grammatical sentences and their treatment of ungrammatical sentences. If subjects had not acquired the embedding structure, then they should make consistent judgements neither on grammatical sentences nor on ungrammatical sentences. If subjects had acquired the embedding structure, then they should make consistent judgement on grammatical and ungrammatical sentences.

Subjects were tested with 2 grammaticality judgement tests, and 1 comprehension test.

The first grammaticality judgement test was an unpaced task with a multiple-choice format, given in the written format. Test sentences were placed in groups of 3 or 4 sentences, and each group was preceded by a context sentence. Subjects were asked to circle any sentence which they thought to be incorrect, to put a question mark by any sentence they were not sure of, and to leave unmarked any sentences they thought to be correct. There were 80 sentences, 40 of which were relevant to Subjacency and the ECP. Of the 40 sentences relevant to Subjacency and the ECP, 19 were grammatical, and 21 were ungrammatical.

The second grammaticality judgement test was a paced task, in which sentences were presented visually as well as auditorily. Subjects viewed each sentence in the written form and also heard it as pronounced by a native speaker of Canadian English on a tape recording. The tape was paced so that only 3 seconds were allowed for response to each sentence. The sentences were presented without a context. Subjects were asked to mark, on a 9 cm line below each sentence, a stroke on the lefthand side if they thought the sentence was incorrect, a stroke on the righthand side if they thought the sentence was correct, and a stroke in the middle if they were not sure whether the sentence was correct or incorrect. Subjects were allowed to mark a stroke anywhere on the 9 cm line, according to the degree of correctness or incorrectness that they felt as to the sentence. In the analysis of subjects' responses, a scale was imposed on the 9 cm line, so that the response "totally incorrect" received the score 0.5 and the response "totally correct" received the score 9, and the response "not sure" received the score 4.5 and 5. There were 42 sentences, 21 of which were relevant to Subjacency and the ECP. Of the 21 sentences, 9 were grammatical and 12 were ungrammatical.

In the comprehension test, subjects viewed pairs of written sentences with extraction from a complement of an object NP, and were asked to answer a question for each pair. The sentences involved an ambiguity in interpretation of the type exemplified in (59).

(59)
The boy hit the cat with a short tail.
He hit the cat with a stick.
What did the boy hit the cat with?

If the NP <u>a short tail</u> is extracted from the NP <u>a cat with a short tail</u>, then it is a violation of Subjacency because the wh-phrase moves over NP and PP. Thus, the answer to the question cannot be "a short tail". There were 6 test questions and 3 control questions, the latter of which were to test whether the subjects knew the relevant structure without extraction.

The adult 1 group (low intermediate) was tested in 2 batches, and 1 batch did not have time to do the paced grammaticality judgement task. Some subjects in the adult 2 group (high intermediate/advanced) did not complete the multiple-choice grammaticality judgement task. The control group took all the tests.

The results of the unpaced multiple-choice grammaticality judgement are presented in terms of percentages of correct responses in Table 7.3.1 (Table 2 in White (1988: 157)).

Table 7.3.1: White's (1988) results for unpaced multiple-choice grammaticality judgement

	ungrammatical				grammatical			
	C	1	2	3	C	1	2	3
Complex NP	96	80	81	47	81	76	53	60
Wh-island	91	65	80	59	97	80	86	56
Object NP	87	80	80	58	83	76	75	49
Subject NP	89	87	81	54	85	76	76	39
That-trace	82	54	67	57	98	57	83	66

C = Control n = 14
1 = Adult 1 n = 18
2 = Adult 2 n = 17
3 = Secondary IV n = 23

The secondary IV group performed at the chance level in grammatical sentences, suggesting that they had not acquired the complex sentence structure. They also performed at the chance level in ungrammatical sentences, as predicted.

The 2 adult groups showed a performance closer to the native control group both in grammatical sentences and in ungrammatical sentences. The performance was 75% correct or higher in all structures except for ungrammatical wh-island sentences and grammatical and ungrammatical that-trace sentences in the adult 1 group, and grammatical complex NP sentences and ungrammatical that-trace sentences in the adult 2 group. White claimed that the overall performance of the adult groups on grammatical sentences showed that they had a control of complex sentences.

As for extraction from a complement of an object NP, there was no significant difference between the 2 adult groups and the control group both in grammatical sentences and in ungrammatical sentences. However, the control group accepted ungrammatical sentences, and therefore, this structure was not able to test L2 learners' knowledge of Subjacency.

As for extraction from a complex NP, the adult 1 group performed relatively high in both grammatical and ungrammatical sentences, as predicted. However, the adult 2 group performed significantly less accurately in grammatical sentences than in ungrammatical sentences, which contradicted the prediction that the accuracy in grammatical sentences and the accuracy in ungrammatical sentences should not be significantly different, regardless of whether the subjects had acquired the relevant complex structure.

As for extraction from a wh-clause, the adult 2 group performed relatively accurately both in grammatical sentences and in ungrammatical sentences. The adult 1 group performed relatively accurately in grammatical sentences, while they performed significantly less accurately in ungrammatical sentences. Since French does not count S as a bounding node, White speculated that the lower performance in ungrammatical sentences may be due to the transfer of L1 parameter setting to the interlanguage.

White attributed the difference between the adult 1 group and the adult 2 group in the judgement of ungrammatical extraction from a wh-clause to parameter resetting. White claimed that the adult 2 group, which was more advanced than the adult 1 group in English proficiency, had reset the parameter value to the correct L2 setting, while the adult 1 group had not.

As for extraction from a complement of a subject NP, there was no significant difference between the control group and the adult groups, both in grammatical sentences and in ungrammatical sentences.

As for subject extraction from a that-clause, the adult 1 group performed significantly less accurately than the adult 2 group. Since the adult 1 group responded randomly to grammatical sentences, no interpretation was made about their responses to ungrammatical sentences. The adult 2 group performed relatively accurately in grammatical sentences, while they performed less accurately in ungrammatical sentences. While the large difference between grammatical sentences and ungrammatical sentences was contradictory to the prediction, White claimed that the acceptance of that-trace violations was not a UG violation, because there are languages in which that-trace sequences are grammatical.

The results of the paced grammaticality judgement are presented in terms of mean ratings on different types of sentences in Table 7.3.2 (Table 3 in White (1988: 160)).

Table 7.3.2: White's (1988) results for paced grammaticality judgement

	ungrammatical				grammatical			
	C	1	2	3	C	1	2	3
Complex NP	0.55	1.34	1.86	5.13	8.08	8.18	6.59	5.64
Wh-island	0.52	4.34	2.16	3.57	8.32	7.44	6.28	5.31
Object NP	3.54	4.08	3.47	5.18	8.83	7.41	7.85	5.05
Subject NP	1.27	2.90	2.50	5.65				
That-trace	1.54	6.21	6.14	7.31	9.00	8.42	8.73	5.13

C = Control n = 14
1 = Adult 1 n = 8
2 = Adult 2 n = 24
3 = Sec. IV n = 23

Scores close to 0.5 show strong rejection, and scores close to 9 show strong acceptance.

The secondary IV group marked the middle range, showing "not sure" judgements in grammatical sentences and in ungrammatical sentences.

As for extraction from a complement of an object NP, there was no significant difference between the 2 adult groups and the control group. The adult groups performed highly accurately in grammatical sentences for extraction, while they failed to reject ungrammatical sentences. However, the control group also failed to reject ungrammatical sentences, resulting in a nonsignificant difference.

As for extraction from a complex NP, there was no significant difference between the 2 adult groups and the control group both in grammatical sentences and in ungrammatical sentences. However, the adult 2 group showed lower acceptance of grammatical sentences than other groups.

As for extraction from a wh-clause, there was a significant difference among the 2 adult groups and the control group in grammatical sentences, due to the fact that the adult 2 group did not show definite judgements, compared with the adult 1 group and the control group. There was also a significant difference among the 2 adult groups and the control in ungrammatical sentences, due to the fact that the adult 1 group did not reject violations.

As for extraction from a complement of a subject NP, the adult groups performed highly accurately, and there was no significant difference among the 2 adult groups and the control group in ungrammatical sentences. (There was no grammatical sentences for extraction from a subject NP.)

As for subject extraction from a that-clause, there was a significant difference among the 2 adult groups and the control group. The adult groups performed highly accurately in grammatical sentences, while they failed to reject ungrammatical sentences. The control group correctly rejected them.

The results of the comprehension test are presented in Table 7.3.3 (modified from Table 4 in White (1988: 162)).

Table 7.3.3: White's (1988) results for the comprehension test

	control	test
Control n = 14	92.85	97.61
Adult 1 n = 8	79.16	87.50
Adult 2 n = 25	77.33	87.33
Sec. II n = 29	58.62	34.48
Sec. IV n = 23	53.62	38.40

The adolescents performed poorly on the control sentences, suggesting that they had not had a control of the relevant structure. White reported that the adolescents chose an NP from the first sentence significantly more than an NP from the second sentence of the pair of sentences for each item, regardless of the structure in the test sentences.[4]

The adult groups performed highly accurately in the control items, suggesting that they knew the relevant structure. The adult groups also performed highly accurately in test items, suggesting that they observed Subjacency. There was no significant difference between the 2 adult groups both in the control sentences and in the test sentences.

White concluded the following on the basis of the results.

Since the adults performed highly accurately on grammatical sentences, they had a control of the relevant structures. Then, the adults should observe Subjacency and the ECP. White claimed that the adults' performance in grammaticality judgement on extraction from a complex NP, a complement of an object NP, and a complement of a subject NP, and their performance in comprehension task on extraction from a complement of an object NP supported the hypothesis.

The hypothesis predicted that wh-island violations may be accepted by L2 learners. White claimed that the adult 1 group accepted wh-island violations, probably due to the parameter setting of L1, and that since the adult 2 group however rejected wh-island violations, parameter re-setting was possible.

The discrepancy between the adult 2 group's poorer performance on grammatical sentences for extraction from a complex NP and their better performance on ungrammatical sentences contradicted the prediction. White attributed it to possible problems with the test items, since the control group showed a similar pattern.

Both adult groups rejected extraction from a subject NP, while they performed variably on that-trace sequences. The difficulty in that-trace cannot be attributed to the difficulty in resetting the parameter since the ECP applies to that-trace sequences both in L1 and in L2. White claimed that the difference in accuracy in judging extraction from a subject NP and extraction from a that-clause suggested that the latter should be analyzed differently from other ECP effects, and that in this regard, L2 acquisition data could be used to test linguistic theories.

There were some opportunistic arguments in White's claims. I have already discussed the circularity problem in the claim that L2 learners' performance on that-trace sequences contradicting the prediction can be used to test linguistic theories in Section 1.2.1. There were some additional problems in her claims.

While White concluded that UG was accessible on the basis of the absence of a significant difference between the adult groups and the control group in extraction from a complex NP and a complement of an NP, it is unclear how the conclusion could be justified.

As for extraction from a complex NP, the adult 2 group performed significantly less accurately on grammatical sentences than they did on ungrammatical sentences, contradicting the prediction that before L2 learners have acquired the relevant structure, as indicated by chance level judgement on the grammatical sentences. If the testing measure was valid, then the result suggests that the adult 2 group had not acquired the relevant structure, and therefore, their performance cannot be a test of the knowledge of Subjacency. If the testing measure was invalid, then all groups' performance on this structure cannot be a test of the knowledge of Subjacency. The adult

2 group's correct rejection of the ungrammatical sentence therefore cannot be evidence that they have applied the knowledge of Subjacency to judge those sentences. Also, the result that the adult 2 group contradicted the UG prediction while the adult 1 group conformed to it poses a problem to White's explanation of difference between the 2 adult groups in the acceptance of ungrammatical sentences for extraction from a wh-clause, where the adult 2 group correctly rejected ungrammatical sentences, while the adult 1 group failed to reject them. If the adult 2 group was more advanced in L2 English proficiency than the adult 1 group, then the adult 2 group should have performed better than the adult 1 group in extraction from a complex NP.

As for extraction from a complement of an object NP, the grammaticality judgement tests failed to elicit expected native speakers' responses. Both in the unpaced multiple-choice grammaticality test and in the paced judgement test, the control group accepted ungrammatical sentences for extraction from a complement of an object NP. Thus, the grammaticality judgement on this structure was not able to test L2 learners' knowledge of Subjacency. Meanwhile, White claimed that L2 learners had knowledge of Subjacency in term of this structure, since they could correctly reject interpretations involving extraction from a complement of an object NP in the comprehension test.

The only consistent result in the grammaticality judgement that could bear on testing L2 learners' knowledge of Subjacency or the ECP was the judgement on extraction from a complement of a subject NP, in which L2 learners and the control group correctly rejected ungrammatical sentences as predicted. L2 learners' judgement on extraction from a complement of an object NP and from a wh-clause was not able to test their knowledge of Subjacency because either native speakers failed to reject ungrammatical sentences, or because ungrammatical structures in English are grammatical in some other languages. The results of extraction from a complement NP was not able to test the knowledge of Subjacency, either, because the adult 2 group rejected grammatical sentences in the unpaced multiple-choice test, as discussed above.

L2 learners' judgement on the other structure, extraction from a that-clause was also problematic. While White attributed L2 learners' acceptance of ungrammatical sentences for extraction from a wh-clause to the transfer of L1 parameter setting to L2, White could not explain L2 learners' acceptance of ungrammatical sentences for extraction from a that-clause. White predicted that L2 learners would reject that-trace sequences, because in both French and English, the relevant structure is ungrammatical. The result contradicted the prediction, and White claimed post hoc that the acceptance of that-trace sequences was not UG violations because some languages allow for that-trace sequences. If the acceptance of that-trace sequences do not count as a UG violation, then the structure does not provide any information about UG-accessibility, since both the acceptance and the rejection of the structure are compatible with UG, and it is unclear why White included the structure in the first place. Also, the acceptance of that-trace sequences was contradictory to the claim that the L2 learner initially transfers L1 parameter setting, because both French and English do not have rich agreement that licenses subject extraction from a that-clause as in Spanish and Italian, and that-trace sequences should have been rejected, if French speakers had transferred the L1 parameter setting.

7.4. Martohardjono (1993; 1994)

Martohardjono (1993; 1994) claimed that it is inadequate to test UG-accessibility with the presence/ absence of significant difference between native speakers and L2 learners in terms of their judgement on structures involving a violation of a single UG constraint, and that it is necessary to test whether L2 learners' judgements over different structures are systematic as the theory predicts and whether L2 learners show the same gradient acceptability judgements over those structures as native speakers do.

Martohardjono tested 19 Chinese speakers, 24 Indonesian speakers, 11 Italian speakers learning L2 English, and 10 English speakers on their knowledge of Subjacency and the ECP, using a grammaticality judgement test and an elicited production test.

In the grammaticality judgement test, subjects were asked to judge sentences involving the following structures.

(60)
wh-extraction from an embedded relative clause
wh-extraction from a noun-phrase complement
wh-extraction from a wh-island
wh-extraction from an adjunct clause
wh-extraction from a sentential argment (gerund)
wh-extraction from a that-clause

The test sentences were presented in sets of 4 wh-questions, preceded by a base declarative sentence. Each set consisted of 2 grammatical and 2 ungrammatical sentences using the same base sentence.

In NP complements, wh-islands, and adjunct clauses, the violations in each set were 1 sentence of subject extraction and 1 sentence of object extraction.

In relative clauses, the 2 ungrammatical sentences were a sentence with extraction from either the subject position or the object position and a sentence with a wh-phrase in situ. The 2 grammatical sentences were a sentence with a wh-phrase piedpiping the relative clause and a sentence with an extraposed relative clause.

In that-trace sentences, the 2 ungrammatical sentences were a subject extraction sentence and a sentence without subject-auxiliary inversion. The 2 grammatical sentences were a subject extraction sentence without the complementizer and an object extraction sentence.

In sentential argument (gerund) sentences, the 2 ungrammatical sentences were an object extraction sentence and a sentence with a wh-phrase in situ. The 2 grammatical sentences were a sentence with object extraction from the matrix clause and a sentence with <u>why</u> as the wh-phrase.

There were different subtypes of sentences in each of the 6 types of sentences.

(61)
Relative clause:
type 1: the head of the relative clause in the subject position
type 2: the head of the relative clause in the object position
type 3: the head of the relative clause in the object position and with a pragmatic bias, such that the wh-phrase extracted from the relative clause to the matrix clause is likely to be construed as the complement of the matrix verb, though syntactically, the head of the relative clause is the complement of the verb.

NP complement:
. Sentences with a head noun which does not subcategorize for the complement clause (apositive constructions)
type 1: rumour that ...
type 2: news that ...
. Sentences with a head noun which subcategorizes for the complement clause
type 3: fact that ...
type 4: claim that ...

Wh-island:
type 1: where
type 2: why
type 3: how
type 4: whether

Adjunct clause:
type 1: after
type 2: when

Sentential argument:
type 1: sentential subject (PRO-ing gerund with object extraction)
type 2: sentential object (PRO-ing gerund with object extraction)

That-trace:
type 1: think
type 2: say

There were 4 sets of sentences for each of types 1, 2, and 3 of relative clause, wh-island, NP complement, adjunct clause, and types 1 and 2 of sentential argument. The test sets were divided into 2 batteries of 18 sets (72 sentences), counterbalanced for type.

Each of the 2 batteries was administered in a separate test session. In each session, subjects were tested individually. The subject was given a sheet which contained only the base declarative sentences, listened to the tape recording of test sentences which contained both the declarative sentences and the test items, with 6 seconds between sentences and 10 seconds between sets, and was instructed to respond to each item either as a "good" sentence in English or as a "bad" sentence in English, by answering "yes" or "no", respectively. They were also allowed to respond "not sure" and "don't understand".

In the elicited production test, subjects were asked to produce interrogative sentences which would involve the following types of extraction.

(62)
- wh-extraction from a relative clause with a head in the subject position
- wh-extraction from a relative clause with a head in the object position
- wh-extraction from an NP complement
- wh-extraction from a wh-island
- wh-extraction from an adjunct clause
- wh-extraction from a that clause
- wh-extraction from a sentential subject (gerund)
- wh-extraction from a sentential object (gerund)

There were 2 stimulus sentences for each wh-construction type.

The elicited production test was administered individually in a session separate from both of the grammaticality judgement test sessions. In the elicited production test session, the subject was given a sheet which contained base declarative sentences, each with 2 underlined words. The experimenter read each base sentence to the subject, and the subject was asked to produce, orally, an interrogative sentence to which one of the 2 underlined nouns was the answer. A half of extractions was grammatical, and the other half was ungrammatical.

The results of the grammaticality judgement test are presented in Table 7.4.1 and Table 7.4.2 (Table 13 and Table 14 (modified), respectively, in Martohardjono (1993: 104-105)).[5]

Table 7.4.1: Martohardjono's (1993) results: Overall rejection of ungrammatical sentences

	Chinese	Indonesian	Italian	English
mean no.	33.38	35.09	44.02	49.6
mean %	60%	63%	79%	89%

range = 0 - 56

Table 7.4.2: Martohardjono's (1993) results: Mean number and percentage of rejection of ungrammatical sentences

	RC-O/P	RC-O	RC-S	NC	WIC	ADJ	SS	That
Chinese								
subject extraction								
mean no.	3.05	2.95	2.95	1.61	2.68	3.53		.632
mean %	76%	74%	74%	40%	67%	88%		15%
object extraction								
mean no	2.63	2.0	2.63	1.31	1.26	3.05	3.1	
mean %	65%	50%	65%	32%	31%	76%	77%	
total	71%	62%	70%	36%	49%	82%	77%	15%
Indonesian								
subject extraction								
mean no.	3.0	2.87	3.08	1.08	2.41	3.3		.833
mean %	75%	71%	77%	27%	61%	83%		20%
object extraction								
mean no.	2.91	3.42	3.29	1.5	1.45	3.16	2.79	
mean %	72%	85%	82%	37%	36%	79%	69%	
total	74%	78%	80%	32%	49%	81%	69%	20%
Italian								
subject extraction								
mean no.	3.54	3.63	3.36	3.0	2.45	3.63		2.18
mean %	89%	91%	84%	75%	61%	91%		54%
object extraction								
mean no.	3.81	3.90	3.63	2.18	2.27	3.72	2.72	
mean %	95%	98%	91%	54%	57%	93%	68%	
total	92%	95%	88%	65%	59%	92%	68%	54%
English								
subject extraction								
mean no.	4.0	3.8	4	3.6	3.8	4		3.4
mean %	100%	95%	100%	90%	95%	100%		85%
object extraction								
mean no.	3.9	4	3.9	2.8	2.3	4	2.1	
mean %	97%	100%	97%	70%	57%	100%	52%	
total	99%	98%	99%	80%	76%	100%	52%	85%

Martohardjono claimed that if subjects' hypotheses about English grammar were not derived from UG, then the results should have shown a random pattern, and there should not have been similarities in judgement patterns among the different language groups. However, the results showed a similar pattern of rejection across different types of violations among the experiment groups and the control group. Martohardjono claimed that the similarity in patterns across the language groups strongly suggests that the experiment groups as well as the control group were guided by the same hypotheses.

Most of the subjects in the experimental groups were advanced in terms of their performance on the Michigan English Placement Test. However, some subjects in the Chinese group and the Indonesian group were intermediate. For a comparison across language groups, Martohardjono eliminated those intermediate subjects from analysis, keeping only 16 in the Chinese group and 17 in the Indonesian group. All subjects in the Italian group were advanced.

The mean rejection rates of the 4 groups are presented in Table 7.4.3 (Table 16 in Martohardjono (1993: 121)).

Table 7.4.3: Martohardjono's (1993) results: Overall mean rejection of ungrammatical sentences

Chinese	63%
Indonesian	71%
Italian	79%
English	89%

An ANOVA with language group as an independent 4 value factor on rejection of ungrammatical sentences showed a significant difference across language groups. There was a significant difference between all language group pairs with $p < .05$.

Martohardjono claimed, following Chomsky (1986b), that ECP violations are stronger than Subjacency violations, and that violations of both the ECP and Subjacency are stronger than violations of either one of them alone. Martohardjono claimed that the difference in the strength of violation should be reflected in the accuracy of grammaticality judgement. Martohardjono also claimed that violations that are invariable across languages (extraction from an adjunct, a sentential subject, and a relative clause) should be stronger than violations that vary according to parameter setting (extraction from a wh-island)[6] and lexical learning (extraction from NP complement), and violations of constraints that native speakers do not often observe (that-trace sequences).

The results classified according to the violation types are presented in Table 7.4.4 (Table 18 in Martohardjono (1993: 124)).

Table 7.4.4: Martohardjono's (1993) results: Combined mean rejection of ungrammatical sentences strong vs. weak wh-constructions

	strong	weak
Chinese	87%	42%
Indonesian	76%	38%
Italian	89%	61%
English	94%	79%

A two-way ANOVA with the violation type (strong vs. weak) x language group design showed significant main effects for violation type and for language group, and a significant interaction between violation type and language group. There was a significant difference between strong and weak violations in each language group.

Martohardjono predicted that judgement on extraction from an NP complement would be less accurate than judgement on extraction from a wh-island, because the former involves lexical learning in addition to parameter setting while the latter involves only parameter setting. As for the Chinese and Indonesian groups, the prediction was born out. However, the Italian group did not show the expected difference, and they performed better on NCs than on wh-islands.

The results classified according to the position in a clause (subject vs. object) from which an NP is extracted are presented in Table 7.4.5 (Table 19 in Martohardjono (1993: 125)).

Table 7.4.5: Martohardjono's (1993) results: Subject vs. object extraction from a relative clause, an adjunct clause, a wh-island, and an NP complement

	subject	object
Chinese	75%	73%
Indonesian	72%	58%
Italian	82%	81%
English	97%	87%
Overall	80%	73%

Martohardjono predicted that judgement on subject extraction from a relative clause, an adjunct clause, a wh-island, or an NP complement would be more accurate than judgement on object extraction from respective structures, because the former violates both the ECP and Subjacency, while the latter violates only Subjacency.

Martohardjono claimed that the results confirmed the hypothesis, because all groups performed better on subject extraction than on object extraction.

A three-way ANOVA showed significant main effects for violation type, for language group, and for position of extraction, and significant interactions between violation type and language group, between language group and position of extraction, and between violation type and position of extraction.

The interaction between language group and position of extraction was due to the fact that for the Chinese group and the Italian group, the difference between the positions was minimal, while for the Indonesian group and the control group, the difference was large.

The interaction between violation type and position of extraction was due to the fact that for weak violations, subject vs. object asymmetry was large, while for strong violations, either subject vs. object asymmetry was smaller or judgement on object extraction was more accurate than judgement on subject extraction.

The results of the elicited production test are presented in Table 7.4.6 (Table 20 in Martohardjono (1993: 141)).

Table 7.4.6: Martohardjono's (1993) results: Production task, sentences with potential violations

utterance type	Chinese mean no.	Chinese mean %	Indonesian mean no.	Indonesian mean %	Italian mean no.	Italian mean %	English mean no.	English mean %
correct	9.43	59%	10.6	66.3%	8.45	53%	4.2	26.3%
incorrect	5.81	36%	5.3	33%	6.5	41%	11.7	73.1%
violations	0.75	5%	0.12	0.7%	1	6%	0.1	0.6%

Incorrect means that the sentence was ungrammatical for reasons other than a UG principle violation.
Violation means that the sentence was ungrammatical due to a UG principle violation.

Subjects did not produce many UG violations. Structural changes were made, in spite of instruction, to the sentence in order to avoid a violation, as predicted. However, the control group unexpectedly gave the majority of questions with wh-phrase in situ.

The classification of violations over construction types is given in Table 7.4.7 (Table 21 in Martohardjono (1993: 141)). More weak violations were made than strong violations.

Table 7.4.7: Martohardjono's (1993) results: Distribution of violations, production task

	RC obj	ADJ subj	SS obj	WH subj	NC subj	NC obj	That subj	total
Chinese	5	0	1	0	3	2	1	12
Indonesian	0	0	1	0	0	1	0	2
Italian	0	0	1	0	3	0	7	11
English	0	0	1	0	0	0	0	1

Martohardjono concluded that the elicited production data generally confirmed the grammaticality judgement data.

Martohardjono claimed that while the rejection of ungrammatical sentences by all experimental groups was lower compared with that of the control group, none of the experiment groups treated ungrammatical extractions as grammatical, and that the similarity of the rejection pattern across different construction types between the experimental groups and the control group, the differential treatment of strong violations and weak violations in all groups, and the differential treatment of subject extraction and object extraction in the Chinese group and the control group, confirmed the claim that UG constrains L2.

However, there are problems in Martohardjono's claims, both in terms of the method she used in eliciting data and the analysis of data that she obtained.

As for the elicitation method, Martohardjono presented sentences to be judged auditorily in the grammaticality judgement test. As Bley-Vroman & Chaudron (1990) criticized Flynn (1987) on a similar point, if the testing measure for the knowledge of syntactic structure/constraint involves listening comprehension and/or oral production, subjects' proficiency for listening comprehension and/or oral production should be controlled. Though Martohardjono used the Michigan English Placement Test in selecting subjects, which did have a component that tested listening comprehension, the test did not measure oral production, and the subject groups were matched neither in listening comprehension nor in oral production in L2 English. Thus, the results gained from the grammaticality judgement test could have been affected by the learners' proficiency in listening comprehension.

Bley-Vroman & Chaudron (1994) also claimed that the short-term memory of L2 learners who are not familiar with the target language segments, syllables structures, or phonotactics will be overloaded by the input because the unfamiliar sound patterns must be stored in terms of units analyzed at a low level (ex. segments), while the short-term memory of those who are familiar with the target language phonological system are not, because the familiar sound patterns can be analyzed at a higher level (ex. morphemes, words, etc.). Thus, phonological short-term memory can affect the performance in grammaticality judgement with auditory presentation, to the extent that L2 learners must store linguistic input to make grammatical judgement on it. In this respect, subjects' phonological short-term memory, which was not controlled for, could have affected the results as well. Also, the sentence length, which varied to some extent in Martohardjono's test sentences from one construction to another, might have been another confound.

As for the analysis of data, there are several problems.

First, Martohardjono presented results only for judgement on ungrammatical sentences, and it was not clear whether L2 learners correctly accepted grammatical extractions. Though Martohardjono attempted to emphasize the similarity in the judgement pattern across different construction types between L2 learners and native speakers in supporting the claim of UG-accessibility in L2, it is not possible to evaluate her claim of the similar judgement pattern without results on grammatical sentences.

Second, though Martohardjono claimed that the judgement pattern across different construction types was similar among all language groups, the claim was based on the impressionistic observation over the data, and no test of significance was reported with respect to the similarity/ difference of the judgement pattern, except for the difference between strong violations and weak violations and between subject extraction and object extraction in each group.

To clarify the general pattern across 8 constructions that Martohardjono analyzed, I presented the rank order of construction types according to the accuracy of judgement in (63), based on the data in Table 7.4.2.

(63) Rank ordering of construction types in terms of the accuracy judgement on ungrammatical sentences

Total

Chinese	ADJ	>	SS	>	RC-O/P	:	RC-S	>	RC-O	>	wh	>	NC	>	that
	82		77		71		70		62		49		36		20
Indonesian	ADJ	:	RC-S	:	RC-O	>	RC-O/P	>	SS	>	wh	>	NC	>	that
	81		80		78		74		69		49		32		20
Italian	RC-O	:	ADJ	:	RC-O/P	:	RC-S	>	SS	:	NC	>	wh	>	that
	95		92		92		88		68		65		59		54
English	ADJ	:	RC-O/P	:	RC-S	:	RC-O	>	that	>	NC	:	wh	>	SS
	100		99		99		98		85		80		76		52

(63 continued.)

Subject extraction

Chinese	ADJ	>	RC-O/P	:	RC-O	:	RC-S	>	wh	>	NC	>	that
	88		76		74		74		67		40		15
Indonesian	ADJ	>	RC-S	:	RC-O/P	:	RC-O	>	wh	>	NC	>	that
	83		77		75		71		61		27		20
Italian	RC-O	:	ADJ	:	RC-O/P	>	RC-S	>	NC	>	wh	>	that
	91		91		89		84		75		61		54
English	RC-O/P	:	RC-S	:	ADJ	>	RC-O	:	wh	>	NC	>	that
	100		100		100		95		95		90		85

Object extraction

Chinese	SS	:	ADJ	>	RC-O/P	:	RC-S	>	RC-O	>	NC	:	wh
	77		76		65		65		50		32		31
Indonesian	RC-O	:	RC-S	:	ADJ	>	RC-O/P	:	SS	>	NC	:	wh
	85		82		79		72		69		37		36
Italian	RC-O	:	RC-O/P	:	ADJ	:	RC-S	>	SS	>	wh	:	NC
	98		95		93		91		68		57		54
English	RC-O	:	ADJ	:	RC-O/P	:	RC-S	>	NC	>	wh	>	SS
	100		100		97		97		70		57		52

A colon is placed between construction types if the difference in the percentages between them was less than 5% and a greater-than sign is placed if the difference was 5% or greater. Where the difference was less than 5%, the mean of the 2 percentages was calculated, and was used to compare the 2 constructions together against the next highest construction. If the difference between the mean and the percentage of the next highest construction type was less than 5%, then a colon was placed between the first 2 construction types and the next highest construction type, and the mean percentage for the 3 construction types was calculated for a further comparison. If the difference was 5% or greater, then a greater-than sign was placed between the lower of the first 2 construction types and the next highest construction type.

I calculated tau coefficients and gamma coefficients for the agreement in the rank order of construction types between each of the experiment groups and the control group. The results were as follows.

Table 7.4.8: Tau and gamma coefficients for the agreement in the rank order of construction types between each of the experiment groups and the control group

Overall:

	tau	gamma
Chinese - control	0.76	0.43
Indonesian - control	0.54	0.23
Italian - control	0	0

Subject extraction:

	tau	gamma
Chinese - control	0.48	1
Indonesian - control	0.48	1
Italian - control	0.29	0.60

Object extraction:

	tau	gamma
Chinese - control	0.21	.50
Indonesian - control	0.24	.67
Italian - control	0.07	.20

A tau coefficient shows how much larger the probability is that 2 objects taken at random from the ranked objects have the same order in 2 rankings than the probability is that those objects have different orders. A gamma coefficient shows the difference between the probability that 2 objects taken at random from the ranked objects have the same order in 2 rankings and the probability that those objects have different orders, provided that the 2 objects are tied in neither rankings.

The absolute value of both coefficients tends to be small where there are many ties in 2 rankings, and therefore, not many objects that are discretely ordered. A negative coefficient suggests that the 2 objects are more likely to be ordered in a reverse order in 2 rankings.

The larger coefficients for the Chinese group and the Indonesian group than for the Italian group were due to the fact that many construction types tied in the ranking for the Italian group as they did for the control group. Gamma coefficients were larger than the tau coefficients, because the probabilities for ties in rankings are not considered for gamma. The fact that the coefficients were positive shows that the order of construction types tended to be the same for each of the experiment groups and for the control group. However, it must be noted that the positive coefficients were due to the relatively large difference between strong violation constructions and the weak violation constructions. There is a problem in relying on this difference in claiming the UG/LM-accessibility.

While Martohardjono claimed that there was a similarity in the rejection pattern across different construction types among all groups, there were some differences among language groups. Generally, judgement on extraction from a relative clause and an adjunct clause was more accurate than the judgement on extraction from an NP complement, a wh-island, and a that-clause, showing that judgement on strong violations were in general more accurate than judgement on weak violations. However, the relative ranking of extraction from a sentential subject, which was a strong violation, was quite variable across language groups.

To test the goodness of fit of the performance of each of the experiment groups with the performance of the control group, it should have been possible to obtain a chi-square for comparison between each experiment group and the control group across relevant construction types, if each subject was classified into a discrete class according to the number of sentences he judged correctly. Unfortunately, Table 7.4.2 presents results in terms of mean percentages or mean numbers of sentences judged correct, and since in that presentation, each observation in reconstructed frequencies was not independent, the reanalysis using chi-squares was not possible with the data reported by Martohardjono.

The problem with the generalization on the judgement pattern becomes more evident when the significant difference between strong violations and weak violations and between subject extraction and object extraction is carefully examined.

Martohardjono claimed that the prediction that judgement on stronger violations would be more accurate than judgement on weaker violations was confirmed by the significant difference between judgement on stronger violations and judgement on weaker violations in each language group. There are problems in this claim.

There was less than chance level performance on some construction types.

The Chinese group and the Indonesian group performed consistently at less than chance level on extraction from an NP complement both in subject extraction and in object extraction. The Italian group performed much better, while their performance was at chance level in object extraction. The control group performed 90% correct in subject extraction and 70% correct in object extraction.

The Chinese group and the Indonesian group performed at less than chance level in extraction from a that clause, and the Italian group performed at chance level. The control group performed 85% correct.

The Chinese group and the Indonesian group performed at less than chance level in extraction from a wh-island in object extraction, while they performed at slightly higher than chance level in subject extraction. The Italian group performed at slightly higher than chance level both in subject extraction and object extraction. The control group performed 95% correctly in subject extraction, while they performed only 57% correctly in object extraction.

If L2 learners are not constrained by UG, and if no other factors are involved in judgement on these constructions, then they should perform 50% correctly and 50% incorrectly, showing random judgement. If L2 learners are constrained by UG, then they should perform more accurately than 50%. Regardless of whether L2 learners are constrained by UG or not, there should not be less than chance level performance. The fact that L2 learners performed at less than a chance level clearly shows that there was some factor, external to the issue of UG-accessibility, involved in judgement on these constructions by L2 learners, biasing their judgement in the direction opposite to what linguistic theory predicted.

In fact, there was a significant interaction between violation type and language group in the two-way ANOVA with the violation type x language group design. While Martohardjono did not discuss the possible source of the interaction, it appears that there was a significant difference between the L2 groups and the control group (especially between the Chinese group and the Indonesian group on the one hand and the control group on the other), in that the former performed at less than a chance level on weak violations, while the latter performed above the chance level.

Thus, the use of a significant difference between judgement on extraction from a NP complement, a wh-island, and a that-clause and judgement on other construction as evidence for UG-accessibility is unjustified, since the lower performance on these 3 constructions were unexplainable in terms of UG-accessibility. Unfortunately, there was no other construction type for weak violations, and therefore, the comparison between strong violations and weak violations excluding data from these 3 constructions was impossible.

Moreover, the control group failed to perform as expected on extraction from a sentential subject.

Martohardjono claimed that extraction from a sentential subject was a strong violation. As predicted, the L2 groups performed better on extraction from a sentential subject than on extraction from an NP complement, a wh-island, and a that-clause.

However, native speakers' performance on this construction was the least accurate among constructions for object extraction, and even less accurate than their performance on extraction from an NP complement and a wh-island, which Martohardjono claimed to be weak violations. (Items for extraction from a sentential subject were all object extraction sentences.) While L2 learners' performance on extraction from a sentential subject was better than their performance on constructions for weak violations, the results of extraction from a sentential subject cannot be used to support UG-accessibility, because native speakers did not show the expected performance.

Thus, due to the contamination by some unknown factors other than UG-accessibility, neither data for strong violations nor data for weak violations was usable to make an adequate evaluation of whether there was a significant difference between strong violations and weak violations.

While there was a significant main effect for position of extraction in the three-way ANOVA with the violation type x language group x position of extraction design, showing an overall tendency that judgement on subject extraction was better than judgement of object extraction, the tendency was clear only for weak violations in all groups. The Indonesian group and the Italian group tended to perform more accurately on object extraction than on subject extraction in strong violations, while they performed better on subject extraction than on object extraction in weak violations, resulting in roughly the same performance on subject extraction and object extraction in overall performance. Since the better performance on subject extraction than on object extraction was due to the data for weak violations, which was invalid due to the less than a chance level performance, the main effect for position of extraction cannot be used to claim UG-accessibility.

Third, there was a significant difference in overall performance in the grammaticality judgement test between each of the L2 groups and the control group. This difference would be taken as evidence against UG-accessibility under frameworks assumed by other researchers. However, Martohardjono (1994) attributed the overall "depressed" performance of L2 groups compared with the control group to a decrease in adults in the ability to learn peripheral properties, and claimed that the similarity of judgement pattern across different construction types among language groups was evidence that UG constrained L2, while Martohardjono did not specify how one could test the similarity/difference in the judgement pattern across different construction types. Thus, it is not clear how the claim of UG-accessibility can be falsified under Martohardjono's framework.

7.5. Martohardjono & Gair (1993)

Martohardjono & Gair (1993) claimed that the initial grammar that the L2 learner constructs may not be the correct target grammar, due to the failure to recognize a structure to which a UG principle applies, while the incorrect L2 grammar is still constrained by UG.

Since some languages do not instantiate movement in some constructions, the L2 learner may generate those constructions in his interlanguage without movement, when the target language involves movement in those constructions.

Diagnostics of movement in a given construction are whether the distribution of gaps in the construction is constrained by Subjacency, and whether those gaps are different in nature from non-movement gaps, pro and PRO.

A movement gap, i.e. a trace, is distinguished from a pro and a PRO by its distribution. A PRO can appear only in an ungoverned position, such as the subject of infinitive, due to the Binding Principles A and B. A pro is subject to

Huang (1984) and Raposo's (1986) constraint against a pro in an object gap in languages with subject-verb agreement or with no agreement, and is not constrained by Subjacency nor by the ECP. A trace is subject to the ECP and Subjacency.

If L2 is constrained by UG, then the same diagnostics can be used to determine whether an L2 grammar involves movement in a given construction. Martohardjono & Gair claimed that if a construction does not involve movement, with a gap filled by a pro, then the construction would not be constrained by Subjacency nor the ECP, and certain object gaps would be ruled out due to Huang (1984) and Raposo's (1986) constraint against a pro in an object gap.

In Indonesian, wh-interrogatives and relative clauses do not involve syntactic movement, as indicated by the lack of Subjacency effects and object gaps. In topicalization, the gap topicalization obeys Subjacency, and shows no restriction against object gaps, suggesting a movement construction, while the left-dislocation topicalization with a resumptive pronoun does not obey Subjacency, suggesting a pro construction.

Martohardjono & Gair hypothesized that if Indonesian speakers misidentify gaps in English as gaps filled with a pro, then Subjacency would be violated, and there would be a restriction against object gaps, in their L2 English.

Martohardjono & Gair tested 27 Indonesian speakers learning L2 English, 15 intermediate and 12 advanced, and 12 English speakers with an elicited imitation task, and 9 intermediate learners and 10 advanced learners with a grammaticality judgement task.

In the elicited imitation task, subjects were asked to repeat each sentence that the experimenter read. The test sentences involved construction types in (64).

(64)
wh-interrogative, direct question
wh-interrogative, indirect question
relative clause with <u>what</u>
relative clause with <u>which</u> NP
pseudo-cleft with <u>what</u>
pseudo-cleft with <u>who</u>
gap topicalization
left-dislocation topicalization with a resumptive pronoun

In the grammaticality judgement test, subjects were presented visually as well as auditorily with sentences involving grammatical subject wh-extraction from a complement CP of a V and ungrammatical subject wh-extraction from a complement CP of an N.

(65)
What did the doctor say he thought should be done for John?

* Who did you read the news had won the election yesterday?

The results of the elicited imitation task are presented in Table 7.5.1 (Table 2 in Martohardjono & Gair (1993: 92)).

Table 7.5.1: Martohardjono & Gair's (1993) results for elicited imitation: Error rate in percentage

	intermediate	advanced	control
overall			
mean	16.733 (42%)	6.417 (16%)	0
SD	4.415	2.575	0
subject gap			
mean	6.933 (35%)	3.167 (16%)	0
SD	2.017	1.267	0
object gap			
mean	9.8 (49%)	3.25 (16%)	0
SD	2.455	1.603	0

Two-tailed t-tests showed a significant difference between subject extraction and object extraction in the intermediate group, a significant difference between the intermediate group and the advanced group both in subject extraction and in object extraction, and a significant difference between each of the Indonesian groups and the control group in the overall performance.

The results for the grammaticality judgement test are presented in Table 7.5.2 (Table 4 in Martohardjono & Gair (1993: 93)).

Table 7.5.2: Martohardjono & Gair's (1993) results for grammaticality judgement

	intermediate	advanced
overall correct	66%	91%
correct grammatical	72%	95%
correct ungrammatical	60%	87%

T-tests showed a significant difference between the intermediate group and the advanced group both in grammatical sentences and in ungrammatical sentences.

applicability of some specific UG principle to a specific L2 structure.

There was a circularity problem with the conclusion that the results supported the claim that L2 is constrained by UG. That L2 is constrained by UG was an initial assumption or a premise to apply a diagnosis of presence/ absence of movement in a given construction. Under the assumption that L2 is constrained by UG, Martohardjono & Gair applied the diagnosis to L2 English and determined that wh-extraction in the intermediate group did not involve movement. The results were consistent with the claim that L2 is constrained by UG because the result was interpreted in such a way that is consistent with the assumption, due to the premise. Without that assumption, the results would be ordinarily taken as evidence against UG-accessibility in that there was a significant difference between each of the Indonesian groups and the control group in the overall performance in the elicited imitation task. (There was no control group in the grammaticality judgement test.)

Though Martohardjono & Gair used the fact the intermediate group had a greater difficulty with object gaps than subject gaps as the basis to analyze apparent Subjacency violations as a non-movement construction involving a pro, the difficulty with object gaps may be an artifact of the elicitation measure. Bley-Vroman & Chaudron (1994) claimed that the elicited imitation task is highly sensitive to the short-term memory effect, with strong

Table 7.5.3: Martohardjono & Gair's (1993) results for elicited imitation: Error rate in percentage per type of structure

wh-constructions:	
direct questions	70%
indirect questions	42%
relative clause with <u>which</u> subject	45%
relative clause with <u>which</u> object	40%
relative clause with <u>what</u> subject	51%
relative clause with <u>what</u> object	43%
pseudo-cleft with <u>who</u>	60%
pseudo-cleft with <u>what</u>	25%
topic constructions:	
+ movement	
gap topic	18%
- movement	
left dislocation	25%

In the topic constructions, the intermediate group as well as the advanced group performed well, and errors in the left-dislocation topicalization were mainly the omission of the resumptive pronoun, converting the construction into a gap topicalization construction. The result was contradictory to Martohardjono & Gair's prediction that the non-movement construction would prevail across the board in L2. Since Indonesian has a topic construction in which the gap is filled by a trace, Martohardjono & Gair suggested that the L1-L2 parallelism facilitated the necessary recognition of gaps as traces in the topic constructions in L2.

Martohardjono & Gair concluded that the results of the study supported the hypothesis that the apparent unavailability of UG in L2 acquisition is not due to its unavailability but the learner's failure to recognize the

Martohardjono & Gair claimed that the results for the intermediate group were consistent with the hypothesis that L2 learners had a pro in the object gap, because the intermediate group had a greater difficulty with object gaps than subject gaps in the elicited imitation task, while the advanced group did not, and because they performed less well in detecting Subjacency violations than the advanced group in the grammaticality judgement test. Martohardjono & Gair claimed in addition that the intermediate group's treatment of English gaps was incorrect for English but was consistent with UG, and therefore, that their L2 grammar was constrained by UG.

Martohardjono & Gair argued that the subject-object asymmetry could not be attributed to a general characteristic of L2 acquisition, because Flynn & Brown (1988) found similar subject-object asymmetry in Japanese speakers but not in Chinese speakers learning L2 English. Martohardjono & Gair suggested that the difference between Chinese speakers and Japanese speakers appeared to be due to the difference in the direction of canonical government in their L1.

The error rates in percentages for constructions tested in the elicited imitation task are presented in Table 7.5.3 (Table 6 in Martohardjono & Gair (1993: 95)).

ceiling and floor effects, for reasons discussed in 7.4. Therefore, without a control for subjects' capacity in phonological short-term memory, it is not clear the obtained results were due to their knowledge of syntax. (See 9.3 for more discussion.) Since object gaps are further away from the beginning of the sentence than subject gaps, learners with a limited phonological short-term memory capacity would have a greater difficulty with object gaps than subject gaps. If the intermediate group had a more restricted capacity in phonological short-term memory than the advanced group, then the difference in the phonological short-term memory capacity may explain why the intermediate group had a greater difficulty with object gaps, eliminating the necessity to appeal to the UG constraint against a pro in the object gap.

7.6. Gair, Flynn, & Brown (1994)

Gair, Flynn, & Brown (1994) reanalyzed the results of Flynn & Brown (1989), following Martohardjono & Gair's (1993) claim that UG constraints cannot function until the learner identifies linguistic elements, in the data, that the UG constraints refer to.

Flynn & Brown (1989) tested Japanese, Chinese, and Spanish speakers learning L2 English with an elicited imitation task with sentences involving 4 different types of relative clauses.

(66)
a. head noun matrix subject / operator embedded subject
b. head noun matrix subject / operator embedded object
c. head noun matrix object / operator embedded subject
d. head noun matrix object / operator embedded object

Flynn & Brown (1989) predicted that speakers of relative clause + head (head final) languages would have more difficulty in learning English relative clause structures than speakers of head + relative clause (head initial) languages.

Flynn & Brown's (1989) results are presented in Table 7.6.1 (Table 1 in Gair, Flynn, & Brown (1994: 4)).

Table 7.6.1: Flynn & Brown's (1989) results: Level means for amount correct (score range 0-3)

group	sub/sub	sub/obj	obj/sub	obj/obj
Spanish				
low	.63	.69	.38	.61
mid	2.19	1.33	1.00	1.57
high	2.57	1.93	1.50	2.05
overall	1.80	1.32	1.51	1.40
Japanese				
low	.14	.00	.29	.14
mid	.64	.16	.20	.28
high	1.28	.48	.90	.83
overall	.68	.21	.46	.41
Chinese				
low	.00	.09	.09	.07
mid	.55	.60	.55	.59
high	1.27	1.66	1.14	1.44
overall	.61	.78	.59	.70

Gair, Flynn, & Brown claimed that while the overall results came out as predicted, since Chinese and Japanese speakers' performance was lower than Spanish speakers' performance, the lower performance of Japanese speakers than the performance of Chinese speakers was not predicted.

A large part of the difference between Japanese speakers and Chinese speakers were due to Japanese speakers' preference of subject gaps to object gaps. While Japanese speakers preferred parallel grammatical functions (sub/sub, obj/obj) to different grammatical functions (sub/obj, obj/sub) within each of X/sub and X/obj, the difference between X/sub and X/obj was large. Chinese speakers preferred object gaps to subject gaps, while the difference between X/sub and X/obj was not as large as it was for Japanese speakers.

The results thus showed that different L1 groups performed differently on the task intended to elicit their knowledge of head directionality. Gair, Flynn, & Brown attempted specify a) what the crucial L1 differences were, and b) what general principles were involved.

Beginners of both Japanese speakers and Chinese speakers had difficulty with repeating 2-clause sentences with a relative clause, and often responded with 2 separate sentences, with the relative clause as an (ungrammatical) independent sentence.

Japanese and Chinese speakers who were able to respond with a 2-clause sentence made conversions of relative clauses to other structures (often coordinate structures) and conversions changing the grammatical relation of the head (subject vs. object in the matrix) and changing the grammatical relation of the operator (subject vs. object in the relative clause).

(67)

Stimulus sub/obj:
  The policeman [who the student called] greeted the businessman.
Response sub/sub:
  The policeman [who called the student] greeted the businessman.

Stimulus sub/sub:
  The policeman [who called the gentleman] answered the student.
Response sub/obj:
  The policeman [who the gentleman called] answered the student.

While all groups made fewer X/sub --> X/obj conversions than X/obj --> X/sub conversions, Japanese speakers made far more of the latter type (58%) than the former type, and the conversion increased with the proficiency of the learner (as measured by the Michigan English Placement Test).

Gair, Flynn, & Brown claimed that the subject operator preference was due to the relative clause internal word order.

In Japanese, there is no overt wh-phrase in the relative clause, and the relative clause word order is:

(68)
  [NP-sub e-obj V] NP ...

In English, the relative clause word order is:

(69)
... NP [who NP-sub V e-obj]

Thus, Gair, Flynn, & Brown argued that Japanese speakers who were able to produce 2-clause sentences were recognizing the empty category (the trace of the operator) to the right of V in English relative clauses, whereas they had not reset the head directionality parameter to the English value to allow for proper government of the empty category to the right of V. Thus, Gair, Flynn, & Brown claimed that Japanese speakers attempted to eliminate the empty category by inserting an overt NP to avoid an ECP violation, ignoring the grammatical function of the overt subject NP and the operator.

In Chinese, except for the absence of the wh-phrase, the word order in a relative clause is the same as English.

(70)
[NP-sub V e-obj de-comp] NP

Thus, if the wh-phrase is ignored, constituents in an English relative clause and constituents in a Chinese relative clause match in the order. Thus, the crosslinguistic mismatch between L1 and L2 does not exist for Chinese speakers.

Gair, Flynn, & Brown's explanation appears to be a self-contradiction. Gair, Flynn, & Brown claimed that Japanese speakers recognized the existence of empty category to the right of V in English relative clauses, while Japanese speakers had not reset the head directionality parameter (which determines the direction of lexical government). If Japanese speakers had not reset the head directionality parameter, it is not clear how they could recognize the existence of an empty category to the right of V. If they did recognize the existence of an empty category to the left of V, then they should have reset the parameter to the English value, and there should have been no motivation to eliminate the empty category. Somehow, Gair, Flynn, & Brown assumed that L2 learners were able to have a knowledge of relative ordering of V head and its complement independent of the directionality parameter which determined the direction of proper lexical government. Though they claimed that the Japanese speakers had learned that an English transitive verb required an object NP to the right of the verb because the object NP shows up in this position in the primary data, the argument does not explain why the Japanese speaker did not eliminate such an overt object NP to the right of the verb, if UG constraints were accessible, because if the head directionality had not been reset, the overt object NP to the right of the verb would not have had Accusative Case, which is assigned under head-government by the verb, and therefore, the object NP should have violated the Case Filter.

The relevant data may have a simpler explanation based on the effect of short-term memory. As discussed in 7.4 and

7.5, elicited imitation is highly sensitive to the short-term memory effect. Thus, if the learners' short-term memory is not controlled, elicited imitation results can be simply a reflection of their phonological short-term memory capacity. While the Michigan English Placement Test that Flynn & Brown used to measure subjects' proficiency level had a component that tested listening comprehension, it was not an adequate measure for the phonological short-term memory. Thus, the overall superior performance of Spanish speakers can be explained by the phonological short-term memory effect. Japanese speakers' problem with an empty category in the object position may also be due to the memory effect, in that the object gap is further away from the beginning of the sentence than the subject gap (if there is a gap). It may also be the case that L2 learners (and possibly native speakers as well) perceive the subject wh-phrase as an operator in situ without a gap. In that case, subject extraction (not extraction in fact) is easier to process than object extraction. Alternatively, it may be claimed that subject extraction does not change the surface word order of SVO, while object extraction changes the surface order to OSV, and therefore, subject extraction is easier to process because it has the word order of declaratives.

Notes for Chapter 7

1. Structures relevant for violations in 3b and 3d of (50) are as in (1) under the framework of Chomsky (1981).

(1)

a). * Which piano is to play fun?
$[_{S'}$ which piano $[_{S}$ is $[_{S'}$ t $[_{S}$ PRO to play t] fun]]]

b). * Which girl is to love a pleasure?
$[_{S'}$ which girl $[_{S}$ is $[_{S'}$ t $[_{S}$ PRO to love t] a pleasure]]]

In both cases, if the wh-phrase moves directly to the COMP of the matrix clause, then the movement crosses 2 Ss, and therefore, it is a violation of Subjacency. If the wh-phrase moves to the COMP of the subject clause and then moves to the COMP of the matrix clause, then the intermediate trace in the COMP of the subject clause is neither lexically head-governed nor antecedent-governed, because Infl is not rich in English, and because there are 2 maximal projections intervenes between the intermediate trace and the wh-phrase in the COMP of the matrix clause. Thus, in this case, it is a violation of the ECP.

2. Apparently, White (1988) misrepresented Chomsky's (1981) analysis of Subjacency. In English, the bounding nodes should have been S and NP, and in French, they should have been S' and NP. If S' were a bounding node in English, then any wh-extraction from a finite embedded clause, such as (1), would be ruled out.

(1)

who did $[_{S}$ you think $[_{S'}$ t $[_{S}$ t won the prize]]]

Since extraction from any finite clause to a COMP position in a higher clause involves S' and S, if S' and S were both bounding nodes in a language, there could not be grammatical extraction from an embedded finite clause.

The ungrammaticality of relevant extractions in English can be explained without a problem without assuming S' to be a bounding node. In extraction from a complement (PP) of an N, extraction involves the NP and the matrix S. In extraction from a complex NP, extraction involves the NP and the matrix S. In extraction from a wh-clause, if one assumes that the extracted wh-phrase cannot move through a COMP which is filled by another wh-phrase, then extraction involves the embedded S and the matrix S. As for English sentences, there is no need to assume that PP is a bounding node.

As for French, it appears necessary to assume that PP is a bounding node, in order to rule out extraction from a complement (PP) of an N, since S is not a bounding node in French.

3. In Chomsky (1986b), Subjacency is a constraint on representations at SS (rather than a constraint on derivations as in Chomsky (1981)), which rules out a representation which contains a wh-chain in which any 2 adjacent members in the chain are intervened by a barrier, as discussed in Chapter 6.

4. White (1988) did not report the group identified as Secondary II in Table 7.3.3 in her discussion of subjects. The Secondary II subjects were included in the analysis of the comprehension test.

5. Martohardjono (1993) did not report the results for sentential objects.

6. Martohardjono (1993) claimed that the relevant parameter is whether the most deeply embedded finite IP (English) or CP (Italian) counts as a barrier, citing Chomsky (1986b).

8. Review of preceding artificial language studies of language acquisition

The evidence that the L2 learner can or cannot learn linguistic structures incompatible with UG/LM can be gained only by studying the L2 learner's acquisition of an artificial language that is designed to be incompatible with UG/LM, as discussed in Chapter 4.

Use of an artificial language also has an advantage with respect to the problem of irregularities and crosslinguistic variations. One can design an artificial language in such a way that there will be no irregular property that may allow for alternative analyses of the experimental data (McLaughlin & Nayak, 1989; Nation & McLaughlin, 1986). Thus, it is also possible to use an artificial language that conforms to UG/LM for studying the process of language acquisition in general.

There have been some studies in L2 acquisition that used an artificial language as the target language. In this chapter, I will review some of those studies to summarize the claims that have been made as to the conditions under which certain structural properties can or cannot be learned through input.

One type of artificial language study was devoted to the investigation of the type of information necessary for successful syntax learning. While this type of study was aimed at discovering the process of L1 acquisition through experiments that carefully controlled the input conditions, the findings may be considered more relevant to adult L2 acquisition, in that all subjects in those studies were adult English speakers.[1]

Another type of artificial language study addressed the issue of whether experienced language learners (multilinguals) use a learning strategy different from novice language learners (monolinguals or bilinguals) under different task conditions. This type of study investigated the strategies used and the levels of knowledge achieved by experienced and novice learners under implicit learning and explicit learning conditions.

Still another type of artificial language study addressed the issue of whether language universals constrain L2 acquisition. This type of study investigated whether L2 learners exhibited knowledge of syntax that was underdetermined by the input and the knowledge of L1.

8.1. Artificial language studies on the effect of input conditions

In cognitive psychology, some researchers used an artificial language to investigate what information the learner uses to internalize a pattern or regularity of a symbolic system. The major issue was whether morpho-syntactic grouping cues that indicated constituent boundaries were sufficient for learning a phrase structure grammar, or structured reference (semantic) system that reflected the phrase structure and syntactic constraints was necessary.

8.1.1. Moeser & Bregman (1972)

Moeser & Bregman (1972) claimed that syntax learning is affected both by the complexity of the language and by the amount of syntactic information reflected in the semantic reference field.

Moeser & Bregman tested 120 English speakers on their ability to learn 3 artificial languages of different degrees of complexity under 4 different input conditions.

The 3 different languages were designed with different syntactic complexity. All languages used the same 14 CVC trigrams with word association values between 70 and 80 in Archer (1960). The trigrams were grouped into 4 classes, with 4 words in each of classes A, B, and C, and 2 words in class D. The phrase structure rules of the 3 languages are given in (71).

(71)

a). system 1:

S --> AP + BP + (CP)
AP --> A + (D)
BP --> B + (CP)
CP --> C

b). system 2:

S --> AP + BP + (CP)
AP --> A + (D)

$$\text{BP} \dashrightarrow \begin{bmatrix} \text{B1} \\ \text{B2 + CP} \end{bmatrix}$$

CP --> C

c). system 3:

S --> AP + BP + (CP)
AP --> A + (D)

$$\text{BP} \dashrightarrow \begin{bmatrix} \text{B1} \\ \text{B2 + CP} \end{bmatrix}$$

CP --> C + (D)

System 1 was the least complex with no disjunction. System 2 was more complex than system 1, in that BP involved a disjunction of 2 different phrase structures, in which the choice of B1 or B2 determined the presence or absence of CP. System 3 was more complex than system 2, in that it had additional optionality of a D word in CP.

The 4 input conditions were set up with different amounts of syntactic information encoded in the reference field for each of the 3 different languages, as in (72).

(72)

a). words-only
Only the words of the languages were presented.

b). arbitrary figures
Figures were presented with the words of the languages, while there was no cue to word classes in the figures.

c). class correspondence
Figures were presented with the words of the languages, and the visual features of the figures reflected the syntactic class.

d). syntax correlation
Figures were presented with the words of the languages, and the visual features of the figures reflected the syntactic class and syntactic restrictions.

In (72b), (72c), and (72d), referents were assigned to words of the artificial languages.

(73) Referents of words

a). arbitrary correspondence
Word referents were assigned to trigrams randomly.

b). class correspondence
A word: colored rectangles in the horizontal orientation
B word: colored rectangles in different orientations
C word: geometric figures
D word: line variations
The referents of A, B, and D words were presented as independent figures in sequence.

c). syntax correlation
A word: colored rectangles
B word: orientations of colored rectangles
C word: geometric figures separate from the rectangle
D word: line variations of colored rectangles
The referents of A, B, and D words were combined to form a single perceptual entity (a rectangle with a given color (A), with a given orientation (B), and with a given type of border (D)).

The shared characteristics of referent figures for each word class in (73c) and (73d) encoded the word class information. The combination of word referents into a single figure in (73d) encoded the cooccurrence restriction information.

For systems 2 and 3, word referents were changed to reflect the selectional restriction of CP within BP and of a D within CP. In system 2, a following CP is obligatory when B2 appears, while a following CP is not obligatory when B1 appears. Thus, the B2 words were given a referent which consisted of an orientation of a colored rectangle and the presence of a C figure (geometric shape) above or below the rectangle. In system 3, the occurrence of a D word depends on the occurrence of a preceding A word or a preceding C word. Thus, D words were given a referent of either a border variation of a colored rectangle or a border variation of a geometric shape.

Ten Subjects were randomly assigned to each of the treatment conditions (language x input condition), and were asked to discover the grammatical structure of the artificial language, while they viewed 40 sentences, with 2 exposures for each sentence, in each of the 4 training sessions.

After each training session, subjects were tested on their knowledge of 8 syntactic generalizations by a grammaticality judgement test involving a contrastive presentation of pairs of a grammatical sentence and an ungrammatical sentence, which differed from each other only in terms of the targeted syntactic generalization.

The tests included 3 questions testing each of the 5 generalizations in (74).

(74)
a). An A word must appear in a sentence.
b). Only one A word can appear in a sentence.
c). A B word must appear in a sentence.
d). Only one B word can appear in a sentence.
e). A D word can only follow an A word.

The tests used for system 2 included questions for 2 additional generalizations.

(75)
f). Two C words cannot appear with a B1 word.
g). Zero C words cannot appear with a B2 word.

The tests used for system 3 were identical to those for system 2 except that the counterpart of rule (74e) was:

(76)
A D word can only follow an A word or a C word.

In all systems, rules (74a)-(74d) were about the restriction that each sentence must have one word from one word class and one word from another word class. Rule (74e)/(76) was about the relative position, in a sentence, of one word class with respect to another word class. Rules

(75f) and (75g) were about the selectional restrictions in systems 2 and 3.

It was predicted that the difficulty in learning the language would be affected by both the reference conditions and the complexity of the system.

A two-way ANOVA for the reference condition x system (complexity) design over questions for rules (74a)-(74e)/(76) found significant main effects for reference condition and for system (complexity), while there was no significant interaction between reference condition and system.

A two-way ANOVA for the reference condition x system (complexity) design over questions for rules (74a)-(75g) found significant main effects for reference conditions and for system, and a significant interaction between reference condition and system.

It was predicted that if syntax is learned through the mediation by semantic reference, then subjects' performance would be better, where the semantic reference reflected the syntactic constraints. Thus, the expected ordering of performance was:

(77)
syntax correlation > class correspondence
> words-only : arbitrary figures

This led to 15 specific predictions of differences between means in the 3 languages.

(78)

```
s1-syntax correlation  > s1-class correspondence
s1-syntax correlation  > s1-arbitrary figures
s1-syntax correlation  > s1-words only
s1-class correspondence > s1-arbitrary figures
s1-class correspondence > s1-words only

s2-syntax correlation  > s2-class correspondence
s2-syntax correlation  > s2-arbitrary figures
s2-syntax correlation  > s2-words only
s2-class correspondence > s2-arbitrary figures
s2-class correspondence > s2-words only

s3-syntax correlation  > s3-class correspondence
s3-syntax correlation  > s3-arbitrary figures
s3-syntax correlation  > s3-words only
s3-class correspondence > s3-arbitrary figures
s3-class correspondence > s3-words only
```

T-tests performed on pairs of means for questions for rules (74a)-(74e)/(76) found a significant difference between 14 pairs of means out of 15 in the predicted direction.

It was predicted that in the syntax correlation condition, there should be no difference in performance among different languages, since the complexity of language was expected not to be significant where the maximal amount of syntactic information was given in the reference field. The prediction was supported by the non-significant differences between each pair of languages in the syntax correlation condition.

It was predicted that in the words-only condition and in the arbitrary figures condition, performance would decrease with the complexity of the language. This led to 6 specific predictions.

(79)

s1-words only > s2-words only
s1-words only > s3-words only
s2-words only > s3-words only

s1-arbitrary figure > s2-arbitrary figure
s1-arbitrary figure > s3-arbitrary figure
s2-arbitrary figure > s3-arbitrary figure

T-tests performed on pairs of means for questions for rules (74a)-(74e)/(76) found a significant difference between means in 3 pairs in the predicted direction, a non-significant difference between means in 2 pairs in the predicted direction, and a non-significant difference between means in 1 pair in the non-predicted direction.

A three-way ANOVA with the 4 reference condition x 3 system x 5 rule design for systems 1, 2, and 3 showed a significant main effects for rule, a significant interaction between system and rule, and a significant interaction between reference condition and rule.

A three-way ANOVA with the 4 reference condition x 3 system x 7 rule design for systems 2 and 3 showed a significant main effect for rule, a significant interaction between system and rule, and a significant interaction between reference condition and rule.

In the words-only condition, subjects performed above chance on rules 1 and 2 and slightly above chance on rule 4, in all 3 systems. Subjects performed slightly above chance on rule 5 in systems 1 and 2. There was a marked decline in performance on rule 5 in system 3, where the D word varied in its position.

In the arbitrary figures condition, subjects performed roughly equally to subjects in the words-only condition in systems 1 and 2, and above chance only on rule 2 in system 3.

In the class-correspondence condition, if the semantic learning strategy was employed, and if information provided in the reference field did not reflect all of the syntax rules, then those rules not reflected in the reference field (rules 6, 7 in system 2, rules 5, 6, 7 in system 3) should not be learned. Subjects performed above chance on all rules in system 1, and on all rules in system 2 except for rules 6 and 7, and all rules in system 3 except for rules 5 and 7. Subjects performed above chance in system 3 on rule 6, contrary to the expectation.

In the syntax correlation condition, if the semantic learning strategy is employed, all grammatical rules are learned since those rules are reflected in the reference field. Subjects performed above chance on all rules and in all systems.

The results showed that the ease of five syntax rules was not the same for different reference conditions and different systems. Under the syntax correlation condition, the performance on each rule was not affected by systems, while under the other 3 conditions, the performance on rules varied across different systems.

Moeser & Bregman concluded that the results supported the hypothesis that the learning strategies employed when semantic referents are present are different from the learning strategies employed when semantic referents are not present, and that when semantic referents are present, the learners first learn the word referents and how the referents are organized, and then project the knowledge of reference organization onto the word distribution across sentence positions.

Moeser & Bregman also claimed that only when the elements in the semantic field reflects the syntactic constraints, complex grammatical relations are easily learned.

8.1.2. Green (1979)

Green (1979) tested the marker hypothesis, which claimed that natural languages contain a small number of markers that signal particular syntactic constructions, and that the human parsing system would make markerless languages virtually unusable.

Green criticized the method that Moeser & Bregman used in their study. Braine (1963, 1966) reported that young children were able to learn a meaningless artificial language, while Moeser & Bregman (1972, 1973) reported that subjects could learn complex syntax only when the semantic reference field reflected the syntactic constraints. Green attributed the difference in the results in the 2 studies to the difference in the vocabulary used and the method of the training in the artificial language.

As for the vocabulary, Braine used words that were pronounceable and highly discriminable, while Moeser & Bregman used CVC trigrams with a comparable word association values, and therefore, Moeser & Bregman's words were much less discriminable than Braine's words. Green claimed that short-term memory is important in learning an artificial language, and that the acoustic discriminability is important in short-term memory.

As for the method of training, Moeser & Bregman presented slides showing sentences with or without referents in the training session, while Braine presented incomplete sentences through a computer, and asked subjects to choose words to complete each sentence from a list of words. Moeser & Bregman's motivation to choose the reception regime was the problem with Miller's (1967) study in which subjects were given feedback by the computer when the sentence that subjects typed was correct. Miller's pure selection regime gave very poor learning results, because subjects had to generate strings randomly before they typed a grammatical sentence by chance. However, the reception-only regime is less effective than the selection regime in that the latter allows for subjects to test out their hypotheses.

Thus, Green claimed that artificial languages to be used in the experiment must contain pronounceable and highly discriminable words, and that the regime must be neither pure reception nor pure selection.

In Experiment 1, Green tested 15 English speakers, with 3 varieties of a simple artificial language Jabbarish. The prediction was that sentences without markers would be hard to parse, and that a language would be difficult to learn if the sentences were hard to parse.

Subjects were trained and tested through a teleprinter attached to a small computer, with access to the list of the words of Jabbarish at any time. Subjects attended 2 sessions, each consisting of 2 learning stages and a test stage. At the beginning of each learning stage, the computer typed 5 grammatical sentences, and then subjects either typed YOU to have the computer type another grammatical sentence, or typed ME and then typed what subjects thought to be a grammatical sentence. The computer responded to the sentence that subjects typed by 1 of 3 responses: OK, INCORRECT, and UNKNOWN WORDS. When the computer responded UNKNOWN WORDS, subjects had to retype a sentence until they achieved either OK or INCORRECT. In the learning stage, the last 9 or 10 sentences typed on the teleprinter were visible to the subjects so that they could compare sentences. Each learning stage ended when the number of YOU responses + the number of ME responses x 2 reached 30. Subjects were not told of the criterion used to end the learning stage.

Jabbarish was a referenceless language with a phrase structure grammar, with the following phrase structure rules and words.

(80)

```
S  -->  [ P d D(0.2)
          P(0.7)
          d(0.1) ]

P  -->  [ a A c C(0.33)
          c C a A(0.44)
          a A b B c C(0.22) ]

A  -->  [ LOTHOG
          STINY
          TYAN
          PANK
          LING ]

B  -->  [ BATIM
          GORT
          SKOP ]

C  -->  [ FENGLE
          FURD
          STOPE
          PURSER
          RARK
          CUMO ]

D  -->  [ RELO
          DOOB
          PLACK ]
```

Words represented by the lower case letters were the markers that varied across the 3 dialects. The figures in parentheses represent the probability for the given expansion to be selected by the computer when the subject typed YOU. The probabilities were assigned to expansions so that the frequencies of each word would be roughly the same.

Dialect 1 (effective markers) had the following markers, and the markers were signaled by the three-letter length.

(81)

```
a --> ERD
b --> IRP
c --> ALT
d --> ETH
```

Dialect 2 (no markers) did not realize the non-terminal symbols a-d. Dialect 3 (useless markers) rewrote the non-terminal symbols a-d by any of the words ERD, IRP, ALT, and ETH, so that which particular marker appears in the a-d position could not be predicted.

At each test stage, the computer presented 16 forced-choice sentence completion problems, in which a grammatical sentence was presented with 1 word missing, and subjects were asked to choose the correct word from a list of 4 words. Only non-maker words were the target words.

Subjects who learned dialect 1 (effective markers) performed better than subjects who learned the other 2 varieties in all practice sessions, and subjects who learned dialect 2 and subjects who learned dialect 3 were similar in their performance.

An ANOVA using a fixed-effects analysis with repeated measures over practice sessions showed a significant difference among dialects and a significant interaction between dialect and practice session. The interaction was largely due to the a surprisingly high score of subjects who learned dialect 2 (no markers) in practice session 1, close to the score of those who learned dialect 1 (effective markers). However, the high score was largely contributed by 1 exceptional subject.

Green concluded that the results of experiment 1 supported the marker hypothesis, since dialect 1 with effective markers was learned better than dialect 2 with no markers and dialect 3 with arbitrary markers.

In experiment 2, Green tested 42 English speakers with 6 dialects of an artificial language. The purpose of experiment 2 was to test whether subjects could learn phrase classes better from markers. The effect of markers on phrase class learning was important in testing the marker hypothesis, in that the marker hypothesis claimed that markers signal the occurrence of particular constructions, which were phrases. The prediction was that learning would be improved not only by markers that were cues to word classes but also by markers that were cues to phrase classes.

Subjects attended a single session, consisting of 1 learning stage and 1 test stage. The procedure was the same as experiment 1. The learning stage ended when the number of YOUs + the number of MEs x 2 reached 60.

The artificial language had the following phrase structure rules and words.

(82)

$$S \dashrightarrow \begin{bmatrix} \mathrm{a\ A\ x\ X} \\ \mathrm{y\ Y\ a\ A} \end{bmatrix}$$

$$X \dashrightarrow \begin{bmatrix} \mathrm{b\ B\ c\ C} \\ \mathrm{c\ C\ b\ B} \end{bmatrix}$$

$$Y \dashrightarrow \mathrm{d\ D\ e\ E}$$

$$A \dashrightarrow \begin{bmatrix} \text{GRILE} \\ \text{CLOPE} \\ \text{VEAB} \\ \text{SYMP} \\ \text{HABE} \\ \text{TASP} \end{bmatrix}$$

$$B \dashrightarrow \begin{bmatrix} \text{LOSYM} \\ \text{RINTH} \\ \text{DERGO} \\ \text{BUIN} \\ \text{GARL} \\ \text{NATH} \end{bmatrix}$$

$$C \dashrightarrow \begin{bmatrix} \text{CHOLT} \\ \text{LAIK} \\ \text{FLUN} \end{bmatrix}$$

$$D \dashrightarrow \begin{bmatrix} \text{NESSY} \\ \text{MAXEL} \\ \text{RAFEN} \\ \text{REUT} \\ \text{MERB} \\ \text{IVAT} \end{bmatrix}$$

$$E \dashrightarrow \begin{bmatrix} \text{TISOL} \\ \text{PURA} \\ \text{CLAV} \end{bmatrix}$$

Dialect 1 (effective markers for word classes and phrases) had the following markers.

(83)

```
a --> NAL
b --> KON
c --> UST
d --> OOM
e --> AIT
x --> EAG
y --> ACK
```

Dialect 2 (no phrase markers) had y as the marker for both X and Y. Dialect 3 (no between-phrase markers) had d as the marker for B and D, and e as the marker for C and E, thus making the distinction between X and Y impossible from the word class markers (while retaining the distinction between X and Y by x and y). Dialect 4 (no within-phrase word markers) had d as the marker for B and C, and e as the marker for D and E, thus making the word class distinction within each of X and Y impossible from the word class markers. Dialect 5 (no word markers) had d as the marker for B, C, D, E, making the word class distinction impossible from the word class marker. Dialect 6 (no effective markers at all) had a as the marker for B, C, D, E, X, Y, making distinction of word classes and phrase types impossible from the marker.

(84) Summary of markers

	X	Y
Dialect 1	x b c	y d e
Dialect 2	y b c	y d e
Dialect 3	x d e	y d e
Dialect 4	x d d	y e e
Dialect 5	x d d	y d d
Dialect 6	a a a	a a a

The test stage consisted of 3 tests. The word completion test consisted of 15 forced-choice problems, each with 3 alternative words. The phrase completion test consisted of 9 problems, each with 3 alternative phrases. The reordering test consisted of 15 problems in which words of an anagrammatized sentence was to be reordered into the correct order.

The predictions on the performance on the 6 dialects were:

(85)

a). Performance on dialects 1 and 2 would not differ on the word test, because each word class had a distinct marker in both dialects. Performance on dialect 1 would be better than performance on dialect 2 on the phrase test, because X and Y phrases had distinct markers in dialect 1, but they had the same marker in dialect 2.

b). Performance on dialect 3 would be better than performance on dialect 4 in the word test, because words were distinguished for word classes by the pair of markers, x or y plus d or e in dialect 3, while no combination of markers distinguished B words from C words or D words from E words in dialect 4. Performance on dialect 4 would be better than performance on dialect 3 in the phrase test, because X and Y phrases were doubly marked in dialect 4, while phrases were distinguished only by x and y in dialect 3.

(85 continued.)

c). Performance on dialect 5 would be better than performance on dialect 6 in both the word test and the phrase test, because dialect 5 had some effective markers, while dialect 6 had no effective markers.

d). While detailed predictions could not be made as to the performance on the anagram test since it was a blunt measure, performance of dialect 6 would be the worst.

As for prediction (85a), an ANOVA using a model with 2 fixed effects of dialect (dialect 1 and dialect 2) and type of test (word and phrase), taking repeated measures over type of test, showed no significant main effect of dialect at the word level, and a significant main effect of dialect at the phrase level.

As for prediction (85b), an ANOVA using a model with 2 fixed effects of dialect (dialect 3 and dialect 4) and type of test (word and phrase), taking repeated measures over type of test, showed no significant difference between dialect 3 and dialect 4 overall, and a significant interaction between dialect and type of test.

As for prediction (85c), an ANOVA using a model with 2 fixed effects of dialect (dialect 5 and dialect 6) and type of test (word and phrase), taking repeated measures over type of test, showed no significant difference between dialect 5 and dialect 6. The probability of the difference by chance was greater than 0.20.

As for prediction (85d), Dunnet's t for comparison of the means of anagram test scores for dialects 1-5, one at a time to the mean of anagram test score for dialect 6, using one-tailed tests, showed a significant difference between each of the means for dialects 1-5 and the mean for dialect 6, with $p < .01$ in all cases.

Green concluded that the results of the 2 experiments supported the marker hypothesis in that dialects with effective markers were learned better than dialects without effective markers. Results of experiment 2 showed that markers aided the identification of phrase constituents as well as word constituents.

While there was not a significant difference between dialect 3 and dialect 4 for the word test nor for the phrase test, there was a significant interaction between dialect and type of test in the predicted direction.

While the prediction (85c) was not borne out, with no significant difference between dialect 5 and dialect 6 in both the word test and the phrase test, subjects who learned dialect 5 performed better than subjects who learned dialect 6 in the anagram test. Green suspected that subjects for dialect 5 learned the relative ordering relation between words (and thus performing relatively well on the anagrams test), while they did not learn the selectional restrictions (and thus performed well on neither the word test nor on the phrase test).

Moeser & Bregman (1972, 1973) claimed that subjects learning a meaningless language could only try to learn class membership and order relations of words from their positions in the sentence, and that this strategy is effective for only very simple language systems. They also claimed that it may be possible to learn order relations in a meaningless language, while the selectional restrictions will not be learned.

Green concluded, contrary to Moeser & Bregman (1972, 1973), a complex syntactic system can be learned, even if it is meaningless, as long as there are markers to show its structure. The results of dialect 5 and dialect 6 showed that Moeser & Bregman's claim may be correct where the language has no markers and no semantics, since subjects for dialect 5 were able to learn the ordering relations, while both subjects for dialect 5 and subjects for dialect 6 were not able to learn selectional restrictions. Efficient learning of selectional restrictions requires either a well-organized semantic system or a well-organized marker system.

8.1.3. Morgan & Newport (1981)

Morgan & Newport (1981) tested 36 subjects with an artificial language in 4 different input conditions.
The artificial language had the following phrase structure rules.

(86)
S --> AP + BP + (CP)
AP --> A + (D)

$$\text{BP} \dashrightarrow \begin{bmatrix} \text{E} \\ \text{CP + F} \end{bmatrix}$$

CP --> C + (D)

While this was a phrase structure grammar, the same set of terminal strings as the grammar (86) generated could also be generated by a finite-state grammar. However, the dependency relations holding within a phrase can be captured better with a phrase structure grammar than a finite-state grammar, in that the phrase structure grammar represents a level of structure that corresponds to phrases, while a finite-state grammar assigns the same status to all the links between pairs of words in a sequence.

In the training session, subjects were told that they would view many slides, each of which containing a sentence of an artificial language and a set of figures that the sentence referred to, and were asked to discover how the words and figures were paired and patterns in the arrangements of words.

The training set consisted of 40 sentences, with 2 sentences for each of the 14 sentence types with 2-5 words and 12 additional sentences to adjust the frequency of each word to be 10 occurrences within the 40 sentences. The vocabulary was 15 CVC trigrams with word association values between 70 and 80 in Archer (1960).

The 40 slides, each containing a training sentence and the referents (in all input conditions except for one), were randomized in order in 2 different sequences, and the 2 sequences with 80 slides in total were presented in 1 training session. The 80 slides were presented for 4 times, and after each presentation subjects were given a battery of tests.

The reference field of each slide varied across 4 input conditions.

In the no grouping condition, each word was paired with a unique figure. The referents for a given class of words shared some common features, as in (87). There was equal spacing between referents.

(87)
A words ... colored rectangles
C words ... brown geometric shapes
D words ... variations of two parallel vertical lines
E words ... intersecting bars in different orientations
F words ... dome shapes

In the arbitrary grouping condition, the referents were the same for condition 1, and they were grouped into the following units, which did not correspond to the constituents of the sentence.

(88)
A - (D)E(C) - (D)
or
A - (D)C - (D)F(C) - (D)

In the constituent grouping condition, the referents were the same as condition 1, and they were grouped into units which corresponded to the constituents of the sentence.

(89)
A(D) - E - C(D)
or
A(D) - C(D)F - C(D)

In the syntax incorporation condition, the referents were assigned as in (90).

(90)

A words ...	colored rectangles
C words ...	brown geometric shapes
D words ...	border variations of A and D word referents
E words ...	the orientation of colored rectangles
F words ...	the spatial relations of a rectangles for an A word and a geometric shape for a D word (a geometric shape above or below a rectangle)

The E and F word referents were assigned in such a way that they could not occur without an A word referent and/or a C word referent (a rectangle and/or a geometric shape), thus, encoding the syntactic dependency of E and F words in the reference field. The referents were grouped into units that corresponded to the constituents of the sentence.

The test sessions consisted of 2-4 tests, the vocabulary test and the rules test for all test sessions, the additional fragmental constituent test for test sessions for training sessions 2 and 4, and the additional transformational constituent test for the test session for training session 4.

In the vocabulary test, subjects viewed a figure, and were asked to select the corresponding word from a list of 4 alternative words, for each of 15 questions. The vocabulary test for each training session was different from the vocabulary test for another training session.

In the rules test, subjects viewed a pair of sentences without reference fields, one grammatical and the other ungrammatical, and were asked to choose the grammatical one, for each of 32 items. There were 4 items for each of the 8 rules in (91). The rules test for each training session was different from the rules test for another training session.

(91)
Rule 1: Every sentence must contain at least one A word.
Rule 2: No sentence may contain more than one A word.
Rule 3: There may be at most one C phrase at the end of a sentence.
Rule 4: Every sentence must contain at least one E or F word.
Rule 5: No sentence may contain more than one E or F word.
Rule 6: A D word cannot appear after an E or F word.
Rule 7: A C phrase cannot occur before an E word.
Rule 8: A C phrase must occur before an F word.

In the fragmental constituent test, subjects viewed a pair of sentence fragments without reference fields, consisting of 2 or 3 permissibly adjacent words, one a constituent and the other a non-constituent, and were asked to choose the fragment that was a better "group" or "unit", for each of 24 items. There were 8 items for each of phrases A, B and C. The fragment constituent test for learning session 2 was different from the fragment constituent test for learning session 4.

In the transformational constituent test, subjects viewed a pair of word sequences that were generated by rearranging the words of a grammatical sentence, one moving a constituent and the other moving a non-constituent, and were told that the 2 sentences were generated by rearranging words of a sentence, and were asked to choose the better arrangement, for each of 24 items. There were 8 items for each of phrases A, B, and C.

Three comparisons were performed on the rules test results summed over the 4 trials and on the last rules test results.

There was no significant difference between the constituent grouping condition and the syntax incorporation condition, either in the summed scores or in the scores of the last rules test, suggesting no effect of the explicit semantic representation of syntactic dependencies.

There was a significant difference between the arbitrary grouping condition and the constituent grouping condition, both in the summed scores and in the scores of the last rules test, suggesting an effect of the presence of constituent information in the reference field.

There was no significant difference between the no grouping condition and the arbitrary grouping condition, both in the summed scores and in the scores for the last rules test, suggesting no effect of the presence of arbitrary grouping in the reference field.

The results indicated that the constituent structure information semantically encoded had an effect on the learning of syntax, while additional semantic information about linguistic dependency did not affect the learning of syntax.

For rules 1-4, there was no significant difference among the 4 conditions. The syntax incorporation, constituent grouping, and arbitrary grouping conditions showed linear trends, with performance increase over sessions. Analyses of liner x liner interactions among the 3 conditions failed to show any significant differences in the slopes of these trends. The no grouping condition did not show a liner trend. The failure to show a linear trend was due to a drop off between the second and the third trials, and Morgan & Newport attributed it to the administration of the sentence fragment test after the second trial.

For rules 6-8, there was a significant difference between 2 of the conditions. Only the constituent grouping condition and the syntax incorporation condition scored above chance. The syntax incorporation condition and the constituent grouping condition showed significant linear trends across the 4 sessions, while the arbitrary grouping condition and the no grouping condition did not show a significant linear trend. A test of linear x linear interaction between the syntax incorporation condition and the constituent grouping condition showed a significant difference in the slopes of the 2 learning trends. Morgan & Newport attributed the interaction to the poor vocabulary learning in early sessions in the syntax incorporation condition. In the first trial, subjects in the syntax incorporation condition performed poorly in the vocabulary test and in the rules test, while after they had mastered vocabulary in trial 3 and trial 4, they performed slightly better in the rules test.

Subjects in all conditions learned the unconditional syntactic rules (rules 1-4), while only subjects in the constituent grouping condition and in the syntax incorporation condition learned the dependency rules of the language (rules 5-6). The results supported the hypothesis that the constituent structure information in the reference field is sufficient for the learning of complex aspects of syntax.

The results of the rules tests show that all subjects showed knowledge of some finite-state grammar, though not necessarily the correct one, since all subjects performed above chance on at least some rules. However, to claim that the learner has achieved a phrase structure grammar, the learner must show knowledge of hierarchical structure. The results of the fragment constituent test and the transformational constituent test indicate the knowledge of phrase structure.

The group means for constituent grouping and syntax incorporation were above the chance level. The group means for no grouping and arbitrary grouping were at the chance level. There was a significant difference between the constituent grouping condition and the arbitrary grouping condition for the first fragment test, for the second fragment test, and for the transformational constituent test, suggesting that there was an effect of the constituent information in the reference field in learning the phrase structure. There was no significant difference between the syntax incorporation condition and the constituent grouping condition for the first fragment test, for the second fragment test, nor for the transformational constituent test, suggesting that there was no effect of the additional information on the dependencies. There was no significant difference between the arbitrary grouping condition and the no grouping condition for the first fragment test, for the second fragment test, nor for the transformational constituent test, suggesting that subjects in these conditions did not learn the phrase structure.

The results supported the hypothesis that the learning of dependencies between words occurs in the learning of constituent structure, since only subjects in the constituent grouping condition and the syntax incorporation condition learned the phrase structures, and only subjects in those conditions learned rules on syntactic dependencies (rules 5-8).

Moeser & Bregman (1972) claimed that learning of complex features of syntax is possible only when they are reflected by the properties of the reference field. Morgan & Newport agreed that semantic mediation plays a role in the induction of complex systems in that subjects exposed to input systems which differed only in the organizations of their reference worlds showed difference in the form and extent of the learning of syntax. However, Morgan & Newport disagreed with Moeser & Bregman in that subjects learned dependencies when dependency information was not presented in the reference field, i.e., the constituent grouping condition, and in that additional information given to the syntax incorporation condition did not significantly improve learning.

Thus, Morgan & Newport concluded that the grouping cues in the reference field are sufficient for the learning of phrase structure grammar and dependencies, while without the grouping cues, only the learning of the finite-state grammar is possible. Morgan & Newport also suggested that the reason why natural languages have a phrase structure grammar was not because the child has an innate knowledge linguistic structure, but because natural languages have multiple correlated cues to the constituent structure required for the learning of the phrase structure grammar. They also suggested that the reason why natural languages often have a transformational grammar, which is more complex than a phrase structure grammar, is because movement of constituents cues the constituent structure and helps the learning of phrase structure.

8.1.4. Mori & Moeser (1983)

Mori & Moeser (1983) reported 3 experiments on the effects of markers and semantic reference in syntax learning.

In a pilot study, Mori compared the effects of markers and semantic reference in syntax learning. Mori used a language similar to the one used in Moeser & Bregman (1972; 1973) and Morgan & Newport (1981). The semantic system was the system used for Moeser & Bregman's (1972) syntax correlation condition. The results of the pilot study showed that the artificial language with an organized marker system and without a reference system was learned faster than the artificial language with an organized semantic system and without a marker system.

Mori & Moeser, however, claimed that the 2 languages were not comparable in 2 aspects. The organized marker system was easier to learn than the organized semantic system, because the former required the learning of only the syntax of the language, while the latter required the learning of the correlation between words and referents in addition to syntax. Therefore, learning a language with a marker system required the learning of less information. Also, the language with a marker system but without a semantic system was not as similar to natural languages as the language with a semantic system, because all natural languages have a semantic system. Thus, Mori & Moeser concluded that the pilot study did not assess the relative effectiveness of an organized maker system and that of an organized semantic system adequately.

In experiment 1, Mori & Moeser compared 4 language conditions.

(92)
a). a well organized semantic system and a well organized marker system
b). a well organized semantic system and an arbitrary marker system
c). a well organized marker system and an arbitrary semantic system
d). an arbitrary semantic system and an arbitrary marker system

If an organized semantic system is equally effective as an organized marker system, then the performance in (92b) and (92c) should be the same, and should be better than the performance in (92d). If the effects are additive, then the performance in (92a) should be better than the performance in both (92b) and (92c).

Four languages with the following phrase structure rules were prepared.

(93)
S --> AP + BP + (CP)
AP --> A + (D)

$$BP \dashrightarrow \begin{bmatrix} B1 \\ B2 + CP \end{bmatrix}$$

CP --> C

There were 8 types of sentences generated from the phrase structure rules, with the length of 2 to 5 words. All 8 types were used in the experiment.

The vocabulary consisted of 16 CVC trigrams, which were highly discriminable and easily pronounced by English speakers, to which 1 of 5 affixes, -A, -IE, -I, -O, -U, was attached.

There were 4 input conditions. In the organized reference/marker condition, the word order and the suffix markers corresponded to the reference field in a systematic way, and the suffix markers corresponded to the word classes. In the organized reference condition, the word order corresponded to the reference field in a systematic way, while the suffix markers did not correspond to the reference field nor to the word classes. In the organized marker condition, neither the word order nor the suffix markers corresponded to the reference field in a systematic way, while the suffix markers corresponded to the word classes. In the arbitrary correspondence condition, neither the word order nor the suffix markers corresponded to the reference field in a systematic way, and the suffix markers did not correspond to the word classes.

Each sentence was presented with a reference field consisting of colored rectangles and/or geometric figures. In the organized reference system and in the organized reference/marker system, the referents were assigned to words as in (94).

(94)

A words ... colors of the rectangle
B1 words ... orientations of the rectangle
B2 words ... vertical relations between the rectangle and a geometric figure (a figure above or below the rectangle)
C words ... types of the geometric figure
D words ... border variations of the rectangle

In the organized marker condition and in the organized reference/marker condition, words of a given word class shared the same suffix, while in the organized reference condition and in the arbitrary correspondence condition, the suffix forms were irrelevant to word classes.

(95)

A words ... -A
B1 words ... -IE
B2 words ... -I
C words ... -O
D words ... -U

The training stimuli consisted of 60 colored slides in each input condition. There were 30 different reference field arrangements. Of the 60 slides, 30 contained the reference field and the corresponding sentence, and 30 contained only the reference field.

In the organized reference/marker condition and the organized reference condition, the stimuli contained both sentences consistent with the phrase structure rules and the referents consistent with the semantic rules in (96).

(96)
Rule 1: There can be only one colored rectangle for a sentence, and therefore, there can be one type of border.
Rule 2: If the rectangle is in a diagonal position, then there can be only one geometric figure.
If the rectangle is in a horizontal position, then there must be one or two geometric figures.

In the organized marker condition and the arbitrary correspondence condition, sentences consistent with the phrase structure rules did not reflect any semantic rules. However, there was a subset of sentences whose reference field was consistent with the semantic rules. In the training, this subset was used, so that subjects in all 4 conditions would see the same reference field arrangements.

In the organized reference/marker condition and the organized marker condition, sentences consistent with the phrase structure rules reflected the marker rules in (97).

(97)
Rule 1: Each sentence contains one -A suffix.
Rule 2: Each sentence contains one -IE or -I suffix.
Rule 3: Each sentence may contain two or fewer -O suffixes.
Rule 4: Each sentence may contain one or no -U suffix.

In the organized reference condition and the arbitrary correspondence condition, sentences consistent with the phrase structure rules did not reflect any marker rules. However, there was a subset of sentences in which word forms observed the marker rules. In the training, this subset was used, so that subjects in all conditions would see the same marker arrangements.

Mori & Moeser tested 32 English speakers in the 4 input conditions. Subjects were told that they would see 2 types of slides, one containing only a picture, and the other containing a picture and a sentence that described the picture, and were asked to learn what each word referred to and to provide a sentence corresponding to a picture presented without an accompanying sentence. Before the presentation of sentences, subjects viewed an alphabetical list of 16 words and learned how to pronounce them, as the experimenter pronounced the words according to English conventions. Then, subjects viewed 60 slides, projected on a screen by a slide projector. Each picture-only slide was followed by its corresponding slide with a picture and a sentence. Subjects' responses to picture-only slides were recorded.

The same set of 60 slides was presented to subjects repeatedly for 6 times or until they provided the correct sentence for 27 out of 30 consecutive pictures.

After the training session, subjects took 4 tests: the transfer test, the vocabulary test, the rules test, and the acceptability judgement test.

In the transfer test, subjects viewed 10 slides of new pictures and were asked to provide sentences that corresponded to the pictures. Sentences that reflected semantic rules were used in all conditions.

In the vocabulary test, subjects viewed pictures of the 16 individual referents and were asked to provide the most suitable word to describe each picture.

In the rules test, subjects viewed 14 pairs of sentences on paper, one grammatical and the other ungrammatical, without reference fields, and were asked to choose the grammatical one. There was only 1 error in each ungrammatical sentence. Two versions of the test, one for the organized reference/marker condition and the organized marker condition, and the other for the organized reference condition and the arbitrary correspondence condition, were prepared. These versions were identical except for the suffixes attached to words.

In the acceptability judgement test, subjects viewed 10 sentences on paper, 3 of which were grammatical and reflected the rules presented in the training, 4 of which were grammatical but did not reflect the rules (reference rules in the organized marker and arbitrary correspondence conditions, marker rules in the organized reference and arbitrary correspondence conditions), and 3 of which were ungrammatical, and were asked to judge whether each sentence was correct.

In addition to the above 4 measures, the acquisition speed score was calculated by converting the number of trials before reaching the criterion of 27 out of 30 consecutive trials into a reciprocal number, and multiplying it with 10^3 to produce an integral number.

A two-factor ANOVA with the organized marker x organized reference design on the results from the 5 measures showed a significant main effect for organized reference, while there was no main effect for organized marker nor a significant interaction between organized marker and organized reference.

Sixteen subjects out of 32 (organized reference/marker 7, organized reference 6, organized marker 2, arbitrary reference 1) reached the learning criterion. The 13 subjects in the 2 conditions with organized reference performed well on the 4 tests. The 3 subjects from the 2 conditions without organized reference performed well on the vocabulary test, reasonably well on the transfer test and the rules test, and below the chance level (40% correct) on the acceptability test.

Sixteen subjects out of 32 failed to reach the learning criterion. The 3 subjects in the 2 conditions with organized reference who failed to reach the criterion performed reasonably well on all 4 tests, while the 13 subjects in the 2 conditions without organized reference who failed to reach the criterion performed poorly on all 4 tests.

The results of experiment 1 showed that a well-organized reference system was necessary for learning syntactic rules.

There were 2 possible types of learning strategies: the reference learning strategy and the word order strategy. In the reference learning strategy, subjects first learn the word-reference correspondences, and then arrange words into a grammatically correct sentence. In the word order strategy, subjects first learn the word order rule, and then learn the referents associated with each word.

In experiment 1, Mori & Moeser did not observe responses with correct order of word classes, with incorrect individual word choice (suggesting the word order strategy) while they observed responses with the correct word choice with an incorrect word order (suggesting the referent learning strategy). The lower performance in the conditions without organized reference might have been due to the fact that the reference learning strategy delayed word-referent association because the word order did not correspond to the order of elements in the reference field.

In experiment 2, Mori & Moeser tested whether subjects in the organized marker condition could discover the marker regularities once they had acquired the language vocabulary.

If the problem of the conditions without organized reference is the vocabulary learning, and if the organized marker system aids syntax learning, then the performance in the organized marker condition should be better than the performance in the arbitrary correspondence condition, if subjects are trained with vocabulary before sentences are presented.

Also, if the organized marker is as effective as the organized reference, then the performance in the organized marker condition should be the same as the performance in the organized reference condition.

Mori & Moeser tested 24 English speakers in 3 input conditions: the organized reference condition, the organized marker condition, and the arbitrary correspondence condition. The 3 linguistic systems used in the organized reference condition, the organized marker condition, and the arbitrary correspondence condition in experiment 1 were used in the respective conditions. The test materials were also the same as those in the respective conditions in experiment 1. The procedure was the same as experiment 1, except that subjects were given a vocabulary training session prior to the presentation of the slides.

In the vocabulary training session, subjects studied 16 cards, each containing 1 of the 16 words and its referent, for 10 minutes, and were then asked to say the word corresponding to the pictures shown to the subjects. If subjects made an error, the experimenter corrected the mistake. The 16 pictures were shown repeatedly until subjects provided correct words for all pictures in 2 consecutive trials. No subject failed to learn the vocabulary, and the session lasted about 15 minutes.

In the syntax training session, subjects were asked to provide a sentence to each of the picture-only slides.

The results showed that in all conditions, the acquisition speed score was higher in experiment 2 than in experiment 1, while the performance on the rules test in experiment 2 was not higher than that in experiment 1 in the organized marker condition and the arbitrary correspondence condition, suggesting no effect of vocabulary training in syntax learning for those conditions.

Univariate F-tests comparing 3 conditions for each of the 4 performance measures (including the acquisition speed score) and Scheffe's post hoc method for comparing the 3 input conditions on each univariate analysis showed that subjects in the organized reference condition were significantly better than subjects in the other 2 conditions on all 4 performance measures, and that there was no significant difference between the organized maker condition and the arbitrary correspondence condition on any of the 4 measures.

The results of experiment 2 showed that subjects in the organized marker condition did not discover marker regularities even when they did not have to attend to word meanings.

The results of experiment 1 and experiment 2 contradicted the results of Green (1979). Mori & Moeser hypothesized that a marker system may be only effective when it does not contradict the language reference system.

In experiment 3, Mori & Moeser tested whether the organized marker system in experiment 1 and experiment 2 could be learned when it was presented without a reference system.

Mori & Moeser tested 16 English speakers in 2 input conditions: the organized marker condition and the arbitrary correspondence condition.

Two artificial languages were prepared. One was identical to the system used in the organized marker condition in experiment 1, except that the language did not have a reference field. The other was identical to the system used in the arbitrary correspondence condition in experiment 1, except that the language did not have a reference field.

The training materials consisted of 60 slides in each input condition. Thirty slides contained a sentence consisting of words arranged according to the phrase structure rules. The other 30 slides contained a sentence consisting of the same words as words in the corresponding phrase structure sentences, but the words were randomly arranged. The 60 slides were identical in the 2 input conditions, except for the differences in suffixes.
The 30 sentences used in the training were a subset of sentences that observed the marker rules both in the organized marker condition and in the arbitrary

correspondence condition. Thus, subjects in both conditions in experiment 3 viewed sentences observing marker rules. The only difference between the organized marker condition and the arbitrary correspondence condition was that the marker rule occurred in conjunction with an order rule in the former, while the marker rule did not occur in conjunction with an order rule in the latter.

The procedure was the same as the procedure in experiment 1, except that subjects were told that they would see 2 types of slides, one containing a list of words at random and the other containing the same words in a correct order. Subjects were told to learn how to arrange words into a sentence, and to provide a correct order of words when they viewed a randomly ordered list of words whenever they could. Subjects viewed a list of the 16 words in the alphabetical order and learned how to pronounce them. Then, subjects viewed the 60 slides in the same order as experiment 1, except that the random order slides were shown in place of the picture-only slides.

Three tests were given after the training: the transfer test, the rules test, and the acceptability judgement test.

In the transfer test, subjects viewed 10 slides containing word sequences that had not appeared in the training, and were asked to state the correct arrangements of these words. Sentences used in the transfer test was a subset of sentences that observed the marker rules.

The rules test and the acceptability judgement test were identical to those used in experiment 1 and experiment 2.

The results showed that subjects in the organized marker condition in experiment 3 performed better than subjects in the organized marker condition in experiment 2, and that subjects in the arbitrary correspondence condition in experiment 3 performed only slightly better than subjects in the arbitrary correspondence condition in experiment 2.

Univariate F tests performed to compare the 2 input conditions on each of the 4 measures (including the acquisition speed score) showed a significant difference between the 2 input conditions on all measures. In all measures, subjects in the organized marker condition performed better than subjects in the arbitrary correspondence condition.

The results of experiment 3 replicated the results of Green (1979). However, the results of experiment 1 and experiment 2 suggest that subjects will not pay attention to a systematic marker system unless this is the only type of information they have about the language. Thus, the results of the 3 experiments suggest that when subjects are required to learn a language with a semantic system, they adopt a learning strategy that is consistent with the semantic system.

8.1.5. Meier & Bower (1986)

Morgan & Newport (1981) and Morgan, Meier, & Newport (1986) reported that the syntax of a variant of Moeser & Bregman's (1972) language could be learned, even if the input contained much less highly structured reference fields used by Moeser & Bregman (1972).

Morgan & Newport (1981) claimed that the crucial property of the reference field for syntax learning was that the reference field cued the constituent structure of the word strings. Subjects were able to learn a phrase structure grammar (not only the constituents but also the dependencies within a constituent), where the spatial grouping of geometric figures in accordance with the constituent structure, without a direct cue for constituent-internal dependencies.

Morgan, Meier, & Newport (1986) manipulated the presence/absence of 3 types of grouping cues: prosodic intonation, function words, and concord morphology. Subjects learned syntax only if the stimuli contained grouping cues which demarcated syntactic conditions.
In Morgan, Meier, & Newport's experiment, the reference fields indicated the meaning and word class, redundantly indicated by the adjacencies within the sentences. The reference fields did not cue dependencies nor the constituent structure. Subjects in all conditions had the same reference fields, and therefore, the redundant

representation of word class by reference fields was not sufficient for learning syntax.

Meier & Bower (1986) examined whether reference plays any necessary role (rather than the *sufficient* role) in the acquisition of syntax and the efficacy of concord inflections as grouping cues.

Meier & Bower tested 30 English speakers in 3 input conditions: the reference field condition, the morphology condition, and the control condition.

Three dialects of an artificial language were prepared. The artificial language was a variant of the language used by Anderson (1975), which had English words as vocabulary. The artificial language had phrase structure rules and words in (98).

```
(98)
S --> NP PRED
NP --> N [ (SIZE) (PATTERN) (CLAUSE) ]
         [ te ADJ                    ]
CLAUSE --> te PRED
PRED --> NP REL
N --> {square, circle, diamond, triangle}
SIZE --> {large, small}
PATTERN --> {striped, dotted}
ADJ --> {red, broken}
REL --> {above, below, right-of, left-of}
```

The language was recursive, in that a clause could be embedded in another clause, and that a clause can be embedded in a noun phrase. An embedded clause was introduced by a word *te*. The language had a constituent-internal dependency that te introducing a clause must appear immediately before a noun at the beginning of the embedded clause, and that te must also appear between a noun and an adjective modifying the noun.

There were 3 different types of sentences in terms of embedding: no embedding, embedded clause within a subject NP, and embedded clause within an object NP.

Except for te, all words were English words. Using English words eliminated the need for learning word-referent pairs, and allowed for distinguishing between the semantics of English words and the other information indicated by reference fields, which was present only in the reference field condition.

The input conditions differed in the presence/absence of reference field and in the presence/absence of inflectional morphology.

In the reference field condition, sentences were presented with a semantically appropriate reference field, containing 2 or 3 geometric figures. The figures were arranged in a spatial arrangement stated in the sentence. The word te was not associated with any feature in the reference fields. The set of possible figures included 2 sizes of 4 basic geometric forms. Where the noun phrase did not specify the size of the figure, the large or small version was randomly assigned.

In the morphology condition, sentences were presented with concord suffixes attached to appropriate words and without a reference field. Four inflectional suffixes were used, typed in the upper case letters and separated with a hyphen from the stem. The stem was typed in the lower case letters.

(99)

-O suffixed to the subject noun of the matrix clause and its modifiers, and to matrix relations and embedded relations whose subject is the matrix subject

-A suffixed to the object noun of the matrix clause and its modifiers, and to embedded relations whose subject is the matrix object

-AO suffixed to the object noun and its modifiers of the embedded clause that modifies the matrix clause subject

-AA suffixed to the object noun and its modifiers of the embedded clause that modifies the matrix clause object

No inflectional morpheme was suffixed to te. The suffixes -AA and -AO can be analyzed as sequences of suffixes -A -A and -A -O.

In the control condition, sentences were presented with neither a reference field nor concord suffixes.

The training material consisted of 48 sentences, 24 with 2 nouns with or without an embedded clause and 24 with 3 nouns with an embedded clause, in 4-12 syllables. The 48 sentences were presented in 8 study blocks of 6 sentences each.

Subjects were told that they would view a series of cards, each of which would contain a single sentence from the artificial language. Subjects in the reference field condition were also told that a set of pictures that the sentence referred to would be above each sentence. Subjects were asked to learn the rules by which the words were organized into sentences. Then, subjects viewed 48 cards in 8 blocks.

After each block of 6 study sentences, subjects were given a test booklet containing 6 two-alternative forced-choice questions, and were asked to choose the grammatical sentence from each pair. Test sentences were presented without reference fields, while in the morphology condition, sentences were presented with inflectional morphology.

Six rules of the syntax of the language were tested.

(100)
Rule 1: Size modifiers precede pattern modifiers
Rule 2: te must precede an embedded object.
Rule 3: te cannot occur before the main clause object.
Rule 4: A relation must occur in the main and embedded clauses.
In the morphology condition, the single relation present in incorrect test items had the suffix -O, indicating agreement with the main clause subject.
Rule 5: A sentence cannot have 3 main clause arguments.
Rule 6: A sentence must have a main clause object.

An ANOVA with the condition x trial design showed significant main effects for condition and for trial. There was no significant interaction between condition and trial.

There was a significant difference between the reference field condition and the control condition, and there was no significant interaction between condition and trial for the reference field vs. control comparison. The significantly better learning in the reference field condition replicated the results of Anderson (1975).

There was a significant difference between the morphology condition and the control condition, and there was no significant interaction between condition and trial for the morphology vs. control comparison. The significantly better learning in the morphology condition supported the hypothesis that concord morphology can provide the basis for leaning syntax without reference fields.

There was no significant difference between the reference field condition and the morphology condition, and there was no significant interaction between condition and trial for the reference field vs. morphology comparison. The absence of a significant difference between the reference field condition and the morphology condition showed that concord morphology was as useful as reference field organization in learning syntax.

Subjects in both the reference field condition and the morphology condition showed significant upward linear trends over trials. Subjects in the control condition did not show a significant linear trend. The analysis of linear x linear interaction showed a significant difference in the slopes of the linear trends for the reference field condition and the control condition. The difference between the slopes of the linear components in the morphology condition and the control condition approached, but did not reach, significance. The difference between the slopes of the linear components in the reference field condition and the morphology condition did not reach significance.

The results showed that subjects can learn a phrase structure grammar without semantic reference, if the sentence strings contain cues for the constituent structure, since subjects in the morphology condition learned syntax significantly better than subjects in the control condition, in spite of the fact that they saw sentence strings longer than those that subjects in other conditions viewed. The results supported the claim that grouping cues can subserve the learning of a miniature syntax.

The issue of whether the semantics of individual lexical items is necessary for successful learning of syntax was unresolved. However, such information was not sufficient for syntax learning. Subjects in the control group did not learn syntax rules, though information as to the meaning, the word class, and the required number of arguments of lexical items was available.

8.2. Artificial language studies on the effect of multilingualism on learning strategies

8.2.1. Nation & McLaughlin (1986)

Nation & McLaughlin (1986) compared information processing strategies in multilingual, bilingual, and monolingual subjects learning a miniature linguistic system. Nation & McLaughlin hypothesized that expert language learners do not use the same information-processing strategies as more novice learners do.

Nation & McLaughlin hypothesized that in L2 learning, controlled processing is needed to achieve a correct or at least adequate phonetic expression of words in early stages, and that controlled processing is used for developing syntax or the lexicon after the learner has mastered the basic sounds of the language. Thus, they attempted to determine whether expert language learners who had acquired multiple languages used different strategies in learning a new language.

The experiment group consisted of 14 multilinguals, and the control group consisted of 14 bilinguals and 14 monolinguals. All subjects rated themselves on Naiman, Frohlich, Stern, & Todesco's (1978) scale of language proficiency (3 levels: elementary proficiency, working knowledge, advanced knowledge) on 4 languages skills: understanding, speaking, writing, and reading. Monolinguals were fluent in English, but did not possess an elementary proficiency in any other language. Bilinguals were fluent in L1 and rated L2 skills as advanced, but did not possess an elementary proficiency in any other language. Multilinguals rated their skills as advanced in 4 or more languages.

To avoid the effect of having learned a similar language before on learning a new language, and to manipulate formal properties of the stimulus materials, a miniature artificial linguistic system was used as the target language.

Two different grammars were developed for 2 different sessions. Each set of grammatical stimuli was made up of strings of 5 letters derived from a finite-state Markov grammar.

(101)
Grammar 1:

```
                      M*
--> 1 -- S ----> 2 ----- P --> 4 ----------->
    |            ^            / \
    |            | +---- J --+   +--- M --> 6 -->
    |            W |                        ^
    |            | |                        |
    |            | |               +-- S ----+
    |            | v               |
    +--- P ----> 3 ----- W -----> 5 ---------->
                                  J*
```

S M* P
S M* P M
S M* P J W J*
S M* P J W J* S
S M* P J W M* P
P W M* P J W J*
P W M* P J W M* P
S M* P J W M* P M
P W J*
P W J* S
P W J* P
P W M* P M

Grammar 2:

```
--> 1 -- B --> 2 -- B -----+
    |          |^          |
    |          ||_X_       |
    |          |    |      |
    |          N    4C*    |
    |          |    ^      v
    |          v    |      5X* -->
    |               |      ^  \
    +--- G --> 3 -- G      |   N --> 6 -->
               |           |
               +--- C -----+
```

B B X*
B B X* N
B N C X*
B N C X* N
B N G C* X B X*
B N G C* X B X* N
G C X*
G C X* N
G G C* X B X*
G G C* X B X* N
G G C* X N C X*
G G C* X N C X* N
The asterisked element may be omitted or inserted for any number of times.

Letters were chosen in such a way that the 2 grammars were equivalent to English in the frequency of letters. The 2 grammars were equivalent in the structure function. The structure function f(x) is the number of exemplars of exactly length x that can be generated by the grammar (Chomsky & Miller, 1958). For each grammar, there were 5 exemplars of 3 letters, 7 exemplars of 4 letters, 11 exemplars of 5 letters, and 18 exemplars of 6 letters. The longest exemplar used was 18 letters long.

The learning stimuli consisted of 20 exemplars from each grammar. The test stimuli consisted of 20 exemplars from each grammar different from any of the learning stimuli and 5 exemplars from the learning stimuli, as well as 25 ungrammatical stimuli of the following types.

(102)
5 initial letter violations
5 penultimate letter violations
5 ultimate letter violations
2 deep-internal violations
8 grammatical strings spelled backwards

There were 2 phases of experiment. Each phase consisted of a learning task, a test of the rules of the language, and an introspective questionnaire.

Subjects were instructed to use different learning strategies in the 2 phases, implicit learning in the first phase and explicit learning in the second phase. The second phase was scheduled about 10 days after the first phase.

Reber (1980) defined implicit learning and explicit learning as follows.

(103)
a). implicit learning
a non-deliberate process by which the structural nature of the stimulus is mapped onto the mind of the attentive subject

b). explicit learning
a deliberate process by which the subject induces the rules underlying the structure of the stimulus environment through intentional examination and analysis of stimuli

Subjects were exposed to each grammar only once. The grammars were counterbalanced across subjects and tasks, so that some subjects learned Grammar 1 in the implicit learning phase and others learned Grammar 2 in the implicit learning phase.

There were 2 versions of the implicit learning task, the random condition and the structured condition. Each subject was given only 1 of the 2 versions. In the random condition, subjects viewed a set of 20 stimuli, 1 stimulus at a time, in a randomized order. In the structured condition, subjects viewed a set of 20 stimuli, 1 stimulus at a time, in a structured order following the options of pathways. Under both conditions, subjects were shown the set of stimuli for 3 times.

Each exemplar was presented on a large cardboard sheet on an easel in front of the subjects for 7 seconds. In the implicit learning task, the subjects were told to pay close attention to the stimuli.

After the learning phase, subjects were told that the 20 exemplars that they saw followed a set of rules of the letter order. The subjects were then told that they would be shown another set of 100 exemplars, and that exactly a half of these would follow the rules for the letter order. Subjects were asked to judge whether each exemplar could be considered to be well-formed according to the rules that were represented by the stimuli in the learning phase. Subjects indicated their responses by circling "yes" or "no" on an answer sheet. Then, the 50 test exemplars, 25 grammatical and 25 ungrammatical, were presented twice. The stimuli were printed on sheets of cardboard, 1 stimuli on a sheet. The sheets were placed one at a time on an easel in full view of all subjects, for 5 seconds for each. After the test, the subjects filled out the introspective questionnaire.

There were 2 versions of the explicit learning task: one random and the other structured. Each subject was given a sheet of paper on which all 20 of the grammatical stimuli were printed. In the structured version, the stimuli were arranged in a structured order based on the grammar, so that each column contained the exemplars from one string type. In the random version, the stimuli were arranged in columns in a random order.

Subjects were told that they would be shown a group of artificial "words" derived from a complex set of rules governing letter order, and were suggested to discover the rules. Subjects were allowed to scan the sheet for 7 minutes. Then, subjects were told that they would be shown 100 new artificial words, and that exactly a half of them could be considered well-formed. Subjects were asked to indicate whether each stimulus was well-formed by circling "yes" or "no" on an answer sheet. Then, the 50 test exemplars, 25 grammatical and 25 ungrammatical, were presented twice. After the test, subjects filled out the introspective questionnaire.

The results showed that subjects exposed to the structured stimuli gave significantly more correct responses than those exposed to the random stimuli in both the implicit learning task and the explicit learning task. There was no interaction between subject group and presentation order, with all groups exposed to the structured stimuli performing better than their counterparts exposed to the random stimuli, in both learning tasks. Since there was no interaction, structured and random presentations were not distinguished in the subsequent analyses.

There was no significant difference between 2 different Markov grammars. There was no interaction between subject group and grammar. Thus, the scores for the 2 grammars were combined within groups in the analyses.

A mixed ANOVA with the group x learning task design showed significant main effects for group and task, and a significant interaction between group and task. Tests for the difference between individual means of subject groups (the Newman-Keuls method) showed that multilinguals performed significantly better than bilinguals and monolinguals in the implicit learning task, while there was no difference among groups in the explicit learning task.

Since each subject judged the same item twice during the test, there were 4 possible response patterns, CC, CE, EC, and EE where C = correct, E = error.

In the implicit learning task, the EE values for bilingual and monolingual subjects were significantly higher than the CE and EC values, suggesting that they had hypothesized an invalid rule and applied it consistently. The difference between the EE value and the CE/EC values for multilingual subjects was not significant, indicating that they were less likely to make misclassification errors on both presentations.

The EE values did not differ significantly from CE/EC values for any group in the explicit learning task.

The pattern of incorrect rejection of correct stimuli and the pattern of incorrect acceptance of incorrect stimuli were very similar. For both types of errors, the interaction between group and task was significant. Multilinguals performed better in the implicit learning task than the other groups.

A comparison was made between ungrammatical strings with an offending character in the initial or final position (external position errors) and ungrammatical strings with an offending character in the non-peripheral positions (internal position errors). Multilinguals performed better on both types of ungrammatical strings than the other 2 groups in the implicit learning condition. There was no difference among groups in the explicit learning condition.

In the implicit learning condition, the majority of the subjects reported that their primary activity was "say or pronounce letter groups" or "associate letter groups with words". In the explicit learning condition, most subjects reported that they had searched for rules for the letter order.

When subjects were asked to select 1 activity from a list of 5 that best described what they had done during the learning task, more multilingual subjects responded that they had "responded intuitively" on the implicit learning condition than monolingual and bilingual subjects, while the difference was not significant. There was no difference among groups in what activities they chose as describing what they did in the explicit learning condition.

Other responses to the introspective questionnaire did not show any difference among groups.

The results showed that multilinguals learned the grammar significantly better than monolinguals and bilinguals in the implicit learning condition. The subject groups did not show a difference in the explicit learning condition. Nation & McLaughlin speculated that the superiority of multilinguals may derive from an ability to abstract structural information from linguistic stimuli under conditions where no instruction is given to learn the material or to derive underlying rules.

Error patterns did not reveal characteristic differences among groups. Multilinguals had fewer EE errors than monolinguals and bilinguals while the groups did not differ in CE and EE errors. Nation & McLaughlin speculated that the reason may be that multilinguals have greater linguistic sensitivity than the other groups.

8.2.2. Nayak, Hansen, Krueger, & McLaughlin (1990)

Nayak, Hansen, Krueger, & McLaughlin (1990) also tested the hypothesis that multilinguals have language-acquisition strategies different from those of monolinguals. Nayak, Hansen, Krueger, & McLaughlin used an artificial linguistic system more like a natural language than the Markov grammars Nation & McLaughlin (1986) used, in that the language involved a phrase structure grammar in which constituents were defined by dependencies between words, as well as by regularities of substitution equivalence (Morgan & Newport, 1981).

Nayak, Hansen, Krueger, & McLaughlin tested 48 subjects, 24 multilinguals and 24 monolingual English speakers in 2 different task conditions (memory vs. rule discovery). All subjects rated their language skills on a 7-point scale (1 = no ability, 7 = completely fluent) with respect to reading, writing, and speaking. Multilinguals rated their skills as 6 or higher in 3 or more languages. Monolinguals rated their skills as 3 or lower in any language other than English.

An artificial language based on Morgan & Newport (1981) was prepared. The language had the following structure rules.

```
(104)
S  --> AP + BP + (CP)
AP --> A  + (D)
BP --> [ E      ]
       [ CP + F ]
CP --> C + (D)

Therefore:
S --> A (D) E        (C (D))
            C (D) F
```

There were 14 different types of sentences consisting of 5 or fewer words. The vocabulary consisted of 15 CVC trigrams with word association values between 70 and 80 in Archer (1960). The referents of words in the same class shared the same property.

(105)

class A ... rectangles
class C ... geometric figures
class D ... intersecting bars
class F ... variations of lines

The training set consisted of 40 sentences containing at least 2 examples of each type of sentences. Each word occurred approximately 10 times in the 40 sentences. All stimuli were presented on a Macintosh computer.

In the learning phase, subjects viewed 6 sample trigram strings with reference fields, and then viewed a set of 40 sentences with reference fields for 3 times in a random order. Each sentence appeared on the screen for 5 seconds.

In the memory condition, subjects were told to memorize each sentence. The learning phase was interrupted for 3 times, and subjects were asked to give and tape record instructions, as specifically as possible, for a naive subject who would undergo the same task, such that the naive subject would be able to do the task in the same way.

In the rule discovery condition, subjects were told that the order of the words in sentences was determined by a complex set of rules, and they were asked to discover the rules. The learning phase was interrupted for 3 times, and subjects were asked to give and tape record instructions for a naive subject.

Neither subjects in the memory condition nor subjects in the rule discovery condition were specifically oriented to the reference field above the words in the sentence.

The learning phase lasted for 25 minutes. After the learning phase, a vocabulary test and a syntax test were administered.

In the vocabulary test, subjects were presented with the items of the following types.

(106)

a).	Normal:	a word paired with the correct referent
b).	Class ref:	a word paired with a referent from the same class but not the correct referent
c).	Arb ref:	a word from any one class paired with a referent from a different class
d).	Novel ref:	a word from the grammar presented with referent never seen before
e).	Novel word:	a word never seen before paired with a referent from the set used in the language

There were 15 tokens of each type. The subjects were asked to judge, as quickly and as accurately as possible, whether the word and its referent in a given item was an item in the learning phase, by pressing a "yes" key or a "no" key.

In the syntax test, subjects were presented with novel sentences without referents and were asked to read each sentence carefully and to decide, as quickly and as accurately as possible, whether it was an acceptable sentence in the language, by pressing a "correct" key or an "incorrect" key. Subjects were told that there were no new words in the sentences.

Subjects were tested on 8 rules of the grammar. Each rule was tested 6 times with 3 correct and 3 incorrect sentences, with a total of 48 items. The 8 items were qualitatively divided into 2 subsets. Rules 1-4 are concerned with occurrence of individual word classes, defining unconditional aspects of the liner structure. Rules 5-8 are concerned with dependencies between word classes.

(107)
Rule 1: Every sentence must contain at least one A word.
Rule 2: Only one A word can appear in a sentence.
Rule 3: There may be at most one C phrase at the end of the sentence. (no sequence of C words)
Rule 4: Every sentence must contain at least one E or F word.
Rule 5: No sentence may contain more than one E or F word.
Rule 6: A D word can appear only after an A word
Rule 7: A C phrase cannot occur before an E word.
Rule 8: A C phrase must occur before an F word.

Subjects' account of strategies that they were using was transcribed from the tape recordings. Each subject had 3 protocols for each phase of learning. These protocols were coded by 2 judges who were unaware of the conditions to which each subject was exposed nor the group to which each subject belonged. Subjects' strategies were rated in terms of the following 4 strategies.

(108)
a). an emphasis on structure
b). an emphasis on position
c). use of visual cues
d). use of verbal cues

The protocols were scored in terms of the distribution of 10 points across the 4 strategies. Interjudge agreement on 15 protocols coded by both judges was .92.

A mixed ANOVA on the accuracy data of the vocabulary test with the group (multilingual vs. monolingual) x condition (memory vs. rule discovery) x type (5 item types) design showed significant main effects for condition (memory > rule discovery) and type, and a significant interaction between condition and type. The interaction was due to the failure of subjects in the rule discovery condition to identify incorrect word-referent pairs in which the word was paired with an incorrect referent from the same class (class ref). There was no main effect nor an interaction for group.

A mixed ANOVA on the speed data of the vocabulary test with the group x condition x type design showed a significant main effect for type. Responses to words paired with incorrect referents from the same class (class ref) and novel words paired with referents from the learning set (novel word) were significantly quicker than other types. There was no other significant main effect or interaction.

In the analyses of the rules test data, items were divided into 2 classes: simple rules (rules 1-4) and complex rules (rules 5-8). The simple rules defined unconditional aspects of the linear structure, while the complex rules involved dependencies between word classes.

A mixed ANOVA on the accuracy data of the rules test with the group x condition x class design showed a significant main effect for class (simple > complex) and a significant interaction between group and condition. The interaction was due to the superior performance of multilingual subjects to that of monolingual subjects in the rule discovery condition. The effect was stronger for the simple rules than for the complex rules with a marginally significant interaction among group, condition, and class.

A mixed ANOVA on the speed data of the rules test with the group x condition x class design showed a marginal main effect for class (complex faster than simple), showing a speed-accuracy trade off. There was no other significant main effect or interaction.

The verbalizations of the strategies were examined in 2 ways: a) group x condition x category (4 categories) x protocol ANOVA and b) group x condition x category (2 categories: linguistic vs. mnemonic) x protocol ANOVA.

A mixed ANOVA using 4 categories showed a significant main effect for category, and a significant interaction between condition and category, showing that visual cues were used more often then other strategies in the memory condition.

A mixed ANOVA using 2 categories showed significant interactions between group and category, between condition and category, and among group, condition, and category. Both multilinguals and monolinguals preferred linguistic strategies to mnemonic strategies in the rule-discovery condition, and multilinguals used more mnemonic devices than linguistic strategies in the memory condition. There was no significant main effect or interaction for the protocol factor in either analysis, suggesting that the subjects did not change strategies over the course of the learning session.

The number of different strategies used by the subjects indicated that multilinguals used a greater variety of different strategies in the rule-discovery condition than in memory condition. No such difference was found for monolinguals.

The results showed that multilinguals and monolinguals were significantly more accurate in identifying correct vocabulary items in the memory condition than in the rule-discovery condition, and that multilinguals were better at discovering the rules than monolinguals in the rule-discovery condition, but not in the memory condition.

The results were contradictory to Nation & McLaughlin (1986). However, the memory condition was significantly different from Nation & McLaughlin's (1986) implicit learning condition, in that the subjects were instructed to memorize the stimuli in the memory condition, while the subjects were oriented toward the materials in Nation & McLaughlin's implicit learning condition, and that the complex constituent structure rules in this experiment required more linguistic processing than the pattern recognition procedures in Nation & McLaughlin's experiment.

Multilinguals performed better than monolinguals in the rules test, reflecting multilinguals' experience with language, their willingness and ability to search for rules.

Multilinguals took longer than monolinguals in the rules test in the rule-discovery condition, suggesting that multilinguals exerted more processing effort to determine the rules.

Both multilinguals and monolinguals preferred linguistic strategies to mnemonic devices in the rule-discovery condition, while multilinguals preferred mnemonic devices more than monolinguals in the memory condition.

Multilinguals used a greater variety of different strategies in the rule-discovery condition than in the memory condition, while monolinguals did not change the strategies significantly in the rule-discovery condition and in the memory condition. One reason why multilinguals performed better in the rule-discovery condition may be multilingual's greater flexibility in switching strategies. The finding is consistent with Nation & McLaughlin's (1986) that multilinguals were able to avoid perseveration of errors more than bilinguals and monolinguals.

Multilinguals did not surpass monolinguals on all aspects of the language learning task. This was most likely to be due to the limited exposure to the artificial linguistic system. In the long run, Nayack, Hansen, Krueger, & McLaughlin expected that multilinguals perform better on language learning due to their superior ability to shift strategies and restructure their internal representation of the linguistic system.

8.3. Studies on language universals in L2 acquisition

8.3.1. Cook (1988)

Cook (1988) tested the adult learner's ability to extrapolate from a known word order in one type of phrase to an unknown word order in another type of phrase. Cook made the following predictions from Hawkins' (1983) Cross Category Harmony, which states that there is a quantifiable preference for the ratio of preposed to postposed operators within one phrasal category to generalize to the others.

(109)

a). The learner extrapolates form the order of V and NP in VP to the order of P and NP in PP

b). The learner extrapolates form the order of V and NP in VP to the order of N and Adj in NP

c). The learner extrapolates from the order of V and NP in VP and the order of P and NP in PP to the order of N and Adj in NP

d). The learner extrapolates from the order of V and NP in VP and the order of N and Adj in NP to the order of P and NP in PP.

The head direction parameter postulated under government and binding theory also makes prediction (109a) in that the complement should be on the same side of the head in any phrase, since the head direction is set once for all in the phrase structure of a given language. However, the head directionality parameter does not make predictions as to the extrapolation from or to the order of N and Adj in NP, in that Adj is neither a head nor a complement and therefore, outside of X-bar specification.

Two sets of related artificial languages were prepared. Artificial languages in set 1 tested extrapolation from the order of V and NP to the order of N and Adj or to the order of P and NP. Artificial languages in set 2 tested extrapolation from the order of V and NP and either the order of P and NP or the order of N and Adj to either the order of N and Adj or the order of P and NP, respectively.

Set 1 included SOV languages A and C and VSO languages B and D. Extrapolation to the order of N and Adj was tested in languages A and B. Extrapolation to the order of P and NP was tested in languages C and D.

Set 2 included SOV/NP P languages E and G and VSO/ P NP languages F and H. Extrapolation to the order of N and Adj was tested in languages E and F. Extrapolation to the order of P and N was tested in languages G and H.

The vocabulary for the 8 artificial languages was the same pronounceable monosyllables used by Morgan & Newport (1981).

(110)
Nouns: BIF tiger, HES lion, MIK cow, VOT dog, RUD cat
Verbs: NEB sees, SOG hears, KAG follows
Adjectives: JAX big, TIZ old, FAC clever, CAV strong
Adpositions: DUP near, PEL to, LUM on, KOR with

The sentences were given meaningful reference by English translations.

Cook tested 409 English speaking middle school pupils learning French as a foreign language at 2 middle schools in Colchester, Essex. Subjects were told that they would learn a made-up language called Xtopal, and that they did not have to learn all words, because they would always have a translation to look at.

In the training phase, the class teacher read aloud the training sentences with literal English translations in the artificial word order and also natural English translations in the English order. For set 1 languages, 30 sentences were presented, and for set 2 languages, 26 sentences were presented. The vocabulary was introduced in a sequence so that each new item was heard several times in the context of old items before another item was introduced. All vocabulary items had equal frequency.

In test 1, subjects were asked to answer 15 multiple choice questions in which they were asked to choose a correct word order. For set 1 languages, subjects were asked to choose the correct order from 3 alternatives, VSO, SVO, and SOV orders. For set 2 languages, subjects were asked to choose the correct order from 2 alternatives, N P and P N, or N Adj and Adj N, in addition to the questions on the S, V, O order.

In test 2, subjects were asked to answer 14 questions in which they were asked to read English translations of an artificial language sentence, and were asked to choose the best translation from 2 alternatives. Subjects who had learned languages A, B, G, and H were tested on the order of N and Adj. Subjects who had learned languages C, D, E, and F were tested on the order of P and N.

The subjects' consistency of response was judged by whether they selected one word order for a given type of phrase in 12 or more items out of 15 in test 1 and in 12 or more items out of 14 in test 2.

In test 1, for set 1 languages A-D, 178 out of 181 subjects (98.3%) were consistent. For set 2 languages E-H, 168 out of 228 subjects (71.1%) were consistent.

There was a significant difference in the observed frequency of consistent subjects/inconsistent subjects and the expected frequency (50%/50%) for all languages except for language G.

In test 2, for set 1 languages, 157 out of 159 subjects (98.7%) were consistent. For set 2 languages, 142 out of 162 subjects (87.7%) were consistent.

Whether the artificial languages were learnable was tested by the number of subjects who were correct for 12 or more out of 15 questions and the number of subjects who were incorrect for more than 3 out of 15 questions in test 1 for each of the languages.

There was a significant difference between the observed frequency of correct subjects/incorrect subjects and the expected frequency (50%/50%) for all languages except for language G.

For set 1 languages A-D, 159 out of 181 subjects (87.8%) performed correctly. For set 2 languages E-H, 162 out of 228 subjects (71.1%) performed correctly. Set 1 languages A-D were significantly easier to learn than set 2 languages E-H.

Cook speculated that the reason may be that there were 30 examples for each phrase type for set 1 languages, while there were 13 examples for each phrase type in set 2 languages.

There was no significant difference among the 4 languages in set 1. There was no significant difference between 2 sets of languages in set 1, A and C on the one hand and B and D on the other.

There was a significant difference among the 4 languages in set 2. The order of difficulty was E > H > F > G or SOV + Adj N > VSO + P N > VSO + N Adj > SOV + N P.

As for the extrapolation from the order of V and NP to the order of P and N, the results of test 2 showed that 62.5% of subjects extrapolated from the V NP order to the N P order in language D, and that 89.7% of subjects extrapolated from the NP V order to the N P order in language C. The result for language D was the reverse of the prediction made by both the Cross Category Harmony and the head direction parameter. Subjects extrapolated the N P order regardless of the order of V and NP. However, the difference between language C and language D in the numbers of subjects who extrapolated to the N P order and those who extrapolated to the P N order was significant.

As for the extrapolation from the order of V and NP to the order of N and Adj, the results of test 2 showed that 93.3% of subjects extrapolated from the NP V order to the Adj N order in language A, and that 67.3% of subjects extrapolated from the V NP order to the N Adj order in language B. There was a significant difference between language A and language B in the numbers of subjects who extrapolated to the N Adj order and those who extrapolated to the Adj N order, showing an effect of the order of V and NP on the extrapolation to the order of N and Adj in the predicted direction.

As for the extrapolation from the order of V and NP and the order of P and N to the order of N and Adj, the results of test 2 showed that 94.7% of subjects extrapolated from the NP V order and the N P order to the N Adj order in language G, and that 62.8% of subjects extrapolated from the V NP order and the P N order to the Adj N order in language H. There was a significant difference between language G and language H in the numbers of subjects who extrapolated to the N Adj order and those who extrapolated to the Adj N order, showing an effect of the combinations of word orders in 2 phrases.

As for the extrapolation from the order of V and NP and the order of N and Adj to the order of P and N, the results of test 2 showed that 72.3% of subjects extrapolated from the NP V order and the Adj N order to the P N order in language E, and that 81.1% of subjects extrapolated from the V NP order and the N Adj order to the N P order in language F. There was a significant difference between language E and language F in the numbers of subjects who extrapolated to the P N order and those who extrapolated to the N P order, showing an effect of the combination of word orders in 2 phrases.

The majority of subjects were consistent and were able to learn artificial languages, except for language G (SOV + N P). However, the consistent subjects who learned language G were correctly consistent.

While the results supported 3 of the predicted extrapolations the results contradicted the prediction that the learner should extrapolate from the V NP order to the P N order.

Cook claimed that the learners of artificial languages assumed the following strategies for extrapolation of word orders.

(111)
strategy 1:
If only the order of V and NP in VP is known, then the language has the N P order in PP; i.e., both the V NP order and the NP V order extrapolate to the N P order.

strategy 2:
If only the order of V and NP in VP is known, then the language has Adj in NP on the same side as NP in VP; i.e., the V NP order extrapolates to the N Adj order, and the NP V order extrapolates to the Adj N order.

strategy 3:
If the order of V and NP in VP and the order of N and Adj in NP are known, then the language has P in PP on the same side as Adj in NP; i.e., the NP V order and the Adj N order extrapolate to the P N order, and the V NP order and the N Adj order extrapolate to the N P order.

strategy 4:
If the order of V and NP in VP and the order of P and N in PP are known and are consistent (NP V + N P or V NP + P N), then the language has the Adj N order in NP.

The UG explanation for consistency of complement position in a phrase is supported only by the order of P and NP in strategy 3. It is contradicted by the preference of the N P order in strategy 1. The Cross Category Harmony explanation was supported partially, by strategies 2 and 3. It was contradicted by strategies 1 and 4.

Neither of the 2 main linguistic theories of word order could explain more than a portion of the results. Cook claimed that the nature of the task perhaps affected subjects, leading them to treat the task as problem solving. If this was the case, the high degree of consistency in subjects' strategies cannot be explained by linguistic theories, and requires further research. If the experiment design was valid, then the research appeared to have discovered the existence of a set of extrapolation strategies that 2 main linguistic theories did not predict.

8.3.2. Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995)

There has been one study, reported in Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995), that looked at the issue of whether Chomskian Universal Grammar constrains an L2.

Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995) tested the ability of adult learners to learn an artificial language, Epun, that was deliberately designed to violate some of the universal generalizations on natural language structure claimed under generative linguistics. They tested 4 undergraduate students with a linguistics major in terms of their ability to learn structures that allegedly violated some UG constraints.

There were 2 kinds of UG violations: structure-independent operations and structure-dependent operations. The former included the distribution of the emphatic marker dependent on the number of orthographic words in a clause and unattested agreement resolution. The latter included the negation marking by obligatory V-raising and the obligatory object NP preposing for transitive verbs in the past tense.

a). Emphasis

In Epun, the emphatic element nog was suffixed to the third orthographic word, and if there were fewer than 3 words, the emphatic element nogin occurred in the final position as a separate orthographic word.

b). Morphology of agreement

Natural languages resolve a conflict in agreement marking on verbs when the verb is supposed to take different agreement markers for the different members of a coordinate subject. Corbett (1991) claimed that a). if the conjuncts include a first person, then the first person agreement forms are used;

b). if there is at least one non-plural conjunct, then plural agreement forms are used;

c). if all conjuncts are feminine, then the feminine form is used, otherwise the masculine form is used.

Epun verbs took the third person plural feminine agreement form if the coordinate subject included a first person singular member and a third person singular feminine member, and they took the second person singular agreement form if the coordinate subject included a first person singular member and a third person singular masculine member.

c). Syntax of negation

Epun had no overt negative morpheme. Negative sentences were characterized by the verb preceding the subject.

(112)

SV(O)	...	affirmative	present and future
VS(O)	...	negative	present and future
(O)SV	...	affirmative	past
(O)VS	...	negative	past

To interpret the pattern with respect to the natural language phrase structure, the negation syntax of Epun requires obligatory verb raising to C. Since the head Neg is a (phonetically-null) affix, the verb must first move into Neg at S-structure to satisfy Lasnik's Filter. It is standardly assumed that either the spec of NegP or the head Neg must be overt for the recoverability reasons in this configuration, as given in (113).

(113)

```
          NegP
          /  \
      spec    Neg'
              /  \
           Neg   AgrP
                    \
                     Agr' ...
```

Since Epun's Neg and the spec of NegP are both phonetically null, it violates UG.

d). Syntax of tense

Epun object NPs moved to a pre-subject position in the past tense, while the past tense was marked by the past tense prefix on the verb.

(114)

```
     (O)SV ... affirmative past
     (O)VS ... negative    past
```

The 2 possibilities for the object movement are topicalization, in which the object adjoins to CP, and focusing/operator movement, in which the object moves into the spec of CP. However, there is no correlation between the choice of tense and the word order in any natural language.

Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995) reported that the subjects were unable to learn the distribution of the emphatic marker, and only 1 out of 4 was able to learn the agreement resolution. Meanwhile, the subjects had no problem with the negative word order, and they were overwhelmingly successful in the past tense word order.

Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995) concluded that L2 learners were capable of going beyond the limits imposed by UG by utilizing the general cognitive mechanism, while they claimed that the results were not conclusive, given the small number of subjects.

There are some problems with their study. With regard to the agreement resolution, there was a design problem. Smith & Tsimpli (1995) claim that the pattern of agreement resolution for the coordination of the first person singular and the third person singular feminine resulting in the agreement marking for the third person plural feminine was based on gender, while the resolution for the coordination of the first person singular and the third person singular masculine resulting in the marking for the second person singular was based on number. The former marking is recognizable as a pattern. That is, the coordination of singular nouns constitutes a plural subject (compatible with UG and also conceptually understandable), while the feminine feature of one coordinate becomes the gender value for the coordinate subject, which violates UG but is conceptually understandable. However, it is very difficult to find any pattern with respect to the latter marking. There is no reason (conceptually, rather than linguistically) why the coordination of 2 singular nouns should be considered singular (going against the conceptual generalization) and why the coordination of the first person (speaker) and the third person (non-participant of discourse) should be considered the second person (hearer). Thus, it is not surprizing that most of the subjects were unable to learn the marking, because there was not a readily conceptually recognizable pattern. The property may not have been surface-inducible as a pattern, while it may have been possible to memorize the agreement-marking for these particular combinations of subject nouns in different persons as exceptions to the patterns. Without an argument that such lexical irregularities are universally prohibited for learnability reasons, it is difficult to determine whether the rote memorization of inflectional paradigm constitutes a violation of UG. Since the learner does not internalize the regularities readily when he is exposed to the relevant data, but he stores the data as unanalyzed forms at least for a while before he starts to make generalizations over the data, it may have been the case that the one subject that got the correct marking had memorized the markings as idiosyncratic irregular forms for particular types of coordination of nouns. Thus, it is difficult to conclude that the subjects' failure to learn the agreement marking was due to the knowledge of UG or to conclude that the success of one subject is evidence that the L2 learner is not constrained by UG.

Smith, Tsimpli, & Ouhalla (1993) and Smith & Tsimpli (1995) maintain that the L2 learners were capable of going beyond the limits imposed by UG, while they do not deny UG-accessibility. Their reservation of denying UG-accessibility was partly based on the subjects' failure to learn structure-independent operations. However, as I reviewed in Chapter 1, the very motivation for appealing to the construct of UG in the explanation of language acquisition is to provide a device to constrain the hypothesis space of the language learner. If the L2 learner entertains a hypothesis that is outside of the limits imposed by UG, then UG is not fulfilling the role that it is expected to play in language acquisition, and there is no motivation for appealing to the construct of UG in the explanation of language acquisition.

Note to Chapter 8

1. Bever, Fodor, & Weksel (1965) argued that one could not apply the results of artificial language studies to the explanation of L1 acquisition, for the following reasons.

a). The psychological processes mediating L1 acquisition may be used only for the acquisition of natural languages, which possess specific formal properties, and not for the acquisition of artificial languages, which may be arbitrarily different in structure from natural languages.

b). There may be specific brain mechanisms for natural language acquisition, which are activated during a particular period of the life span, and which cannot be activated later if it is not activated during the sensitive period. Thus, adult language acquisition is essentially different from L1 acquisition in childhood.

c). The acquisition of artificial languages consisting of a finite set of strings does not require phrase structure analyses, while intuition about the grammaticality natural language sentences requires the knowledge of phrase structure. Thus, the knowledge of the syntax of an artificial language consisting of a finite set of strings is not comparable to the knowledge of syntax of a natural language.

While criticism (a) may apply to studies that used some kind of finite-state grammars (ex. Nation & McLaughlin, 1986), it does not apply to other studies which used phrase structure grammars as the target. Also, the argument assumes that such structural properties of natural languages are crucial in determining the learning process employed for learning. The claim that different learning mechanisms are used for linguistic systems and non-linguistic systems is a hypothesis, and there is no _a priori_ reason why one should assume that it is the case.

Criticism (b) may apply to claims made about the L1 acquisition process or the language acquisition process in general, on the basis of results gained through artificial language studies. If the claims are confined to L2 acquisition, then there should be no problem with respect to (b).

While criticism (c) may apply to studies that used certain kinds of finite-state grammars, it does not apply to studies that used phrase structure grammars. Also, some finite-state grammars contain loops that can generate an infinite number of licit strings of symbols, and therefore, (c) does not apply even to some kinds of finite-state grammars.

9. Testing measures

Different measures have been used to elicit type (11a) evidence in studies that attempted to falsify UG/LM-inaccessibility. Among them are grammaticality/ acceptability judgement, sentence matching, and elicited imitation. In this chapter, I will review the motivations for using these measures for eliciting L2 knowledge, some of the problems of these measures, and suggested remedies for them.

9.1. Grammaticality judgement

Birdsong (1992), Felix (1988), Johnson & Newport (1991), Schachter (1989), White (1988; 1990) among others used grammaticality judgement to elicit data on L2 learners' knowledge of UG principles in L2. Gass (1994) distinguishes between grammaticality, which is based on whether a given sentence is generable by a given grammar, and acceptability, which is based on whether a speaker has a feel of well-formedness. I use the terms grammaticality judgement and acceptability judgement interchangeably, in the sense of acceptability judgement in Gass (1994). I use the term grammaticality judgement as the cover term.

The advantage of using grammaticality judgement is that the data can be obtained as to what L2 learners consider to be impossible in L2, and grammaticality judgement is a crucial testing measure for testing of the knowledge of UG constraints, because whether L2 learners observe UG constraints or not can not be determined by the spontaneous production data; i.e., the absence of UG constraint violations in L2 production does not necessarily mean that L2 learners consider such structures to be impossible. However, there are some problems with grammaticality judgement as a means for eliciting L2 knowledge.

9.1.1. Reliability

Ellis (1990) tested 3 groups of subjects, Chinese advanced L2 English learners resident in U.K. and 2 groups of Japanese intermediate L2 English learners in Japan, with 2 different grammaticality judgement tasks, one that asked for binary judgement (with an option for "unsure") and correction of what the subject perceived as incorrect, and the other that asked for a choice between or acceptance of both of a pair of sentences that differed minimally from each other, with sentences involving dative alternations. The tests were administered twice to ensure reliability of judgements. The Chinese speakers (binary/correction task) had the second session 1 week after the first session, with a shortened version of the original test, and the Japanese speakers (one group--binary/correction, the other group--paired choice) repeated the same test 2 weeks after the first test session. While the group performance did not change significantly between time 1 and time 2, there was great intra-individual variation. The Chinese speakers changed their judgements for 22.5%, one group of Japanese speakers changed their judgements for 31.0%, and the other group of Japanese speakers changed their judgements for 45%. Subjects varied greatly in their reliability of judgements, and neither providing an option for "unsure" for binary judgements, nor paired choices instead binary judgements, made subjects' judgements reliable. Ellis (1990) concluded that it is impossible to make an inference about learners' competence on the basis of grammaticality judgement data.

Nagata (1988) tested 3 groups of native speakers of Japanese with grammaticality judgement on Japanese sentences adopted from examples given in Kuno (1973; 1983). The first group was asked to give grammaticality judgement on each item in terms of a 20-point scale in the first session, and then they were presented the same items, each for 9 times in succession with each exposure for 3 seconds, and were asked to re-judge the item at the tenth exposure, in the second session. The result showed that the grammaticality rating for the second session was significantly lower than that of the first time, suggesting that the criteria for judging had changed by proactive interference through repeated exposure to the test items. The second group was tested with the same treatment as the first group, except that in the second session, they were exposed to each item for 10 times, and were presented the item for the eleventh time in a context and were asked to judge the item. The result showed that there was no significant difference in judgements between the 2 sessions. The third group had the same treatment as the first group, except that they were presented all items in a context both in the first and the second sessions. The result showed that there was no significant difference in judgement between the 2 sessions. Thus, Nagata concluded that grammaticality judgement can be affected by the repeated exposure to test items, while the proactive interference effect can be blocked by contextualizing the test items.

Gass (1994), however, claimed that grammaticality judgement is not so unreliable. Gass tested 23 Chinese, Korean, and Japanese ESL students with binary (correct vs. incorrect) as well as 7-point gradient (-3 = definitely incorrect, 0 = unsure, +3 = definitely correct) judgement tasks using sentences involving different types of relative clauses (as identified on the Accessibility Hierarchy), and compared their judgements in 2 test sessions, conducted 1 week apart. Gass claimed that reliability of the test items was a function of the type of the relative clause involved in the items, with higher reliability of judgements on relative clause types higher on the Accessibility Hierarchy and lower reliability of judgements on relative clause types lower on the Accessibility Hierarchy. Gass found a high correlation between time 1 judgements and time 2 judgements, when test items whose judgement by some subject changed for

5 or 6 points between time 1 and time 2 were removed. Gass found only 3 individuals out of 23 who changed the binary judgement on more than 10 items out of 30 and concluded that intersubject variability of reliability in her sample was not great.

9.1.2. Validity

Chaudron (1983) cautioned that the criteria that L2 learners use to make grammaticality judgement may not be consistent, and Birdsong (1989) warned that the grammaticality judgement task does not necessarily elicit judgement based on the properties that are intended to be crucial. Especially, when a subject gives a judgement "ungrammatical/unacceptable" to an ungrammatical item, there is no way to tell whether perceived ungrammaticality/ unacceptability is based on the tested structural property.

One may present pairs of sentences, one grammatical and the other ungrammatical, with the minimal difference between them only in terms of the critical property being tested, and ask subjects to indicate which one is better. However, the contrastive presentation of minimally different sentences necessarily draws subjects' attention to the contrast, and makes the task into judgement based on the analysis of contrast rather than judgement based on the intuitive feel of well-formedness.

One may ask subjects to correct sentences that they think is ungrammatical. The correction of the offending critical property may ensure that the subjects have judged the sentence on the basis of the ungrammaticality caused by the property intended to be critical. However, this method suffers from a confound of ability to articulate the appropriate correction. In some cases, such as sentences involving a Subjacency violation, subjects may not be able to identify the position of the gap, and unable to make a grammatical version of the sentence with the intended meaning.

To minimize the attention problem and the explicit metalinguistic awareness problem, Birdsong (1989) suggested the use of sequential non-consecutive presentation of a pair of grammatical and ungrammatical sentences which are minimally different from each other in terms of the tested structural property and the use of fillers.

Birdsong (1989) also suggested the contextualization of test sentences and the use of high association word items to minimize the confound of subjects' imaginativeness in finding a context in which the test sentence can be pragmatically appropriate. To control for subjects' ability to detect deviances due to training, he suggested to exclude those who have studied linguistics from a judgement test. Chaudron (1983) suggested that the instruction to subjects must be as explicit as possible to make subjects' criteria consistent.

9.1.3. Response bias

Birdsong (1989) cautioned against an uncareful analysis of judgement data that involves a response bias. In a binary judgement task, where the number of well-formed items and the number of deviant items are equal, the percentage difference between judgements "grammatical" and judgments "ungrammatical" will necessarily affect the accuracy rate for the judgements on well-formed and deviant items.

For example, if there are 50 grammatical items and 50 ungrammatical items, and if subjects judge items "ungrammatical" for 85% of responses and judge items "grammatical" for 15% of responses (70% differential), then the judgements on 35 ungrammatical items are necessarily correct (thus at least 70% correct for ungrammatical items), and judgements on 35 grammatical items are necessarily incorrect (thus at most 30% correct for grammatical items), simply because the subjects gave more "ungrammatical" judgements than "grammatical" judgements, regardless of whether their judgements reflected their linguistic knowledge or not.

Felix (1988) found L2 learners' superior performance on ungrammatical items (80.5% correct) to their performance on grammatical items (57.5% correct) and attributed it to the additive screening effect. He claimed that UG is accessible to L2 learners, and therefore, ungrammatical items violating UG constraints are rejected. Meanwhile, UG constraints are not the only source for judgments "ungrammatical". Other sources of information can be used by L2 learners to reject grammatical items. Therefore, L2 learners performed more accurately on ungrammatical items than they did on grammatical items. Birdsong (1989) argued that Felix data however showed a clear response bias, with 61.5% of judgements "not grammatical" and 38.5% of judgements "grammatical", which predicts the accuracy rate for ungrammatical items exceeds the accuracy rate for grammatical items. Given an equal number of grammatical and ungrammatical items in the test, subjects' tendency to judge "ungrammatical" explains the superior performance on the ungrammatical items, and the results cannot be a basis for claiming UG-accessibility.

Birdsong suggested that a paired choice task is free from the response bias in that subjects always have an option to choose either a grammatical or an ungrammatical sentence in the pair, and the choice in effect forces them to judge one sentence grammatical and the other grammatical at the same time, while the test has other disadvantages, as discussed above.

9.1.4. Controlling for confounds in judgement tasks

Chaudron (1983) suggested the use of a variety of testing measures along with grammaticality judgement to enhance the concurrent validity. Birdsong (1989) suggested to controls for subjects' background variables, such as years of language study, length of residence in the target-language environment, age when language study began, method and emphasis of language instruction, foreign language course grades, achievement test scores, etc. in order to homogenize the group of subjects. While limiting variation in the background variables constrains the generalizability of the results, it enhances the reliability of the results.

9.2. Sentence matching

Bley-Vroman & Masterson (1989), Eubank (1993), Clahsen & Hong (1995), and Duffield, Prévost, & White (1996) used the sentence matching task.

The sentence matching task is founded on the studies made on the response time difference in judgements on whether 2 strings visually presented are identical for different types of linguistic stimuli.

Chambers & Forster (1975) found that 4 or 5 letter strings are matched faster in a simultaneous visual matching task when they were words than when they were legal letter clusters, that legal letter clusters were matched faster than illegal letter clusters, and that high frequency words were matched faster than low frequency words. Meanwhile, when the letter strings were not matched, the response time was not significantly different among the string types. Thus, Chambers & Forster claimed that in the matching task, the letter strings are analyzed simultaneously at 3 different levels, word, letter cluster, and letter, and matching completes when the 2 strings are matched at any of the 3 levels (controlling level), leading to a shorter response time for words than for legal letter clusters and a shorter response time for legal letter clusters than for illegal clusters, because fewer units are involved at a higher level of analysis. The lexical access is involved in matching, because there is a word frequency effect.

Freedman & Forster (1985) claimed that a similar response time difference is observed for matched grammatical multiple word strings and matched ungrammatical word stings. Where the matched ungrammatical word strings involved random word sequences, switched major constituents, or errors in agreement markings, the response time increased significantly. Meanwhile, where the matched ungrammatical strings involved Subjacency violations, there was no significant change in the response time. Freedman & Forster therefore claimed that in sentence matching, there is a level of analysis higher than the individual word level, while the matching task is not sensitive to Subjacency because the task taps on the representations to which transformations have applied but the filter constraints have not applied. Thus, Freedman & Forster claimed that overgeneration is psychologically real.

Bley-Vroman & Masterson (1989) suggested that the sentence matching task can be used as a measure to tap into the state of the developing interlanguage grammar. Since the task is sensitive to the grammaticality of word strings, it can be used to test whether L2 learners' current interlanguage grammar allows for a given sentence as a grammatical representation. They tested 14 Korean speakers and 14 native English speakers with 3 types of sentences in English. They found that the reaction time was longer for strings with an NP with a modifier outside of a determiner and for word scrambles than for grammatical strings. Bley-Vroman & Masterson claimed that Korean speakers had reset the Functional Category parameter to the target [+FC] value from the L1 [-FC] value. They suggested that while both grammatical judgement and the sentence matching task are not perfect as a test measure, where their results converge, researchers can have confidence on the result.

9.3. Elicited imitation

Flynn (1987), Martohardjono & Gair (1993), Munnich, Flynn, & Martohardjono (1994), etc. used elicited imitation to infer L2 learners interlanguage competence.

In an elicited imitation task, subjects are asked to repeat stimulus sentences including both grammatical and ungrammatical ones, typically longer than 10 syllables. The assumption underlying the task as a testing measure for linguistic competence is that subjects must analyze the stimulus sentence and filter it through their own linguistic system before they can repeat it, since the materials in each stimulus sentence are beyond the capacity of their short-term memory. If the stimulus sentence matches the representation allowed by the subjects' interlanguage grammar, the sentence is repeated correctly (regardless of whether it is grammatical or ungrammatical). If the stimulus sentence does not match the representation allowed by the subjects' interlanguage grammar, the sentence is not repeated correctly.

Balcom (1990) tested 15 native speakers of English, full-time undergraduate students at University of Ottawa, with elicited imitation of grammatical and ungrammatical English sentences involving structures relevant to that-trace effects and other types of embedded clauses. Test sentences were 11 syllables long, and 5 out 20 test sentences were ungrammatical, and the rest was grammatical. To block rote repetition, subjects heard a random number after each stimulus sentence, and were asked to count backwards before repeating the stimulus sentence. Balcom reported that only 52% of the grammatical sentences were repeated exactly while 39% of the sentences were changed into minimally different grammatical sentences. Meanwhile, 28% of the ungrammatical sentences were repeated exactly or changed into different ungrammatical sentences. Balcom warned that the fact that adult native speakers who were supposed to have full competence in their L1 changed the grammatical stimuli and did not correct ungrammatical stimuli shows that the inability of L2 learners to repeat grammatical sentences or to correct ungrammatical sentences in elicited imitation may not be interpreted as due to the difference between the learners' interlanguage grammar and the native speakers' grammar. Balcom suggested that L2 studies using elicited imitation should have a native speaker control group, and that the working memory of subjects should be controlled for.

Bley-Vroman & Chaudron (1994) suspected that the optimal control level for elicited imitation may be different for each individual, and that the control level may change across stimuli within a single individual as well. To the extent that the stimulus sentences are too long to be stored in the short-term memory as it is analyzed into units of a lower level such as syllables, the control level at which the stimulus sentence is analyzed must be higher. However, if the control level is too high, for example, the interpretive level, the units stored in the short-term memory are not helpful for repeating the stimulus sentence. Thus, the optimal control level for elicited imitation is the lowest possible level of analysis at which the number of analyzed units is sufficiently small to be stored in the short-term memory. If the learner's interlanguage grammar is incapable of analyzing the stimulus sentence at the optimal control level, due to the difference between the interlanguage grammar and the native speakers' grammar, then the learner is forced to analyze the stimulus sentence at a higher or a lower level, which leads to a greater difficulty in reproducing the sentence. Thus, the control level used by each individual may be different from the one used by another, due to the difference of each individual's interlanguage grammar. It is even not clear whether an L2 learner performs the analysis at a consistent level.

Bley-Vroman & Chaudron claimed that elicited imitation is sensitive to syntactic properties only in a narrow range where the stimulus length approaches the limits of short-term memory, and that it is insensitive to syntactic properties where the stimulus length is shorter or longer, leading to the ceiling effect or the floor effect. Thus, they suggest that a study using elicited imitation should sample imitation of a range of stimulus sentences of varying length to ensure that the results are not showing a ceiling or a floor effect.

Bley-Vroman & Chaudron also claimed that successful reproduction of specific structural properties in imitation is a function of the serial position at which they occur in the stimulus sentence. In any recall task, the last item on a list is most likely to be recalled and the first item on the list is next most likely to be recalled, with middle items less likely to be recalled. Munnich, Flynn, & Martohardjono's (1994) test involving the contrast between relativization of subject and object and the ungrammatical use of resumptive pronouns in these gap positions was confounded by the uncontrolled serial position of the gap/resumptive pronoun position. The object gaps/resumptive pronouns occurred in the sentence final position while the subject gaps/resumptive pronouns occurred in a middle position. By the facts of any recall task, one can expect that the sentence final item is more likely to be recalled than an item in the middle position, and in fact Munnich, Flynn, & Martohardjono reported more accurate repetition of the ungrammatical object resumptive pronouns than the ungrammatical subject resumptive pronouns, while they attributed the results to preference based on grammatical properties. Since the effect was predicted by the serial order alone, Bley-Vroman & Chaudron claimed that no conclusion based on grammatical property is warranted. They claimed that the serial position of the structural property under investigation must be controlled for.

9.4. Selection of testing measures for the proposed study

As discussed above, there are disagreements among researchers with respect to the reliability of grammaticality judgement as a measure for eliciting L2 learners' knowledge of syntax, and there are problems of validity and response bias as well, under certain types of grammaticality judgement task. However, the reliability issue is still controversial, and there are suggested remedies for the validity problems. The proposed study adopts a grammaticality judgement task which involves a sequential, non-consecutive presentation of sentences that are different from each other only in the structure that is intended to be the target of judgement, as suggested by Birdsong (1989), in order to avoid the validity problem (the subjects may accept/reject sentences for reasons other than the target structure) and the problem of the attention to contrast associated with the contrastive presentation of paired sentences. The proposed presentation also avoids the problem of response bias, through the analysis of responses under which the acceptance or rejection of both of the grammatical and ungrammatical sentences that are different only in the target structure is not counted toward the judgement data to evaluate L2 learners' performance with respect to the conformity with UG/LM predictions. Furthermore, the proposed study repeats grammaticality judgement for each measurement session, so that the test-retest reliability index can be obtained.

As for sentence matching, there may be arguments as to whether the response time difference between grammatical matched pairs and ungrammatical matched pairs reflects UG-related knowledge of phrase structure. However, the issue is not currently settled, and I will follow the arguments by Bley-Vroman & Masterson (1989) in assuming that the sentence matching task complements grammaticality judgement as a measure to elicit L2 learners' knowledge of phrase structure. Thus, the proposed research adopts sentence matching for comparing the learners' performance on their L1 with their performance on the artificial language.

As for elicited imitation, the problems of the failure of native speakers to perform the task in the expected way and the effect of short-term memory are present in the framework of the proposed study. Since there is no native speaker of the artificial language, there cannot be a native speaker control group to compare L2 learners with. The use of structures in English that are comparable to the tested artificial language structures for testing native speakers of English is not a valid comparison because sentences in English and those in the artificial language necessarily have word forms and word sequences that are different in segments, syllable structure, and length (as measured by segments, syllables, morphemes, words, etc.), which can introduce the short-term memory problem. Since it is very difficult to design an artificial language that would provide sentences that match English counterparts in terms of not only syntactic structures but also the units of analysis at all levels of phonology and morphology that may affect the short-term memory load, the proposed study does not adopt elicited imitation as a measure for eliciting L2 learners' knowledge of syntactic structure and the relevant UG constraint.

10. A proposed study

In this chapter, I will present a possible empirical study that could provide evidence against UG/LM-accessibility under the framework presented in Chapter 1 and 4. The purpose of this proposal is to provide an example of a possible experiment using an artificial language that can falsify the UG/LM-accessibility claim. While the proposal is a hypothetical expedition, it is intended to be a realistically administrable experiment.

10.1. Subjects

Subjects are minimally 16 native speakers of English in an undergraduate or graduate program. To control for the native language, individuals who have acquired more than 1 language natively in childhood are excluded from the experiment, on the basis of a language questionnaire and the pre-experiment interview. However, individuals who acquired a proficiency in a non-native language after age 6 are allowed to participate in the experiment.

10.2. Materials

To obtain the language, social, and educational background information for each individual, a questionnaire is prepared. The questionnaire includes questions on the subjects' age, sex, time spent in higher education, major at college, education before entering college, 3 most proficient languages including English, self-evaluation of their skills in listening comprehension, speaking, reading, and writing, languages used in the family, in the neighborhood, and at school, and how and when the subjects acquired skills in those languages. (See Appendix A for the questionnaire.)

In order to test the knowledge of UG-related structural property (the ECP), 2 artificial languages are designed. Language A and Language B are modelled on the subjects' L1 (English) in terms of the salient structural properties, such as word order and major constituents in a finite clause, both in affirmative and interrogative sentences. Wh-phrases are fronted to the initial position of the matrix clause, as in English, and the modal must be placed in the pre-subject position in interrogatives.

The phrase structure is generated by the following rules.

(115)
CP --> (complementizer) IP
IP --> NP mod (neg) VP

$$\text{VP} \dashrightarrow \text{(adv)} \begin{bmatrix} \text{V} \\ \text{V NP} \\ \text{V CP} \end{bmatrix}$$

A CP has an optional complementizer (in complement clauses and adjunct clauses) and an IP. An IP has an obligatory NP (subject), an obligatory modal, which marks tense, an optional negation marker, and a VP. A VP has an optional adverb and an obligatory V head. An NP object appears in the post-verb position when the verb takes an NP complement. A CP object appears in the post-verb position when the verb takes a CP complement.

The languages have 2 transformation rules. In interrogatives of any kind, the modal in IP must be moved to the C position, to the left of the subject NP. In wh-interrogatives, in addition, the wh-phrase must be moved to the matrix clause initial position.

There are 12 possible matrix clause types generated by the phrase structure rules.

(116)
NP modal V
NP modal V NP
NP modal V CP
NP modal adv V
NP modal adv V NP
NP modal adv V CP
NP modal neg V
NP modal neg V NP
NP modal neg V CP
NP modal neg adv V
NP modal neg adv V NP
NP modal neg adv V CP

By the rule of modal fronting, there are 12 additional clause types for yes/no questions, and by the wh-fronting rule, there are 6 additional for wh-adv question, 12 additional for wh-NP-subject questions, and 4 additional for wh-NP-object questions.

With the option of expanding a CP complement or adding an adjunct clause to the matrix or any complement/adjunct clause, the languages have a capacity to generate a string of an infinite length (thus satisfying one of the structural properties of natural languages that Chomsky (1957, 1963) observed, i.e., having a recursive phrase structure grammar, rather than a finite-state grammar). When an adjunct clause is added to the matrix clause, the adjunct clause is always placed to the right of the matrix clause, and it is introduced by the adjunct clause introducer. Adjunct clauses share the same sentence types as matrix clauses.

Words of the languages are all CVC trigrams with word association values between 70 and 80 (Archer, 1960). There are 8 NPs (4 human, 4 non-human), 3 Vs (1 intransitive, 1 transitive with an NP complement, 1 transitive with a CP complement), 2 modals (1 present, 1 past), 2 adverbs, 1 negative marker, 2 Cs (1 complement introducer, 1 adjunct introducer), and 3 wh-phrases (1 wh-human NP, 1, wh-non-human NP, 1 wh-adv). The total number of words in these languages is 21.

Archer's (1960) CVC trigrams with word association values between 70 and 80 contain a large number of possible acronyms and real words in English. Also, the trigrams do not necessarily represent the same type of syllables. To eliminate the familiarity effect of possible acronyms and real words in the subjects' L1, I eliminated trigrams that are relatively familiar acronyms and all real word trigrams from the trigram set. I also eliminated trigrams that do not necessarily represent a light syllable with a single consonant onset, a short vowel, and a single consonant coda (trigrams starting with C, G, Q, or Y, those containing Y in the middle position, and those ending with C, H, Q, R, W, X, or Y). I also eliminated trigrams whose evaluation was unreliable or biased by sex. Twenty-two trigrams were retained out of the 187 trigrams. (See Appendix B.)

Language A observes the ECP in the same way as English does. Wh-extraction from the subject position of a complement clause of the matrix verb is prohibited, where there is an overt C, due to the ECP. Wh-extraction from the subject position of a complement clause is allowed where there is no overt C in the complement clause. Wh-extraction of an adverb or a complement NP of the verb of the complement clause of the matrix verb is always allowed. Language A does not allow for wh-extraction from an adjunct clause.

Language B observes the ECP in the same way as Language A with respect to wh-extraction from a complement clause of the matrix verb. However, it allows for wh-extraction of the subject NP, the object NP, and the adverb from an adjunct clause. As discussed in Chapter 6, the grammar of Language B cannot be described under the assumptions made in Rizzi (1990).

Language A is a subset of Language B in that all the sentences in Language A are grammatical in Language B, while not all sentences in Language B are grammatical in Language A.

10.3. Procedure

10.3.1. Collecting subjects' information

All subjects are assigned an identification code to match up the questionnaire that they fill in and their performance in the experiment. The subjects answer the background questionnaire anonymously but with an ID code. Any individual who rates 3 or lower on any type of knowledge in any skill in English or who rates 4 or 5 on any type of knowledge in any skill in any language other than English are interviewed with respect to their language learning experiences in childhood. Those who acquired any language other than English natively before age 6 are excluded from the experiment. Minimally 16 subjects are selected from those who meet the above criterion.

The mean age, the mean years of pre-higher education, the mean years spent in college, the majors pursued by the subjects, the mean number of languages understood or used by the subjects, and the mean of the total scores from the evaluation matrix for English and for languages other than English will be reported for each group.

Gathercole & Baddeley (1990) reported that children who were poor in non-word repetition were slower in learning new vocabulary with phonologically unfamiliar forms than those who were good in non-word repetition, while they were not slower in learning vocabulary with phonologically familiar forms. Service (1992) reported that Finnish children's short-term memory for pseudowords that sounded like English predicted their acquisition of English as a foreign language two and a half years later. Ellis & Beaton (1993) claimed that the capacity of phonological short-term memory, represented by the ability to repeat non-word verbal sequences, predicts the L1 and L2 vocabulary acquisition, since repetition and productive rehearsal of novel words promotes their long-term consolidation and retention.

Speidel (1993) described poor language development with word order and syntactic errors of a child with a phonological short-term memory disability. Blake, Austin, Cannon, Lisus, & Vaughan (1994) reported that short-term memory for words predicted mean length of utterance in 2- or 3-year olds better than chronological age or mental age. Adams & Gathercole (1995) reported that good phonological memory ability of 3-year old children was associated with longer, more grammatically complex productions.

Daneman and Case (1981) reported that the short-term memory predicted the acquisition of an artificial language, which involved 1, 2, or 3 semantic features (as indicated by actions) and their labels (stem, prefix, suffix) by children between 2 and 6 years old. Ellis & Sinclair (1996) claimed that the phonological short-term memory span also predicts

L1 and L2 syntax acquisition, since superior phonological short-term memory allows for the learner to comprehend and translate unfamiliar L2 words given in an utterance and to attend to the detailed content of grammatical regularities.

Thus, variation in phonological short-term memory across individual may affect the result of artificial language learning. It is expected to be a predictor of implicit learning of language. To ensure that the subject groups are matched, phonological short-term memory is measured as one of the subject variables. Phonological short-term memory is measured by a method modified from Daneman & Case (1981). The test items are prepared from Archer's (1960) trigrams with word association values between 50 and 60, which represent a syllable with a single consonant onset, a short vowel, and a single consonant coda, and which are not words nor common acronyms in English. Items whose evaluation was unreliable or were biased by sex in Archer's study are not used. The monosyllables are arranged in sets of 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 monosyllables, with each monosyllable used only in one set. Subjects are tested with the monosyllable sets, starting with the smallest set. They are auditorily presented with a set of monosyllables and are asked to repeat them in the order presented. Monosyllables are presented 1 second apart, and subjects repeat the entire set after they have heard it. Subjects are given 3 trials for each set. If they succeed in repeating the set correctly at least once in

the 3 trials, subjects are tested with the next larger set. The test continues until they fail in repeating the monosyllables in the correct order for 3 times in succession. The short-term memory span is given as:
2 + (total number of correct repetitions of the set) / 3 .
The formula gives 1 point for three correct repetitions for a given level. The addition of 2 is intended to adjust the score for the fact that no trial is given for the set of 1 monosyllable and the set of 2 monosyllables. This adjustment assumes that subjects are capable of repeating the set of 1 monosyllable and the set of 2 monosyllables correctly for 3 times, if they are asked to do so. If there is any subject who cannot repeat the set of 3 monosyllables correctly for 3 times, then this adjustment will not be done.

10.3.2. Native speaker judgement on English sentences

In order to establish the equivalence of the designed artificial languages to a natural language in terms of the UG-related structural property in question, the subjects' performance on the grammaticality judgement and the sentence matching task in their L1 (English) is compared with the performance on the same tasks in Language A.

Subjects are tested with grammaticality judgement on English sentences involving ECP-related sentences, and with sentence matching involving violations of matrix clause word order.

The order of the tasks that the subjects perform is counterbalanced across the individuals, and the order of items in each task is randomized differently for each subject.

10.3.2.1. Grammaticality judgement in English

The subjects in the 2 experimental groups are given a grammaticality judgement test on 128 items, 64 of which involve a construction relevant to the ECP, before they start artificial language learning.

(117)
argument extraction from an adjunct
... 8 grammatical, 8 ungrammatical
adjunct extraction from an adjunct
... 8 grammatical, 8 ungrammatical
that-trace
... 8 grammatical, 8 ungrammatical
Superiority
... 8 grammatical, 8 ungrammatical

The other 64 sentences consist of 32 grammatical and 32 ungrammatical sentences that do not involve the above constructions. The subjects are asked to provide a binary acceptability judgement (acceptable vs. unacceptable) on each sentence.

While Chaudron (1983) and Birdsong (1989) suggested that the reliability of grammaticality judgement increases when subjects give gradient judgements on a multi-point scale rather than binary judgements, the present study uses the binary judgement, because the data is to be compared with the judgements of artificial language sentences. Given the short period of exposure and the limited amount of artificial language material, it is expected that the learners of artificial languages will not be able to give a fine tuned gradient judgement on artificial language sentences. Thus, the proposed study adopts the binary judgement for the grammaticality judgement task for the test of knowledge of artificial languages, and therefore, the binary judgement is used also for the L1 test.

To ensure that the judgement given on each item is reliable, the same set of 128 sentences is presented and judged for the second time with a different order.

The test sentences are prepared in pairs of 1 grammatical sentence and 1 ungrammatical sentence, which differ from each other minimally only in terms of the syntactic property being tested. The test item pairs are then divided into 4 groups, in such a way that 2 grammatical items and 2 ungrammatical counterparts of each of the 4 types of the ECP related structures are in each of the pair groups.

The grammatical items of group 1, the ungrammatical items of group 2, and 16 filler sentences are then combined and randomized to form presentation block 1. Similarly, the grammatical items of group 3, ungrammatical items of group

4, and 16 filler sentences are combined and randomized to form presentation block 2. The ungrammatical items of group 1, the grammatical items of group 2, and 16 filler sentences are combined and randomized to form presentation block 3. The ungrammatical items of group 3, the grammatical items of group 4, and 16 filler sentences are combined and randomized to form presentation block 4. Randomization is done differently for each subject.

This format for the presentation order ensures that subjects see a grammatical item and its ungrammatical counterpart at least 1 presentation block apart, while it retains the even distribution of grammatical and ungrammatical items as well as the 4 types of ECP related structures across the 4 presentation blocks.

(118)
Groups:
The number for each type shows the number of pairs consisting of a grammatical item and a counterpart ungrammatical item.

Group 1
2 that-trace
2 Superiority
2 argument extraction from adjunct
2 adjunct extraction from adjunct

Group 2
2 that-trace
2 Superiority
2 argument extraction from adjunct
2 adjunct extraction from adjunct

Group 3
2 that-trace
2 Superiority
2 argument extraction from adjunct
2 adjunct extraction from adjunct

Group 4
2 that-trace
2 Superiority
2 argument extraction from adjunct
2 adjunct extraction from adjunct

(119)
Presentation blocks:

block1	block2	block3	block4
1g 2u	3g 4u	1u 2g	3u 4g

1g = Group 1 grammatical
1u = Group 1 ungrammatical
2g = Group 2 grammatical
2u = Group 2 ungrammatical
3g = Group 3 grammatical
3u = Group 3 ungrammatical
4g = Group 4 grammatical
4u = Group 4 ungrammatical

To ensure the reliability of subjects' judgement, the test items are presented twice to the subjects. For the second presentation, items in each of the presentation blocks are re-randomized, but the order of the presentation blocks is kept the same as the first presentation.

Each sentence is presented on a computer screen, and subjects are prompted to make a grammaticality judgement. Subjects are allowed to take as much time as they need to make a judgement on each item, while they are not allowed to take notes of the items or their responses, and they see only the current item on the screen.

The test sessions are preceded by a short practice session, with 16 items, 8 grammatical and 8 ungrammatical, which do not involve the ECP related structures.
(See Appendix C.)

10.3.2.2. Sentence matching task in English

In the sentence matching task, the subjects are asked to judge as quickly and accurately as possible whether the two sentences on a PC screen are identical or not. When the subjects touch a key on the computer keyboard, the first sentence appears at the top of the screen, and then, with a short delay, the second sentence appears at the bottom of the screen. Both sentences remain on screen for a short period and then disappear. The subjects respond by pressing a key designated as "matching" or another key designated as "non-matching". The subjects' response time is measured from the moment that the second sentence appears on the screen to the subjects' response reaction.

All test sentences involve 12 syllables and 10 words. There are 4 types of violations tested. Test sentences consist of pairs of a grammatical sentence and an ungrammatical sentence, which differ from each other only in terms of one phrase structural property (in the omission of obligatory element or word order). The syntactic properties that are being contrasted are always instantiated in the matrix clause. To keep the pair to be different only in one point in the phrase structure, the complement or adjunct clause structure is kept grammatical for both grammatical and ungrammatical items, though this arrangement creates a mismatch in the phrase structure between the matrix clause and the complement or adjunct clause in ungrammatical items, where the relevant matrix structure is also present in the complement or adjunct clause. (See modal-VP placement in Appendix D.)

The ordering of words for modal-VP placement and for V-complement placement can be taken as tests for head directionality, since both the grammatical version and the ungrammatical version can be base-generated in different natural languages. Other word order relations tested are linear word order relations, in that the ungrammatical version cannot be base-generated (while the structure may be derived by some movement in some cases).

10.3.3. Language A instruction and examination

To establish the equivalence of the artificial languages to natural languages, subjects first learn Language A, which is modelled upon English while it has the artificial trigram vocabulary. The subjects' performance in the grammaticality judgement and the sentence matching task in Language A is compared to their performance in English.

10.3.3.1. Training in Language A

The instruction of the artificial language proceeds in steps. The subjects learn the matrix clause structures generated by the phrase structure rules in step 1, and are tested for their knowledge of words and sentence structures by an exercise. If they perform sufficiently well, the subjects proceed to the complement clause structure in step 2, and are tested for their knowledge of words and sentence structures. Then, the subjects proceeds to the adjunct clause structure in step 3, and finally they learn transformations for yes/no questions and wh-questions in step 4 and step 5.

Training set:

The training set for each step contains at least 2 tokens of each possible clause type being learned. Each sentence in Language A is displayed on a PC screen, till the subject presses a key on the keyboard. The presentation order of the sentence is the same for all subjects, and materials are sequenced from simpler and shorter sentences to more complex and longer sentences. Each sentence is displayed once in each learning set. Subjects are given opportunities to view the learning set twice in each step, with the second opportunity as an option. Subjects are asked to attend carefully to the sentences displayed on the screen, and are informed that they will have a vocabulary test and a grammar test at the end of the learning session.

Exercise for the matrix phrase structure:

a). Vocabulary test

An English word and 5 artificial language words, each numbered, are presented on a computer screen. Subjects are asked to identify the artificial language word that corresponds to the presented English word, by typing the number that corresponds to the selected artificial language word. Subjects are given feedback as to whether their answer is correct or not, and if the answer is not correct, they are given one more chance to select an artificial language word. If they make a mistake twice, they are told that they made a mistake and are instructed to attend to the sentences more carefully when they go through the training sentences again later, and proceed to the next item. The correct trigram is not given to the learner.

If the learner completes the vocabulary test at least 85% correct, then the learner proceeds to the grammaticality judgement test. If the learner fails in the vocabulary test, they will be re-exposed to the learning set and retake the test. The test does not require 100% accuracy to pass, though incomplete knowledge of vocabulary may affect the grammaticality judgement. The possibility of inaccuracy in grammaticality judgement due to the lack of lexical knowledge is allowed in the training sessions, since the grammatical judgement test for the training sessions is to monitor subjects' progress rather than to evaluate the current knowledge of the language.

b). Grammaticality judgement

Subjects are asked to provide a binary acceptability judgement (acceptable vs. unacceptable) on each sentence. Feedback is given as to whether the judgement is correct or not for each sentence.

The test set has at least 2 tokens of each sentence type. All the test sentences except for those involving a simple sentence with the intransitive verb are novel (i.e., different from any of the sentences used in the training session). Since all possible simple sentences with the intransitive verb are presented in the training session, there cannot be a novel sentence for this sentence type.

If the learner completes the grammaticality judgement test at least 85% correct, the learner proceeds to the next step of training. If the learner does not achieve the criterion, then he will be re-exposed to the learning set and re-take the tests.

For the training set sentences and the exercise grammaticality judgement tests, see Appendix E.

10.3.3.2. Examination

Subjects take an examination after they have completed the first 5 steps in the learning phase. The examination consists of the vocabulary test, the grammaticality judgement test, and the sentence matching task.

a). Vocabulary test

All the words in the languages are tested. An English word and 5 trigram are presented to subjects, and subjects are asked to choose the trigram representing the English word. Subjects must perform 100% correct before proceeding to the grammaticality judgement test.

b). Grammaticality judgement

The grammaticality judgement test involves the sentences in Language A that involve the 4 constructions relevant to the ECP and filler sentences that do not involve those constructions. The test set consists of 128 sentences. Sixty-four sentences contain the constructions relevant to the ECP. There are 8 grammatical and 8 ungrammatical sentences for each of the types of the constructions relevant to the ECP (argument extraction from an adjunct, adjunct extraction from an adjunct, that-trace, Superiority). The rest of the test set consists of 32 grammatical and 32 ungrammatical sentences that do not involve the above constructions. The filler items are made of the 32 pairs of sentences involving the word order rules in the matrix clause, one grammatical and the other ungrammatical, which differ from each other only in one structural property.

Stimulus sentences are ordered in the same way as they are in the sentences for the English grammaticality judgement test. Two sessions of grammaticality judgement are given in succession. There is a practice session with 16 practice sentences, 8 grammatical and 8 ungrammatical, that do not involve ECP related structures.

c). Sentence matching task

If subjects have learned Language A in the same way as they would learn a natural language and internalized the grammatical regularities, the sentence matching task should show a difference in the response time between grammatical pairs and ungrammatical pairs. Thus, subjects' performance in the sentence matching task in Language A is compared with their performance in the sentence matching task in English.

The grammatical test sentences for modal/tense marking involve 9 syllables/words, and the ungrammatical test sentences for modal/tense marking involve 8 syllables/words. All other test sentences involve 9 syllables/words. There are 4 types violations tested. Test sentences consist of pairs of a grammatical sentence and an ungrammatical sentence, which differ from each other only in terms of one phrase structural property (in the omission of obligatory element or word order). The syntactic properties that are being contrasted are always instantiated in the matrix clause. To make the pair to be different only in one point in the phrase structure in the matrix clause, the complement or adjunct clause structure is kept grammatical for both grammatical and ungrammatical items, though this arrangement creates a mismatch in the phrase structure between the matrix clause and the complement or adjunct clause in an ungrammatical item, where the relevant matrix structure is also present in the complement or adjunct clause. (See modal-V placement and modal-adv placement in Appendix F.)

The ordering of words for modal-V placement and for V-complement placement can be taken as tests for head directionality, since both the grammatical version and the ungrammatical version can be base-generated as UG-compatible base structure. Other word order relations tested are linear word order relations, in that the ungrammatical version cannot be base-generated (while the structure may be derived by some movement in some cases).

If the analysis of the performance in English and the performance in Language A reveals no significant difference, then Language A is considered an equivalent of a natural language with respect to the ECP-related structures and the base-generated phrase structures.

10.3.4. Language B instruction and examination

In order to determine whether adult L2 learners are able to learn non-UG-conforming structural properties, the subjects will learn Language B, which is identical to Language A in its phrase structure rules and its transformations, but is different from Language A in that it does not observe the ECP, allowing for extraction from adjuncts. Subjects' performance in grammaticality judgement and the sentence matching task is compared with their performance on Language A.

Since Language A and Language B are identical in the phrase structure and the question formation involving the matrix clause, subjects will have already learned the these properties of Language B at the beginning of the instruction for Language B. Subjects are told that they will continue the learning of the same artificial language in steps 6-8.

10.3.4.1. Training in non-UG-conforming properties of Language B

As in the instruction of Language A, the instruction of Language B proceeds in steps. In each step, subjects learn the structures targeted at and are tested for their knowledge of artificial language words and sentence structures by exercises.

Subjects are exposed to examples of ECP violations, involving extraction of objects from an adjunct CP in step 6, extraction of subjects from an adjunct CP in step 7, and extraction of an adverb from an adjunct CP in step 8. (See Appendix G for the training set sentences and the exercise grammaticality judgement tests.)

10.3.4.2. Examination 2

After learning the non-UG-conforming structural properties, subjects take the examination that involves the same tasks as the ones for examination 1. The test sentences are those not used in the training sessions. The results are compared with those of examination 1. To equalize the number of grammatical sentences and the number of ungrammatical sentences in the grammaticality judgement test, 32 grammatical sentences will be added to the test sentences for examination 1 as grammatical counterparts for sentences involving extraction from an adjunct CP.

10.3.4.3. Re-tests

To ensure that the performance of subjects in the examination 2 is a representative of the steady state knowledge, subjects will be tested by the above 3 tests 1 week after examination 2. Subjects are tested again 1 week after the first re-test.

The results from re-test 1 and re-test 2 are compared with the results from the examination 2. If there is no significant change over times in subjects' performance in the grammaticality judgement test and the sentence matching task, the results from examination 2 are taken as representative of the steady state knowledge of Language B. If subjects consistently accept ECP violations, then it is evidence that L2 knowledge is not constrained by UG.

10.4. Limits and alternatives

In this section, I will review the claims made by various researchers on the learnability of a phrase structure grammar and syntactic dependencies under different input conditions, presentation methods, and learning tasks, and discuss how the claims relate to the proposed experiment.

10.4.1. Learnability of the language materials

Moeser & Bregman (1972) claimed that a phrase structure grammar and syntactic dependency can be learned only if the semantic reference fields of the target language reflect the syntactic constraints on the distribution of constituents and word classes. Green (1979) argued that a phrase structure grammar and syntactic dependency can be learned as long as the target language provides cues for constituent boundaries and word classes by syntactic markers. Morgan & Newport (1981) claimed that a phrase structure grammar can be learned only when the constituent boundaries are marked by the semantic reference fields, and that it is not required that the reference fields represent the syntactic constraints on the distribution of constituents and word classes. Mori & Moeser (1983) claimed that syntactic markers are effective in learning a phrase structure grammar and syntactic dependency only when the semantic reference fields are not available or when the structure of the semantic reference fields does not contradict the syntactic structure.

In order to eliminate the burden of learning morphology, which is not relevant to the test of the knowledge of a syntactic constraint on extraction, Languages A and B are designed to have no syntactic markers. Thus, the issue of the interaction between syntactic markers and reference field structure that Mori & Moeser (1986) suggested does not arise in the proposed study. The boundary information that Green (1979) and Morgan & Newport (1981) claimed to be required for the learning of a phrase structure grammar is not represented by the structure of sentences, presented as strings of CVC trigams. However, since the training set sentences are prepared in such a way that pairs of sentences that are different only in 1 word to allow for the identification of the changed word, if the learner either has access to the innate knowledge of possible phrase structure, or can transfer the knowledge of L1 phrase structure, the phrase structure of Languages A and B should be learnable. Whether the learner has achieved the knowledge of the phrase structure as well as transformations of Languages A and B is checked by the sentence exercise at each stage, and therefore, no question as to whether the learner has acquired the knowledge of phrase structure as well as transformations should arise when the learner takes the examinations, which test the knowledge of the ECP.

10.4.2. Method of presentation

Green (1979) claimed that neither a pure reception regime nor a pure production regime is adequate for testing language learning. There is a potential conflict between the purpose of the proposed study and the use of a mixed regime in which the learner has opportunities to produce sentences in the target language and have feedback as to the grammaticality of the produced sentences. Since the UG/LM-accessibility claim is based on the assumption that natural language learning takes place without negative feedback, one may argue that learning driven by negative feedback does not constitute the same process as natural language learning, and therefore, that the results of language learning experiment which provides negative feedback to the learner cannot be a test of UG/LM-accessibility in L2 acquisition.

However, the above claim is invalid in that many L2 learners undergo formal language instruction, which provides negative feedback to the learners, in the process of L2 acquisition, and therefore, claiming that L2 learners who have been provided with negative feedback cannot be used to test UG/LM-accessibility would entail that all preceding studies that used such subjects would be invalid as studies on the issue of UG/LM-accessibility or inaccessibility. Typically, the preceding studies on UG/LM-accessibility in L2 acquisition used subjects who had had extensive formal training in the tested L2. Thus, if UG/LM-accessibility proponents argue for UG/LM-accessibility on the basis of their studies, which used learners who had had negative feedback in L2 learning, then the proposed study, which provides negative feedback in sentence exercises, must be considered equally valid for testing UG/LM-accessibility.

Moreover, one must attend to the fact the negative feedback given to subjects is only in terms of the phrase structure and the movement of auxiliary or wh-phrase, in steps 1-5, and not in terms of the constraint on extraction, the ECP, that will be tested in the examination. At no point in instruction in steps 1-5, subjects will receive a correction on extraction from an embedded clause, and therefore, when they are tested in examination 1, they will provide their judgement on extraction sentences without having had any information about them through the instruction.

In steps 6-8, in which subjects learn the wild extractions, the subjects will be provided with negative feedback as to their judgement on wild extraction sentences in sentence exercise; i.e., subjects have opportunities to judge wild extraction sentences that are grammatical in the artificial language as ungrammatical and then get informed that their judgement is incorrect. If subjects initially consistently reject wild extraction sentences, and then learn to accept those sentences through corrections, one may argue that the result cannot be evidence against UG/LM-accessibility, because the subjects are corrected on their judgement on wild extractions so that they are forced to accept them by negative feedback. However, I argue that the result is valid as evidence against UG/LM-accessibility in that a) if UG/LM constrains L2 acquisition, then it should be the case that such a wild grammar is outside of the hypothesis field of the learner, and in that b) if one is to appeal to general learning mechanism to explain how the learner could learn such a wild grammar, then there will be no way to falsify the UG/LM-accessibility claim by empirical evidence.

The proposed study could also provide decisive evidence against UG/LM-accessibility without an ambiguity of interpretation of results discussed above. If subjects perform grammaticality judgement mostly correctly for the first time, in the sentence exercises in Steps 6-8, without receiving corrections, then there will be no question as to the effect of negative feedback. Subjects have learned the correct wild grammar without negative feedback.

10.4.3. Discriminability of vocabulary

Green (1979) claimed that words of the target language must be phonologically highly discriminable. There is a potential problem in the selected CVC trigrams as listed in Appendix B, in that some words have turned out to be phonologically similar, so that the replacement of one consonant in one word with another produces another word. This was a result of selecting CVC trigrams that did not have characters whose sound values are ambiguous in the English orthography. While the phonological similarity of the selected words may pose a problem in word learning, it does not affect the interpretation of results, since the knowledge of presented words is checked at each step, and 100% correct performance in the word test is required for the subjects to take an examination.

10.4.4. Learning strategies

Nation & McLaughlin (1986) reported that multilinguals performed better in learning an artificial language than bilinguals and monolinguals in the implicit learning condition, while multilinguals did not surpass bilinguals and monolinguals in the explicit learning condition.

Nayack, Hansen, Krueger, & McLaughlin (1990) reported that multilinguals performed better in learning an artificial language grammar than monolinguals in the rule-discovery condition, while multilinguals did not surpass monolinguals in the memory condition.

The proposed study instructs the subjects to find the rules of the language, as in the explicit learning condition and the rule-discovery condition of the above studies. As the above studies suggest, it may be the case that the learning strategies affect the result of language learning, as it was the case for multilinguals in those studies, while the results were not consistent. The repeated learning session, each of which has a sentence exercise, made it impossible to use the implicit learning task, since the subjects would naturally expect a sentence exercise after having completed the first few steps, even if they are not told that they will have a sentence exercise in the current session. While it would be ideal to test the same experiment procedure with the implicit learning condition, the option is not available for the current design of the experiment. A learning strategy like the one used under the implicit learning condition may be effected by sequencing the training set sentences randomly, rather than in the structured sequence, making it impossible to consciously contrast the sentence presented with the sentence presented immediately before. This is a possible alternative that can be used in future studies.

10.4.5. Length of instruction

The proposed study instructs subjects over a 2-week period. One may argue that the duration of instruction is too short to be considered a representative of a natural language learning process. This is a limit of experimental study that uses an artificial language which has no value outside the research context, and thus, has no value to the subjects that motivates them to continue learning it. Under an ideal condition, such as that of Yang (1993) and Yang & Givón (1997), in which the subjects were funded for their artificial language learning over a 5-week period, a better representation of the natural language learning process can be achieved in the artificial language learning experiment.

11. Conclusion

In this thesis, I reviewed problems in L2 acquisition research that relate to the methodology of science in general, namely, those of falsifiability of UG/LM-accessibility claim under certain assumptions held by some UG/LM-accessibility proponents, and proposed a possible study that could in principle provide evidence against the claim.

I argued that only the use of an artificial language can falsify the UG/LM-accessibility claim, because the failure to achieve knowledge of UG constraints in a natural target language can be attributed to factors other than UG/LM-accessibility, and therefore, only the achievement of a wild target language, which must be artificial, can provide evidence against the claim.

I also argued that a combination of a given formulation of UG constraints and a given formulation of associated learning mechanism can make a testable prediction on language acquisition, not either one alone.

I reviewed preceding studies on the knowledge of Subjacency and the ECP in wh-extraction in L2 in terms of problems in research methods and analyses, and raised questions on the validity of the claim of UG/LM-accessibility made by the researchers who conducted those studies.

I also reviewed previous studies on language acquisition that used artificial languages, and reflected the claims on the necessary conditions for the learning of a phrase structure grammar in the design of the artificial language and the instruction procedure in the proposed study.

I evaluated 3 means for the measurement of the knowledge of UG constraints used in preceding studies, and adopted grammaticality judgement and the sentence matching task as the measures of the knowledge of the ECP.

I presented as a proposal a hypothetical study which could potentially provide evidence against UG/LM-accessibility in L2 acquisition, even under the assumption that alleged UG-violations in natural language acquisition cannot be evidence against UG/LM-accessibility. I designed 2 artificial languages, one a subset of another, which have a phrase structure grammar similar to that of English, but one of which differs from English and all natural languages in that it allows for wild extraction from a finite adjunct clause. For the comparison of the learners' performance on L1 with their performance on the artificial language in terms of the ECP, I prepared test sentences involving Superiority violations, that-trace violations, argument extraction from an adjunct, and adjunct extraction from an adjunct were prepared for grammaticality judgement, and sentences involving various phrase structure violations for the sentence matching task, both in English and artificial languages. I emphasized the possible effect of phonological short-term memory on the results of syntax learning, and developed a phonological short-term memory test using artificial vocabulary.

While UG/LM-accessibility research still attracts the attention of many L2 researchers, the viability of this apporach has been undermined by some untestable claims. I hope that the above discussion provides an introduction to a new research paradigm that would restore the viability of UG/LM-accessibility research in empirical science.

Appendix A: Questionnaire

____
I.D. Number

1. Age ... _____ years
2. Sex ... Check one: __ male __ female
3. Major ... ___________________
4. Semesters in college ... _____ semesters
5. Language background

a). What languages do you understand or use? Please evaluate, by yourself, your proficiency in three languages that you are most proficient in.

Ranking of languages you understand or use:
(If you understand or use fewer than three languages, then leave non-applicable slots blank.)

most proficient ... English
second proficient ... ____________________
third proficient ... ____________________

b). For each language, please indicate, in terms of 5-point scale, how good you are in recognizing different sounds in listening comprehension (cell a) and in producing different sounds in speaking (cell b), and how good you are in recognizing written symbols in reading (cell c) and in reproducing written symbols in writing (cell d).

Also, for each language, please indicate how much control of grammar, vocabulary, and style you think you have in each of four skills: listening comprehension, speaking, reading, and writing.

Language 1: English

Language English	Listening comprehension	Speaking	Reading	Writing
Sounds	a	b	-----	-----
Symbols	-----	-----	c	d
Grammar				
Vocabulary				
Style				

5 = Excellent, 4 = Good, 3 = Fair, 2 = Poor, 1 = Very poor

Language 2: __________

Language English	Listening comprehension	Speaking	Reading	Writing
Sounds	a	b	-----	-----
Symbols	-----	-----	c	d
Grammar				
Vocabulary				
Style				

5 = Excellent, 4 = Good, 3 = Fair, 2 = Poor, 1 = Very poor

Language 3: __________

Language English	Listening comprehension	Speaking	Reading	Writing
Sounds	a	b	-----	-----
Symbols	-----	-----	c	d
Grammar				
Vocabulary				
Style				

5 = Excellent, 4 = Good, 3 = Fair, 2 = Poor, 1 = Very poor

c). Please state briefly how much time (in terms of years, semesters, etc.) you have spent for learning each of the languages you listed in (5a), and how you learned the language.

Languages	Time spent	How you learned the language
English	____________	______________________________
______________	____________	______________________________
______________	____________	______________________________

Appendix B1: Archer's (1960) trigrams with word association values between 70 and 80

Notes:
a = Female individuals rated the word as significantly more meaningful than male individuals.
d = There was a significant change in the rating between the first time and the second time.

Trigrams	Note	Association	Possible word
DYM		70	[dim] dim
HEV		70	[hEv]
HUS		70	[h^s]
KEP		70	[kEp] non-standard kept
KUB		70	[k^b] cub
LOF		70	[lOf] non-standard loft
RYP	a	70	[rIp] rip
SOT		70	[sOt] sought
SUT		70	[s^t]
TAV		70	[tæv]
VON		70	[vOn] [fOn] von(G)
WOD		70	[wOd] regional word
YER		70	[j@r] year
ZAP		70	[zæp] zap
BIP	a	71	[bip]
CER		71	[s@r] [tS@r] sir, chirr
CIV		71	[sIv] [tSIv] civ(ilian)
FAS		71	[fæs] non-standard fast
FEZ		71	[fEz] fez
HES		71	[hEs] Hesse
KOF		71	[kOf] cough
LIQ		71	[lIk] liq(uid)
NEB		71	[nEb] neb
TAF		71	[tæf]
BIS		72	[bIs] bis B.I.S.
CIL		72	[sIl] [tSIl] chill
CYN	a	72	[sIn] [tSIn] sin, chin
DAS		72	[dæs] non-standard that is
DOK		72	[dOk] dock, doc(tor)
HYD		72	[hId] hid
LAV		72	[læv] lav(atory)
MAZ		72	[mæz]
NAC		72	[næk] [nætS] natch
NAV		72	[næv] nav(al)
NES		72	[nEs] [nEz] Ness, n.e.s., nas(al)

NOP		72	[nOp] alternant nope
REL		72	[rEl] rel(ative)
TID		72	[tId]
VOT		72	[vOt] V.O.T.
WEY	a	72	[weI] way, weigh
CED	a	73	[sEd] [tSEd] said CED
COV		73	[kOv]
CUN	d	73	[k^n]
DUS		73	[d^s] non-standard dust
GYN		73	[dZIn] gin
JUN		73	[dZ^n] [dZu:n] Jun.
KOD	a	73	[kOd] cod
LUM	d	73	[l^m]
NAM		73	[næm] N.A.M.
REK		73	[rEk] reck
RUD		73	[r^d] rudd
SIV		73	[sIv] non-standard sieve
YOW		73	[jaW] yow
CAY		74	[keI] K, Kay
COS		74	[kOs] course
COZ		74	[kOz] cause
DAF		74	[dæf]
DAL		74	[dæl]
DUP		74	[d^p]
DUX		74	[d^ks] ducks
FEN	a	74	[fEn] fen, F.E.N.
HEK		74	[hEk] heck
HOF		74	[hOf]
HOX	a	74	[hOks] hocks
KOL		74	[kOl] call
MAJ		74	[mædZ] maj(or)
MUL		74	[m^l] mull
NAK		74	[næk] knack
PAG		74	[pæg]
PIR	a	74	[pIr] [pir] peer
SIB		74	[sIb] sib
TEK		74	[tEk] tech
TYM	a	74	[tIm] Tim
VIK		74	[vIk] Vick
WAP	a	74	[wæp] WAP
BEY		75	[beI] bay
CAS		75	[kæs] Cass
CEN		75	[sEn] [tSEn] cen(tral)
CIP		75	[sIp] [tSIp] sip, chip

CYD	a	75	[sId] Sid
DES		75	[dEs] des(F)
DOB		75	[dOb] daub
FOP		75	[fOp] fop
HIZ		75	[hIz] his
HOK		75	[hOk] hock
HUP		75	[h^p] hup
HUX		75	[h^ks] alternant <u>husk</u>
KOR		75	[kOr] core
LAN	a	75	[læn] L.A.N.
LIB	a	75	[lIb] lib(rary)
MOS		75	[mOs] moss
NOK		75	[nOk] knock
PEL		75	[pEl] pel pell
TIZ	a	75	[tIz] 'tis
VAG		75	[væg]
VIS		75	[vIs] vis(L)

BIF		76	[bIf] biff
DAZ	a	76	[dæz]
FAK		76	[fæk] fac(simili)
JUS		76	[j^s] jus
KER		76	[k@r] cur
KOG		76	[kOg] cog
LAR		76	[lAr] lar
MAH		76	[mA:] ma
MER		76	[mE@] mer(idian)
MUR	a	76	[mjur]
NUB		76	[n^b] nub
PAV		76	[pæv]
RAB		76	[ræb]
RES		76	[rEs] [ri:z] res
ROP		76	[rOp]
RUL	a	76	[r^l]
TEW	a	76	[tju:]
TIF	a	76	[tIf] tiff
VAS		76	[væs] vas
YAW		76	[jaW] yow

BUK		77	[b^k] buck
CAV		77	[kæv] cav(alier)
FAC		77	[fæk] [fætS] fac(simili)
FET		77	[fEt]
GAV		77	[gæv]
KUS		77	[k^s] cuss

LEV		77	[lEv] lev
RYM		77	[rIm] rim
WIF		77	[wIf] whiff
YEH		77	[jE:]
BIZ		78	[biz] biz
COK	d	78	[kOk] cock
DEP		78	[dEp] dep(artment)
DEX		78	[dEks] decks
FOK		78	[fOk]
GOL	ad	78	[gOl] Gaul
KAL		78	[kæl] cal(orie)
KOW		78	[kaW] cow
KOY		78	[kOI] coy
KUZ	a	78	[k^z] 'cause
LIM		78	[lIm] limb
MIR		78	[mIr] [mI@r] mir mere
MOV		78	[mOv] mauve
NOL		78	[nOl] Noll
POS		78	[pOs] [pOz] pos(ition), pos(itive), pos(session)
REN	a	78	[rEn] ren(ame)
TEC	d	78	[tEk] tech
YON		78	[jOn] yawn
YOR		78	[yOr] your
ZOR	d	78	[zOr]
DIF		79	[dIf] diff(erence)
FAL		79	[fæl] regional <u>fell</u>
FUK		79	[f^k] fuck
HOY		79	[hOI] hoy
JAX		79	[dZæks] jacks
JES		79	[dZes] jess
KIP		79	[kIp] kip
NOC		79	[nOk] [nOtS] knock, notch
NUL		79	[n^l] null
PAX	d	79	[pæks] packs
REY	a	79	[rEI] ray
RIF		79	[rIf] riff
SOG		79	[sOg]
SUK		79	[s^k] suck
TER		79	[tEr] tare
VEG		79	[vEg] veg(itable)
BEC	a	80	[bEk] beck
CIS		80	[sIs] [tSIs] sis(ter) sys(tem)
DER		80	[dEr] dare

GAT	a	80	[gæt]	G.A.T.T.
GIB		80	[gIb]	gib
GIM		80	[dZIm]	gym Jim
JAS		80	[dZæs]	Jas.<James
JOK		80	[dZOk]	jock
KAW		80	[kaW] [kO:]	cow
KOB		80	[kOb]	cob
KON		80	[kOn]	con
KUD		80	[k^d]	cud
LEX		80	[lEks]	lex
MIK		80	[mIk]	Mick
MOD		80	[mOd]	mod
NEV		80	[nEv]	Nev(ada)
RAD	d	80	[ræd]	rad
RAV	d	80	[ræv]	
ROV		80	[rOv]	
ROZ	a	80	[rOz]	
TES		80	[tEs]	Tess
TIS		80	[tIs]	'tis
YUK		80	[y^k]	yuk
TYP	a	80	[tIp]	tip
YEW		80	[ju:]	you

Total 187 words

Remaining:

HEV	MAZ	DUP	RAB	SOG
HUS	TID	HOF	ROP	ROV
SUT	KOV	PAG	FET	
TAV	DAF	VAG	GAV	
TAF	DAL	PAV	FOK	

Translations:

MAZ	NP1: boy
DAL	NP2: girl
HUS	NP3: man
DUP	NP4: woman
HOF	NP5: office
RAB	NP6: computer
SOG	NP7: library
DAF	NP8: book
TAF	V1: work (intransitive)
ROP	V2: use (transitive NP)
KOV	V3: say (transitive CP)
TAV	adv1: often
ROV	adv2: rarely

FET	modal1: present
FOK	modal2: past
TID	NEG: not
GAV	wh-NPs: who
PAG	wh-NPo: what
PAV	wh-adv: how-frequently
VAG	C1: that
SUT	C2: after

Appendix B2: Trigrams for the phonological short term memory test

116 trigrams that had unbased responses in the total of 423 trigrams with the word association value between 40 and 60

Trigam		Possible word
FUB	[f^b]	fub (=fob)
MOF	[mOf]	
PAF	[pæf]	
TEV	[tEv]	TEV Today's English Version
FOZ	[fOz]	faugh's
HEZ	[hEz]	
HIG	[hIg]	
NEM	[nEm]	
NIS	[nIs]	
SEF	[sEf]	nonstandard pronunciation of Seth
FIP	[fIp]	
VAZ	[væz]	vase
WIV	[wIv]	nonstandard with
ZAN	[zæn]	
ZON	[zOn]	
BEZ	[bEz]	
DUT	[d^t]	
FAP	[fæp]	
HIB	[hIb]	
KIB	[kIb]	
NID	[nId]	
PIV	[pIv]	
RUK	[r^k]	ruck
HEG	[hEg]	
MOG	[mOg]	
PEM	[pEm]	
POV	[pOv]	
WOB	[wOb]	
HUZ	[h^z]	has
KEV	[kEv]	
LIG	[lIg]	
NEP	[nEp]	
PEV	[pEv]	
VEM	[vEm]	
ZEP	[zEp]	zep (=zeppelin)
SUG	[s^g]	Sugg
TOF	[tOf]	toff
TUL	[t^l]	
ZIN	[zIn]	

KIZ	[kIz]	
SEB	[sEb]	
VEP	[vEp]	
VUL	[v^l]	Vul. =Vulgate
BIV	[bIv]	
LEB	[lEb]	
MUZ	[m^z]	muzz
NEF	[nEf]	nef
NUS	[n^s]	
BEM	[bEm]	B.E.M. British Empire Medal, Bachelor of Engineering of Mines
JIS	[dZIs]	JIS Japanese Industrial Standard
KES	[kEs]	
LUF	[l^f]	luff
MAB	[mæb]	Mab
VID	[vId]	vid. (=vide < Latin)
VOD	[vOd]	
JOP	[dZOp]	
NAZ	[næz]	
SUF	[s^f]	suf. (=sufficient, suffix), Suff (=Suffork)
VIZ	[vIz]	viz. (=videlicet, namely)
DAK	[dæk]	dak [dA:k], Dak. (=Dakota)
FID	[fId]	fid
FOT	[fOt]	fought
HEF	[hEf]	
KUL	[k^l]	cull
LEZ	[lEz]	les
MEZ	[mEz]	
MIF	[mIf]	miff
SAZ	[sæz]	
VOS	[vOs]	
DEZ	[dEz]	
LUP	[l^p]	
MEK	[mEk]	nonstandard Mex
NIF	[nIf]	
NIM	[nIm]	
POF	[pOf]	
POG	[pOg]	
VIT	[vIt]	
ZIM	[zIm]	
ZIT	[zIt]	
KOS	[kOs]	nonstandard cost
KUN	[k^n]	
LUT	[l^t]	
NUP	[n^p]	

PID	[pId]	
PUZ	[p^z]	
FAZ	[fæz]	
HOZ	[hOz]	
JIT	[dZIt]	
JOD	[dzOd]	jawed
JUM	[dZ^m]	nonstandard jump
MUV	[m^v]	
NAS	[næs]	NAS (=National Academy of Science)
TUS	[t^s]	nonstandard tusk
WUD	[w^d]	would
ZAT	[zæt]	
ZEL	[zEl]	
ZUM	[z^m]	
DEV	[dEv]	
JAV	[dZæv]	Jav. (=Javanese)
PEB	[pEb]	
WEG	[wEg]	
FAV	[fæv]	
JEZ	[dZEz]	
NAL	[næl]	
PIF	[pIf]	PIF (=Program information file)
PIM	[pIm]	
WOV	[wOv]	
BEP	[bEp]	
JEP	[dZEp]	
KET	[kEt]	
LUD	[l^d]	
MAV	[mæv]	
MIZ	[mIz]	Ms.
SEK	[sEk]	sec, sec. (=second)
TAS	[tæs]	nonstandard task
BAF	[bæf]	nonstandard bath
DOF	[dOf]	doff

75 trigrams retained from the total of 423 trigrams with word association values between 40 and 60

Set 3:
MOF [mOf]
PAF [pæf]
HEZ [hEz]

Set 4:
HIG [hIg]
NEM [nEm]
NIS [nIs]
FIP [fIp]

Set 5:
ZAN [zæn]
ZON [zOn]
BEZ [bEz]
DUT [d^t]
FAP [fæp]

Set 6:
HIB [hIb]
KIB [kIb]
PIV [pIv]
HEG [hEg]
MOG [mOg]
PEM [pEm]

Set 7:
POV [pOv]
WOB [wOb]
KEV [kEv]
LIG [lIg]
NEP [nEp]
PEV [pEv]
VEM [vEm]

Set 8:
TUL [t^l]
ZIN [zIn]
KIZ [kIz]
SEB [sEb]
VEP [vEp]
BIV [bIv]
LEB [lEb]
NUS [n^s]

Set 9:
KES [kEs]
VOD [vOd]
JOP [dZOp]
NAZ [næz]
HEF [hEf]
MEZ [mEz]
SAZ [sæz]
VOS [vOs]
DEZ [dEz]

Set 10:
LUP [l^p]
NIF [nIf]
NIM [nIm]
POF [pOf]
POG [pOg]
VIT [vIt]
ZIM [zIm]
ZIT [zIt]
KUN [k^n]
LUT [l^t]

Set 11:
NUP [n^p]
PID [pId]
PUZ [p^z]
FAZ [fæz]
HOZ [hOz]
JIT [dZIt]
MUV [m^v]
ZAT [zæt]
ZEL [zEl]
ZUM [z^m]
DEV [dEv]

Set 12:
PEB [pEb]
WEG [wEg]
FAV [fæv]
JEZ [dZEz]
NAL [næl]
PIM [pIm]
WOV [wOv]
BEP [bEp]
JEP [dZEp]
KET [kEt]
LUD [l^d]
MAV [mæv]

Appendix C: English grammaticality judgement test sentences

test sentences:

That-trace effect

001: * Who did the boy think that saw a UFO?
002: * Who does the girl think that will clean the pavement?
003: * Who did the boy think that took his apple?
004: * Who does the girl think that will do the homework?
005: * Who did the man think that ordered a coffee?
006: * Who does the woman think that will enter her room?
007: * Who did the man think that demanded an answer?
008: * Who does the woman think that will love the cat?

009: Who did the boy think saw a UFO?
010: Who does the girl think will clean the pavement?
011: Who did the boy think took his apple?
012: Who does the girl think will do her homework?
013: Who did the man think ordered a coffee?
014: Who does the woman think will enter her room?
015: Who did the man think demanded an answer?
016: Who does the woman think will love the cat?

Superiority

017: * What did the boy think who saw?
Answer: The boy thought the girl saw a UFO.
018: * What does the girl think who will clean?
Answer: The girl thinks her neighbor will clean the pavement.
019: * What did the boy think who took?
Answer: The boy thought his classmate took his apple.
020: * What does the girl think who will do?
Answer: The girl thinks her classmate will do her homework.
021: * What did the man think who ordered?
Answer: The man thought the customer ordered a coffee.
022: * What does the woman think who will enter?
Answer: The woman thinks a burglar will enter her room.
023: * What did the man think who demanded?
Answer: The man thought his students demanded an answer.
024: * What does the woman think who will love?
Answer: The woman thinks her husband will love the cat.

025: Who did the boy think saw what?
Answer: The boy thought the girl saw a UFO.
026: Who does the girl think will clean what?

Answer: The girl thinks her neighbor will clean the pavement.

027: Who did the boy think took what?
Answer: The boy thought his classmate took his apple.

028: Who does the girl think will do what?
Answer: The girl thinks her classmate will do her homework.

029: Who did the man think ordered what?
Answer: The man thought the customer ordered a coffee.

030: Who does the woman think will enter what?
Answer: The woman thinks a burglar will enter her room.

031: Who did the man think demanded what?
Answer: The man thought his students demanded an answer.

032: Who does the woman think will love what?
Answer: The woman thinks her husband will love the cat.

Argument extraction from an adjunct

033: * What did the boy arrive after the girl saw?
Answer: The boy arrived after the girl saw a UFO.

034: * What will the girl jog before her neighbor will clean?
Answer: The girl will jog before her neighbor will clean the pavement.

035: * What did the boy cry because his classmate took?
Answer: The boy cried because his classmate took his apple.

036: * What will the girl sleep when her classmate will do?
Answer: The girls will sleep when her classmate will do her homework.

037: * Who did the boy arrive after saw a UFO?
Answer: The boy arrived after the girl saw a UFO.

038: * Who will the girl jog before will clean the pavement?
Answer: The girl will jog before her neighbor will clean the pavement.

039: * Who did the boy cry because took his apple?
Answer: The boy cried because his classmate took his apple.

040: * Who will the girl sleep when will do her homework?
Answer: The girl will sleep when her classmate will do her homework.

041: What did the boy see after the girl arrived?
Answer: The boy saw a UFO after the girl arrived.

042: What will the girl clean before her neighbor will jog?
Answer: The girl will clean the pavement before her neighbor will jog.

043: What did the boy take because his classmate cried?
Answer: The boy took his apple because his classmate cried.
044: What will the girl do when her classmate will sleep?
Answer: The girl will do her homework when her classmate will sleep.
045: Who saw a UFO after the girl arrived?
Answer: The boy saw a UFO after the girl arrived.
046: Who will clean the pavement before her neighbor will jog?
Answer: The girl will clean the pavement before her neighbor will jog.
047: Who took his apple because his classmate cried?
Answer: The boy took his apple because his classmate cried.
048: Who will do her homework when her classmate will sleep?
Answer: The girl will do her homework when her classmate will sleep.

Adjunct extraction from an adjunct

049: * Where did the boy arrive at the Air Force base after the girl saw a UFO?
Answer: The boy arrived at the Air Force base after the girl saw a UFO at the crash site.
050: * How will the girl jog hesitantly before her neighbor will clean the pavement?
Answer: The girl will jog hesitantly before her neighbor will clean the pavement completely.
051: * When did the boy cry at lunch time because his classmate had taken his apple?
Answer: The boy cried at lunch time because his classmate had taken his apple an hour earlier.
052: * Why will the girl sleep because she has no homework to do when her classmate will do her homework?
Answer: The girl will sleep because she has no homework to do when her classmates will do her homework because the girl bribed them to do it.
053: * Where did the man live in Wisconsin after his sister moved?
Answer: The man lived in Wisconsin after his sister moved to New York.
054: * How did the dancer perform well before her husband abused her?
Answer: The dancer performed well before her husband abused her badly.
055: * When did the teacher worked on the difficult problem yesterday because his students demanded an answer?
Answer: The teacher worked on the difficult problem yesterday because his students demanded an answer the day before.

056: * Why did the woman call her husband at his office because she was lonely when her husband was not in?
Answer: The woman called her husband because she was lonely when her husband not in because he was visiting his client's place.

057: Where did the boy arrive after the girl saw a UFO at the crash site?
Answer: The boy arrived at the Air Force base after the girl saw a UFO at the crash site.

058: How will the girl jog before her neighbor will clean the pavement completely?
Answer: The girl will jog hesitantly before her neighbor cleans the pavement completely.

059: When did the boy cry because his classmate had taken his apple an hour earlier?
Answer: The boy cried at lunch time because his classmate had taken his apple an hour earlier.

060: Why will the girl sleep when her classmates will do her homework because she bribed them to do it?
Answer: The girl sleeps because she has no homework to do when her classmates will do her homework because she bribed them to do it.

061: Where did the man live after his sister moved to New York?
Answer: The man lived in Wisconsin after his sister moved to New York.

062: How did the dancer perform before her husband abused her badly?
Answer: The dancer performed well before her husband abused her badly.

063: When did the man work on the difficult problem because his students demanded an answer?
Answer: The man worked on the difficult problem yesterday because his students demanded an answer.

064: Why did the woman call her husband when her husband was out because he was visiting his client's place?
Answer: The woman called her husband because she was lonely when her husband was out because he was visiting his client's place.

filler sentences:

001: The boy will work while the girl uses the office.
002: The boy will use the computer when the girl works.
003: The boy will say that the girl uses the office.
004: The girl will work while the boy uses the office.
005: The girl will use the computer while the boy works.
006: The girl will say that the boy uses the office.
007: The man uses the computer when the boy works.
008: The man uses the library when the boy works.
009: The man uses the office when the woman works.
010: The woman says that the man uses the office.
011: The woman says that the boy uses the office.
012: The woman says that the girl uses the office.
013: The boy will work when the man uses the office.
014: The boy will work when the woman uses the girl.
015: The boy will use the computer when the man works.
016: The boy will use the office when the woman works.
017: The boy will say that the man uses the computer.
018: The boy will say that the woman uses the office.
019: The girl will work while the man uses the office.
020: The girl will work while the woman uses the boy.
021: The girl will use the computer while the man works.
022: The girl will use the office while the woman works.
023: The girl will say that the man uses the office.
024: The girl will say that the woman uses the boy.
025: The man uses the computer when the girl works.
026: The man uses the copier when the woman works.
027: The man uses the library when the girl works.
028: The man uses the timer when the woman works.
029: The man uses the diary when the girl works.
030: The man uses the printer when the woman works.
031: The woman says that the man uses the timer.
032: The woman says that the man uses the printer.
033: * The boy work while the girl will use the computer.
034: * The boy use the computer when the girl will work.
035: * The boy say that the girl will use the computer.
036: * The girl work will while the boy uses the office.
037: * The girl use the computer will while the boy works.
038: * The girl say that the boy uses the office will.
039: * The man the computer uses when the boy works.
040: * The man the library uses when the boy works.
041: * The man the office uses when the woman works.
042: * That the man uses the office the woman says.
043: * That the boy uses the office the woman says.
044: * That girl uses the office the woman says.
045: * The boy work when the man will use the computer.
046: * The boy work when the woman will use the office.
047: * The boy use the dictionary when the man will work.
048: * The boy use the computer when the woman will work.
049: * The boy say that the man will use the computer.
050: * The boy say that the woman will use the office.
051: * The girl work will while the man uses the office.
052: * The girl work will while the woman uses the boy.

053: * The girl use the computer will while the man works.
054: * The girl use the office will while the woman works.
055: * The girl say that the man uses the office will.
056: * The girl say that the woman uses the boy will.
057: * The man the computer uses when the girl works.
058: * The man the copier uses when the woman works.
059: * The man the library uses when the girl works.
060: * The man the timer uses when the woman works.
061: * The man the diary uses when the girl works.
062: * The man the printer uses when the woman works.
063: * That the man uses the timer the woman says.
064: * That the man uses the printer the woman says.

Appendix D: English sentence matching task sentences

matched items

tense/modal:

1. The boy will work while the girl uses the office.
   The boy will work while the girl uses the office.

2. The boy work while the girl will use the computer.
   The boy work while the girl will use the computer.

3. The boy will use the computer when the girl works.
   The boy will use the computer when the girl works.

4. The boy use the computer when the girl will work.
   The boy use the computer when the girl will work.

5. The boy will say that the girl uses the office.
   The boy will say that the girl uses the office.

6. The boy say that the girl will use the computer.
   The boy say that the girl will use the computer.

modal-VP order:

7. The girl will work while the boy uses the office.
   The girl will work while the boy uses the office.

8. The girl work will while the boy uses the office.
   The girl work will while the boy uses the office.

9. The girl will use the computer while the boy works.
   The girl will use the computer while the boy works.

10. The girl use the computer will while the boy works.
    The girl use the computer will while the boy works.

11. The girl will say that the boy uses the office.
    The girl will say that the boy uses the office.

12. The girl say that the boy uses the office will.
    The girl say that the boy uses the office will.

V-complement NP order:

13. The man uses the computer when the boy works.
    The man uses the computer when the boy works.

14. The man the computer uses when the boy works.
    The man the computer uses when the boy works.

15. The man uses the library when the boy works.
    The man uses the library when the boy works.

16. The man the library uses when the boy works.
    The man the library uses when the boy works.

17. The man uses the office when the woman works.
    The man uses the office when the woman works.

18. The man the office uses when the woman works.
    The man the office uses when the woman works.

matrix clause-complement clause order:

19. The woman says that the man uses the office.
    The woman says that the man uses the office.

20. That the man uses the office the woman says.
    That the man uses the office the woman says.

21. The woman says that the boy uses the office.
    The woman says that the boy uses the office.

22. That the boy uses the office the woman says.
    That the boy uses the office the woman says.

23. The woman say that the girl uses the office.
    The woman say that the girl uses the office.

24. That girl uses the office the woman says.
    That girl uses the office the woman says.

unmatched items

tense/modal:

25. The boy will work when the man uses the office.
    The boy will work when the woman uses the girl.

26. The boy work when the man will use the computer.
    The boy work when the woman will use the office.

27. The boy will use the computer when the man works.
    The boy will use the office when the woman works.

28. The boy use the dictionary when the man will work.
    The boy use the computer when the woman will work.

29. The boy will say that the man uses the computer.
    The boy will say that the woman uses the office.

30. The boy say that the man will use the computer.
    The boy say that the woman will use the office.

modal-VP order:

31. The girl will work while the man uses the office.
    The girl will work while the woman uses the boy.

32. The girl work will while the man uses the office.
    The girl work will while the woman uses the boy.

33. The girl will use the computer while the man works.
The girl will use the office while the woman works.

34. The girl use the computer will while the man works.
The girl use the office will while the woman works.

35. The girl will say that the man uses the office.
The girl will say that the woman uses the boy.

36. The girl say that the man uses the office will.
The girl say that the woman uses the boy will.

V-complement NP order:

37. The man uses the computer when the girl works.
The man uses the copier when the woman works.

38. The man the computer uses when the girl works.
The man the copier uses when the woman works.

39. The man uses the library when the girl works.
The man uses the timer when the woman works.

40. The man the library uses when the girl works.
The man the timer uses when the woman works.

41. The man uses the diary when the girl works.
The man uses the printer when the woman works.

42. The man the diary uses when the girl works.
The man the printer uses when the woman works.

matrix clause-complement clause order:

43. The woman says that the man uses the timer.
The woman says that the man uses the printer.

44. That the man uses the timer the woman says.
That the man uses the printer the woman says.

45. The woman says that the boy uses the timer.
The woman says that the boy uses the printer.

46. That the boy uses the timer the woman says.
That the boy uses the printer the woman says.

47. The woman says that the girl uses the timer.
The woman says that the girl uses the printer.

48. That the girl uses the timer the woman says.
That the girl uses the printer the woman says.

Appendix E: Language A training sentences

Step 1: Matrix phrase structure training set

001: NP1 pres V1
002: NP2 pres V1
003: NP1 pres V2 NP5
004: NP2 pres V2 NP6
005: NP1 pres adv1 V1
006: NP2 pres adv1 V1
007: NP1 pres adv1 V2 NP5
008: NP2 pres adv1 V2 NP6
009: NP1 pres neg V1
010: NP2 pres neg V1
011: NP1 pres neg V2 NP5
012: NP2 pres neg V2 NP6
013: NP1 pres neg adv1 V1
014: NP2 pres neg adv1 V1
015: NP1 pres neg adv1 V2 NP5
016: NP2 pres neg adv1 V2 NP6

017: NP1 past V1
018: NP2 past V1
019: NP1 past V2 NP5
020: NP2 past V2 NP6
021: NP1 past adv1 V1
022: NP2 past adv1 V1
023: NP1 past adv1 V2 NP5
024: NP2 past adv1 V2 NP6
025: NP1 past neg V1
026: NP2 past neg V1
027: NP1 past neg V2 NP5
028: NP2 past neg V2 NP6
029: NP1 past neg adv1 V1
030: NP2 past neg adv1 V1
031: NP1 past neg adv1 V2 NP5
032: NP2 past neg adv1 V2 NP6

033: NP1 pres adv2 V1
034: NP2 pres adv2 V1
035: NP1 pres adv2 V2 NP5
036: NP2 pres adv2 V2 NP6
037: NP1 pres neg adv2 V1
038: NP2 pres neg adv2 V1
039: NP1 pres neg adv2 V2 NP5
040: NP2 pres neg adv2 V2 NP6
041: NP1 past adv2 V1
042: NP2 past adv2 V1
043: NP1 past adv2 V2 NP5
044: NP2 past adv2 V2 NP6
045: NP1 past neg adv2 V1
046: NP2 past neg adv2 V1
047: NP1 past neg adv2 V2 NP5
048: NP2 past neg adv2 V2 NP6

049: NP3 pres V1
050: NP4 pres V1
051: NP3 pres V2 NP7
052: NP4 pres V2 NP8
053: NP3 pres adv1 V1
054: NP4 pres adv1 V1
055: NP3 pres adv1 V2 NP7
056: NP4 pres adv1 V2 NP8
057: NP3 pres neg V1
058: NP4 pres neg V1
059: NP3 pres neg V2 NP7
060: NP4 pres neg V2 NP8
061: NP3 pres neg adv1 V1
062: NP4 pres neg adv1 V1
063: NP3 pres neg adv1 V2 NP7
064: NP4 pres neg adv1 V2 NP8

065: NP3 past V1
066: NP4 past V1
067: NP3 past V2 NP7
068: NP4 past V2 NP8
069: NP3 past adv1 V1
070: NP4 past adv1 V1
071: NP3 past adv1 V2 NP7
072: NP4 past adv1 V2 NP8
073: NP3 past neg V1
074: NP4 past neg V1
075: NP3 past neg V2 NP7
076: NP4 past neg V2 NP8
077: NP3 past neg adv1 V1
078: NP4 past neg adv1 V1
079: NP3 past neg adv1 V2 NP7
080: NP4 past neg adv1 V2 NP8

081: NP3 pres adv2 V1
082: NP4 pres adv2 V1
083: NP3 pres adv2 V2 NP7
084: NP4 pres adv2 V2 NP8
085: NP3 pres neg adv2 V1
086: NP4 pres neg adv2 V1
087: NP3 pres neg adv2 V2 NP7
088: NP4 pres neg adv2 V2 NP8
089: NP3 past adv2 V1
090: NP4 past adv2 V1
091: NP3 past adv2 V2 NP7
092: NP4 past adv2 V2 NP8
093: NP3 past neg adv2 V1
094: NP4 past neg adv2 V1
095: NP3 past neg adv2 V2 NP7
096: NP4 past neg adv2 V2 NP8

Exercise

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
neg
adv1, adv2
V1, V2

Grammaticality judgement

```
modal / tense:
097:    NP1 pres V1
098:  * NP1 adv1 V1
099:    NP2 pres V1
100:  * NP2 adv1 V1

101:    NP1 pres V2 NP7
102:  * NP1 adv1 V2 NP7
103:    NP2 pres V2 NP8
104:  * NP2 adv1 V2 NP8

105:    NP3 past V1
106:  * NP3 adv2 V1
107:    NP4 past V1
108:  * NP4 adv2 V1

109:    NP3 past V2 NP5
110:  * NP3 adv2 V2 NP5
111:    NP4 past V2 NP6
112:  * NP4 adv2 V2 NP6

null subject:
113:    NP1 pres V1
114:  * pres adv1 V1
115:    NP2 pres V1
116:  * pres adv2 V1

117:    NP3 past V1
118:  * past adv1 V1
119:    NP4 past V1
120:  * past adv2 V1

121:    NP1 pres V2 NP7
122:  * pres adv1 V2 NP7
123:    NP2 pres V2 NP8
124:  * pres adv2 V2 NP8

125:    NP3 past V2 NP5
126:  * past adv1 V2 NP5
127:    NP4 past V2 NP6
128:  * past adv2 V2 NP6
```

modal-negation placement:
129:   NP1 pres neg V1
130: * NP1 neg pres V1
131:   NP2 pres neg V1
132: * NP2 neg pres V1

133:   NP1 pres neg V2 NP7
134: * NP1 neg pres V2 NP7
135:   NP2 pres neg V2 NP8
136: * NP2 neg pres V2 NP8

137:   NP3 past neg V1
138: * NP3 neg past V1
139:   NP4 past neg V1
140: * NP4 past neg V1

141:   NP3 past neg V2 NP5
142: * NP3 neg past V2 NP5
143:   NP4 past neg V2 NP6
144: * NP4 neg past V2 NP6

modal-V placement:
145:   NP1 pres V1
146: * NP1 V1 pres
147:   NP2 pres V1
148: * NP2 V1 pres

149:   NP1 pres V2 NP7
150: * NP1 V2 NP7 pres
151:   NP2 pres V2 NP8
152: * NP2 V2 NP8 pres

153:   NP3 past V1
154: * NP3 V1 past
155:   NP4 past V1
156: * NP4 V1 past

157:   NP3 past V2 NP5
158: * NP3 V2 NP5 past
159:   NP4 past V2 NP6
160: * NP4 V2 NP6 past

V-complement placement:
161:   NP1 pres V2 NP7
162: * NP1 pres NP7 V2
163:   NP2 pres V2 NP8
164: * NP2 pres NP8 V2

165:   NP3 pres V2 NP5
166: * NP3 pres NP5 V2
167:   NP4 pres V2 NP6
168: * NP4 pres NP6 V2

```
169:   NP1 past V2 NP7
170: * NP1 past NP7 V2
171:   NP2 past V2 NP8
172: * NP2 past NP8 V2

173:   NP3 past V2 NP5
174: * NP3 past NP5 V2
175:   NP4 past V2 NP6
176: * NP4 past NP6 V2

adv-V placement:
177:   NP1 pres adv1 V1
178: * NP1 pres V1 adv1
179:   NP2 pres adv1 V1
180: * NP2 pres V1 adv1

181:   NP1 pres adv1 V2 NP7
182: * NP1 pres V2 adv1 NP7
183:   NP2 pres adv1 V2 NP8
184: * NP2 pres V2 adv1 NP8

185:   NP3 past adv2 V1
186: * NP3 past V1 adv2
187:   NP4 past adv2 V1
188: * NP4 past V1 adv2

189:   NP3 past adv2 V2 NP5
190: * NP3 past V2 adv2 NP5
191:   NP4 past adv2 V2 NP6
192: * NP3 past V2 adv2 NP6

modal-adv placement:
193:   NP1 pres adv1 V1
194: * NP1 adv1 pres V1
195:   NP2 pres adv1 V1
196: * NP2 adv1 pres V1

197:   NP1 pres adv1 V2 NP7
198: * NP1 adv1 pres V2 NP7
199:   NP2 pres adv1 V2 NP8
200: * NP2 adv1 pres V2 NP8

201:   NP3 past adv2 V1
202: * NP3 adv2 past V1
203:   NP4 past adv2 V1
204: * NP4 adv2 past V1

205:   NP3 past adv2 V2 NP5
206: * NP3 adv2 past V2 NP5
207:   NP4 past adv2 V2 NP6
208: * NP4 adv2 past V2 NP6

adjunct CP - matrix placement:
  no examples
```

```
complement CP - matrix inverse:
  no examples
```

Step 2: Complement clause training set

```
001: NP1 pres V3 C1 NP2 pres V1
002: NP1 pres V3 C1 NP3 pres V1
003: NP1 pres V3 C1 NP2 pres V2 NP6
004: NP1 pres V3 C1 NP3 pres V2 NP7
005: NP1 pres V3 C1 NP2 pres adv1 V1
006: NP1 pres V3 C1 NP3 pres adv1 V1
007: NP1 pres V3 C1 NP2 pres adv1 V2 NP6
008: NP1 pres V3 C1 NP3 pres adv1 V2 NP7
009: NP1 pres V3 C1 NP2 pres neg V1
010: NP1 pres V3 C1 NP3 pres neg V1
011: NP1 pres V3 C1 NP2 pres neg V2 NP6
012: NP1 pres V3 C1 NP3 pres neg V2 NP7
013: NP1 pres V3 C1 NP2 pres neg adv1 V1
014: NP1 pres V3 C1 NP3 pres neg adv1 V1
015: NP1 pres V3 C1 NP2 pres neg adv1 V2 NP6
016: NP1 pres V3 C1 NP3 pres neg adv1 V2 NP7

017: NP1 past V3 C1 NP2 past V1
018: NP1 past V3 C1 NP3 past V1
019: NP1 past V3 C1 NP2 past V2 NP6
020: NP1 past V3 C1 NP3 past V2 NP7
021: NP1 past V3 C1 NP2 past adv1 V1
022: NP1 past V3 C1 NP3 past adv1 V1
023: NP1 past V3 C1 NP2 past adv1 V2 NP6
024: NP1 past V3 C1 NP3 past adv1 V2 NP7
025: NP1 past V3 C1 NP2 past neg V1
026: NP1 past V3 C1 NP3 past neg V1
027: NP1 past V3 C1 NP2 past neg V2 NP6
028: NP1 past V3 C1 NP3 past neg V2 NP7
029: NP1 past V3 C1 NP2 past neg adv1 V1
030: NP1 past V3 C1 NP3 past neg adv1 V1
031: NP1 past V3 C1 NP2 past neg adv1 V2 NP6
032: NP1 past V3 C1 NP3 past neg adv1 V2 NP7

033: NP1 pres V3    NP2 pres V1
034: NP1 pres V3    NP3 pres V1
035: NP1 pres V3    NP2 pres V2 NP6
036: NP1 pres V3    NP3 pres V2 NP7
037: NP1 pres V3    NP2 pres adv1 V1
038: NP1 pres V3    NP3 pres adv1 V1
039: NP1 pres V3    NP2 pres adv1 V2 NP6
040: NP1 pres V3    NP3 pres adv1 V2 NP7
041: NP1 pres V3    NP2 pres neg V1
042: NP1 pres V3    NP3 pres neg V1
043: NP1 pres V3    NP2 pres neg V2 NP6
044: NP1 pres V3    NP3 pres neg V2 NP7
045: NP1 pres V3    NP2 pres neg adv1 V1
046: NP1 pres V3    NP3 pres neg adv1 V1
047: NP1 pres V3    NP2 pres neg adv1 V2 NP6
048: NP1 pres V3    NP3 pres neg adv1 V2 NP7
```

```
049: NP1 past V3    NP2 past V1
050: NP1 past V3    NP3 past V1
051: NP1 past V3    NP2 past V2 NP6
052: NP1 past V3    NP3 past V2 NP7
053: NP1 past V3    NP2 past adv1 V1
054: NP1 past V3    NP3 past adv1 V1
055: NP1 past V3    NP2 past adv1 V2 NP6
056: NP1 past V3    NP3 past adv1 V2 NP7
057: NP1 past V3    NP2 past neg V1
058: NP1 past V3    NP3 past neg V1
059: NP1 past V3    NP2 past neg V2 NP6
060: NP1 past V3    NP3 past neg V2 NP7
061: NP1 past V3    NP2 past neg adv1 V1
062: NP1 past V3    NP3 past neg adv1 V1
063: NP1 past V3    NP2 past neg adv1 V2 NP6
064: NP1 past V3    NP3 past neg adv1 V2 NP7

065: NP1 pres V3 C1 NP2 pres adv2 V1
066: NP1 pres V3 C1 NP3 pres adv2 V1
067: NP1 pres V3 C1 NP2 pres adv2 V2 NP6
068: NP1 pres V3 C1 NP3 pres adv2 V2 NP7
069: NP1 pres V3 C1 NP2 pres neg adv2 V1
070: NP1 pres V3 C1 NP3 pres neg adv2 V1
071: NP1 pres V3 C1 NP2 pres neg adv2 V2 NP6
072: NP1 pres V3 C1 NP3 pres neg adv2 V2 NP7
073: NP1 past V3 C1 NP2 past adv2 V1
074: NP1 past V3 C1 NP3 past adv2 V1
075: NP1 past V3 C1 NP2 past adv2 V2 NP6
076: NP1 past V3 C1 NP3 past adv2 V2 NP7
077: NP1 past V3 C1 NP2 past neg adv2 V1
078: NP1 past V3 C1 NP3 past neg adv2 V1
079: NP1 past V3 C1 NP2 past neg adv2 V2 NP6
080: NP3 past V3 C1 NP3 past neg adv2 V2 NP7

081: NP1 pres V3    NP2 pres adv2 V1
082: NP1 pres V3    NP3 pres adv2 V1
083: NP1 pres V3    NP2 pres adv2 V2 NP6
084: NP1 pres V3    NP3 pres adv2 V2 NP7
085: NP1 pres V3    NP2 pres neg adv2 V1
086: NP1 pres V3    NP3 pres neg adv2 V1
087: NP1 pres V3    NP2 pres neg adv2 V2 NP6
088: NP1 pres V3    NP3 pres neg adv2 V2 NP7
089: NP1 past V3    NP2 past adv2 V1
090: NP1 past V3    NP3 past adv2 V1
091: NP1 past V3    NP2 past adv2 V2 NP3
092: NP1 past V3    NP3 past adv2 V2 NP2
093: NP1 past V3    NP2 past neg adv2 V1
094: NP1 past V3    NP3 past neg adv2 V1
095: NP1 past V3    NP2 past neg adv2 V2 NP6
096: NP1 past V3    NP3 past neg adv2 V2 NP7
```

```
097: NP3 pres V3 C1 NP4 pres V1
098: NP3 pres V3 C1 NP1 pres V1
099: NP3 pres V3 C1 NP4 pres V2 NP8
100: NP3 pres V3 C1 NP1 pres V2 NP5
101: NP3 pres V3 C1 NP4 pres adv1 V1
102: NP3 pres V3 C1 NP1 pres adv1 V1
103: NP3 pres V3 C1 NP4 pres adv1 V2 NP8
104: NP3 pres V3 C1 NP1 pres adv1 V2 NP5
105: NP3 pres V3 C1 NP4 pres neg V1
106: NP3 pres V3 C1 NP1 pres neg V1
107: NP3 pres V3 C1 NP4 pres neg V2 NP8
108: NP3 pres V3 C1 NP1 pres neg V2 NP5
109: NP3 pres V3 C1 NP4 pres neg adv1 V1
110: NP3 pres V3 C1 NP1 pres neg adv1 V1
111: NP3 pres V3 C1 NP4 pres neg adv1 V2 NP8
112: NP3 pres V3 C1 NP1 pres neg adv1 V2 NP5

113: NP3 past V3 C1 NP4 past V1
114: NP3 past V3 C1 NP1 past V1
115: NP3 past V3 C1 NP4 past V2 NP8
116: NP3 past V3 C1 NP1 past V2 NP5
117: NP3 past V3 C1 NP4 past adv1 V1
118: NP3 past V3 C1 NP1 past adv1 V1
119: NP3 past V3 C1 NP4 past neg V1
120: NP3 past V3 C1 NP1 past neg V1
121: NP3 past V3 C1 NP4 past neg V2 NP8
122: NP3 past V3 C1 NP1 past neg V2 NP5
123: NP3 past V3 C1 NP4 past neg adv1 V1
124: NP3 past V3 C1 NP1 past neg adv1 V1
125: NP3 past V3 C1 NP4 past neg adv1 V2 NP8
126: NP3 past V3 C1 NP1 past neg adv1 V2 NP5

127: NP3 pres V3    NP4 pres V1
128: NP3 pres V3    NP1 pres V1
129: NP3 pres V3    NP4 pres V2 NP8
130: NP3 pres V3    NP1 pres V2 NP5
131: NP3 pres V3    NP4 pres adv1 V1
132: NP3 pres V3    NP1 pres adv1 V1
133: NP3 pres V3    NP4 pres adv1 V2 NP8
134: NP3 pres V3    NP1 pres adv1 V2 NP5
135: NP3 pres V3    NP4 pres neg V1
136: NP3 pres V3    NP1 pres neg V1
137: NP3 pres V3    NP4 pres neg V2 NP8
138: NP3 pres V3    NP1 pres neg V2 NP5
139: NP3 pres V3    NP4 pres neg adv1 V1
140: NP3 pres V3    NP1 pres neg adv1 V1
141: NP3 pres V3    NP4 pres neg adv1 V2 NP8
142: NP3 pres V3    NP1 pres neg adv1 V2 NP5
```

143: NP3 past V3 NP4 past V1
144: NP3 past V3 NP1 past V1
145: NP3 past V3 NP4 past V2 NP8
146: NP3 past V3 NP1 past V2 NP5
147: NP3 past V3 NP4 past adv1 V1
148: NP3 past V3 NP1 past adv1 V1
149: NP3 past V3 NP4 past adv1 V2 NP8
150: NP3 past V3 NP1 past adv1 V2 NP5
151: NP3 past V3 NP4 past neg V1
152: NP3 past V3 NP1 past neg V1
153: NP3 past V3 NP4 past neg V2 NP8
154: NP3 past V3 NP1 past neg V2 NP5
155: NP3 past V3 NP4 past neg adv1 V1
156: NP3 past V3 NP1 past neg adv1 V1
157: NP3 past V3 NP4 past neg adv1 V2 NP8
158: NP3 past V3 NP1 past neg adv1 V2 NP5

159: NP3 pres V3 C1 NP4 pres adv2 V1
160: NP3 pres V3 C1 NP1 pres adv2 V1
161: NP3 pres V3 C1 NP4 pres adv2 V2 NP8
162: NP3 pres V3 C1 NP1 pres adv2 V2 NP5
163: NP3 pres V3 C1 NP4 pres neg adv2 V1
164: NP3 pres V3 C1 NP1 pres neg adv2 V1
165: NP3 pres V3 C1 NP4 pres neg adv2 V2 NP8
166: NP3 pres V3 C1 NP1 pres neg adv2 V2 NP5
167: NP3 past V3 C1 NP4 past adv2 V1
168: NP3 past V3 C1 NP1 past adv2 V1
169: NP3 past V3 C1 NP4 past adv2 V2 NP8
170: NP3 past V3 C1 NP1 past adv2 V2 NP5
171: NP3 past V3 C1 NP4 past neg adv2 V1
172: NP3 past V3 C1 NP1 past neg adv2 V1
173: NP3 past V3 C1 NP4 past neg adv2 V2 NP8
174: NP3 past V3 C1 NP1 past neg adv2 V2 NP5

175: NP3 pres V3 NP4 pres adv2 V1
176: NP3 pres V3 NP1 pres adv2 V1
177: NP3 pres V3 NP4 pres adv2 V2 NP8
178: NP3 pres V3 NP1 pres adv2 V2 NP5
179: NP3 pres V3 NP4 pres neg adv2 V1
180: NP3 pres V3 NP1 pres neg adv2 V1
181: NP3 pres V3 NP4 pres neg adv2 V2 NP8
182: NP3 pres V3 NP1 pres neg adv2 V2 NP5
183: NP3 past V3 NP4 past adv2 V1
184: NP3 past V3 NP1 past adv2 V1
185: NP3 past V3 NP4 past adv2 V2 NP8
186: NP3 past V3 NP1 past adv2 V2 NP5
187: NP3 past V3 NP4 past neg adv2 V1
188: NP3 past V3 NP1 past neg adv2 V1
189: NP3 past V3 NP4 past neg adv2 V2 NP8
190: NP3 past V3 NP1 past neg adv2 V2 NP5

Exercise

Vocabulary

```
NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
neg
V1, V2, V3
C1
```

Grammaticality judgement

```
modal / tense:
191:   NP4 pres V3 C1 NP2 pres V1
192: * NP4 pres V3 C1 NP2 adv1 V1
193:   NP4 pres V3    NP3 pres V1
194: * NP4 pres V3    NP3 adv1 V1

195:   NP1 pres V3    NP2 pres V2 NP8
196: * NP1 pres V3    NP2 adv1 V2 NP8
197:   NP1 pres V3 C1 NP3 pres V2 NP5
198: * NP1 pres V3 C1 NP3 adv1 V2 NP5

199:   NP2 past V3 C1 NP4 past V1
200: * NP2 past V3 C1 NP4 adv2 V1
201:   NP2 past V3    NP1 past V1
202: * NP2 past V3    NP1 adv2 V1

203:   NP3 past V3    NP4 past V2 NP6
204: * NP3 past V3    NP4 adv2 V2 NP6
205:   NP3 past V3 C1 NP1 past V2 NP7
206: * NP3 past V3 C1 NP1 adv2 V2 NP7

null subject:
207:   NP4 pres V3 C1 NP2 pres V1
208: * NP4 pres V3 C1 pres adv1 V1
209:   NP4 pres V3    NP3 pres V1
210: * NP4 pres V3    pres adv2 V1

211:   NP1 pres V3    NP2 pres V2 NP8
212: * NP1 pres V3    pres adv1 V2 NP8
213:   NP1 pres V3 C1 NP3 pres V2 NP5
214: * NP1 pres V3 C1 pres adv2 V2 NP5

215:   NP2 past V3 C1 NP4 past V1
216: * NP2 past V3 C1 past adv1 V1
217:   NP2 past V3    NP1 past V1
218: * NP2 past V3    past adv2 V1

219:   NP3 past V3    NP4 past V2 NP6
220: * NP3 past V3    past adv1 V2 NP6
221:   NP3 past V3 C1 NP1 past V2 NP7
222: * NP3 past V3 C1 past adv2 V2 NP7
```

```
modal-negation placement:
223:   NP4 pres V3 C1 NP2 pres neg V1
224: * NP4 pres V3 C1 NP2 neg pres V1
225:   NP4 pres V3    NP3 pres neg V1
226: * NP4 pres V3    NP3 neg pres V1

227:   NP1 pres V3    NP2 pres neg V2 NP8
228: * NP1 pres V3    NP2 neg pres V2 NP8
229:   NP1 pres V3 C1 NP3 pres neg V2 NP5
230: * NP1 pres V3 C1 NP3 neg pres V2 NP5

231:   NP2 past V3 C1 NP4 past neg V1
232: * NP2 past V3 C1 NP4 neg past V1
233:   NP2 past V3    NP1 past neg V1
234: * NP2 past V3    NP1 past neg V1

235:   NP3 past V3    NP4 past neg V2 NP6
236: * NP3 past V3    NP4 neg past V2 NP6
237:   NP3 past V3 C1 NP1 past neg V2 NP7
238: * NP3 past V3 C1 NP1 neg past V2 NP7

modal-V placement:
239:   NP4 pres V3 C1 NP2 pres V1
240: * NP4 pres V3 C1 NP2 V1 pres
241:   NP4 pres V3    NP3 pres V1
242: * NP4 pres V3    NP3 V1 pres

243:   NP1 pres V3    NP2 pres V2 NP8
244: * NP1 pres V3    NP2 V2 NP8 pres
245:   NP1 pres V3 C1 NP3 pres V2 NP5
246: * NP1 pres V3 C1 NP3 V2 NP5 pres

247:   NP2 past V3 C1 NP4 past V1
248: * NP2 past V3 C1 NP4 V1 past
249:   NP2 past V3    NP1 past V1
250: * NP2 past V3    NP1 V1 past

251:   NP3 past V3    NP4 past V2 NP6
252: * NP3 past V3    NP4 V2 NP6 past
253:   NP3 past V3 C1 NP1 past V2 NP7
254: * NP3 past V3 C1 NP1 V2 NP7 past

V-complement placement:
255:   NP1 pres V3 C1 NP2 pres V2 NP8
256: * NP1 pres V3 C1 NP2 pres NP8 V2
257:   NP1 pres V3    NP3 pres V2 NP5
258: * NP1 pres V3    NP3 pres NP5 V2

259:   NP1 pres V3    NP2 pres V2 NP8
260: * NP1 pres V3    NP2 pres NP8 V2
261:   NP1 pres V3 C1 NP3 pres V2 NP5
262: * NP1 pres V3 C1 NP3 pres NP5 V2
```

```
263:   NP3 past V3 C1 NP4 past V2 NP6
264: * NP3 past V3 C1 NP4 past NP6 V2
265:   NP3 past V3    NP1 past V2 NP7
266: * NP3 past V3    NP1 past NP7 V2

267:   NP3 past V3    NP4 past V2 NP6
268: * NP3 past V3    NP4 past NP6 V2
269:   NP3 past V3 C1 NP1 past V2 NP7
270: * NP3 past V3 C1 NP1 past NP7 V2

adv-V placement:
271:   NP4 pres V3 C1 NP2 pres adv1 V1
272: * NP4 pres V3 C1 NP2 pres V1 adv1
273:   NP4 pres V3    NP3 pres adv1 V1
274: * NP4 pres V3    NP3 pres V1 adv1

275:   NP1 pres V3    NP2 pres adv1 V2 NP8
276: * NP1 pres V3    NP2 pres V2 adv1 NP8
277:   NP1 pres V3 C1 NP3 pres adv1 V2 NP5
278: * NP1 pres V3 C1 NP3 pres V2 adv1 NP5

279:   NP2 past V3 C1 NP4 past adv2 V1
280: * NP2 past V3 C1 NP4 past V1 adv2
281:   NP2 past V3    NP1 past adv2 V1
282: * NP2 past V3    NP1 past V1 adv2

283:   NP3 past V3    NP4 past adv2 V2 NP6
284: * NP3 past V3    NP4 past V2 adv2 NP6
285:   NP3 past V3 C1 NP1 past adv2 V2 NP7
286: * NP3 past V3 C1 NP1 past V2 adv2 NP7

modal-adv placement:
287:   NP4 pres V3 C1 NP2 pres adv1 V1
288: * NP4 pres V3 C1 NP2 adv1 pres V1
289:   NP4 pres V3    NP3 pres adv1 V1
290: * NP4 pres V3    NP3 adv1 pres V1

291:   NP1 pres V3    NP2 pres adv1 V2 NP8
292: * NP1 pres V3    NP2 adv1 pres V2 NP8
293:   NP1 pres V3 C1 NP3 pres adv1 V2 NP5
294: * NP1 pres V3 C1 NP3 adv1 pres V2 NP5

295:   NP2 past V3 C1 NP4 past adv2 V1
296: * NP2 past V3 C1 NP4 adv2 past V1
297:   NP2 past V3    NP1 past adv2 V1
298: * NP2 past V3    NP1 adv2 past V1

299:   NP3 past V3    NP4 past adv2 V2 NP6
300: * NP3 past V3    NP4 adv2 past V2 NP6
301:   NP3 past V3 C1 NP1 past adv2 V2 NP7
302: * NP3 past V3 C1 NP1 adv2 past V2 NP7

adjunct CP - matrix placement:
  no examples
```

```
complement CP - matrix inverse:
303:    NP4 pres V3 C1 NP2 pres V1
304:  * C1 NP2 pres V1 NP4 pres V3
305:    NP4 pres V3 C1 NP3 pres V1
306:  * C1 NP3 pres V1 NP4 pres V3

307:    NP1 pres V3 C1 NP2 pres V2 NP8
308:  * C1 NP2 pres V2 NP8 NP1 pres V3
309:    NP1 pres V3 C1 NP3 pres V2 NP5
310:  * C1 NP3 pres V2 NP5 NP1 pres V3

311:    NP2 past V3 C1 NP4 past V1
312:  * C1 NP4 past V1 NP2 past V3
313:    NP2 past V3 C1 NP1 past V1
314:  * C1 NP1 past V1 NP2 past V3

315:    NP3 past V3 C1 NP4 past V2 NP6
316:  * C1 NP4 past V2 NP6 NP3 past V3
317:    NP3 past V3 C1 NP1 past V2 NP7
318:  * C1 NP1 past V2 NP7 NP3 past V3
```

Step 3: Adjunct clause training set

001: NP1 pres V1 C2 NP2 pres V1
002: NP1 pres V1 C2 NP3 pres V1
003: NP1 pres V1 C2 NP2 pres V2 NP6
004: NP1 pres V1 C2 NP3 pres V2 NP7
005: NP1 pres V1 C2 NP2 pres adv1 V1
006: NP1 pres V1 C2 NP3 pres adv1 V1
007: NP1 pres V1 C2 NP2 pres adv1 V2 NP6
008: NP1 pres V1 C2 NP3 pres adv1 V2 NP7
009: NP1 pres V1 C2 NP2 pres neg V1
010: NP1 pres V1 C2 NP3 pres neg V1
011: NP1 pres V1 C2 NP2 pres neg V2 NP6
012: NP1 pres V1 C2 NP3 pres neg V2 NP7
013: NP1 pres V1 C2 NP2 pres neg adv1 V1
014: NP1 pres V1 C2 NP3 pres neg adv1 V1
015: NP1 pres V1 C2 NP2 pres neg adv1 V2 NP6
016: NP1 pres V1 C2 NP3 pres neg adv1 V2 NP7

017: NP1 past V1 C2 NP2 past V1
018: NP1 past V1 C2 NP3 past V1
019: NP1 past V1 C2 NP2 past V2 NP6
020: NP1 past V1 C2 NP3 past V2 NP7
021: NP1 past V1 C2 NP2 past adv1 V1
022: NP1 past V1 C2 NP3 past adv1 V1
023: NP1 past V1 C2 NP2 past adv1 V2 NP6
024: NP1 past V1 C2 NP3 past adv1 V2 NP7
025: NP1 past V1 C2 NP2 past neg V1
026: NP1 past V1 C2 NP2 past neg V1
027: NP1 past V1 C2 NP2 past neg V2 NP6
028: NP1 past V1 C2 NP3 past neg V2 NP7
029: NP1 past V1 C2 NP2 past neg adv1 V1
030: NP1 past V1 C2 NP3 past neg adv1 V1
031: NP1 past V1 C2 NP2 past neg adv1 V2 NP6
032: NP1 past V1 C2 NP3 past neg adv1 V2 NP7

033: NP1 pres V1 C2 NP2 pres adv2 V1
034: NP1 pres V1 C2 NP3 pres adv2 V1
035: NP1 pres V1 C2 NP2 pres adv2 V2 NP6
036: NP1 pres V1 C2 NP3 pres adv2 V2 NP7
037: NP1 pres V1 C2 NP2 pres neg adv2 V1
038: NP1 pres V1 C2 NP3 pres neg adv2 V1
039: NP1 pres V1 C2 NP2 pres neg adv2 V2 NP6
040: NP1 pres V1 C2 NP3 pres neg adv2 V2 NP7
041: NP1 past V1 C2 NP2 past adv2 V1
042: NP1 past V1 C2 NP3 past adv2 V1
043: NP1 past V1 C2 NP2 past adv2 V2 NP6
044: NP1 past V1 C2 NP3 past adv2 V2 NP7
045: NP1 past V1 C2 NP2 past neg adv2 V1
046: NP1 past V1 C2 NP3 past neg adv2 V1
047: NP1 past V1 C2 NP2 past neg adv2 V2 NP6
048: NP1 past V1 C2 NP3 past neg adv2 V2 NP7
049: NP3 pres V1 C2 NP4 pres V1
050: NP3 pres V1 C2 NP1 pres V1

051: NP3 pres V1 C2 NP4 pres V2 NP8
052: NP3 pres V1 C2 NP1 pres V2 NP5
053: NP3 pres V1 C2 NP4 pres adv1 V1
054: NP3 pres V1 C2 NP1 pres adv1 V1
055: NP3 pres V1 C2 NP4 pres adv1 V2 NP8
056: NP3 pres V1 C2 NP1 pres adv1 V2 NP5
057: NP3 pres V1 C2 NP4 pres neg V1
058: NP3 pres V1 C2 NP1 pres neg V1
059: NP3 pres V1 C2 NP4 pres neg V2 NP8
060: NP3 pres V1 C2 NP1 pres neg V2 NP5
061: NP3 pres V1 C2 NP4 pres neg adv1 V1
062: NP3 pres V1 C2 NP1 pres neg adv1 V1
063: NP3 pres V1 C2 NP4 pres neg adv1 V2 NP8
064: NP3 pres V1 C2 NP1 pres neg adv1 V2 NP5

065: NP3 past V1 C2 NP4 past V1
066: NP3 past V1 C2 NP1 past V1
067: NP3 past V1 C2 NP4 past V2 NP8
068: NP3 past V1 C2 NP1 past V2 NP5
069: NP3 past V1 C2 NP4 past adv1 V1
070: NP3 past V1 C2 NP1 past adv1 V1
071: NP3 past V1 C2 NP4 past adv1 V2 NP8
072: NP3 past V1 C2 NP1 past adv1 V2 NP5
073: NP3 past V1 C2 NP4 past neg V1
074: NP3 past V1 C2 NP1 past neg V1
075: NP3 past V1 C2 NP4 past neg V2 NP8
076: NP3 past V1 C2 NP1 past neg V2 NP5
077: NP3 past V1 C2 NP4 past neg adv1 V1
078: NP3 past V1 C2 NP1 past neg adv1 V1
079: NP3 past V1 C2 NP4 past neg adv1 V2 NP8
080: NP3 past V1 C2 NP1 past neg adv1 V2 NP5

081: NP3 pres V1 C2 NP4 pres adv2 V1
082: NP3 pres V1 C2 NP1 pres adv2 V1
083: NP3 pres V1 C2 NP4 pres adv2 V2 NP8
084: NP3 pres V1 C2 NP1 pres adv2 V2 NP5
085: NP3 pres V1 C2 NP4 pres neg adv2 V1
086: NP3 pres V1 C2 NP1 pres neg adv2 V1
087: NP3 pres V1 C2 NP4 pres neg adv2 V2 NP8
088: NP3 pres V1 C2 NP1 pres neg adv2 V2 NP5
089: NP3 past V1 C2 NP4 past adv2 V1
090: NP3 past V1 C2 NP1 past adv2 V1
091: NP3 past V1 C2 NP4 past adv2 V2 NP8
092: NP3 past V1 C2 NP1 past adv2 V2 NP5
093: NP3 past V1 C2 NP4 past neg adv2 V1
094: NP3 past V1 C2 NP1 past neg adv2 V1
095: NP3 past V1 C2 NP4 past neg adv2 V2 NP8
096: NP3 past V1 C2 NP1 past neg adv2 V2 NP5

Exercise

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
neg
adv1, adv2
V1, V2
C2

Grammaticality judgement

modal / tense:
097:   NP4 pres V1 C2 NP2 pres V1
098: * NP4 pres V1 C2 NP2 adv1 V1
099:   NP4 pres V1 C2 NP3 pres V1
100: * NP4 pres V1 C2 NP3 adv1 V1

101:   NP1 pres V1 C2 NP2 pres V2 NP8
102: * NP1 pres V1 C2 NP2 adv1 V2 NP8
103:   NP1 pres V1 C2 NP3 pres V2 NP5
104: * NP1 pres V1 C2 NP3 adv1 V2 NP5

105:   NP2 past V1 C2 NP4 past V1
106: * NP2 past V1 C2 NP4 adv2 V1
107:   NP2 past V1 C2 NP1 past V1
108: * NP2 past V1 C2 NP1 adv2 V1

109:   NP3 past V1 C2 NP4 past V2 NP6
110: * NP3 past V1 C2 NP4 adv2 V2 NP6
111:   NP3 past V1 C1 NP1 past V2 NP7
112: * NP3 past V1 C1 NP1 adv2 V2 NP7

null subject:
113:   NP4 pres V1 C2 NP2 pres V1
114: * NP4 pres V1 C2 pres adv1 V1
115:   NP4 pres V1 C2 NP3 pres V1
116: * NP4 pres V1 C2 pres adv2 V1

117:   NP1 pres V1 C2 NP2 pres V2 NP8
118: * NP1 pres V1 C2 pres adv1 V2 NP8
119:   NP1 pres V1 C2 NP3 pres V2 NP5
120: * NP1 pres V1 C2 pres adv2 V2 NP5

121:   NP2 past V1 C2 NP4 past V1
122: * NP2 past V1 C2 past adv1 V1
123:   NP2 past V1 C2 NP1 past V1
124: * NP2 past V1 C2 past adv2 V1

125:   NP3 past V1 C2 NP4 past V2 NP6
126: * NP3 past V1 C2 past adv1 V2 NP6
127:   NP3 past V1 C2 NP1 past V2 NP7
128: * NP3 past V1 C2 past adv1 V2 NP7

modal-negation placement:

```
129:   NP4 pres V1 C2 NP2 pres neg V1
130: * NP4 pres V1 C2 NP2 neg pres V1
131:   NP4 pres V1 C2 NP3 pres neg V1
132: * NP4 pres V1 C2 NP3 neg pres V1

133:   NP1 pres V1 C2 NP2 pres neg V2 NP8
134: * NP1 pres V1 C2 NP2 neg pres V2 NP8
135:   NP1 pres V1 C2 NP3 pres neg V2 NP5
136: * NP1 pres V1 C2 NP3 neg pres V2 NP5

137:   NP2 past V1 C2 NP4 past neg V1
138: * NP2 past V1 C2 NP4 neg past V1
139:   NP2 past V1 C2 NP1 past neg V1
140: * NP2 past V1 C2 NP1 past neg V1

141:   NP3 past V1 C2 NP4 past neg V2 NP6
142: * NP3 past V1 C2 NP4 neg past V2 NP6
143:   NP3 past V1 C2 NP1 past neg V2 NP7
144: * NP3 past V1 C2 NP1 neg past V2 NP7
```

modal-V placement:

```
145:   NP4 pres V1 C2 NP2 pres V1
146: * NP4 pres V1 C2 NP2 V1 pres
147:   NP4 pres V1 C2 NP3 pres V1
148: * NP4 pres V1 C2 NP3 V1 pres

149:   NP1 pres V1 C2 NP2 pres V2 NP8
150: * NP1 pres V1 C2 NP2 V2 NP8 pres
151:   NP1 pres V1 C2 NP3 pres V2 NP5
152: * NP1 pres V1 C2 NP3 V2 NP5 pres

153:   NP2 past V1 C2 NP4 past V1
154: * NP2 past V1 C2 NP4 V1 past
155:   NP2 past V1 C2 NP1 past V1
156: * NP2 past V1 C2 NP1 V1 past

157:   NP3 past V1 C2 NP4 past V2 NP6
158: * NP3 past V1 C2 NP4 V2 NP6 past
159:   NP3 past V1 C2 NP1 past V2 NP7
160: * NP3 past V1 C2 NP1 V2 NP7 past
```

V-complement placement:

```
161:   NP1 pres V1 C2 NP2 pres V2 NP8
162: * NP1 pres V1 C2 NP2 pres NP8 V2
163:   NP1 pres V1 C2 NP3 pres V2 NP5
164: * NP1 pres V1 C2 NP3 pres NP5 V2

165:   NP1 past V1 C2 NP2 past V2 NP8
166: * NP1 past V1 C2 NP2 past NP8 V2
167:   NP1 past V1 C2 NP3 past V2 NP5
168: * NP1 past V1 C2 NP3 past NP5 V2
```

```
169:   NP3 pres V1 C2 NP4 pres V2 NP6
170: * NP3 pres V1 C2 NP4 pres NP6 V2
171:   NP3 pres V1 C2 NP1 pres V2 NP7
172: * NP3 pres V1 C2 NP1 pres NP7 V2

173:   NP3 past V1 C2 NP4 past V2 NP6
174: * NP3 past V1 C2 NP4 past NP6 V2
175:   NP3 past V1 C2 NP1 past V2 NP7
176: * NP3 past V1 C2 NP1 past NP7 V2

adv-V placement:
177:   NP4 pres V1 C2 NP2 pres adv1 V1
178: * NP4 pres V1 C2 NP2 pres V1 adv1
179:   NP4 pres V1 C2 NP3 pres adv1 V1
180: * NP4 pres V1 C2 NP3 pres V1 adv1

181:   NP1 pres V1 C2 NP2 pres adv1 V2 NP8
182: * NP1 pres V1 C2 NP2 pres V2 adv1 NP8
183:   NP1 pres V1 C2 NP3 pres adv1 V2 NP5
184: * NP1 pres V1 C2 NP3 pres V2 adv1 NP5

185:   NP2 past V1 C2 NP4 past adv2 V1
186: * NP2 past V1 C2 NP4 past V1 adv2
187:   NP2 past V1 C2 NP1 past adv2 V1
188: * NP2 past V1 C2 NP1 past V1 adv2

189:   NP3 past V1 C2 NP4 past adv2 V2 NP6
190: * NP3 past V1 C2 NP4 past V2 adv2 NP6
191:   NP3 past V1 C2 NP1 past adv2 V2 NP7
192: * NP3 past V1 C2 NP1 past V2 adv2 NP7

modal-adv placement:
193:   NP4 pres V1 C2 NP2 pres adv1 V1
194: * NP4 pres V1 C2 NP2 adv1 pres V1
195:   NP4 pres V1 C2 NP3 pres adv1 V1
196: * NP4 pres V1 C2 NP3 adv1 pres V1

197:   NP1 pres V1 C2 NP2 pres adv1 V2 NP8
198: * NP1 pres V1 C2 NP2 adv1 pres V2 NP8
199:   NP1 pres V1 C2 NP3 pres adv1 V2 NP5
200: * NP1 pres V1 C2 NP3 adv1 pres V2 NP5

201:   NP2 past V1 C2 NP4 past adv2 V1
202: * NP2 past V1 C2 NP4 adv2 past V1
203:   NP2 past V1 C2 NP1 past adv2 V1
204: * NP2 past V1 C2 NP1 adv2 past V1

205:   NP3 past V1 C2 NP4 past adv2 V2 NP6
206: * NP3 past V1 C2 NP4 adv2 past V2 NP6
207:   NP3 past V1 C2 NP1 past adv2 V2 NP7
208: * NP3 past V1 C2 NP1 adv2 past V2 NP7
```

```
adjunct CP - matrix placement:
209:   NP4 pres V1 C2 NP2 pres V1
210: * C2 NP2 pres V1 NP4 pres V1
211:   NP4 pres V1 C2 NP3 pres V1
212: * C2 NP3 pres V1 NP4 pres V1

213:   NP1 pres V1 C2 NP2 pres V2 NP8
214: * C2 NP2 pres V2 NP8 NP1 pres V1
215:   NP1 pres V1 C2 NP3 pres V2 NP5
216: * C2 NP3 pres V2 NP5 NP1 pres V1

217:   NP2 past V1 C2 NP4 past V1
218: * C2 NP4 past V1 NP2 past V1
219:   NP2 past V1 C2 NP1 past V1
220: * C2 NP1 past V1 NP2 past V1

221:   NP3 past V1 C2 NP4 past V2 NP6
222: * C2 NP4 past V2 NP6 NP3 past V1
223:   NP3 past V1 C2 NP1 past V2 NP7
224: * C2 NP1 past V2 NP7 NP3 past V1

complement CP - matrix inverse:
  no examples
```

Step 4: Yes/no question training set

001: pres NP1 V1
002: pres NP2 V1
003: pres NP1 V2 NP5
004: pres NP2 V2 NP6
005: pres NP1 adv1 V1
006: pres NP2 adv1 V1
007: pres NP1 adv1 V2 NP5
008: pres NP2 adv1 V2 NP6
009: pres NP1 neg V1
010: pres NP2 neg V1
011: pres NP1 neg V2 NP5
012: pres NP2 neg V2 NP6
013: pres NP1 neg adv1 V1
014: pres NP2 neg adv1 V1
015: pres NP1 neg adv1 V2 NP5
016: pres NP2 neg adv1 V2 NP6

017: past NP1 V1
018: past NP2 V1
019: past NP1 V2 NP5
020: past NP2 V2 NP6
021: past NP1 adv1 V1
022: past NP2 adv1 V1
023: past NP1 adv1 V2 NP5
024: past NP2 adv1 V2 NP6
025: past NP1 neg V1
026: past NP2 neg V1
027: past NP1 neg V2 NP5
028: past NP2 neg V2 NP6
029: past NP1 neg adv1 V1
030: past NP2 neg adv1 V1
031: past NP1 neg adv1 V2 NP5
032: past NP2 neg adv1 V2 NP6

033: pres NP1 adv2 V1
034: pres NP2 adv2 V1
035: pres NP1 adv2 V2 NP5
036: pres NP2 adv2 V2 NP6
037: pres NP1 neg adv2 V1
038: pres NP2 neg adv2 V1
039: pres NP1 neg adv2 V2 NP5
040: pres NP2 neg adv2 V2 NP6
041: past NP1 adv2 V1
042: past NP2 adv2 V1
043: past NP1 adv2 V2 NP5
044: past NP2 adv2 V2 NP6
045: past NP1 neg adv2 V1
046: past NP2 neg adv2 V1
047: past NP1 neg adv2 V2 NP5
048: past NP1 neg adv2 V2 NP6

```
049: pres NP3 V1
050: pres NP4 V1
051: pres NP3 V2 NP7
052: pres NP4 V2 NP8
053: pres NP3 adv1 V1
054: pres NP4 adv1 V1
055: pres NP3 adv1 V2 NP7
056: pres NP4 adv1 V2 NP8
057: pres NP3 neg V1
058: pres NP4 neg V1
059: pres NP3 neg V2 NP7
060: pres NP4 neg V2 NP8
061: pres NP3 neg adv1 V1
062: pres NP4 neg adv1 V1
063: pres NP3 neg adv1 V2 NP7
064: pres NP4 neg adv1 V2 NP8

065: past NP3 V1
066: past NP4 V1
067: past NP3 V2 NP7
068: past NP4 V2 NP8
069: past NP3 adv1 V1
070: past NP4 adv1 V1
071: past NP3 adv1 V2 NP7
072: past NP4 adv1 V2 NP8
073: past NP3 neg V1
074: past NP4 neg V1
075: past NP3 neg V2 NP7
076: past NP4 neg V2 NP8
077: past NP3 neg adv1 V1
078: past NP4 neg adv1 V1
079: past NP3 neg adv1 V2 NP7
080: past NP4 neg adv1 V2 NP8

081: pres NP3 adv2 V1
082: pres NP4 adv2 V1
083: pres NP3 adv2 V2 NP7
084: pres NP4 adv2 V2 NP8
085: pres NP3 neg adv2 V1
086: pres NP4 neg adv2 V1
087: pres NP3 neg adv2 V2 NP7
088: pres NP4 neg adv2 V2 NP8
089: past NP3 adv2 V1
090: past NP4 adv2 V1
091: past NP3 adv2 V2 NP7
092: past NP4 adv2 V2 NP8
093: past NP3 neg adv2 V1
094: past NP4 neg adv2 V1
095: past NP3 neg adv2 V2 NP7
096: past NP4 neg adv2 V2 NP8
```

Excercise

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
neg
adv1, adv2
V1, V2

Grammaticality judgement

modal / tense:
```
097:   pres NP4 V1 C2 NP2 pres V1
098: * pres NP4 V1 C2 NP2 adv1 V1
099:   pres NP4 V1 C2 NP3 pres V1
100: * pres NP4 V1 C2 NP3 adv1 V1

101:   pres NP1 V1 C2 NP2 pres V2 NP8
102: * pres NP1 V1 C2 NP2 adv1 V2 NP8
103:   pres NP1 V1 C2 NP3 pres V2 NP5
104: * pres NP1 V1 C2 NP3 adv1 V2 NP5

105:   past NP2 V1 C2 NP4 past V1
106: * past NP2 V1 C2 NP4 adv2 V1
107:   past NP2 V1 C2 NP1 past V1
108: * past NP2 V1 C2 NP1 adv2 V1

109:   past NP3 V1 C2 NP4 past V2 NP6
110: * past NP3 V1 C2 NP4 adv2 V2 NP6
111:   past NP3 V1 C1 NP1 past V2 NP7
112: * past NP3 V1 C1 NP1 adv2 V2 NP7
```

null subject:
```
113:   pres NP4 V1 C2 NP2 pres V1
114: * pres NP4 V1 C2 pres adv1 V1
115:   pres NP4 V1 C2 NP3 pres V1
116: * pres NP4 V1 C2 pres adv2 V1

117:   pres NP1 V1 C2 NP2 pres V2 NP8
118: * pres NP1 V1 C2 pres adv1 V2 NP8
119:   pres NP1 V1 C2 NP3 pres V2 NP5
120: * pres NP1 V1 C2 pres adv2 V2 NP5

121:   past NP2 V1 C2 NP4 past V1
122: * past NP2 V1 C2 past adv1 V1
123:   past NP2 V1 C2 NP1 past V1
124: * past NP2 V1 C2 past adv2 V1

125:   past NP3 V1 C2 NP4 past V2 NP6
126: * past NP3 V1 C2 past adv1 V2 NP6
127:   past NP3 V1 C2 NP1 past V2 NP7
128: * past NP3 V1 C2 past adv1 V2 NP7
```

```
modal-negation placement:
129:   pres NP4 V1 C2 NP2 pres neg V1
130: * pres NP4 V1 C2 NP2 neg pres V1
131:   pres NP4 V1 C2 NP3 pres neg V1
132: * pres NP4 V1 C2 NP3 neg pres V1

133:   pres NP1 V1 C2 NP2 pres neg V2 NP8
134: * pres NP1 V1 C2 NP2 neg pres V2 NP8
135:   pres NP1 V1 C2 NP3 pres neg V2 NP5
136: * pres NP1 V1 C2 NP3 neg pres V2 NP5

137:   past NP2 V1 C2 NP4 past neg V1
138: * past NP2 V1 C2 NP4 neg past V1
139:   past NP2 V1 C2 NP1 past neg V1
140: * past NP2 V1 C2 NP1 past neg V1

141:   past NP3 V1 C2 NP4 past neg V2 NP6
142: * past NP3 V1 C2 NP4 neg past V2 NP6
143:   past NP3 V1 C2 NP1 past neg V2 NP7
144: * past NP3 V1 C2 NP1 neg past V2 NP7

modal-V placement:
145:   pres NP4 V1 C2 NP2 pres V1
146: * pres NP4 V1 C2 NP2 V1 pres
147:   pres NP4 V1 C2 NP3 pres V1
148: * pres NP4 V1 C2 NP3 V1 pres

149:   pres NP1 V1 C2 NP2 pres V2 NP8
150: * pres NP1 V1 C2 NP2 V2 NP8 pres
151:   pres NP1 V1 C2 NP3 pres V2 NP5
152: * pres NP1 V1 C2 NP3 V2 NP5 pres

153:   past NP2 V1 C2 NP4 past V1
154: * past NP2 V1 C2 NP4 V1 past
155:   past NP2 V1 C2 NP1 past V1
156: * past NP2 V1 C2 NP1 V1 past

157:   past NP3 V1 C2 NP4 past V2 NP6
158: * past NP3 V1 C2 NP4 V2 NP6 past
159:   past NP3 V1 C2 NP1 past V2 NP7
160: * past NP3 V1 C2 NP1 V2 NP7 past

V-complement placement:
161:   pres NP1 V1 C2 NP2 pres V2 NP8
162: * pres NP1 V1 C2 NP2 pres NP8 V2
163:   pres NP1 V1 C2 NP3 pres V2 NP5
164: * pres NP1 V1 C2 NP3 pres NP5 V2

165:   pres NP1 V1 C2 NP2 pres V2 NP8
166: * pres NP1 V1 C2 NP2 pres NP8 V2
167:   pres NP1 V1 C2 NP3 pres V2 NP5
168: * pres NP1 V1 C2 NP3 pres NP5 V2
```

```
169:   past NP3 V1 C2 NP4 past V2 NP6
170: * past NP3 V1 C2 NP4 past NP6 V2
171:   past NP3 V1 C2 NP1 past V2 NP7
172: * past NP3 V1 C2 NP1 past NP7 V2

173:   past NP3 V1 C2 NP4 past V2 NP6
174: * past NP3 V1 C2 NP4 past NP6 V2
175:   past NP3 V1 C2 NP1 past V2 NP7
176: * past NP3 V1 C2 NP1 past NP7 V2

adv-V placement:
177:   pres NP4 V1 C2 NP2 pres adv1 V1
178: * pres NP4 V1 C2 NP2 pres V1 adv1
179:   pres NP4 V1 C2 NP3 pres adv1 V1
180: * pres NP4 V1 C2 NP3 pres V1 adv1

181:   pres NP1 V1 C2 NP2 pres adv1 V2 NP8
182: * pres NP1 V1 C2 NP2 pres V2 adv1 NP8
183:   pres NP1 V1 C2 NP3 pres adv1 V2 NP5
184: * pres NP1 V1 C2 NP3 pres V2 adv1 NP5

185:   past NP2 V1 C2 NP4 past adv2 V1
186: * past NP2 V1 C2 NP4 past V1 adv2
187:   past NP2 V1 C2 NP1 past adv2 V1
188: * past NP2 V1 C2 NP1 past V1 adv2

189:   past NP3 V1 C2 NP4 past adv2 V2 NP6
190: * past NP3 V1 C2 NP4 past V2 adv2 NP6
191:   past NP3 V1 C2 NP1 past adv2 V2 NP7
192: * past NP3 V1 C2 NP1 past V2 adv2 NP7

modal-adv placement:
193:   pres NP4 V1 C2 NP2 pres adv1 V1
194: * pres NP4 V1 C2 NP2 adv1 pres V1
195:   pres NP4 V1 C2 NP3 pres adv1 V1
196: * pres NP4 V1 C2 NP3 adv1 pres V1

197:   pres NP1 V1 C2 NP2 pres adv1 V2 NP8
198: * pres NP1 V1 C2 NP2 adv1 pres V2 NP8
199:   pres NP1 V1 C2 NP3 pres adv1 V2 NP5
200: * pres NP1 V1 C2 NP3 adv1 pres V2 NP5

201:   past NP2 V1 C2 NP4 past adv2 V1
202: * past NP2 V1 C2 NP4 adv2 past V1
203:   past NP2 V1 C2 NP1 past adv2 V1
204: * past NP2 V1 C2 NP1 adv2 past V1

205:   past NP3 V1 C2 NP4 past adv2 V2 NP6
206: * past NP3 V1 C2 NP4 adv2 past V2 NP6
207:   past NP3 V1 C2 NP1 past adv2 V2 NP7
208: * past NP3 V1 C2 NP1 adv2 past V2 NP7
```

```
adjunct CP - matrix placement:
209:   pres NP4 V1 C2 NP2 pres V1
210: * C2 NP2 pres V1 pres NP4 V1
211:   pres NP4 V1 C2 NP3 pres V1
212: * C2 NP3 pres V1 pres NP4 V1

213:   pres NP1 V1 C2 NP2 pres V2 NP8
214: * C2 NP2 pres V2 NP8 pres NP1 V1
215:   pres NP1 V1 C2 NP3 pres V2 NP5
216: * C2 NP3 pres V2 NP5 pres NP1 V1

217:   past NP2 V1 C2 NP4 past V1
218: * C2 NP4 past V1 past NP2 V1
219:   past NP2 V1 C2 NP1 past V1
220: * C2 NP1 past V1 past NP2 V1

221:   past NP3 V1 C2 NP4 past V2 NP6
222: * past C2 NP4 past V2 NP6 NP3 V1
223:   past NP3 V1 C2 NP1 past V2 NP7
224: * past C2 NP1 past V2 NP7 NP3 V1

complement CP - matrix inverse:
225:   pres NP4 V3 C1 NP2 pres V1
226: * C1 NP2 pres V1 pres NP4 V3
227:   pres NP4 V3 C1 NP3 pres V1
228: * C1 NP3 pres V1 pres NP4 V3

229:   pres NP1 V3 C1 NP2 pres V2 NP8
230: * C1 NP2 pres V2 NP8 pres NP1 V3
231:   pres NP1 V3 C1 NP3 pres V2 NP5
232: * C1 NP3 pres V2 NP5 pres NP1 V3

233:   past NP2 V3 C1 NP4 past V1
234: * C1 NP4 past V1 past NP2 V3
235:   past NP2 V3 C1 NP1 past V1
236: * C1 NP1 past V1 past NP2 V3

237:   past NP3 V3 C1 NP4 past V2 NP6
238: * C1 NP4 past V2 NP6 past NP3 V3
239:   past NP3 V3 C1 NP1 past V2 NP7
240: * C1 NP1 past V2 NP7 past NP3 V3
```

Step 5: Wh-question training set

001: wh-adv pres NP1 V1
002: wh-adv pres NP2 V1
003: wh-adv pres NP1 V2 NP5
004: wh-adv pres NP2 V2 NP6
005: wh-adv pres NP1 neg V1
006: wh-adv pres NP2 neg V1
007: wh-adv pres NP1 neg V2 NP5
008: wh-adv pres NP2 neg V2 NP6

009: wh-adv past NP3 V1
010: wh-adv past NP4 V1
011: wh-adv past NP3 V2 NP7
012: wh-adv past NP4 V2 NP8
013: wh-adv past NP3 neg V1
014: wh-adv past NP4 neg V1
015: wh-adv past NP3 neg V2 NP7
016: wh-adv past NP4 neg V2 NP8

033: wh-NPs pres V1
034: wh-NPs pres V2 NP6
035: wh-NPs pres adv1 V1
036: wh-NPs pres adv1 V2 NP6
037: wh-NPs pres neg V1
038: wh-NPs pres neg V2 NP6
039: wh-NPs pres neg adv1 V1
040: wh-NPs pres neg adv1 V2 NP6
041: wh-NPs past V1
042: wh-NPs past V2 NP6
043: wh-NPs past adv1 V1
044: wh-NPs past adv1 V2 NP6
045: wh-NPs past neg V1
046: wh-NPs past neg V2 NP6
047: wh-NPs past neg adv1 V1
048: wh-NPs past neg adv1 V2 NP6

049: wh-NPs pres adv2 V1
050: wh-NPs pres adv2 V2 NP6
051: wh-NPs pres neg adv2 V1
052: wh-NPs pres neg adv2 V2 NP6
053: wh-NPs past adv2 V1
054: wh-NPs past adv2 V2 NP6
055: wh-NPs past neg adv2 V1
056: wh-NPs past neg adv2 V2 NP6

057: wh-NPs pres V2 NP8
058: wh-NPs pres adv1 V2 NP8
059: wh-NPs pres neg V2 NP8
060: wh-NPs pres neg adv1 NP8
061: wh-NPs past V2 NP8
062: wh-NPs past adv1 V2 NP8
063: wh-NPs past neg V2 NP8
064: wh-NPs past neg adv1 V2 NP8

```
065: wh-NPs pres adv2 V2 NP8
066: wh-NPs pres neg adv2 V2 NP8
067: wh-NPs past adv2 V2 NP8
068: wh-NPs past neg adv2 V2 NP8

069: wh-NPo pres NP1 V2
070: wh-NPo pres NP1 adv1 V2
071: wh-NPo pres NP1 neg V2
072: wh-NPo pres NP1 neg adv1 V2
073: wh-NPo past NP1 V2
074: wh-NPo past NP1 adv1 V2
075: wh-NPo past NP1 neg V2
076: wh-NPo past NP1 neg adv1 V2

077: wh-NPo pres NP1 adv2 V2
078: wh-NPo pres NP1 neg adv2 V2
079: wh-NPo past NP1 adv2 V2
080: wh-NPo past NP1 neg adv2 V2

081: wh-NPo pres NP3 V2
082: wh-NPo pres NP3 adv1 V2
083: wh-NPo pres NP3 neg V2
084: wh-NPo pres NP3 neg adv1 V2
085: wh-NPo past NP3 V2
086: wh-NPo past NP3 adv1 V2
087: wh-NPo past NP3 neg V2
088: wh-NPo past NP3 neg adv1 V2

089: wh-NPo pres NP3 adv2 V2
090: wh-NPo pres NP3 neg adv2 V2
091: wh-NPo past NP3 adv2 V2
092: wh-NPo past NP3 neg adv2 V2
```

Exercise

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
neg
adv1, adv2
V1, V2
wh-adv, wh-NPs, wh-NPo

Grammaticality judgement

modal / tense:
```
133:   wh-adv pres NP3 V1
134: * wh-adv NP3 neg V1
135:   wh-adv pres NP1 V2 NP7
136: * wh-adv NP1 neg V2 NP7

137:   wh-adv past NP1 V1
138: * wh-adv adv2 NP1 V1
139:   wh-adv past NP3 V2 NP5
140: * wh-adv NP3 neg V2 NP5

143:   wh-NPs pres V2 NP5
144: * wh-NPs adv1 V2 NP5

147:   wh-NPs past V2 NP7
148: * wh-NPs adv2 V2 NP7

149:   wh-NPo pres NP2 V2
150: * wh-NPo NP2 adv1 V2

153:   wh-NPo past NP4 V2
154: * wh-NPo NP4 adv2 V2
```

null subject:
```
157:   wh-adv pres NP3 V1
158: * wh-adv pres neg V1
159:   wh-adv pres NP1 V2 NP7
160: * wh-adv pres neg V2 NP7

161:   wh-adv past NP1 V1
162: * wh-adv past neg V1
163:   wh-adv past NP3 V2 NP5
164: * wh-adv past neg V2 NP5

165:   wh-NPo pres NP2 V2
166: * wh-NPo pres adv1 V2

169:   wh-NPo past NP4 V2
170: * wh-NPo past adv2 V2
```

```
modal-negation placement:
173:   wh-adv pres NP3 neg V1
174: * wh-adv neg NP3 pres V1
175:   wh-adv pres NP1 neg V2 NP7
176: * wh-adv neg NP1 pres V2 NP7

177:   wh-adv past NP1 neg V1
178: * wh-adv neg NP1 past V1
179:   wh-adv past NP3 neg V2 NP5
180: * wh-adv neg NP3 past V2 NP5

183:   wh-NPs pres neg V2 NP5
184: * wh-NPs neg pres V2 NP5

187:   wh-NPs past neg V2 NP7
188: * wh-NPs neg past V2 NP7

189:   wh-NPo pres NP2 neg V2
190: * wh-NPo neg NP2 pres V2

193:   wh-NPo past NP4 neg V2
194: * wh-NPo neg NP4 past V2

modal-V placement:
197:   wh-adv pres NP3 V1
198: * wh-adv V1 NP3 pres
199:   wh-adv pres NP1 V2 NP7
200: * wh-adv V2 NP1 pres NP7

201:   wh-adv past NP1 V1
202: * wh-adv V1 NP1 past
203:   wh-adv past NP3 V2 NP5
204: * wh-adv V2 NP3 past NP5

207:   wh-NPs pres V2 NP5
208: * wh-NPs V2 pres NP5

211:   wh-NPs past V2 NP7
212: * wh-NPs V2 past NP7

213:   wh-NPo pres NP2 V2
214: * wh-NPo V2 NP2 pres

217:   wh-NPo past NP4 V2
218: * wh-NPo V2 NP4 past

V-complement placement:
221:   wh-adv pres NP1 V2 NP7
222: * wh-adv pres NP1 NP7 V2
223:   wh-adv pres NP2 V2 NP8
224: * wh-adv pres NP2 NP8 V2
```

```
225:   wh-adv past NP3 V2 NP5
226: * wh-adv past NP3 NP5 V2
227:   wh-adv past NP4 V2 NP6
228: * wh-adv past NP4 NP6 V2
```

adv-V placement:

```
231:   wh-NPs pres adv1 V2 NP5
232: * wh-NPs pres V2 adv1 NP5

235:   wh-NPs past adv2 V2 NP7
236: * wh-NPs past V2 adv2 NP7

237:   wh-NPo pres NP2 adv1 V2
238: * wh-NPo pres NP2 V2 adv1

241:   wh-NPo past NP4 adv2 V2
242: * wh-NPo past NP4 V2 adv2
```

modal-adv placement:

```
247:   wh-NPs pres adv1 V2 NP5
248: * wh-NPs adv1 pres V2 NP5

251:   wh-NPs past adv2 V2 NP7
252: * wh-NPs adv2 past V2 NP7

253:   wh-NPo pres NP2 adv1 V2
254: * wh-NPo adv1 NP2 pres V2

257:   wh-NPo past NP4 adv2 V2
258: * wh-NPo adv2 NP4 past V2
```

adjunct CP - matrix placement:
  no examples

complement CP - matrix inverse:
  no examples

Appendix F: Examination 1

Vocabulary test

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
neg
adv1, adv2
V1, V2, V3
C1, C2
wh-adv, wh-NPs, wh-NPo

Grammaticality judgement

that-trace (subject extraction from a complement clause):

```
001:   wh-NPs pres NP1 V3    pres V1
002: * wh-NPs pres NP1 V3 C1 pres V1
003:   wh-NPs pres NP1 V3    pres V2 NP5
004: * wh-NPs pres NP1 V3 C1 pres V2 NP5

005:   wh-NPs past NP3 V3    past V1
006: * wh-NPs past NP3 V3 C1 past V1
007:   wh-NPs past NP3 V3    past V2 NP7
008: * wh-NPs past NP3 V3 C1 past V2 NP7

009:   wh-NPs past NP1 V3    past V1
010: * wh-NPs past NP1 V3 C1 past V1
011:   wh-NPs past NP1 V3    past V2 NP5
012: * wh-NPs past NP1 V3 C1 past V2 NP5

013:   wh-NPs pres NP3 V3    pres V1
014: * wh-NPs pres NP3 V3 C1 pres V1
015:   wh-NPs pres NP3 V3    pres V2 NP7
016: * wh-NPs pres NP3 V3 C1 pres V2 NP7
```

Superiority (embedded subject - embedded object):

Since the English grammaticality judgement test uses the embedded subject - embedded object sentences for Superiority, the test for Language A (and also for Language B) uses the embedded subject - embedded object sentences 017 - 032. Eight pairs of a grammatical subject extraction and an ungrammatical object extraction are provided in 017 - 032.

```
017:   wh-NPs pres NP1 V3 pres V2 wh-NPo
018: * wh-NPo pres NP1 V3 wh-NPs pres V2
019:   wh-NPs past NP3 V3 past V2 wh-NPo
020: * wh-NPo past NP3 V3 wh-NPs past V2
021:   wh-NPs pres NP3 V3 pres V2 wh-NPo
022: * wh-NPo pres NP3 V3 wh-NPs pres V2
023:   wh-NPs past NP1 V3 past V2 wh-NPo
024: * wh-NPo past NP1 V3 wh-NPs past V2
```

```
025:   wh-NPs pres NP2 V3 pres V2 wh-NPo
026: * wh-NPo pres NP2 V3 wh-NPs pres V2
027:   wh-NPs past NP4 V3 past V2 wh-NPo
028: * wh-NPo past NP4 V3 wh-NPs past V2
029:   wh-NPs pres NP2 V3 pres V2 wh-NPo
030: * wh-NPo pres NP2 V3 wh-NPs pres V2
031:   wh-NPs past NP4 V3 past V2 wh-NPo
032: * wh-NPo past NP4 V3 wh-NPs past V2
```

Object extraction from an adjunct clause:

```
033:   wh-NPo pres NP1 V2 C2 NP3 pres V1
034: * wh-NPo pres NP1 V1 C2 NP3 pres V2
035:   wh-NPo pres NP3 V2 C2 NP1 pres V1
036: * wh-NPo pres NP3 V1 C2 NP1 pres V2
037:   wh-NPo past NP2 V2 C2 NP4 past V1
038: * wh-NPo past NP2 V1 C2 NP4 past V2
039:   wh-NPo past NP4 V2 C2 NP2 past V1
040: * wh-NPo past NP4 V1 C2 NP2 past V2
```

Subject extraction from an adjunct clause:

```
041:   wh-NPs pres V2 NP6 C2 NP3 pres V1
042: * wh-NPs pres NP1 V1 C2 pres V2 NP8
043:   wh-NPs pres V2 NP8 C2 NP1 pres V1
044: * wh-NPs pres NP3 V1 C2 pres V2 NP6
045:   wh-NPs past V2 NP5 C2 NP4 past V1
046: * wh-NPs past NP2 V1 C2 past V2 NP7
047:   wh-NPs past V2 NP7 C2 NP2 past V1
048: * wh-NPs past NP4 V1 C2 past V2 NP5
```

Adjunct extraction from an adjunct clause:

```
049: Q:  wh-adv pres NP1 V1 C2 NP3 pres V1
     A:  NP1 adv1 pres V1 C2 NP3 pres V1

050: Q:* wh-adv pres NP1 V1 C2 NP3 pres V1
     A:  NP1 pres V1 C2 NP3 adv pres V1

051: Q:  wh-adv past NP3 V1 C2 NP1 past V1
     A:  NP3 past adv1 V1 C2 NP1 past V1

052: Q:* wh-adv past NP3 V1 C2 NP1 past V1
     A:  NP3 past V1 C2 NP1 past adv1 V1

053: Q:  wh-adv pres NP1 V1 C2 NP3 V2 NP7
     A:  NP1 pres adv1 V1 C2 NP3 V2 NP2

054: Q:* wh-adv pres NP1 V1 C2 NP3 V2 NP7
     A:  NP1 pres V1 C2 NP3 adv1 V2 NP2
```

055: Q: wh-adv past NP3 V1 C2 NP1 V2 NP5
A: NP3 past adv1 V1 C2 NP1 V2 NP4

056: Q:* wh-adv past NP3 V1 C2 NP1 V2 NP5
A: NP3 past V1 C2 NP1 adv1 V2 NP4

057: Q: wh-adv pres NP1 V2 NP5 C2 NP3 pres V1
A: NP1 pres adv1 V2 NP5 C2 NP3 pres V1

058: Q:* wh-adv pres NP1 V2 NP5 C2 NP3 pres V1
A: NP1 pres V2 NP5 C2 NP3 pres adv1 V1

059: Q: wh-adv past NP3 V2 NP7 C2 NP1 past V1
A: NP3 past adv1 V2 NP7 C2 NP1 past V1

060: Q:* wh-adv past NP3 V2 NP7 C2 NP1 past V1
A: NP3 past V2 NP7 C2 NP1 past adv1 V1

061: Q: wh-adv pres NP1 V2 NP5 C2 NP3 pres V2 NP7
A: NP1 pres adv1 V2 NP5 C2 NP3 pres V2 NP7

062: Q:* wh-adv pres NP1 V2 NP5 C2 NP3 pres V2 NP7
A: NP1 pres V2 NP5 C2 NP3 pres adv1 V2 NP7

063: Q: wh-adv past NP3 V2 NP7 C2 NP1 past V2 NP5
A: NP3 past adv1 V2 NP7 C2 NP1 past V2 NP5

064: Q:* wh-adv past NP3 V2 NP7 C2 NP1 past V2 NP5
A: NP3 past V2 NP7 C2 NP1 past adv1 V2 NP5

Sentence matching task

Grammatical test sentences for modal / tense marking and null subject involve 9 syllables / words, and ungrammatical test sentences for modal / tense marking and null subject involve 8 syllables / words. All other test sentences involve 9 syllables / words.

matched items

tense/modal:

001: NP1 pres V1 C2 NP2 pres adv1 V2 NP5
NP1 pres V1 C2 NP2 pres adv1 V2 NP5

002: * NP1 V1 C2 NP2 pres adv1 V2 NP5
* NP1 V1 C2 NP2 pres adv1 V2 NP5

003: NP1 pres V2 NP5 C2 NP2 pres adv1 V1
NP1 pres V2 NP5 C2 NP2 pres adv1 V1

```
004: * NP1 V2 NP5 C2 NP2 pres adv1 V1
     * NP1 V2 NP5 C2 NP2 pres adv1 V1

005:   NP1 pres V3 C1 NP2 pres adv1 V2 NP5
       NP1 pres V3 C1 NP2 pres adv1 V2 NP5

006: * NP1 V3 C1 NP2 pres adv1 V2 NP5
     * NP1 V3 C1 NP2 pres adv1 V2 NP5
```

modal-VP order:

```
007:   NP2 pres V1 C2 NP3 pres adv1 V2 NP5
       NP2 pres V1 C2 NP3 pres adv1 V2 NP5

008: * NP2 V1 pres C2 NP3 pres adv1 V2 NP5
     * NP2 V1 pres C2 NP3 pres adv1 V2 NP5

009:   NP2 pres V2 NP5 C2 NP3 pres adv1 V1
       NP2 pres V2 NP5 C2 NP3 pres adv1 V1

010: * NP2 V2 NP5 pres C2 NP3 pres adv1 V1
     * NP2 V2 NP5 pres C2 NP3 pres adv1 V1

011:   NP2 pres V3 C1 NP3 pres adv1 V2 NP5
       NP2 pres V3 C1 NP3 pres adv1 V2 NP5

012: * NP2 V3 C1 NP3 pres adv1 V2 NP5 pres
     * NP2 V3 C1 NP3 pres adv1 V2 NP5 pres
```

V-complement NP order:

```
013:   NP4 past V2 NP5 C2 NP3 past adv2 V1
       NP4 past V2 NP5 C2 NP3 past adv2 V1

014:   NP4 past V2 NP6 C2 NP3 past adv2 V1
       NP4 past V2 NP6 C2 NP3 past adv2 V1

015:   NP4 past V2 NP7 C2 NP3 past adv2 V1
       NP4 past V2 NP7 C2 NP3 past adv2 V1

016: * NP4 past NP5 V2 C2 NP3 past adv2 V1
     * NP4 past NP5 V2 C2 NP3 past adv2 V1

017: * NP4 past NP6 V2 C2 NP3 past adv2 V1
     * NP4 past NP6 V2 C2 NP3 past adv2 V1

018: * NP4 past NP7 V2 C2 NP3 past adv2 V1
     * NP4 past NP7 V2 C2 NP3 past adv2 V1
```

matrix clause-complement clause order:

```
019:   NP3 past V3 C1 NP2 past adv2 V2 NP5
       NP3 past V3 C1 NP2 past adv2 V2 NP5
```

```
020:    NP3 past V3 C1 NP2 past adv2 V2 NP6
        NP3 past V3 C1 NP2 past adv2 V2 NP6

021:    NP3 past V3 C1 NP2 past adv2 V2 NP7
        NP3 past V3 C1 NP2 past adv2 V2 NP7

022:  * C1 NP2 past adv2 V2 NP5 NP3 past V3
      * C1 NP2 past adv2 V2 NP5 NP3 past V3

023:  * C1 NP2 past adv2 V2 NP6 NP3 past V3
      * C1 NP2 past adv2 V2 NP6 NP3 past V3

024:  * C1 NP2 past adv2 V2 NP7 NP3 past V3
      * C1 NP2 past adv2 V2 NP7 NP3 past V3
```

unmatched items

tense/modal:

```
025:    NP3 past V1 C2 NP4 past adv2 V2 NP5
        NP3 past V1 C2 NP1 past adv2 V2 NP6

026:  * NP3 V1 C2 NP4 past adv2 V2 NP5
      * NP3 V1 C2 NP1 past adv2 V2 NP6

027:    NP3 past V2 NP5 C2 NP4 past adv2 V1
        NP3 past V2 NP6 C2 NP1 past adv2 V1

028:  * NP3 V2 NP5 C2 NP4 past adv2 V1
      * NP3 V2 NP6 C2 NP1 past adv2 V1

029:    NP3 past V3 C1 NP4 past adv2 V2 NP5
        NP3 past V3 C1 NP1 past adv2 V2 NP6

030:  * NP3 V3 C1 NP4 past adv2 V2 NP5
      * NP3 V3 C1 NP1 past adv2 V2 NP6
```

modal-VP order:

```
031:    NP4 past V1 C2 NP1 past adv2 V2 NP5
        NP4 past V1 C2 NP2 past adv2 V2 NP6

032:  * NP4 V1 past C2 NP1 past adv2 V2 NP5
      * NP4 V1 past C2 NP2 past adv2 V2 NP6

033:    NP4 past V2 NP5 C2 NP1 past adv2 V1
        NP4 past V2 NP6 C2 NP2 past adv2 V1

034:  * NP4 V2 NP5 past C2 NP1 past adv2 V1
      * NP4 V2 NP6 past C2 NP2 past adv2 V1

035:    NP4 past V3 C1 NP1 past adv2 V2 NP5
        NP4 past V3 C1 NP2 past adv2 V2 NP6
```

```
036: * NP4 V3 C1 NP1 past adv2 V2 NP5 past
     * NP4 V3 C1 NP2 past adv2 V2 NP6 past
```

V-complement order:

```
037:   NP2 pres V2 NP5 C2 NP1 pres adv1 V1
       NP2 pres V2 NP6 C2 NP1 pres adv1 V1

038:   NP2 pres V2 NP7 C2 NP1 pres adv1 V1
       NP2 pres V2 NP8 C2 NP1 pres adv1 V1

039:   NP4 past V2 NP8 C2 NP3 past adv2 V1
       NP4 past V2 NP8 C2 NP3 past adv1 V1 *

040: * NP2 pres NP5 V2 C2 NP1 pres adv1 V1
     * NP2 pres NP6 V2 C2 NP1 pres adv1 V1

041: * NP2 pres NP7 V2 C2 NP1 pres adv1 V1
     * NP2 pres NP8 V2 C2 NP1 pres adv1 V1

042: * NP4 past NP8 V2 C2 NP3 past adv2 V1
     * NP4 past NP8 V2 C2 NP3 past adv2 V1 *
```

matrix clause-complement clause order:

```
043:   NP1 pres V3 C1 NP4 pres adv1 V2 NP5
       NP1 pres V3 C1 NP4 pres adv1 V2 NP6

044:   NP1 pres V3 C1 NP4 pres adv1 V2 NP7
       NP1 pres V3 C1 NP4 pres adv1 V2 NP8

045:   NP3 past V3 C1 NP2 past adv2 V2 NP8
       NP3 past V3 C1 NP2 past adv1 V2 NP8 *

046: * C1 NP4 pres adv1 V2 NP5 NP1 pres V3
     * C1 NP4 pres adv1 V2 NP6 NP1 pres V3

047: * C1 NP4 pres adv1 V2 NP7 NP1 pres V3
     * C1 NP4 pres adv1 V2 NP8 NP1 pres V3

048: * C1 NP2 past adv2 V2 NP8 NP3 past V3
     * C1 NP2 past adv1 V2 NP8 NP3 past V3 *
```

Appendix G: Language B training sentences

Step 6: Training set for wh-extraction of an object from an adjunct CP

001: wh-NPo pres NP1 V1 C2 NP2 pres V2
002: wh-NPo pres NP2 V1 C2 NP1 pres V2
003: wh-NPo pres NP1 V1 C2 NP2 pres adv1 V2
004: wh-NPo pres NP2 V1 C2 NP1 pres adv1 V2
005: wh-NPo pres NP1 V1 C2 NP2 pres neg V2
006: wh-NPo pres NP2 V1 C2 NP1 pres neg V2
007: wh-NPo pres NP1 V1 C2 NP2 pres neg adv1 V2
008: wh-NPo pres NP2 V1 C2 NP1 pres neg adv1 V2

009: wh-NPo past NP1 V1 C2 NP2 past V2
010: wh-NPo past NP2 V1 C2 NP1 past V2
011: wh-NPo past NP1 V1 C2 NP2 past adv1 V2
012: wh-NPo past NP2 V1 C2 NP1 past adv1 V2
013: wh-NPo past NP1 V1 C2 NP2 past neg V2
014: wh-NPo past NP2 V1 C2 NP1 past neg V2
015: wh-NPo past NP1 V1 C2 NP2 past neg adv1 V2
016: wh-NPo past NP2 V1 C2 NP1 past neg adv1 V2

017: wh-NPo pres NP1 V1 C2 NP2 pres adv2 V2
018: wh-NPo pres NP2 V1 C2 NP1 pres adv2 V2
019: wh-NPo pres NP1 V1 C2 NP2 pres neg adv2 V2
020: wh-NPo pres NP2 V1 C2 NP1 pres neg adv2 V2

021: wh-NPo past NP1 V1 C2 NP2 past adv2 V2
022: wh-NPo past NP2 V1 C2 NP1 past adv2 V2
023: wh-NPo past NP1 V1 C2 NP2 past neg adv2 V2
024: wh-NPo past NP2 V1 C2 NP1 past neg adv2 V2

025: wh-NPo pres NP3 V1 C2 NP4 pres V2
026: wh-NPo pres NP4 V1 C2 NP3 pres V2
027: wh-NPo pres NP3 V1 C2 NP4 pres adv1 V2
028: wh-NPo pres NP4 V1 C2 NP3 pres adv1 V2
029: wh-NPo pres NP3 V1 C2 NP4 pres neg V2
030: wh-NPo pres NP4 V1 C2 NP3 pres neg V2
031: wh-NPo pres NP3 V1 C2 NP4 pres neg adv1 V2
032: wh-NPo pres NP4 V1 C2 NP3 pres neg adv1 V2

033: wh-NPo past NP3 V1 C2 NP4 past V2
034: wh-NPo past NP4 V1 C2 NP3 past V2
035: wh-NPo past NP3 V1 C2 NP4 past adv1 V2
036: wh-NPo past NP4 V1 C2 NP3 past adv1 V2
037: wh-NPo past NP3 V1 C2 NP4 past neg V2
038: wh-NPo past NP4 V1 C2 NP3 past neg V2
039: wh-NPo past NP3 V1 C2 NP4 past neg adv1 V2
040: wh-NPo past NP4 V1 C2 NP3 past neg adv1 V2

```
041: wh-NPo pres NP3 V1 C2 NP4 pres adv2 V2
042: wh-NPo pres NP4 V1 C2 NP3 pres adv2 V2
043: wh-NPo pres NP3 V1 C2 NP4 pres neg adv2 V2
044: wh-NPo pres NP4 V1 C2 NP3 pres neg adv2 V2

045: wh-NPo past NP3 V1 C2 NP4 past adv2 V2
046: wh-NPo past NP4 V1 C2 NP3 past adv2 V2
047: wh-NPo past NP3 V1 C2 NP4 past neg adv2 V2
048: wh-NPo past NP4 V1 C2 NP3 past neg adv2 V2
```

Exercise

Vocabulary

NP1, NP2, NP3, NP4
pres, past
neg
adv1, adv2
V1, V2
C2
wh-NPs, wh-NPo

Grammaticality judgement

modal / tense:
049:   wh-NPo pres NP1 V1 C2 NP3 V2
050: * wh-NPo NP1 adv1 V1 C2 NP3 V2
051:   wh-NPo pres NP3 V1 C2 NP1 V2
052: * wh-NPo NP3 adv1 V1 C2 NP1 V2

053:   wh-NPo pres NP2 V1 C2 NP4 V2
054: * wh-NPo NP2 adv1 V1 C2 NP4 V2
055:   wh-NPo pres NP4 V1 C2 NP2 V2
056: * wh-NPo NP4 adv1 V1 C2 NP2 V2

057:   wh-NPo past NP1 V1 C2 NP3 V2
058: * wh-NPo NP1 adv2 V1 C2 NP3 V2
059:   wh-NPo past NP2 V1 C2 NP1 V2
060: * wh-NPo NP2 adv2 V1 C2 NP1 V2

061:   wh-NPo past NP2 V1 C2 NP4 V2
062: * wh-NPo NP2 adv2 V1 C2 NP4 V2
063:   wh-NPo past NP4 V1 C2 NP2 V2
064: * wh-NPo NP4 adv2 V1 C2 NP2 V2

null subject:
065:   wh-NPo pres NP1 V1 C2 NP3 pres V2
066: * wh-NPo pres adv1 V1 C2 NP3 pres V2
067:   wh-NPo pres NP3 V1 C2 NP1 pres V2
068: * wh-NPo pres adv1 V1 C2 NP1 pres V2
069:   wh-NPo pres NP2 V1 C2 NP4 pres V2
070: * wh-NPo pres adv1 V1 C2 NP4 pres V2
071:   wh-NPo pres NP4 V1 C2 NP2 pres V2
072: * wh-NPo pres adv1 V1 C2 NP2 pres V2

073:   wh-NPo past NP1 V1 C2 NP3 past V2
074: * wh-NPo past adv2 V1 C2 NP3 past V2
075:   wh-NPo past NP3 V1 C2 NP1 past V2
076: * wh-NPo past adv2 V1 C2 NP1 past V2

077:   wh-NPo past NP2 V1 C2 NP4 past V2
078: * wh-NPo past adv2 V1 C2 NP4 past V2
079:   wh-NPo past NP4 V1 C2 NP2 past V2
080: * wh-NPo past adv2 V1 C2 NP2 past V2

```
modal-negation placement:
081:   wh-NPo pres NP1 neg V1 C2 NP3 pres V2
082: * wh-NPo neg  NP1 pres V1 C2 NP3 pres V2
083:   wh-NPo pres NP3 neg V1 C2 NP1 pres V2
084: * wh-NPo neg  NP3 pres V1 C2 NP1 pres V2

085:   wh-NPo pres NP2 neg V1 C2 NP4 pres V2
086: * wh-NPo neg  NP2 pres V1 C2 NP4 pres V2
087:   wh-NPo pres NP4 neg V1 C2 NP2 pres V2
088: * wh-NPo neg  NP4 pres V1 C2 NP2 pres V2

089:   wh-NPo past NP1 neg V1 C2 NP3 past V2
090: * wh-NPo neg NP1 past V1 C2 NP3 past V2
091:   wh-NPo past NP3 neg V1 C2 NP1 past V2
092: * wh-NPo neg NP3 past V1 C2 NP1 past V2

093:   wh-NPo past NP2 neg V1 C2 NP4 past V2
094: * wh-NPo neg NP2 past V1 C2 NP4 past V2
095:   wh-NPo past NP4 neg V1 C2 NP2 past V2
096: * wh-NPo neg NP4 past V1 C2 NP2 past V2

modal-V placement:
097:   wh-NPo pres NP1 V1 C2 NP3 pres V2
098: * wh-NPo V1 NP1 pres C2 NP3 pres V2
099:   wh-NPo pres NP3 V1 C2 NP1 pres V2
100: * wh-NPo V1 NP3 pres C2 NP1 pres V2

101:   wh-NPo pres NP2 V1 C2 NP4 pres V2
102: * wh-NPo V1 NP2 pres C2 NP4 pres V2
103:   wh-NPo pres NP4 V1 C2 NP2 pres V2
104: * wh-NPo V1 NP4 pres C2 NP2 pres V2

105:   wh-NPo past NP1 V1 C2 NP3 past V2
106: * wh-NPo V1 NP1 past C2 NP3 past V2
107:   wh-NPo past NP3 V1 C2 NP1 past V2
108: * wh-NPo V1 NP3 past C2 NP1 past V2

109:   wh-NPo past NP2 V1 C2 NP4 past V2
110: * wh-NPo V1 NP2 past C2 NP4 past V2
111:   wh-NPo past NP4 V1 C2 NP2 past V2
112: * wh-NPo V1 NP4 past C2 NP2 past V2

V-complement placement:
   no examples

adv-V placement:
113:   wh-NPo pres NP1 adv1 V1 C2 NP3 pres V2
114: * wh-NPo pres NP1 V1 adv1 C2 NP3 pres V2
115:   wh-NPo pres NP3 adv1 V1 C2 NP1 pres V2
116: * wh-NPo pres NP3 V1 adv1 C2 NP1 pres V2
```

```
117:   wh-NPo pres NP2 adv1 V1 C2 NP4 pres V2
118: * wh-NPo pres NP2 V1 adv1 C2 NP4 pres V2
119:   wh-NPo pres NP4 adv1 V1 C2 NP2 pres V2
120: * wh-NPo pres NP4 V1 adv1 C2 NP2 pres V2

121:   wh-NPo past NP1 adv2 V1 C2 NP3 past V2
122: * wh-NPo past NP1 V1 adv2 C2 NP3 past V2
123:   wh-NPo past NP3 adv2 V1 C2 NP1 past V2
124: * wh-NPo past NP3 V1 adv2 C2 NP1 past V2

125:   wh-NPo past NP2 adv2 V1 C2 NP4 past V2
126: * wh-NPo past NP2 V1 adv2 C2 NP4 past V2
127:   wh-NPo past NP4 adv2 V1 C2 NP2 past V2
128: * wh-NPo past NP4 V1 adv2 C2 NP2 past V2

modal-adv placement:
129:   wh-NPo pres NP1 adv1 V1 C2 NP3 pres V2
130: * wh-NPo adv1 NP1 pres V1 C2 NP3 pres V2
131:   wh-NPo pres NP3 adv1 V1 C2 NP1 pres V2
132: * wh-NPo adv1 NP3 pres V1 C2 NP1 pres V2

133:   wh-NPo pres NP2 adv1 V1 C2 NP4 pres V2
134: * wh-NPo adv1 NP2 pres V1 C2 NP4 pres V2
135:   wh-NPo pres NP4 adv1 V1 C2 NP2 pres V2
136: * wh-NPo adv1 NP4 pres V1 C2 NP2 pres V2

137:   wh-NPo past NP1 adv2 V1 C2 NP3 past V2
138: * wh-NPo adv2 NP1 past V1 C2 NP3 past V2
139:   wh-NPo past NP3 adv2 V1 C2 NP1 past V2
140: * wh-NPo adv2 NP3 past V1 C2 NP1 past V2

141:   wh-NPo past NP2 adv2 V1 C2 NP4 past V2
142: * wh-NPo adv2 NP2 past V1 C2 NP4 past V2
143:   wh-NPo past NP4 adv2 V1 C2 NP2 past V2
144: * wh-NPo adv2 NP4 past V1 C2 NP2 past V2

adjunct CP - matrix placement:
145:   wh-NPo pres NP1 V1 C2 NP3 pres V2
146: * C2 NP3 pres V2 wh-NPo pres NP1 V1
147:   wh-NPo pres NP3 V1 C2 NP1 pres V2
148: * C2 NP1 pres V1 wh-NPo pres NP3 V1

149:   wh-NPo pres NP2 V1 C2 NP4 pres V2
150: * C2 NP4 pres V2 wh-NPo pres NP2 V1
151:   wh-NPo pres NP4 V1 C2 NP2 pres V2
152: * C2 NP3 pres V2 wh-NPo pres NP2 V1

153:   wh-NPo past NP1 V1 C2 NP3 past V2
154: * C2 NP3 past V2 wh-NPo past NP1 V1
155:   wh-NPo past NP3 V1 C2 NP1 past V2
156: * C2 NP1 past V2 wh-NPo past NP3 V1
```

```
157:   wh-NPo past NP2 V1 C2 NP4 past V2
158: * C2 NP4 past V2 wh-NPo past NP2 V1
159:   wh-NPo past NP4 V1 C2 NP2 past V2
160: * C2 NP2 past V2 wh-NPo past NP4 V1
```

complement CP - matrix inverse:
no examples

Step 7: Training set for wh-extraction of a subject from an adjunct CP

001: wh-NPs pres NP1 V1 C2 pres V1
002: wh-NPs pres NP2 V1 C2 pres V1
003: wh-NPs pres NP1 V1 C2 pres V2 NP6
004: wh-NPs pres NP2 V1 C2 pres V2 NP5
005: wh-NPs pres NP1 V1 C2 pres adv1 V1
006: wh-NPs pres NP2 V1 C2 pres adv1 V1
007: wh-NPs pres NP1 V1 C2 pres adv1 V2 NP6
008: wh-NPs pres NP2 V1 C2 pres adv1 V2 NP5
009: wh-NPs pres NP1 V1 C2 pres neg V1
010: wh-NPs pres NP2 V1 C2 pres neg V1
011: wh-NPs pres NP1 V1 C2 pres neg V2 NP6
012: wh-NPs pres NP2 V1 C2 pres neg V2 NP5
013: wh-NPs pres NP1 V1 C2 pres neg adv1 V1
014: wh-NPs pres NP2 V1 C2 pres neg adv1 V1
015: wh-NPs pres NP1 V1 C2 pres neg adv1 V2 NP6
016: wh-NPs pres NP2 V1 C2 pres neg adv1 V2 NP5
017: wh-NPs past NP1 V1 C2 past V1
018: wh-NPs past NP2 V1 C2 past V1
019: wh-NPs past NP1 V1 C2 past V2 NP6
020: wh-NPs past NP2 V1 C2 past V2 NP5
021: wh-NPs past NP1 V1 C2 adv1 V1
022: wh-NPs past NP2 V1 C2 adv1 V1
023: wh-NPs past NP1 V1 C2 adv1 V2 NP6
024: wh-NPs past NP2 V1 C2 adv1 V2 NP5
025: wh-NPs past NP1 V1 C2 past neg V1
026: wh-NPs past NP2 V1 C2 past neg V1
027: wh-NPs past NP1 V1 C2 past neg V2 NP6
028: wh-NPs past NP2 V1 C2 past neg V2 NP5
029: wh-NPs past NP1 V1 C2 past neg adv1 V1
030: wh-NPs past NP2 V1 C2 past neg adv1 V1
031: wh-NPs past NP1 V1 C2 past neg adv1 V2 NP6
032: wh-NPs past NP2 V1 C2 past neg adv1 V2 NP5

033: wh-NPs pres NP1 V1 C2 pres adv2 V1
034: wh-NPs pres NP2 V1 C2 pres adv2 V1
035: wh-NPs pres NP1 V1 C2 pres adv2 V2 NP6
036: wh-NPs pres NP2 V1 C2 pres adv2 V2 NP5
037: wh-NPs pres NP1 V1 C2 pres neg adv2 V1
038: wh-NPs pres NP2 V1 C2 pres neg adv2 V1
039: wh-NPs pres NP1 V1 C2 pres neg adv2 V2 NP6
040: wh-NPs pres NP2 V1 C2 pres neg adv2 V2 NP5

041: wh-NPs past NP1 V1 C2 past adv2 V1
042: wh-NPs past NP2 V1 C2 past adv2 V1
043: wh-NPs past NP1 V1 C2 past adv2 V2 NP6
044: wh-NPs past NP2 V1 C2 past adv2 V2 NP5
045: wh-NPs past NP1 V1 C2 past neg adv2 V1
046: wh-NPs past NP2 V1 C2 past neg adv2 V1
047: wh-NPs past NP1 V1 C2 past neg adv2 V2 NP6
048: wh-NPs past NP2 V1 C2 past neg adv2 V2 NP5

049: wh-NPs pres NP3 V1 C2 pres V1
050: wh-NPs pres NP4 V1 C2 pres V1
051: wh-NPs pres NP3 V1 C2 pres V2 NP8
052: wh-NPs pres NP4 V1 C2 pres V2 NP7
053: wh-NPs pres NP3 V1 C2 pres adv1 V1
054: wh-NPs pres NP4 V1 C2 pres adv1 V1
055: wh-NPs pres NP3 V1 C2 pres adv1 V2 NP8
056: wh-NPs pres NP4 V1 C2 pres adv1 V2 NP7
057: wh-NPs pres NP3 V1 C2 pres neg V1
058: wh-NPs pres NP4 V1 C2 pres neg V1
059: wh-NPs pres NP3 V1 C2 pres neg V2 NP8
060: wh-NPs pres NP4 V1 C2 pres neg V2 NP7
061: wh-NPs pres NP3 V1 C2 pres neg adv1 V1
062: wh-NPs pres NP4 V1 C2 pres neg adv1 V1
063: wh-NPs pres NP3 V1 C2 pres neg adv1 V2 NP8
064: wh-NPs pres NP4 V1 C2 pres neg adv1 V2 NP7

065: wh-NPs past NP3 V1 C2 past V1
066: wh-NPs past NP4 V1 C2 past V1
067: wh-NPs past NP3 V1 C2 past V2 NP8
068: wh-NPs past NP4 V1 C2 past V2 NP7
069: wh-NPs past NP3 V1 C2 past adv1 V1
070: wh-NPs past NP4 V1 C2 past adv1 V1
071: wh-NPs past NP3 V1 C2 past adv1 V2 NP8
072: wh-NPs past NP4 V1 C2 past adv1 V2 NP7
073: wh-NPs past NP3 V1 C2 past neg V1
074: wh-NPs past NP4 V1 C2 past neg V1
075: wh-NPs past NP3 V1 C2 past neg V2 NP8
076: wh-NPs past NP4 V1 C2 past neg V2 NP7
077: wh-NPs past NP3 V1 C2 past neg adv1 V1
078: wh-NPs past NP4 V1 C2 past neg adv1 V1
079: wh-NPs past NP3 V1 C2 past neg adv1 V2 NP8
080: wh-NPs past NP4 V1 C2 past neg adv1 V2 NP7

081: wh-NPs pres NP3 V1 C2 pres adv2 V1
082: wh-NPs pres NP4 V1 C2 pres adv2 V1
083: wh-NPs pres NP3 V1 C2 pres adv2 V2 NP8
084: wh-NPs pres NP4 V1 C2 pres adv2 V2 NP7
085: wh-NPs pres NP3 V1 C2 pres neg adv2 V1
086: wh-NPs pres NP4 V1 C2 pres neg adv2 V1
087: wh-NPs pres NP3 V1 C2 pres neg adv2 V2 NP8
088: wh-NPs pres NP4 V1 C2 pres neg adv2 V2 NP7

089: wh-NPs past NP3 V1 C2 past adv2 V1
090: wh-NPs past NP4 V1 C2 past adv2 V1
091: wh-NPs past NP3 V1 C2 past adv2 V2 NP8
092: wh-NPs past NP4 V1 C2 past adv2 V2 NP7
093: wh-NPs past NP3 V1 C2 past neg adv2 V1
094: wh-NPs past NP4 V1 C2 past neg adv2 V1
095: wh-NPs past NP3 V1 C2 past neg adv2 V2 NP8
096: wh-NPs past NP4 V1 C2 past neg adv2 V2 NP7

Excercise

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
adv1, adv2
V1, V2
C2
wh-NPs, wh-NPo

Grammaticality judgement

modal / tense:
097: wh-NPs pres NP1 V1 C2 pres V2 NP8
098: * wh-NPs NP1 adv1 V1 C2 pres V2 NP8
099: wh-NPs pres NP2 V1 C2 pres V2 NP7
100: * wh-NPs NP2 adv1 V1 C2 pres V2 NP7

101: wh-NPs pres NP3 V1 C2 pres V2 NP6
102: * wh-NPs NP3 adv1 V1 C2 pres V2 NP6
103: wh-NPs pres NP4 V1 C2 pres V2 NP5
104: * wh-NPs adv1 NP4 V1 C2 pres V2 NP5

105: wh-NPs past NP1 V1 C2 past V2 NP8
106: * wh-NPs NP1 adv2 V1 C2 past V2 NP8
107: wh-NPs past NP2 V1 C2 past V2 NP7
108: * wh-NPs NP2 adv2 V1 C2 past V2 NP7

109: wh-NPs past NP3 V1 C2 past V2 NP6
110: * wh-NPs NP3 adv2 V1 C2 past V2 NP6
111: wh-NPs past NP4 V1 C2 past V2 NP5
112: * wh-NPs NP4 adv2 V1 C2 past V2 NP5

null subject:
The null subject can be interpreted as in the embedded clause rather than the matrix clause.
113: wh-NPs pres NP1 V1 C2 pres V2 NP8
114: * wh-NPs pres adv1 V1 C2 pres V2 NP8
115: wh-NPs pres NP2 V1 C2 pres V2 NP7
116: * wh-NPs pres adv1 V1 C2 pres V2 NP7

117: wh-NPs pres NP3 V1 C2 pres V2 NP6
118: * wh-NPs pres adv1 V1 C2 pres V2 NP6
119: wh-NPs pres NP4 V1 C2 pres V2 NP5
120: * wh-NPs pres adv1 V1 C2 pres V2 NP5

121: wh-NPs past NP1 V1 C2 past V2 NP8
122: * wh-NPs past adv2 V1 C2 past V2 NP8
123: wh-NPs past NP2 V1 C2 past V2 NP7
124: * wh-NPs past adv2 V1 C2 past V2 NP7

```
125:   wh-NPs past NP3 V1 C2 past V2 NP6
126: * wh-NPs past adv2 V1 C2 past V2 NP6
127:   wh-NPs past NP4 V1 C2 past V2 NP5
128: * wh-NPs past adv2 V1 C2 past V2 NP5
```

modal-negation placement:

```
129:   wh-NPs pres NP1 neg V1 C2 pres V2 NP8
130: * wh-NPs neg NP1 pres V1 C2 pres V2 NP8
131:   wh-NPs pres NP2 neg V1 C2 pres V2 NP7
132: * wh-NPs neg NP2 pres V1 C2 pres V2 NP7

133:   wh-NPs pres NP3 neg V1 C2 pres V2 NP6
134: * wh-NPs neg NP3 pres V1 C2 pres V2 NP6
135:   wh-NPs pres NP4 neg V1 C2 pres V2 NP5
136: * wh-NPs neg NP4 pres V1 C2 pres V2 NP5

137:   wh-NPs past NP1 neg V1 C2 past V2 NP8
138: * wh-NPs neg NP1 past V1 C2 past V2 NP8
139:   wh-NPs past NP2 neg V1 C2 past V2 NP7
140: * wh-NPs neg NP1 past V1 C2 past V2 NP7

141:   wh-NPs past NP3 neg V1 C2 past V2 NP6
142: * wh-NPs neg NP3 past V1 C2 past V2 NP6
143:   wh-NPs past NP4 neg V1 C2 past V2 NP5
144: * wh-NPs neg NP3 past V1 C2 past V2 NP5
```

modal-V placement:

```
145:   wh-NPs pres NP1 V1 C2 pres V2 NP8
146: * wh-NPs V1 NP1 pres C2 pres V2 NP8
147:   wh-NPs pres NP2 V1 C2 pres V2 NP7
148: * wh-NPs V1 NP2 pres C2 pres V2 NP7

149:   wh-NPs pres NP3 V1 C2 pres V2 NP6
150: * wh-NPs V1 NP3 pres C2 pres V2 NP6
151:   wh-NPs pres NP4 V1 C2 pres V2 NP5
152: * wh-NPs V1 NP4 pres C2 pres V2 NP5

153:   wh-NPs past NP1 V1 C2 past V2 NP8
154: * wh-NPs V1 NP1 past C2 past V2 NP8
155:   wh-NPs past NP2 V1 C2 past V2 NP7
156: * wh-NPs V1 NP2 past C2 past V2 NP7

157:   wh-NPs past NP3 V1 C2 past V2 NP6
158: * wh-NPs V1 NP3 past C2 past V2 NP6
159:   wh-NPs past NP4 V1 C2 past V2 NP5
160: * wh-NPs V1 NP4 past C2 past V2 NP5
```

V-complement placement:
Since the tested structures are realized in the matrix clause, this set also has the V-complement order variation in the matrix, with a transitive verb. The embedded clause contrains an intransitive verb, which is different from all the other examples in the Exercises for Step 6 and Step 7.

```
161:   wh-NPs pres NP1 V2 NP7 C2 pres V1
162: * wh-NPs pres NP1 NP7 V2 C2 pres V1
163:   wh-NPs pres NP2 V2 NP8 C2 pres V1
164: * wh-NPs pres NP2 NP8 V2 C2 pres V1

165:   wh-NPs pres NP3 V2 NP5 C2 pres V1
166: * wh-NPs pres NP3 NP5 V2 C2 pres V1
167:   wh-NPs pres NP4 V2 NP6 C2 pres V1
168: * wh-NPs pres NP4 NP6 V2 C2 pres V1

169:   wh-NPs past NP1 V2 NP7 C2 past V1
170: * wh-NPs past NP1 NP7 V2 C2 past V1
171:   wh-NPs past NP2 V2 NP8 C2 past V1
172: * wh-NPs past NP2 NP8 V2 C2 past V1

173:   wh-NPs past NP3 V2 NP5 C2 past V1
174: * wh-NPs past NP3 NP5 V2 C2 past V1
175:   wh-NPs past NP4 V2 NP6 C2 past V1
176: * wh-NPs past NP4 NP6 V2 C2 past V1

adv-V placement:
177:   wh-NPs pres NP1 adv1 V1 C2 pres V2 NP8
178: * wh-NPs pres NP1 V1 adv1 C2 pres V2 NP8
179:   wh-NPs pres NP2 adv1 V1 C2 pres V2 NP7
180: * wh-NPs pres NP2 V1 adv1 C2 pres V2 NP7

181:   wh-NPs pres NP3 adv1 V1 C2 pres V2 NP6
182: * wh-NPs pres NP3 V1 adv1 C2 pres V2 NP6
183:   wh-NPs pres NP4 adv1 V1 C2 pres V2 NP5
184: * wh-NPs pres NP4 V1 adv1 C2 pres V2 NP5

185:   wh-NPs past NP1 adv2 V1 C2 past V2 NP8
186: * wh-NPs past NP1 V1 adv2 C2 past V2 NP8
187:   wh-NPs past NP2 adv2 V1 C2 past V2 NP7
188: * wh-NPs past NP2 V1 adv2 C2 past V2 NP7

189:   wh-NPs past NP3 adv2 V1 C2 past V2 NP6
190: * wh-NPs past NP3 V1 adv2 C2 past V2 NP6
191:   wh-NPs past NP4 adv2 V1 C2 past V2 NP5
192: * wh-NPs past NP4 V1 adv2 C2 past V2 NP5

modal-adv placement:
193:   wh-NPs pres NP1 adv1 V1 C2 pres V2 NP8
194: * wh-NPs adv1 NP1 pres V1 C2 pres V2 NP8
195:   wh-NPs pres NP2 adv1 V1 C2 pres V2 NP7
196: * wh-NPs adv1 NP2 pres V1 C2 pres V2 NP7

197:   wh-NPs pres NP3 adv1 V1 C2 pres V2 NP6
198: * wh-NPs adv2 NP3 past V1 C2 pres V2 NP6
199:   wh-NPs past NP4 adv2 V1 C2 pres V2 NP5
200: * wh-NPs adv2 NP4 past V1 C2 pres V2 NP5
```

```
201:   wh-NPs past NP1 adv2 V1 C2 past V2 NP8
202: * wh-NPs adv2 NP1 past V1 C2 past V2 NP8
203:   wh-NPs past NP2 adv2 V1 C2 past V2 NP7
204: * wh-NPs adv2 NP2 past V1 C2 past V2 NP7

205:   wh-NPs past NP3 adv2 V1 C2 past V2 NP6
206: * wh-NPs adv2 NP3 past V1 C2 past V2 NP6
207:   wh-NPs past NP4 adv2 V1 C2 past V2 NP5
208: * wh-NPs adv2 NP4 past V1 C2 past V2 NP5

adjunct CP - matrix placement:
209:   wh-NPs pres NP1 V1 C2 pres V2 NP8
210: * C2 pres V2 NP8 wh-NPs pres NP1 V1
211:   wh-NPs pres NP2 V1 C2 pres V2 NP7
212: * C2 pres V2 NP7 wh-NPs pres NP2 V1

213:   wh-NPs pres NP3 V1 C2 pres V2 NP6
214: * C2 pres V2 NP6 wh-NPs pres NP3 V1
215:   wh-NPs pres NP4 V1 C2 pres V2 NP5
216: * C2 pres V2 NP5 wh-NPs pres NP4 V1

217:   wh-NPs past NP1 V1 C2 past V2 NP8
218: * C2 past V2 NP8 wh-NPs past NP1 V1
219:   wh-NPs past NP2 V1 C2 past V2 NP7
220: * C2 past V2 NP7 wh-NPs past NP2 V1

221:   wh-NPs past NP3 V1 C2 past V2 NP6
222: * C2 past V2 NP6 wh-NPs past NP3 V1
223:   wh-NPs past NP4 V1 C2 past V2 NP5
224: * C2 past V2 NP5 wh-NPs past NP3 V1

complement CP - matrix inverse:
  no examples
```

Step 8: Training set for wh-extraction of an adverb from an adjunct CP

001: wh-adv pres NP1 V1 C2 NP2 pres V1
002: wh-adv pres NP2 V1 C2 NP1 pres V1
003: wh-adv pres NP1 V1 C2 NP2 pres V2 NP6
004: wh-adv pres NP2 V1 C2 NP1 pres V2 NP5
005: wh-adv pres NP1 V1 C2 NP2 pres neg V1
006: wh-adv pres NP2 V1 C2 NP1 pres neg V1
007: wh-adv pres NP1 V1 C2 NP2 pres neg V2 NP6
008: wh-adv pres NP2 V1 C2 NP1 pres neg V2 NP5
009: wh-adv past NP1 V1 C2 NP2 past V1
010: wh-adv past NP2 V1 C2 NP1 past V1
011: wh-adv past NP1 V1 C2 NP2 past V2 NP6
012: wh-adv past NP2 V1 C2 NP1 past V2 NP5
013: wh-adv past NP1 V1 C2 NP2 past neg V1
014: wh-adv past NP2 V1 C2 NP1 past neg V1
015: wh-adv past NP1 V1 C2 past NP2 neg V2 NP6
016: wh-adv past NP2 V1 C2 past NP1 neg V2 NP5
017: wh-adv pres NP3 V1 C2 NP4 pres V1
018: wh-adv pres NP4 V1 C2 NP3 pres V1
019: wh-adv pres NP3 V1 C2 NP4 pres V2 NP8
020: wh-adv pres NP4 V1 C2 NP3 pres V2 NP7
021: wh-adv pres NP3 V1 C2 NP4 pres neg V1
022: wh-adv pres NP4 V1 C2 NP3 pres neg V1
023: wh-adv pres NP3 V1 C2 NP4 pres neg V2 NP8
024: wh-adv pres NP4 V1 C2 NP3 pres neg V2 NP7

025: wh-adv past NP3 V1 C2 NP4 past V1
026: wh-adv past NP4 V1 C2 NP3 past V1
027: wh-adv past NP3 V1 C2 NP4 past V2 NP8
028: wh-adv past NP4 V1 C2 NP3 past V2 NP7
029: wh-adv past NP3 V1 C2 NP4 past neg V1
030: wh-adv past NP4 V1 C2 NP3 past neg V1
031: wh-adv past NP3 V1 C2 NP4 past neg V2 NP8
032: wh-adv past NP4 V1 C2 NP3 past neg V2 NP7

Exercise

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
adv1, adv2
V1, V2
C2
wh-adv

Grammaticality judgement

modal / tense:
In order to force the interpretation that the wh-adv is from the adjunct clause, the matrix clause has a separate adverb.

```
033:   wh-adv pres NP1 adv1 V1 C2 NP3 pres V1
034: * wh-adv NP1 neg adv1 V1 C2 NP3 pres V1
035:   wh-adv pres NP3 adv1 V1 C2 NP1 pres V1
036: * wh-adv NP3 neg adv1 V1 C2 NP1 pres V1

037:   wh-adv pres NP2 adv1 V1 C2 NP4 pres V1
038: * wh-adv NP2 neg adv1 V1 C2 NP4 pres V1
039:   wh-adv pres NP4 adv1 V1 C2 NP2 pres V1
040: * wh-adv NP4 neg adv1 V1 C2 NP2 pres V1

041:   wh-adv past NP1 adv2 V1 C2 NP3 past V1
042: * wh-adv NP1 neg adv2 V1 C2 NP3 past V1
043:   wh-adv past NP3 adv2 V1 C2 NP1 past V1
044: * wh-adv NP3 neg adv2 V1 C2 NP1 past V1

045:   wh-adv past NP2 adv2 V1 C2 NP4 past V1
046: * wh-adv NP2 neg adv2 V1 C2 NP4 past V1
047:   wh-adv past NP4 adv2 V1 C2 NP2 past V1
048: * wh-adv NP4 neg adv2 V1 C2 NP2 past V1
```

null subject:

```
049:   wh-adv pres NP1 adv1 V1 C2 NP3 pres V1
050: * wh-adv pres neg adv1 V1 C2 NP3 pres V1
051:   wh-adv pres NP3 adv1 V1 C2 NP1 pres V1
052: * wh-adv pres neg adv1 V1 C2 NP1 pres V1

053:   wh-adv pres NP2 adv1 V1 C2 NP4 pres V1
054: * wh-adv pres neg adv1 V1 C2 NP4 pres V1
055:   wh-adv pres NP4 adv1 V1 C2 NP2 pres V1
056: * wh-adv pres neg adv1 V1 C2 NP2 pres V1

057:   wh-adv past NP1 adv2 V1 C2 NP3 past V1
058: * wh-adv past neg adv2 V1 C2 NP3 past V1
059:   wh-adv past NP3 adv2 V1 C2 NP1 past V1
060: * wh-adv past neg adv2 V1 C2 NP1 past V1
```

```
061:   wh-adv past NP2 adv2 V1 C2 NP4 past V1
062: * wh-adv past neg adv2 V1 C2 NP4 past V1
063:   wh-adv past NP4 adv2 V1 C2 NP2 past V1
064: * wh-adv past neg adv2 V1 C2 NP2 past V1

modal-negation placement:
065:   wh-adv pres NP1 neg adv1 V1 C2 NP3 pres V1
066: * wh-adv neg NP1 pres adv1 V1 C2 NP3 pres V1
067:   wh-adv pres NP3 neg adv1 V1 C2 NP1 pres V1
068: * wh-adv neg NP3 pres adv1 V1 C2 NP1 pres V1

069:   wh-adv pres NP2 neg adv1 V1 C2 NP4 pres V1
070: * wh-adv neg NP2 pres adv1 V1 C2 NP4 pres V1
071:   wh-adv pres NP4 neg adv1 V1 C2 NP2 pres V1
072: * wh-adv neg NP4 pres adv1 V1 C2 NP2 pres V1

073:   wh-adv past NP1 neg adv2 V1 C2 NP3 past V1
074: * wh-adv neg NP1 past adv2 V1 C2 NP3 past V1
075:   wh-adv past NP3 neg adv2 V1 C2 NP1 past V1
076: * wh-adv neg NP3 past adv2 V1 C2 NP1 past V1

077:   wh-adv past NP2 neg adv2 V1 C2 NP4 past V1
078: * wh-adv neg NP2 past adv2 V1 C2 NP4 past V1
079:   wh-adv past NP4 neg adv2 V1 C2 NP2 past V1
080: * wh-adv neg NP4 past adv2 V1 C2 NP2 past V1

modal-V placement:
081:   wh-adv pres NP1 adv1 V1 C2 NP3 pres V1
082: * wh-adv V1 NP1 pres adv1 C2 NP3 pres V1
083:   wh-adv pres NP3 adv1 V1 C2 NP1 pres V1
084: * wh-adv V2 NP3 pres adv1 C2 NP1 pres V1

085:   wh-adv pres NP2 adv1 V1 C2 NP4 pres V1
086: * wh-adv V1 NP2 pres adv1 C2 NP4 pres V1
087:   wh-adv pres NP4 adv1 V1 C2 NP2 pres V1
088: * wh-adv V1 NP4 pres adv1 C2 NP2 pres V1

089:   wh-adv past NP1 adv2 V1 C2 NP3 past V1
090: * wh-adv V1 NP1 past adv2 C2 NP3 past V1
091:   wh-adv past NP3 adv2 V1 C2 NP1 past V1
092: * wh-adv V1 NP3 past adv2 C2 NP1 past V1

093:   wh-adv past NP2 adv2 V1 C2 NP4 past V1
094: * wh-adv V1 NP2 past adv2 C2 NP4 past V1
095:   wh-adv past NP4 adv2 V1 C2 NP2 past V1
096: * wh-adv V1 NP4 past adv2 C2 NP2 past V1

V-complement placement:
097:   wh-adv pres NP1 adv1 V2 NP7 C2 NP3 pres V1
098: * wh-adv pres NP1 adv1 NP7 V2 C2 NP3 pres V1
099:   wh-adv pres NP2 adv1 V2 NP8 C2 NP3 pres V1
100: * wh-adv pres NP2 adv1 NP8 V2 C2 NP3 pres V1
```

```
101:   wh-adv pres NP3 adv1 V2 NP5 C2 NP1 pres V1
102: * wh-adv pres NP3 adv1 NP5 V2 C2 NP1 pres V1
103:   wh-adv pres NP4 adv1 V2 NP6 C2 NP1 pres V1
104: * wh-adv pres NP4 adv1 NP6 V2 C2 NP1 pres V1

105:   wh-adv past NP1 adv2 V2 NP7 C2 NP3 past V1
106: * wh-adv past NP1 adv2 NP7 V2 C2 NP3 past V1
107:   wh-adv past NP2 adv2 V2 NP8 C2 NP3 past V1
108: * wh-adv past NP2 adv2 NP8 V2 C2 NP3 past V1

109:   wh-adv past NP3 adv2 V2 NP5 C2 NP1 past V1
110: * wh-adv past NP3 adv2 NP5 V2 C2 NP1 past V1
111:   wh-adv past NP4 adv2 V2 NP6 C2 NP1 past V1
112: * wh-adv past NP4 adv2 NP6 V2 C2 NP1 past V1

adv-V placement:
113:   wh-adv pres NP1 adv1 V1 C2 NP3 pres V1
114: * wh-adv pres NP1 V1 adv1 C2 NP3 pres V1
115:   wh-adv pres NP3 adv1 V1 C2 NP1 pres V1
116: * wh-adv pres NP3 V1 adv1 C2 NP1 pres V1

117:   wh-adv pres NP2 adv1 V1 C2 NP4 pres V1
118: * wh-adv pres NP2 V1 adv1 C2 NP4 pres V1
119:   wh-adv pres NP4 adv1 V1 C2 NP2 pres V1
120: * wh-adv pres NP4 V1 adv1 C2 NP2 pres V1

121:   wh-adv past NP1 adv2 V1 C2 NP3 past V1
122: * wh-adv past NP1 V1 adv2 C2 NP3 past V1
123:   wh-adv past NP3 adv2 V1 C2 NP1 past V1
124: * wh-adv past NP3 V1 adv2 C2 NP1 past V1

125:   wh-adv past NP2 adv2 V1 C2 NP4 past V1
126: * wh-adv past NP2 V1 adv2 C2 NP4 past V1
127:   wh-adv past NP4 adv2 V1 C2 NP2 past V1
128: * wh-adv past NP4 V1 adv2 C2 NP2 past V1

modal-adv placement:
129:   wh-adv pres NP1 adv1 V1 C2 NP3 pres V1
130: * wh-adv pres NP1 V1 adv1 C2 NP3 pres V1
131:   wh-adv pres NP3 adv1 V1 C2 NP1 pres V1
132: * wh-adv pres NP3 V1 adv1 C2 NP1 pres V1

133:   wh-adv pres NP2 adv1 V1 C2 NP4 pres V1
134: * wh-adv pres NP2 V1 adv1 C2 NP4 pres V1
135:   wh-adv pres NP4 adv1 V1 C2 NP2 pres V1
136: * wh-adv pres NP4 V1 adv1 C2 NP2 pres V1

137:   wh-adv past NP1 adv2 V1 C2 NP3 past V1
138: * wh-adv past NP1 V1 adv2 C2 NP3 past V1
139:   wh-adv past NP3 adv2 V1 C2 NP1 past V1
140: * wh-adv past NP3 V1 adv2 C2 NP1 past V1
```

```
141:   wh-adv past NP4 adv2 V1 C2 NP2 past V1
142: * wh-adv past NP4 V1 adv2 C2 NP2 past V1
143:   wh-adv past NP2 adv2 V1 C2 NP4 past V1
144: * wh-adv past NP2 V1 adv2 C2 NP4 past V1

adjunct CP - matrix placement:
145:   wh-adv pres NP1 adv1 V1 C2 NP3 pres V1
146: * C2 NP3 pres V1 wh-adv pres NP1 adv1 V1
147:   wh-adv pres NP3 adv1 V1 C2 NP1 pres V1
148: * C2 NP1 pres V1 wh-adv pres NP3 adv1 V1

149:   wh-adv pres NP2 adv1 V1 C2 NP4 pres V1
150: * C2 NP4 pres V1 wh-adv pres NP2 adv1 V1
151:   wh-adv pres NP4 adv1 V1 C2 NP2 pres V1
152: * C2 NP4 pres V1 wh-adv pres NP4 pres V1

153:   wh-adv past NP1 adv2 V1 C2 NP3 past V1
154: * C2 NP3 past V1 wh-adv past NP1 adv2 V1
155:   wh-adv past NP3 adv2 V1 C2 NP1 past V1
156: * C2 NP1 past V1 wh-adv past NP3 adv2 V2

157:   wh-adv past NP2 adv2 V1 C2 NP4 past V1
158: * C2 NP4 past V1 wh-adv past NP2 adv2 V1
159:   wh-adv past NP4 adv2 V1 C2 NP2 past V1
160: * C2 NP2 past V1 wh-adv past NP4 adv2 V1

complement CP - matrix inverse:
  no examples
```

Appendix H: Examination 2

Vocabulary

NP1, NP2, NP3, NP4, NP5, NP6, NP7, NP8
pres, past
adv1, adv2
V1, V2, V3
C1, C2
wh-NPs, wh-NPo, wh-adv

Grammaticality judgement

that-trace (subject extraction from a complement clause):

```
001:   wh-NPs pres NP1 V3    pres V1
002: * wh-NPs pres NP1 V3 C1 pres V1
003:   wh-NPs pres NP1 V3    pres V2 NP5
004: * wh-NPs pres NP1 V3 C1 pres V2 NP5

005:   wh-NPs past NP3 V3    past V1
006: * wh-NPs past NP3 V3 C1 past V1
007:   wh-NPs past NP3 V3    past V2 NP7
008: * wh-NPs past NP3 V3 C1 past V2 NP7

009:   wh-NPs past NP1 V3    past V1
010: * wh-NPs past NP1 V3 C1 past V1
011:   wh-NPs past NP1 V3    past V2 NP5
012: * wh-NPs past NP1 V3 C1 past V2 NP5

013:   wh-NPs pres NP3 V3    pres V1
014: * wh-NPs pres NP3 V3 C1 pres V1
015:   wh-NPs pres NP3 V3    pres V2 NP7
016: * wh-NPs pres NP3 V3 C1 pres V2 NP7
```

Superiority (embedded subject - embedded object):

```
017:   wh-NPs pres NP1 V3 pres V2 wh-NPo
018: * wh-NPo pres NP1 V3 wh-NPs pres V2
019:   wh-NPs past NP3 V3 past V2 wh-NPo
020: * wh-NPo past NP3 V3 wh-NPs past V2
021:   wh-NPs pres NP3 V3 pres V2 wh-NPo
022: * wh-NPo pres NP3 V3 wh-NPs pres V2
023:   wh-NPs past NP1 V3 past V2 wh-NPo
024: * wh-NPo past NP1 V3 wh-NPs past V2

025:   wh-NPs pres NP2 V3 pres V2 wh-NPo
026: * wh-NPo pres NP2 V3 wh-NPs pres V2
027:   wh-NPs past NP4 V3 past V2 wh-NPo
028: * wh-NPo past NP4 V3 wh-NPs past V2
029:   wh-NPs pres NP2 V3 pres V2 wh-NPo
030: * wh-NPo pres NP2 V3 wh-NPs pres V2
031:   wh-NPs past NP4 V3 past V2 wh-NPo
032: * wh-NPo past NP4 V3 wh-NPs past V2
```

Object extraction from an adjunct clause:

```
033:   wh-NPo pres NP1 V2 C2 NP3 pres V1
034: > wh-NPo pres NP1 V1 C2 NP3 pres V2
035:   wh-NPo pres NP3 V2 C2 NP1 pres V1
036: > wh-NPo pres NP3 V1 C2 NP1 pres V2
037:   wh-NPo past NP2 V2 C2 NP4 past V1
038: > wh-NPo past NP2 V1 C2 NP4 past V2
039:   wh-NPo past NP4 V2 C2 NP2 past V1
040: > wh-NPo past NP4 V1 C2 NP2 past V2
```

Subject extraction from an adjunct clause:

```
041:   wh-NPs pres V2 NP6 C2 NP3 pres V1
042: > wh-NPs pres NP1 V1 C2 pres V2 NP8
043:   wh-NPs pres V2 NP8 C2 NP1 pres V1
044: > wh-NPs pres NP3 V1 C2 pres V2 NP6
045:   wh-NPs past V2 NP5 C2 NP4 past V1
046: > wh-NPs past NP2 V1 C2 past V2 NP7
047:   wh-NPs past V2 NP7 C2 NP2 past V1
048: > wh-NPs past NP4 V1 C2 past V2 NP5
```

Adjunct extraction from an adjunct clause:

```
049: Q:  wh-adv pres NP1 V1 C2 NP3 pres V1
     A:  NP1 adv1 pres V1 C2 NP3 pres V1

050: Q:> wh-adv pres NP1 V1 C2 NP3 pres V1
     A:  NP1 pres V1 C2 NP3 adv pres V1

051: Q:  wh-adv past NP3 V1 C2 NP1 past V1
     A:  NP3 past adv1 V1 C2 NP1 past V1

052: Q:> wh-adv past NP3 V1 C2 NP1 past V1
     A:  NP3 past V1 C2 NP1 past adv1 V1


053: Q:  wh-adv pres NP1 V1 C2 NP3 V2 NP7
     A:  NP1 pres adv1 V1 C2 NP3 V2 NP2

054: Q:> wh-adv pres NP1 V1 C2 NP3 V2 NP7
     A:  NP1 pres V1 C2 NP3 adv1 V2 NP2


055: Q:  wh-adv past NP3 V1 C2 NP1 V2 NP5
     A:  NP3 past adv1 V1 C2 NP1 V2 NP4

056: Q:> wh-adv past NP3 V1 C2 NP1 V2 NP5
     A:  NP3 past V1 C2 NP1 adv1 V2 NP4


057: Q:  wh-adv pres NP1 V2 NP5 C2 NP3 pres V1
     A:  NP1 pres adv1 V2 NP5 C2 NP3 pres V1
```

058: Q:> wh-adv pres NP1 V2 NP5 C2 NP3 pres V1
A: NP1 pres V2 NP5 C2 NP3 pres adv1 V1

059: Q: wh-adv past NP3 V2 NP7 C2 NP1 past V1
A: NP3 past adv1 V2 NP7 C2 NP1 past V1

060: Q:> wh-adv past NP3 V2 NP7 C2 NP1 past V1
A: NP3 past V2 NP7 C2 NP1 past adv1 V1

061: Q: wh-adv pres NP1 V2 NP5 C2 NP3 pres V2 NP7
A: NP1 pres adv1 V2 NP5 C2 NP3 pres V2 NP7

062: Q:> wh-adv pres NP1 V2 NP5 C2 NP3 pres V2 NP7
A: NP1 pres V2 NP5 C2 NP3 pres adv1 V2 NP7

063: Q: wh-adv past NP3 V2 NP7 C2 NP1 past V2 NP5
A: NP3 past adv1 V2 NP7 C2 NP1 past V2 NP5

064: Q:> wh-adv past NP3 V2 NP7 C2 NP1 past V2 NP5
A: NP3 past V2 NP7 C2 NP1 past adv1 V2 NP5

Additional test sentences to equalize the number of grammatical sentences and ungrammatical sentences

001: * wh-NPo NP1 pres V1 C2 NP3 pres V2
002: * wh-NPo NP3 pres V1 C2 NP1 pres V2
003: * wh-NPo NP2 past V1 C2 NP4 past V2
004: * wh-NPo NP4 past V1 C2 NP2 past V2
005: * wh-NPs NP1 pres V1 C2 pres V2 NP8
006: * wh-NPs NP3 pres V1 C2 pres V2 NP6
007: * wh-NPs NP2 past V1 C2 past V2 NP7
008: * wh-NPs NP4 past V1 C2 past V2 NP5
009: * wh-NPo NP1 pres V2 C2 NP3 pres V1
010: * wh-NPo NP3 pres V2 C2 NP1 pres V1
011: * wh-NPo NP2 past V2 C2 NP4 past V1
012: * wh-NPo NP4 past V2 C2 NP2 past V1
013: * wh-NPs V2 pres NP6 C2 NP3 pres V1
014: * wh-NPs V2 pres NP2 C2 NP1 pres V1
015: * wh-NPs V2 past NP5 C2 NP4 past V1
016: * wh-NPs V2 past NP7 C2 NP2 past V1
017: * wh-adv NP1 pres V1 C2 NP3 pres V1
018: * wh-adv NP3 past V1 C2 NP1 past V1
019: * wh-adv NP1 pres V1 C2 NP3 pres V2 NP7
020: * wh-adv NP3 past V1 C2 NP1 past V2 NP5
021: * wh-adv NP1 pres V2 NP5 C2 NP3 pres V1
022: * wh-adv NP3 past V2 NP7 C2 NP1 past V1
023: * wh-adv NP1 pres V2 NP5 C2 NP3 pres V2 NP7
024: * wh-adv NP3 past V2 NP7 C2 NP1 past V2 NP5
025: * wh-adv NP1 pres V1 C2 NP3 pres V1
026: * wh-adv NP3 past V1 C2 NP1 past V1
027: * wh-adv NP1 pres V1 C2 NP3 pres V2 NP7
028: * wh-adv NP3 past V1 C2 NP1 past V2 NP5

029: * wh-adv NP1 pres V2 NP5 C2 NP3 pres V1
030: * wh-adv NP3 past V2 NP7 C2 NP1 past V1
031: * wh-adv NP1 pres V2 NP5 C2 NP3 pres V2 NP7
032: * wh-adv NP3 past V2 NP5 C2 NP1 past V2 NP5

Sentence matching task
(Same as Appendix F.)

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IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6"

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