The Limits of Context in L2 Semantic Ambiguity Resolution

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1. Introduction
1.1 Native and non-native sentence processing

A growing body of research in the generative paradigm investigates differences between non-native and native sentence processing. Research has focused on syntactic and lexico-syntactic ambiguity resolution, such as filler-gap dependencies (Juffs and Harrington 1995, 1996; White and Juffs 1998), argument structure (Frenck-Mestre and Pynte 1997; Juffs 1998a, 1998b), garden path problems (Juffs 1998b), relative clause attachment (Papadopoulou and Clahsen 2003) and the resolution of VP-ellipsis versus anaphora (Duffield and Matsuo 2001), among others. Recently, Papadopoulou and Clahsen (2003) argued that second language (L2) learners' processing of relative clause attachment reflects a contextual strategy, whereas native speakers' processing is structurally determined. In this paper, we address the respective role of the structure of interpretations versus contextual knowledge in the resolution of scope ambiguity in native versus non-native processing.

With Fodor (2000), we assume that the degree to which computations are determined by the structure of representations (rather than by the global context) distinguishes the processing of specialized modules versus central systems in mental organization. Papadopoulou and Clahsen's (2003) findings, therefore, opened up the possibility that non-native and native sentence processing differ significantly. However, we argue for a syntactically-driven algorithm in the manner in which English-French learners resolve semantic ambiguity due to quantifier scope in the interpretation of cardinality interrogatives.

1.2 Scope ambiguity in cardinality interrogatives

If Monique, Sylvie and Véronique (as restaurant critics) all evaluated Le Nôtre, La Tour D'argent, and each evaluated a different third restaurant, three answers to (1) are possible: *three*, *two* and the collective answer *five*.

(1) Combien   de restaurants est-ce que tous les critiques ont   évalués?
     How many of restaurants is-it-that all the critics   have   evaluated
     "How many restaurants did all the critics evaluate?"

We refer to the answer *three* as the distributive answer and to the answer *two* as the common answer. The distributive and common interpretations depend on whether *de restaurant* 'of restaurants' takes scope under or over *tous les critiques* 'all the critics' respectively. Thus, *three* corresponds to the maximal cardinality n such that for every critic there are some n restaurants that she evaluated. This interpretation requires that the existential object take scope under the universal subject quantifier.

Two corresponds to the maximal cardinality of some set of restaurants that every critic evaluated. This latter interpretation requires that the existential object take scope over the universal subject quantifier. The collective answer *five*, in contrast, does not involve scope.

In French, the particle *de* with a Case-theoretic licenses the restriction of the interrogative quantifier in thematic position as in (2) (Obenauer 1984/1985).

(2) Combien   est-ce que tous les critiques   ont   évalué   de restaurants?
    How many   is-it-that   all the critics   have   evaluated   of restaurants
    "How many restaurants did all the critics evaluate?"

de Swart (1992) argued that in situ arguments take narrow scope. Thus, (2) does not allow common answers, but admits collective and distributive answers. Furthermore, (2) (unlike (1)) is not felicitous in the background provided by (3) because the interpretation of the object in situ does not presuppose that there is a non-empty set of restaurants in the context. It is, therefore, conversationally implied by (2) that there is no such contextual set contrary to what (3) has already established.

(3) Hier, il restait cent restaurants à évaluer, mais plus autant aujourd'hui.
    "Yesterday, there were a hundred restaurants to evaluate, but not as many
      today."

Assuming Diesing's (1992) clausal partition, an indefinite restriction such as *de restaurants* in thematic position inside VP can be interpreted as an inherently restricted individual variable bound by a VP-level existential closure operation at the semantic interface. Then, the existence of restaurants in the context is not presupposed. The indefinite can also be interpreted outside of the VP (either VP-adjoined or IP-adjoined) via Quantifier Raising (QR). Then, existence is presupposed. Scope of the existential restriction under the universal subject (with the restriction either in situ or in a VP-adjoined QR position) determines a distributive interpretation. Scope of the existential restriction over the universal subject (with the restriction in an IP-adjoined QR position) determines a common interpretation.

1.3 Interpretation in English-French development

Dekydtspotter, Sprouse, and Swanson (2001) administered a task in which continuous and discontinuous interrogatives were crossed with distributive and common answers to be accepted or rejected as true answers to the question in the context provided by a scenario. Scenarios included information supporting distributive, common and collective answers. But, distributive answers were matched by a neutral context, whereas common answers were matched with a context that included a presupposition that the common answer was expected. Intermediate learners of French did not exhibit knowledge of the scope constraint on discontinuous cardinality interrogatives as in (2). Intermediate learners accepted distributive and common answers virtually equally irrespective of sentence structure. In contrast, advanced learners developed such knowledge: Advanced learners

accepted distributive answers to discontinuous interrogatives significantly more than common answers, but crucially no such difference appeared with continuous interrogatives. On the basis of a severe poverty of the stimulus problem posed by the acquisition of discontinuous cardinality interrogatives, Dekydtspotter, Sprouse, and Swanson argued that L2 learners' interpretation is governed by Universal Grammar.

Dekydtspotter (2001) noted that those advanced learners who showed knowledge of the constraint on discontinuous interrogatives also exhibited a significantly lower acceptance of common answers than of distributive answers to continuous interrogatives, which is reminiscent of the French natives' pattern on the same task. This asymmetry occurred despite the contextual presuppositions accompanying common answers. In contrast, those advanced learners who did not exhibit knowledge of the constraint on the interpretation of discontinuous sentences accepted common answers more readily, like the English comparison group on a similar task. An asymmetry in the relative salience of scope-dependent interpretations of continuous interrogatives therefore developed with the acquisition of discontinuous interrogatives. This difference between the two types of (advanced) learners mirrored a difference between French native speakers and English native speakers on an instrument eliciting numerical responses to cardinality interrogatives discussed in Villalta (2003).

In summary, those grammars that license *discontinuous* cardinality interrogatives (with their interpretive restrictions) also appear to inhibit acceptance of contextually salient common answers to *continuous* cardinality interrogatives. This pattern suggests a potentially greater role of the context in the response pattern of learners with English-type interlanguage grammars versus learners with French-type interlanguage grammars. What remains to be elucidated, however, are the precise relationships between grammar, processor and context.

1.4 Scope ambiguities and the performance system

We assume *Incremental Comprehension* as organizing principle: *All available information is put to the goal of maximizing the parse—up to the limits of Universal Grammar* (Crocker 1996). In terms of grammar-parser relations, it is feasible that the sentence processor is (largely) universal, constrained by universal principles of economy as conceived in Minimalism. Scope resolution follows the organizing principle Minimal Attachment as in (4) (see Frazier and Clifton (1996) and Gorrell (1995) for formulations of Minimal Attachment in the spirit of Minimalism).

(4) Minimal Attachment: Attach incoming material into the phrase marker being constructed with the fewest nodes consistent with the well-formedness rules of the language (Frazier 1979: 76).

According to the economy-driven parse strategy in (4), the smallest structure that allows an interpretation is built on first pass. If this representation cannot be contextually integrated, then the minimal repair is made to the structure. If this representation can be contextually integrated, no further changes are made. In such a structural model, processor actions are determined by grammatical principles applying incrementally. The least representation that allows for an interpretation is
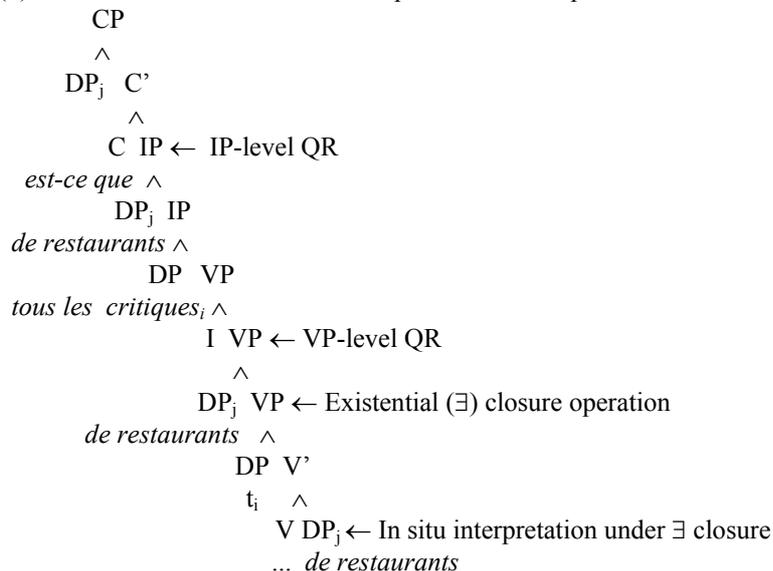
built on first pass. Context has a licensing role: Contextual integration determines commitment to the analysis; lack of contextual integration forces a revision.

Alternatively, the processor can be organized to take full advantage of contextual information. Assuming Crain and Steedman's (1985) *Parsimony Principle* as central organizing principle, the processor selects analyses with the fewest unsatisfied but consistent presuppositions. The relative contextual fitness of competing interpretations in the Maxims of Conversational Cooperation determines the most plausible interpretation, eliminating those that are not plausible. Contextual information can determine syntactic parse actions by specifying the LF representation that satisfies the Parsimony Principle. Information flows from contextual knowledge to the syntactic processor through the interpretive systems. In such a model, grammar constrains the set of possible representations, but does not force access to representations irrespective of contextual plausibility.

1.5 Minimal attachment, argument licensing and access to interpretations

We now consider in (5) how the structural performance system interacts with the syntax of cardinality interrogatives to determine access to common interpretations. Upon encountering *Combien de restaurants* 'how many restaurants,' a CP node as well as its IP and VP substructures is generated by Incremental Comprehension. The existential restriction *de restaurants* is then integrated into the structure in accordance with Minimal Attachment and language-particular, argument-licensing parameters.

(5) "Combien de restaurants est-ce que tous les critiques…"

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        CP
       ∧
    DPⱼ  C'
          ∧
        C  IP ← IP-level QR
 est-ce que ∧
         DPⱼ  IP
 de restaurants ∧
           DP  VP
 tous les  critiquesᵢ ∧
                 I  VP ← VP-level QR
                   ∧
               DPⱼ  VP ← Existential (∃) closure operation
     de restaurants   ∧
                 DP  V'
                 tᵢ    ∧
                   V DPⱼ ← In situ interpretation under ∃ closure
                   … de restaurants
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In French, where *de*-marked arguments can be Case-licensed in situ, Minimal Attachment requires that the restriction be interpreted in thematic position on first pass, since this is the smallest structure that allows an interpretation. This integration

determines a distributive non-presuppositional interpretation. If such an interpretation cannot be contextually integrated because a contextual presupposition is not satisfied, then a QR position is required. Again, Minimal Attachment requires that the restriction be interpreted at the VP level on second pass before an eventual IP-level site (if any) is posited. If such a structure is not contextually integrated, because the set of restaurants in common is uniquely relevant, then an IP-level QR position is posited. Thus, we expect that integration of the restriction into the structure requires more processing time for the common interpretation of the cardinality interrogative than for distributive interpretations.

In English, in contrast, a VP-adjoined node is required for Case checking purposes. The interpretation of the restriction is, therefore, forced in the VP-adjoined position, since an interpretation obtains at that level. The IP-level interpretation of the restriction associated with common answers requires fewer revisions from the first pass (VP-external) representation in English than from the first pass (VP-internal) representation in French.

2. A reading time experiment
2.1 Participants

Thirty nine English-French learners were presented with a randomized battery of forty items on a Macintosh computer using the experimental software, PsyScope. They were all native speakers of English, enrolled at Indiana University. The intermediate learner group (n = 23) was comprised of learners in their fourth semester of college French. They would generally be considered intermediate high in an OPI-ACTFL proficiency test (Magnan 1986). The advanced learner group (n = 16) was composed of graduate students in French. They would generally fall in the advanced category in an OPI-ACTFL proficiency test (Magnan 1986). L1 processing data from young adult native English speakers (n = 32) and native French speakers (n = 16) were also collected. The respondents in the English native group were enrolled in second semester French and the respondents in the French native group were graduate students. All respondents therefore originated from monolingual communities and had been exposed to another language in classroom settings.

2.2 The instrument

Twenty experimental test items, which were randomly chosen from a list of forty items of the types below, and twenty filler items were used in the task. Each item included a scenario in the native language of the respondent, a self-paced segment-by-segment presentation of the interrogative (which was in French for French natives and learners and in English for the English comparison group) and a numerical answer in Arabic notation. The respondents pressed a button to accept the answer, reject the answer, or opt out if they could not accept or reject. The scenarios supported the full range of numerical answers (i.e., the collective answer *5*, the distributive answer *3*, and the common answer *2*). The scenario matching the distributive answer was in principle compatible with a range of answers (dependent on the perspective taken by the respondent). In contrast, the scenarios matching the

common answer included a presupposition that the cardinality of the set of objects in common was relevant.

2.3 Examples of test items

Figure 1: Open-ended context with distributive answer

As chief editor of *Gourmet Magazine*, I must make sure that each restaurant is evaluated by some food critic. Last week, Monique evaluated Le Nôtre, La Tour D'argent and Chez Paul. Sylvie evaluated Le Nôtre, La Tour D'argent and Chez Pierre. Véronique evaluated Le Nôtre, La Tour D'argent and Chez Jacques.

Combien/ de restaurants/ est-ce que/ tous les critiques/ ont/ donc/ évalués?/
how many of restaurants is it that all the critics have thus evaluated

3

Figure 2: Context presupposing a common answer with common answer

As chief editor of *Gourmet Magazine*, I am getting concerned that the food critics visit mostly the same restaurants. Last week, Monique evaluated Le Nôtre, La Tour D'argent and Chez Paul. Sylvie evaluated Le Nôtre, La Tour D'argent and Chez Pierre. Véronique evaluated Le Nôtre, La Tour D'argent and Chez Jacques.

Combien/ de restaurants/ est-ce que/ tous les critiques/ ont/ donc/ évalués?/
how many of restaurants is it that all the critics have thus evaluated

2

2.4 Procedure

Correctly accepted answers indicate which scope-dependent representation was accessed. But, when respondents pressed the *no* button, this was not necessarily because they accessed the alternative scope representation. Therefore, reading times from *yes* answers only are analyzed.

3. Results

Comparisons between the intermediate and advanced English-French learner groups (provided in Table 1 for distributive interpretations and in Table 2 for common interpretations) reveal differences for specific segments only. With *yes* responses to distributive answers *only*, intermediates produced significantly longer reading times than advanced learners only for the *de NP*, *est-ce que* and *tous les N* segments. No other difference was significant. With *yes* responses to common

answers, the verb segment showed significantly longer reading times for the advanced learners than for the intermediate learners.[1]

Segments	intermediate 95 cases	advanced 55 cases	t-test statistics	
combien	420.18 ms	373.07 ms	t(148) =1.77,	p = .078
De NP	439.99 ms.	285.24 ms.	t(132.64) = 3.64,	p < .0005
est-ce que	483.48 ms.	304.18 ms.	t(140.27) = 3.62,	p < .0005
tous les N	655.61 ms.	380.09 ms.	t(140.27) = 3.62,	p < .0005
Aux	571.83 ms.	443.55 ms.	t(148) = 1.79,	p = .076
donc	427.57 ms.	483.11 ms.	t(66.27) = .79,	p = .434
Verb	923.57 ms.	1062.91 ms.	t(129.70) = .70,	p = .484

Table 1: Reading times of interrogatives on the *distributive* interpretation: *Intermediate versus advanced learners*

	intermediate 109 cases	advanced 49 cases	t-test statistics	
combien	445.79 ms.	337.31 ms.	t(156) = 1.38,	p = .170
De NP	409.59 ms.	359.41 ms.	t(156) =1.40,	p = .164
est-ce que	429.13 ms.	385.32 ms.	t(156) = 1.32,	p = .190
tous les N	634.91 ms.	558.29 ms.	t(156) = .81,	p = .422
aux	509.20 ms.	471.82 ms.	t(156) = .52,	p = .604
donc	478.80 ms.	613.04 ms.	t(58.51) = 1.42,	p = .160
verb	776.76 ms.	1598.59 ms.	t(53.18) = 2.46,	p = .017

Table 2: Reading times of interrogatives on the *common* interpretation: *Intermediate versus advanced learners*

These asymmetries do not follow from advanced learners' greater familiarity with lexical items, since familiarity with lexical items should affect both interpretations

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[1] Since there are two subpopulations of learners, we assume a Bonferonni protection measure of $\alpha = .05/2 = .025$.

equally. Asymmetries also do not appear to follow from enhanced use of contextual clues by advanced learners, since this should favor common interpretations.

Analyses of reading times on distributive versus common interpretations also reveal a developing bias for distributive interpretations.

	common 49 cases	distributive 55 cases	t-test statistics	
combien	377.31 ms.	373.07 ms.	t(102) = .17,	p = .867
de NP	359.41 ms.	285.24 ms.	t(102) = 2.32,	p = .022
est-ce que	385.32 ms.	304.18 ms.	t(102) = 3 .19,	p = .002
tous les N	558.29 ms.	380.09 ms.	t(102) = 2 .42,	p = .017
aux	471.82 ms.	443.55 ms.	t(102) = .48,	p = .631
donc	613.04 ms.	483.11 ms.	t(102) = 1.18,	p = .242
verb	1598.59 ms.	1062.91 ms.	t(67.03) = 1.50,	p = .138

Table 3: Reading times of interrogatives-*Advanced* population (n = 16):
Common versus distributive answers

	common 109 cases	distributive 95 cases	t-test statistics	
combien	445.79 ms.	420.18 ms.	t(202) = .67,	p = .503
De NP	409.59 ms.	439.99 ms.	t(147,77) = .70,	p = .485
est-ce que	429.13 ms.	483.48 ms.	t(151,76) = 1.33,	p = .186
tous les N	634.91 ms.	655.61ms.	t(202) = .24,	p = .811
aux	509.20 ms.	571.83 ms.	t(202) = .95,	p = .344
donc	478.80 ms.	427.57 ms.	t(202) = 1.36,	p = .166
verb	776.76 ms.	923.57 ms.	t(202) = .99,	p = .324

Table 4: Reading times of interrogatives-*Intermediate* population (n = 23):
Common versus distributive answers *(no differences emerge)*

Advanced learners exhibited longer reading times on common interpretations than on distributive interpretations, but only for specific segments: *de* NP, *est-ce que* and *tous les* N, as shown in Table 3. Intermediate learners exhibited no significant differences.

Thus, reading time differences are (largely) confined to (segments immediately following) the introduction of ambiguity associated with the interpretation of the restriction of the wh-cardinality expression. There are also effects on the verb, with greater reading times on common interpretations. This is plausibly due to a reconsideration of common interpretations by subjects before they answer.

3.2 Discussion

It is generally assumed that all available information is put to use in order to maximize the parse up to the limits of the allowable relations. Context, therefore, should significantly (i.e., measurably) bias scope ambiguity resolution, *if the flow relations in the processor allow it.* We found, instead, a *bias* that reflects the structure of interpretations. This is highly suggestive of the autonomy of syntax in L2 processing and the limits on the role of context in sentence processing. The flat pattern with the intermediate group is explained if failure of the parse (prior to the acquisition of the *de* morphology) eliminates the constraining power of syntax on the range of interpretive possibilities. Acquisition of the Case-theoretic import of the *de* morphology, which licenses restrictions in situ, leads to asymmetrical access to interpretations in advanced learners (only). If the developing grammar interacts with a universal performance theory in such a way, we expect L1 scope processing to be similarly constrained in the limits of parametric variation.

3.3 Natives and non-natives

English natives (n = 32) produced significantly longer reading times on common than on distributive interpretations for the auxiliary in the C position only.

	common 59 cases	distributive 92 cases	t-test statistics	
how many	439.71 ms.	455.71 ms.	t(149) = .32,	p = .746
NP	396.47 ms.	334.66 ms.	t(77.73) = 1.57,	p = .119
aux	423.49 ms.	351.46 ms.	t(149) = 2.60,	p = .010
all the N	761.73 ms.	593.37 ms.	t(149) = 1.27,	p = .207
thus	593.20 ms.	503.70 ms.	t(149) = .85,	p = .395
verb	1029.68 ms.	668.94 ms.	t(83.41) = 2.51,	p = .014

Table 5: Reading times-*English Natives* (n = 32):
Common versus distributive answers

French natives (n = 16) show asymmetrical scope resolution between the common and distributive interpretations on the subject quantifier in the Specifier of I only.[2]

	common 34 cases	distributive 41 cases	t-test statistics	
combien	454.14 ms.	418.19 ms.	$t(73) = 1.09$,	$p = .281$
de NP	409.35 ms.	355.71 ms.	$t(73) = 1.08$,	$p = .286$
est-ce que	422.09 ms.	388.76 ms.	$t(73) = .75$,	$p = .455$
tous les N	644.85 ms.	421.22 ms.	$t(41.49) = 2.16$,	$p = .036$
aux	511.15 ms.	546.97 ms.	$t(73) = .40$,	$p = .692$
donc	516.50 ms.	456.15 ms.	$t(45.39) = .99$,	$p = .355$
verb	1535.00 ms.	1078.83 ms.	$t(47.38) = 1.80$,	$p = .078$

Table 6: Reading times-*French Natives* (n = 16):
Common versus distributive answers

Thus, interpretation-based contrasts in reading times of cardinality interrogatives are detected on an earlier segment in our English natives than in our French natives. Such a difference is consonant with differences in relative computational complexity between French and English in access to common interpretations. It is also consonant with results of Villalta (1999, 2003) who found differences in rates of suppliance of common answers to cardinality interrogatives in English and French. The reading time effects were limited to one segment in English and French natives. But, advanced L2 learners' patterns showed an effect in reading times spread over several segments. This lower-level difference is possibly due to slower L2 processing.

4. Conclusion

The results from our task suggest that the behavior of both natives and non-natives requires a structural (economy-driven) theory of scope resolution interacting with language-specific parameters. Patterns found in L2 development do not follow from greater familiarity with lexical items, but require a grammatical explanation. We argued that these asymmetries commit us to a structural theory of computations with repercussions for the role of context.

The simplest explanation for our results seems to be that sentence processing involves a (largely) universal parser, *pace* the parameterized functional lexicon. Enhanced L2 parsing competence arises with the development of L2 lexical

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[2] Two outlying tokens were removed from the count of the French native group, with a reading of over 3000 milliseconds for the subject expression. These aberrant measures were well above two standard deviations.

hypotheses developed when the L1 hypotheses fail to characterize the input in the Universal Grammar principles (Schwartz and Sprouse 1994, 1996). L2 processing, therefore, obeys the same theory of performance as native processing, except for the growth of a target language appropriate grammar. Our data are strongly suggestive of this model.

In the absence of a universal parser, greater context-dependency of L2 processing is expected for properties of the target language that the L1 grammar does not license. Therefore, evidence that L2 processing is narrowly constrained by flow relations determined by Universal Grammar threatens the hypothesis of distinct grammar-parser-context relations in L1 and L2 acquisition.

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