LEARNABILITY THEORY AND
THE ACQUISITION OF SYNTAX

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I. Introduction:
Universal grammar and learnability theory

It is now relatively uncontroversial that innate principles must be involved in language acquisition, but a crucial issue is the nature of these innate principles, in particular whether they are formulated as constraints on language or constraints on learning, or both (Wexler and Manzini 1987), and whether they are specific to language or can be related to other cognitive domains (O'Grady 1987). That is, are the acquisition mechanisms formulated in terms of linguistic principles, or are they formulated in terms of learning principles which are used to acquire a linguistic system? In either case the system acquired is linguistic, but the principles used to acquire it are not necessarily so, or may be partially so.

In this paper I would like to explore a distinction between two theories of language acquisition, one which is based on universal grammar (UG), and one which is based on learnability theory (LT). The theory of universal grammar has been widely examined in both first and second language acquisition, whereas learnability theory is a relatively recent area of study which is being developed both within UG and from other theoretical perspectives (Wexler and Manzini 1987, Pinker 1984, O'Grady 1987, Rumelhart and McClellan 1987). For purposes of clarity, I would like to make a distinction between them as potentially different explanations for the

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developmental facts of language acquisition.

Within universal grammar, the mechanisms of language acquisition are formulated primarily in terms of constraints on linguistic systems. Principles such as the Subjacency Condition and the Empty Category Principle constrain possible language structures, and aspects of these principles are parameterized to constrain the hypotheses that a learner can make about the available input. Principles and parameters in UG only minimally depend on the input, under the assumption that input is degenerate and inadequate for acquiring the complexity of language. Therefore input acts as a trigger of already existing structures, not as a source for the structures themselves.

Learnability theory has emerged as an explanation for developmental sequences that depends crucially on learning principles to constrain a learner's hypotheses. Learning principles will likely be a part of any theory of acquisition, however I am taking the point of view that within learnability theory they are the fundamental mechanisms of language acquisition. Learning principles and mechanisms interact with the input to enable the learner to analyze and acquire target structures which are not known in advance. By means of these learning principles, the learner discovers the linguistic system contained within the input data. The semantic concepts underlying language may be innate, and a contributing factor to the acquisition of structure, but the structure itself is not necessarily predetermined.

Important differences between a theory of UG and learnability theory are the degree of weight given to learning principles in accounting for acquisition, and the degree to which learning depends on the structural information contained in the input. UG is strongly innatist and thus depends less on learning principles or input, and more on the innate principles and parameters. This distinction between learnability theory and universal grammar is not uncontroversial, since learnability theory can be maintained within a theory of UG. What I would like to explore is whether or not learnability theory can account for development without recourse to principles and parameters.
II. Learning principles

Learnability theory can be formulated in terms of principles of learning, principles which interact with language input to arrive at reasonable hypotheses about the grammar of a particular language. Literature from diverse frameworks within linguistics, psychology, first language acquisition (L1A), and second language acquisition (L2A) suggests that these principles of learning constrain language acquisition, regardless of one's position on the language-specificity, theoretical explanation, or mechanisms required for operation of these principles.

Some learning principles that have been proposed within different theoretical frameworks that are important for second language acquisition will likely include the following:

Continuity

Within categorial grammar this principle refers to the crosslinguistic preference for items which combine to be adjacent, e.g. for adjectives and nouns, or verbs and direct objects to occur next to each other. On the surface, this may seem so obvious that it doesn't need to be stated, but it has many consequences for language description and acquisition. For example, within UG, there is an adjacency requirement for case assignment (Stowell 1981). Crosslinguistically there seems to be a preference for continuity in that extraction from phrases and clauses is restricted in various ways (O'Grady 1987), and in first and second language acquisition there is an initial preference for canonical word order (Slobin 1973, 1985, Bates and MacWhinney 1987, Pienemann and Johnston 1987).

Conservatism

It is now widely recognized that the hypothesis-testing of a learner needs to be constrained so that initial hypotheses about syntax are the most conservative possible. There are slightly different formulations of this. The Subset Principle proposed by Berwick (1985) maintains that initial hypotheses

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2 Principles are here defined as general conditions on acquisition, whereas mechanisms are defined as specific proposals for how particular principles operate. Thus researchers may agree on the need for a particular constraining principle, but differ fundamentally on the form of the mechanism which achieves this constraint.
The most conservative possible that are consistent with the input data. The Subset Condition on parameters proposed by Wexler and Manzini (1987) maintains that a learner will choose the least marked parameter setting that is consistent with the input data. The Conservatism Thesis proposed by O'Grady (1987) maintains that the initial hypothesis will be the most conservative possible even if a more marked hypothesis is consistent with the input data. Although there are theoretical differences between these points of view, the general principle of conservatism is very similar.

**Cumulative Development**

O'Grady (1987) proposes a Developmental Law which maintains that development must proceed in stages, and that each stage will contain the previous stage plus something more. This is designed to permit development to unfold slowly, in increments. In second language acquisition, Pienemann and Johnston (1987) relate the acquisition of German word order to a more universal scale of development that proceeds in increments of processing difficulty. Note that these views are different from the parameter-setting view in which evidence from the input that is highly marked can theoretically trigger a marked setting of the parameter without requiring the learner to proceed through stages.

**Uniqueness**

This principle refers to learners' preference for one-to-one correspondences between forms and their meaning (Slobin 1973, 1985). This has been formulated as the Uniqueness Principle by Wexler (1979) and the Principle of Contrast by Clark (1987). The mechanisms for forming unique entries have been further developed by Pinker (1984), who specifies how learners process new forms and look for meaning differences consistent with the uniqueness principle.

**Preemption/Loss**

Within any acquisition theory, there is a problem of escaping from overgeneralized forms without having access to negative evidence (Brown and Hanlon 1970). A principle of preemption/loss requires that when a general rule is applied to cases for which there has been no evidence in the input, the
hypothesis will be noted as tentative. If there is input evidence for a different form that what was hypothesized, the tentative hypothesis will be expunged. If there never is any confirming evidence, the hypothesis will be lost (Pinker 1984). In psycholinguistics, this has been related to the strength of rule production (Anderson 1983), and the strength of connections without rules (Rumelhart and McClelland 1987). Although there are very clear differences theoretically between these proposals, as Bowerman (1987) notes, these points of view are converging on a description of mechanisms designed to do the same thing—eliminate erroneous overgeneralizations either by replacement or loss through lack of input.

These learning principles are assumed to be innate, but are not necessarily specific to the language faculty. They are conceivably relatable to general cognitive learning principles used to acquire other complex skills. It is not hard to imagine that in the acquisition of any complex skill, development proceeds gradually and increases in complexity, and that overextended general behaviors can be unlearned in favor of more specific and idiosyncratic ones. The question is how these principles might operate in the acquisition of the specific skill of language, and whether they are sufficient to account for the acquisition of syntax without the need for language structures to be innately pre-specified. The null hypothesis is that the less neurological specificity needed, the better (Jacobs 1988), and the more related to general cognition the principles and mechanisms are, the better (O'Grady 1987, Klein 1989).

In order to examine these issues with respect to a particular syntactic structure, I am investigating the acquisition in English L2A of discontinuous or extracted structures, as found in wh-questions and relative clauses, for example in who did you see ___? and there's the man who I saw ___, in which the wh-pronoun and relative pronoun occur in initial position in the clause. The constraints on possible wh-structures have been treated within a UG framework in terms of the Subjacency Condition and the Empty Category Principle. The crucial question is whether an alternative account of the data within learnability theory is possible without recourse to these innate syntactic principles of UG.

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3 It is assumed in this paper that the same issue of discontinuity underlies the cross-linguistic facts of both the relative clause accessibility hierarchy and wh-question gaps (e.g. Bardovi-Harlig 1987). The relationship between these two types of structures will have to be explored further in another paper.
III. Discontinuity/extraction phenomena

Discontinuity/extraction in English involves the occurrence of a wh-question word or relative pronoun in initial position in a clause\(^4\), with a gap in the place where one would normally expect that argument to occur (compare the examples in Figure 1). Discontinuity results from extraction or movement of an argument into initial position (Chomsky 1981), or direct generation of a constituent in non-canonical word order (O'Grady 1987), a slash category (Gazdar et. al. 1985) or an incomplete F-structure (Kaplan and Bresnan 1982). Within any paradigm, when a syntactic constituent is not adjacent to the constituent with which it normally combines, this results in a discontinuous phrase. In the example of a type i discontinuity given in Figure 1, who is the argument of the verb see, so the non-adjacency of who with respect to see results in a discontinuous VP, because it is the phrase which contains see and the missing argument. Type o is not discontinuous because the object argument of the verb occurs in its canonical position adjacent to the verb.

Figure 1. Discontinuity/extraction in the verb phrase

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>o.</td>
<td>John [vp saw who]?</td>
</tr>
<tr>
<td>i.</td>
<td>Who did John [vp see ____]?</td>
</tr>
</tbody>
</table>

In English, it is permitted to have in initial position an NP which is the argument of a preposition, resulting in a "stranded" preposition (P-S) where the argument was expected to occur (see examples ii-va in Figure 2). The differences between types ii-va are due to the level at which the PP is embedded within the VP. A discontinuity within the PP also results in discontinuity in all of the phrases it is embedded within (O'Grady 1987), thus resulting in a hierarchical relationship between discontinuity types of different levels of embedding. For example, type iva has four simultaneous discontinuities in the PP, NP, PP, and VP. There is a markedness relationship between these different types of discontinuity defined by the degree of

\(^4\) In order to limit the scope of the discussion, in this paper I am considering only discontinuities which are contained within the verb phrase of a non-embedded clause. For a discussion of these proposals with respect to embedded clauses and subject-object asymmetries, see O'Grady (ch. 4: 1987).
embeddedness of the gap. Thus type va is more marked than type iva, etc.

Figure 2. Discontinuity/extraction in preposition-stranded (P-S) questions

iiia. Who did John [VP think [PP about ___]]?

*iva. Who did John [VP think [PP about [NP a picture [PP of ___]]]]?

*va. Who did John [VP read [NP a book [PP about [NP the life [PP of ___]]]]]?

In addition to these P-S types of discontinuous questions in English, there are also non-stranded (N-S) questions in which the preposition occurs initially along with the question pronoun (see Figure 3). The non-stranding of prepositions results in a less marked structural discontinuity for sentences with the same propositional content. Thus, both the P-S type iii and the N-S type iii discontinuities express the same meaning: John read a book about someone and we want to know who it was. But preposition-stranding results in a discontinuous VP, NP and PP, whereas non-stranding results in a discontinuous VP and NP. Thus non-stranded structures are less marked than their propositionally equivalent preposition-stranded structures.

Figure 3. Discontinuity/extraction in non-stranded (N-S) questions

iib. About who(m) did John [VP think ____ ]?

iiib. About who(m) did John [VP read [NP a book ____ ]]?

*ivb. Of who(m) did John [VP think [PP about [NP a picture ____ ]]]?

*vb. Of who(m) did John [VP read [NP a book [PP about [NP the life ____ ]]]]

In English, types iv and v for both P-S and N-S structures are considered ungrammatical (or at least difficult to process). Type iiiia (P-S) is grammatical only for certain VPs (compare *Who did John destroy a book about). N-S structures ii-iiib are grammatical, but are associated with a formal style and are far less frequent in use than P-S structures. Note that a discontinuous VP can result from either the object of the verb occurring in initial position (type i) or a prepositional argument occurring in initial position (N-S type iiiib).

Crosslinguistically, languages differ in the degree of discontinuity they
will tolerate in the formation of questions like these. As O'Grady (1987:87-90) notes, Chinese doesn't permit any discontinuity; Korean and Japanese permit a discontinuous VP only. Dutch permits discontinuous PPs in VP; French permits discontinuous NPs in VP. English permits all of these levels of discontinuity. The different levels of discontinuity are implicationally related to each other, i.e. if a language permits a discontinuity of a certain type, it also permits all the subset types of discontinuity logically included within. This implicational relationship can be diagrammed as in Figure 4 below:

Figure 4. Implicational relationship between types of discontinuity in VPs

- no discontinuity
- discontinuous VP
- discontinuous PP in VP
- discontinuous NP in VP
- discontinuous PP in NP in VP

Note that this hierarchy contains two diverging paths, one of which permits discontinuous PPs, and the other which permits discontinuous NPs. The relationship between these possibilities needs to be explored in much greater detail crosslinguistically; at this point it is merely suggestive. The existence of a hierarchy such as this may be explainable by means of the principle of Cumulative Development, which might require that a more marked alternative develop from a less marked alternative both historically in the development of languages and in the acquisition of discontinuous structures.

IV. Universal grammar account of discontinuity/extraction

The ungrammaticality of certain sentences is assumed to be derived from principles of UG (here those of the Chomsky 1981 version). There are two relevant principles for the extraction of wh-pronouns: The Empty Category Principle (ECP) and the Subjacency Condition (SC). The ECP requires that traces of movement be properly governed, and since prepositions are not taken to be proper governors in that model, movement out of a prepositional phrase is not permitted (so that discontinuity is only allowed within VPs, not NPs or PPs). The result is that grammatical preposition-stranded sentences are
apparent violations of the ECP and consequently are more marked than N-S structures (see iiia and iiiia given again in Figure 5 below). Since sentences like iiia and iiiia are grammatical in English, the verb phrase must be reanalyzed, resulting in a complex verb *think about* or *read a book about*, so that the trace can be properly governed by the verb (Chomsky 1981).

**Figure 5. Examples of verb phrase reanalysis**

iia. Who \([S \text{ did John } [VP \text{ think } [PP \text{ about } _{-}]]]\)?
   Who \([S \text{ did John } [VP \text{ think about } _{-}]]]\)

iiiia. Who \([S \text{ did John } [VP \text{ read } [NP \text{ a book } [PP \text{ about } _{-}]]]]]\)?
   Who \([S \text{ did John } [VP \text{ read a book about } _{-}]]]\)

iiiib. About who(m) \([S \text{ did John } [VP \text{ read } [NP \text{ a book } _{-}]])]\)
   About who(m) \([S \text{ did John } [VP \text{ read a book } _{-}]]]\)

In addition to these ECP effects, the SC requires that movement of a wh-pronoun into initial position not cross more than one bounding node, which for English includes S and NP. In order for the pronoun *who* to move into initial position in the sentence, it is required to cross an S bounding node, consequently it must not cross any other bounding nodes as well. Thus sentences with movement out of an NP are necessarily ungrammatical, and reanalysis is again required so that there is no longer an NP in the complex verb *read a book about* (see example iiiia in Figure 5).

There are two problems with reanalysis. One is that grammatical examples of non-stranded movement, while not violating the ECP, do apparently violate the SC, as movement crosses both an NP and an S node (see example iiiib in Figure 5). In order to account for the grammaticality of the non-stranded version, a different sort of reanalysis of the VP may be required, one that is not required by the ECP. This would result in the complex verb *read a book*, which is a different verb from either *read about* or *read a book about*.

The second problem is that the ungrammaticality of examples like iv-va in Figure 2 is not explained, because these verb phrases could conceivably be reanalyzed also. The ECP and SC are valid principles inasmuch as they capture the crosslinguistic generalization that there are limits on where a
discontinuity can occur. However, once reanalysis is admitted as a possibility, the ECP and SC cannot in themselves account for the ungrammaticality of iva and va. Cases like this will have to be excluded on grounds other than universal principles, such as processing difficulty due to the level of embeddedness of the gap. This reduces the explanatory power of the UG principles.

V. The acquisition of discontinuity/extraction

Universal grammar and parameter setting

The parameter-setting model of acquisition proposed within universal grammar is designed to account for crosslinguistic differences in L1 acquisition. A child has an innate system containing universal constraints, such as the ECP and the SC, which are parameterized with different settings corresponding to the differences between languages. The unmarked setting of a parameter constitutes the initial hypothesis of the child, and marked settings can be triggered on the basis of positive input. The parameter setting approach requires that all the possible options for natural languages be available to each learner biologically.

In the case of wh-questions, the parameters to be set might include the possible lexical categories which count as proper governors, and the possible phrasal categories which count as bounding nodes. Within UG, preposition-stranded structures are considered more marked than non-stranded structures for two possible reasons. One is that the ECP does not permit extraction from a prepositional phrase, and thus preposition-stranded verb phrases require reanalysis (Chomsky 1981). The other possible analysis is that PPs count as a bounding node for subjacency; consequently non-stranded structures that move the entire prepositional phrase are unmarked, whereas movement out of a prepositional phrase is marked (Van Riemsdijk 1978). On either account, it is predicted that non-stranded structures will be acquired before stranded structures.

The existence of innate principles and parameter-settings, combined with the input as a triggering device, implies that acquisition should be relatively rapid. With respect to development, there have been several proposals within a UG account of acquisition. One is that there is a subset
condition on parameters (Wexler and Manzini 1987), such that learners first hypothesize the least marked setting that is consistent with the input. This is consistent with the principle of conservatism, but does not solve the developmental problem because it accounts only for cases in which input data is consistent with more than one setting. Once input data for a more marked setting is apparent to the learner, no developmental stages are predicted. Another proposal is that principles emerge on a maturational schedule (Felix 1987), although this does not explain why for a particular parameter (which should emerge as a unit), the final setting is not achieved as soon as the input is processed.

To explain the possible acquisition sequences for extracted structures, as noted above one prediction is that the acquisition of non-stranded structures precedes stranded structures (Bardovi-Harlig 1987). Another prediction might be that the acquisition of type i discontinuity precedes types ii and iii, since the latter two require reanalysis (French 1984). To summarize, to the extent that UG is meant to be an acquisition theory, it needs to account for the following things:

1. the principles and parameters necessary for all the possibilities that occur in natural language;
2. the mechanisms necessary for reanalyzing apparent counterexamples in the input;
3. the explanation of developmental stages;
4. the prediction that non-stranded structures are acquired before preposition-stranded structures based on theoretical markedness.

Learnability theory

The learning principles discussed within learnability theory are designed to account for both success and developmental stages in acquisition, without recourse to the ECP or SC within universal grammar. In the acquisition of wh-questions, it is not necessary to know in advance what the possible discontinuities are crosslinguistically, but the learner needs a principle of Continuity plus principles that guarantee conservative hypotheses and development based on cumulative complexity. The input will indicate the level of discontinuity permitted, and the learner will start with the most conservative hypothesis consistent with the input and develop gradually
towards the target input. The principles required are as follows:

1. Continuity
2. Conservatism
3. Cumulative Development

Based on Continuity, the learner would never hypothesize discontinuity unless it was present in the input. If discontinuity is present in the input, based on Conservatism, the learner would choose as an initial hypothesis the least marked instantiation of the input. Based on Cumulative Development, regardless of the level of discontinuity the input indicates is possible, a learner must proceed in stages, developing incrementally to the level indicated. Development is forced to proceed from least complex type to more complex, as in the learning of any complex cognitive skill. I recognize that to achieve this, information about how to evaluate markedness relationships and abstract conservative hypotheses must be available to the learner, although this is presumably true in learning any cognitive skill. From a learnability theory perspective, explaining how an input processing mechanism like this might work is where further research needs to be focused.

The incremental learning required by these three principles in the acquisition of English discontinuity involves three stages (what is to be learned is enclosed in <>):

i  <discontinuous VPs>  What did John <read ___>?
ii  discontinuous <PPs in> VPs  What did John read <about ___>?
iii  discontinuous PPs in <certain NPs in> VPs  What did John read <a book> about ___?

Presumably all three types of discontinuity are readily available in the input, although the learner develops in his or her output from type i < ii < iii. (S)he must first be able to produce questions with discontinuous VPs, then discontinuous PPs in VPs, and finally discontinuous PPs in certain NPs, each stage building upon the last. It is seen as impossible that a learner could produce a discontinuity of type iii that involves a discontinuity within three

5 The learning principles of Uniqueness and Preemptibility/Loss are not seen as necessary to explain the acquisition of discontinuous structures in English, because learners do not tend to wrongly overgeneralize gaps.
levels of embeddedness, without already being able to produce a discontinuity within only a VP (type i) or within two levels of embeddedness (type ii).

Learnability theory also assumes that frequency in the input is a crucial factor in determining output, so that regardless of the markedness relationship between preposition-stranded and non-stranded discontinuous phrases, in English P-S structures will be produced earliest because the evidence in the input is primarily of this type. The input determines what kind of discontinuity is acquired in a child, although processing limitations and markedness relationships may determine what types of discontinuity are likely to occur in natural languages.

Thus, the principles within learnability theory provide an account of the acquisition of discontinuity in the following way:

1. all possible discontinuities that occur in natural languages do not need to be specified in advance;
2. there are no apparent counterexamples to learning principles in the input which need to be explained;
3. development through stages is explained in terms of incremental learning;
4. preposition-stranded structures will be acquired before non-stranded structures due to frequency in the input.

VI. Acquisition literature

There have been two areas of inquiry in the acquisition of discontinuity/extraction in English. One area is in the difference between preposition-stranded structures and non-stranded structures, based on the theoretical claim that N-S is less marked than P-S. In English L1A, French (1984) tested the claim that the unmarked N-S structures are acquired prior to the more marked P-S structures. She found that in comprehension there was a slight preference for N-S structures; however in imitation there was a strong preference for P-S structures. In L2A, Bardovi-Harlig (1987) found that 95 learners of English from different L1s produced P-S structures earlier than N-S. In order to account for the earlier emergence of preposition-stranding, she suggests that input frequency can sometimes supercede markedness
predictions. In addition, Bardovi-Harlig found a stage in which no preposition is produced at all, resulting in ungrammatical sentences like those below, which she called a 'no-prep stage:'

Who did Mary give a book?
Who did Susan create a costume?
The man Mary baked a cake was Joe.
The policeman Bill reported the accident arrested him. (1987:393)

Within the learnability theory proposed above, these results are exactly as expected. A no-prep stage contains a type i discontinuity, involving only a discontinuous VP. The learnability view claims that this stage necessarily precedes the acquisition of type ii structures. Additionally, because in English the input is primarily preposition-stranded (N-S being reserved for formal styles), it is also expected that P-S would be the first acquired. Markedness in development is based on the relationship between types available in the input (e.g. types i-iii above), not necessarily between structurally/theoretically more or less marked types independent of the input.

The second area of interest in acquisition is the relationship between the discontinuity types identified earlier, and whether the acquisition sequence mirrors the predicted development from i < ii < iii. In English L1A, Hildebrand (1987) found in a cross-sectional study with both production and imitation tasks that children (ages 4-10) were most accurate for type i, next most accurate for type ii, and least accurate for type iii. They increased in accuracy for all types as age increased. Hildebrand analyzes this data within a UG framework based on the ECP. A difference between type i, which doesn’t involve stranding, and the other two types is expected, but she doesn’t distinguish between types ii and iii because both involve stranding + reanalysis. The learnability view expects all three stages of development because of the different degrees of embedding involved.

In order to examine the second area discussed above in L2 acquisition, i.e. the sequence of development of discontinuous structures, I did a study of L2 learners’ production and judgments of both preposition-stranded and non-stranded structures.

Based on the discussion above, my hypotheses are:
LEARNABILITY THEORY

1. Non-native speakers will show development in incremental stages from discontinuity type i > ii > iii as exhibited by:
   a. decreasing accuracy of use
   b. substitution of lower level types for higher level ones.
2. Production of ungrammatical type iv and v sentences will be rare or non-existent.
3. Production of grammatical non-stranded structures will be rare.

VII. The study

Subjects
The subjects in this study were adult students in the Hawai‘i English Language Program at the University of Hawai‘i. This is an intensive English program which places students into proficiency levels from low-beginning through high-advanced, based on initial placement tests. A wide range of proficiency levels were tested in order to have subjects at different stages of acquisition of the structures to be tested. There were 41 NNS subjects who completed the test; 35 were Japanese speaking and 6 were Chinese speaking. Of the 41 subjects analyzed, all of the subjects completed the first task, and 25 completed the second task. The different numbers of subjects per task was due entirely to classroom time constraints.

Tasks
The tasks were presented in a single test format, requiring a written response to oral input. The input sentences were of the form illustrated in Figure 3 below:

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6 51 subjects attempted the test, but ten of these are not included in the analysis because they simply copied down what the tester said.
7 Note that no actual discontinuity occurred in the input, but the input sentence placed the target noun at various levels of embeddedness, leading to the production of discontinuity types i-v. Thus for ease of discussion, ‘input type’ refers to the level at which the target noun is embedded in the input sentence.
Figure 3. Input examples by discontinuity type

<table>
<thead>
<tr>
<th>Discontinuity Type</th>
<th>Sentence</th>
<th>Words/Syllables</th>
</tr>
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<tbody>
<tr>
<td>i.</td>
<td>At a park a young woman is watching a bird.</td>
<td>10/12</td>
</tr>
<tr>
<td>ii.</td>
<td>In the yard a little girl is playing with a stick.</td>
<td>11/13</td>
</tr>
<tr>
<td>iii.</td>
<td>An old man is telling a story about a house.</td>
<td>10/13</td>
</tr>
<tr>
<td>iv.</td>
<td>A girl is thinking about a picture of a flower.</td>
<td>10/14</td>
</tr>
<tr>
<td>v.</td>
<td>A boy is reading a book about the life of a king.</td>
<td>12/14</td>
</tr>
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</table>

These sentences were controlled for length as determined both by words and number of syllables (10-12 words; 12-14 syllables). This was achieved by introductory prepositional phrases or modifiers of the subject noun only. The noun corresponding to the picture in the test booklet always occurred in the final position of the sentence, so that memory constraints were equal across discontinuity types as the subjects waited for the noun they were to respond to.

In both tasks, the experimenter read a sentence aloud while the subjects looked at a picture in the test booklet illustrating the final noun of the sentence. In the first task, subjects were instructed to listen to the input sentence, look at the picture, and write a response in the format "this is the ___ that/which..." based on the information in the input sentence. In the second task, subjects were instructed to write a question about the picture based on the input sentence (see examples below):

**Task 1**
Input: in a park a young woman is watching a bird
Response: this is the bird that a young woman is watching (in a park)

**Task 2**
Input: in a restaurant an old man is eating a sandwich
Response: what is the old man eating (in a restaurant)?

These tasks require the production of both relative clauses and wh-
questions, both of which involve discontinuous phrases. The sentences used in
the instructions were of type i with no preposition-stranding involved, so the
production of P-S vs. N-S structures for the more marked discontinuity types
was left entirely up to the learner.

Examples of the input sentences are given in Appendix 1. An example
of the test booklet is given in Appendix 2. Note that I have attempted to use
examples that are as acceptable/grammatical as possible, to further the goal of
dealing with what might have been in the input to the learners, and not being
interested in how subjects treat sentences which were not likely to have
contributed to their developing grammar. For comparison purposes, in task 2 I
included an additional three sentences of type iii that are considered
ungrammatical in English. For this paper, I have analyzed only the data from
the task 1 relative clauses. The rest of the data and comparison to native
speaker norms will require further analysis.

Analysis

Responses to task 1 were scored in several ways. The first scoring
method was based on whether the subject produced the target form or not.
That is, if the input was of type iii, did the subject write down a type iii
sentence in the response. For example, if the input was of type ii, e.g. in a yard
a little girl is playing with a stick, and the learner wrote down a type i
discontinuity this is the stick a little girl is playing, it was scored as incorrect.
Due to the ungrammaticality of types iv and v, only types i-iii are considered
in this particular scoring procedure.

The second type of scoring was to look at the percentage of different
discontinuity types produced in response to a given input type. This scoring
procedure included types i-v. For example, if the input was of type v, e.g. a
boy is reading a book about the life of a king, the possible responses are illustrated
in Figure 5 below:
Figure 5. Possible responses to type v input

i. this is the king a boy is reading
ii. this is the king a boy is reading about
iii. this is the king a boy is reading a book about
iv. this is the king a boy is reading about the life of
v. this is the king a boy is reading a book about the life of

In this example, the subject could write down any of types i-v in response to the type v input. In fact, all of the responses given in Table 4 are actual responses found in the data (note the semantic anomaly of the type i response). In doing this second type of analysis, I noticed the occasional presence of resumptive nouns or pronouns, so a third scoring of occurrence of resumption by discontinuity type was also done (see the example of a type i resumption below).

Resumptive nouns/pronouns:
the book/his life/the king/it/him

e.g. this is the king the boy is reading (his life)

Results

The results from task 1 support the hypothesis that discontinuity is acquired by NNS of English gradually in a continuum of increasing complexity. In the analysis of target vs. non-target production, significant differences were observed between target and non-target responses, based on the type of discontinuity provided in the input (c² =136.2, p < .001, see Table 1).

Table 1. % target production by input type

<table>
<thead>
<tr>
<th></th>
<th>%TARGET</th>
<th>%NON-TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>ii</td>
<td>32</td>
<td>68</td>
</tr>
<tr>
<td>iii</td>
<td>12.5</td>
<td>87.5</td>
</tr>
</tbody>
</table>

N=300, df=2, c²=136.2, p < .001
In the analysis of response type, significant differences were observed between the type used in the response, based on the type of discontinuity provided in the input ($c^2 = 57.0$, $p < .001$, see Table 2).

Table 2. % response type by input type

<table>
<thead>
<tr>
<th>RESPONSE TYPE</th>
<th>i</th>
<th>ii</th>
<th>iii</th>
<th>iv</th>
<th>v</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT TYPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>93</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii</td>
<td>62</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii</td>
<td>49</td>
<td>38</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv</td>
<td>29</td>
<td>65</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>55</td>
<td>18</td>
<td>21</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

$N=186, df=8, c^2=57.0, p < .001$

In the analysis of resumption, significant differences were observed between the presence or absence of a resumptive N or PN, based on the type of discontinuity provided in the input ($c^2 = 16.24$, $p < .005$, see Table 3).

Table 3. % use of resumptive PN or N by input type

<table>
<thead>
<tr>
<th>GAP</th>
<th>PN or N</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>90</td>
</tr>
<tr>
<td>ii</td>
<td>90</td>
</tr>
<tr>
<td>iii</td>
<td>76</td>
</tr>
<tr>
<td>iv</td>
<td>68</td>
</tr>
<tr>
<td>v</td>
<td>58</td>
</tr>
</tbody>
</table>

$N=186, df=4, c^2=16.24, p < .005$

In both tasks 1 and 2, non-stranded structures occurred 4 times out of
511 total responses by the 41 subjects.

VIII. Discussion

These results confirm hypothesis 1, showing a clear effect for discontinuity type. As seen in Table 1, NNS subjects were less likely to accurately produce the form that was targeted by the input sentence as the discontinuity type increased in markedness. Type i was mastered by the majority of the subjects (92% target production), type ii only somewhat produced (32%), and type iii mastered by very few subjects (12.5%). This accuracy order suggests an acquisition order of i < ii < iii. Similarly, NNS subjects' preferences for response type (in Table 2) support hypothesis 1. For all types of input sentences except type iv, subjects preferred a type i response more than any other. For type iv input, subjects preferred a type ii response over a type i response, presumably because of the close relationship between these two types: this is the flower the girl is thinking about (a picture of). These results indicate that mastery develops from type i to ii to iii.

Hypothesis 2, that learners would not be likely to produce types iv and v, is supported (See Table 2). Subjects wrote down a type iv or v sentence in 9 cases out of 186, if the input sentence had been a type iv or v. This is relatively rare, considering that the structure of these input sentences and nature of the task encouraged their production. There is a clear line separating grammatical production from ungrammatical production, in that types i - iii are produced substantially, although with decreasing frequency, whereas types iv and v are quite rare in comparison.

Hypothesis 3, that learners would not be likely to produce non-stranded structures, is also supported. Although it was possible for the learners to write down a N-S response to the input sentences, e.g. this is the stick with which the little girl is playing; about what is the man telling a story, these types of structures were produced only 4 times out of 511 total responses on both tasks 1 and 2. The explanation is that in English these types of sentences are rare in the input, and therefore are not produced until relatively late, although they are crosslinguistically less marked.
Sometimes the sentence the subjects wrote down was semantically anomalous (e.g. type i responses for type iii-v input):

This is the house the man is telling.
This is the car the girl is singing.
This is the king the boy is reading.

If these subjects had had a chance to go back and look at what they had written, they might have realized that these sentences didn’t make sense, but at the time they were only able to produce a type 1 discontinuity.

As shown in Table 3, for the identical examples as those analyzed in Table 2, there was increasing likelihood for use of a resumptive N or PN as discontinuity type in the input increased. This is an interesting result in that subjects were most likely to produce a type i response regardless of the input type, but more likely to use a resumption (with the type i response) if the input sentence had contained a higher level of embeddedness. This is also indirect support for the developmental sequence hypothesized.

In general, it seems clear that learners acquire discontinuous structures in English gradually, proceeding from the least discontinuous type to the most discontinuous type for which there has likely been evidence in the input. Thus, a learnability theory that crucially depends on the input to develop structure, and distinguishes between types of discontinuity based on increments of increasing complexity, is a better explanation than UG principles for the developmental stages of L2 learners. It predicts that P-S structures will precede N-S structures in acquisition, it predicts that a no-prep stage (type i) will precede other stages, and it predicts development from i to ii to iii without collapsing ii and iii together into one type of structure as the ECP does.

Two issues in second language acquisition have been whether or not adult learners have access to UG principles and/or parameter settings (e.g. Bley-Vroman et. al. 1988, Schachter 1987), and whether adults transfer L1 settings of parameters (e.g. White 1987). The identical questions of access and transfer within L2A can be posed within the learnability theory discussed in this paper. Do L2 learners have access to L1 learning mechanisms? Are learners equally conservative in L2A as L1A? Are they willing to transfer greater levels of discontinuity from their L1 than is evident in the input of the
L2 (e.g. English to Japanese)? The relevant data may need to be more production-oriented, as in this study and in Bardovi-Harlig (1987), rather than based on grammaticality judgments which have provided inconclusive results thus far.

The evidence that has been offered relevant to access and transfer within UG has not distinguished between theories, because alternative accounts of the same data have not been considered. Evidence for access or transfer does not prove or disprove a particular theory. Only when alternative theories are considered, and one is shown to predict the facts of access or transfer better than another, can the data be construed as evidence for that particular theory. In this paper, learnability theory is shown to be a better predictor of developmental stages in the acquisition of discontinuity than universal grammar. However, for the issues of access and transfer, this type of theoretical comparison has not been done.

IX. Conclusion: Theoretical implications

In order to be adequate, an acquisition theory must be able to explain the initial hypotheses of the learner, developmental stages, the role of input, how overgeneralizations are unlearned, and why certain overgeneralizations never occur. The focus in this paper is on the explanation for the developmental stages found in the acquisition of syntactic discontinuity. Learners are conservative and gradual in their path of development, and this can be accounted for by constraints on learning, e.g. the initial preference for continuity and the principle of cumulative development. Within learnability theory, what is specified for a learner is only the most conservative case, not any of the other options. The input is the primary source of structural information for a language learner, and the learning principles are the source of hypotheses about that input.

In conclusion, I am proposing that in order to explain developmental stages, learning principles are necessary within any theory of language acquisition. I suggest that we move towards developing a rigorous formulation of the specific learning mechanisms that follow from these principles, which can account for how a learner processes the input data, makes hypotheses about that data, and develops in stages towards the target
structures. It is worth our while to investigate the claim that if the mechanisms are well-formulated, learning principles may not only be necessary for language acquisition, but also sufficient.

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References


Appendix 1: Input examples by task and discontinuity type

Input examples for production tasks 1 and 2

i. On a nice day a young boy is washing a boat. In a restaurant an old man is eating a sandwich. At a park a young woman is watching a bird.

ii. In the yard a little girl is playing with a stick. In the rain a woman is waiting for a bus. At the beach a boy is listening to a radio.

iii. A young boy is reading an ad about a guitar. An old man is telling a story about a house. A young woman is eating a bowl of noodles.

iv. A girl is thinking about a picture of a flower. A man is standing near a pile of clean clothes. A boy is looking at an engine from a plane.

v. A man is buying a painting of a pot of flowers. A boy is reading a book about the life of a king. A girl is singing a song about a man in a car.

Ungrammatical type:

iii. A young boy believed the story about a ghost. The new teacher liked the children in the class.
Appendix 2: Example test booklet

INFORMATION ABOUT YOU

writing class level
structure class level
age
country
native language
other languages

A. DESCRIPTIONS

Listen to each sentence. It will give you some information. Then write a description of the item that you see in the picture, using this information.

Practice examples:

a. 

b. 

B. QUESTIONS

Listen to each sentence. It will give you some information. Then write a question about the item that you see in the picture, using this information.

Practice examples:

a. 

b. 
A. Descriptions

1. [Image of a stick]

2. [Image of a chicken]

3. [Image of a boy wearing a crown]

4. [Image of a car]

5. [Image of a radio]

6. [Image of a book]
B. Questions

1. 

2. 

3. 

4. 

5. 

6. 

7. 

8. 

9. 

10.