

# What Constrains the Acquisition of Agreement Relations? Some Evidence from the Acquisition of Gender in L2 French

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## 1. Second language (L2) acquisition in the generative paradigm

### 1.1. L2 acquisition and the computational system for human language

Although (both child L1 and adult L2) learners have been shown to acquire subtle interpretation differences that are absent from the input (e.g., Dekydtspotter & Hathorn, 2005), they also display developmental errors, such as errors on tense marking and agreement despite their overwhelming presence in the input. Nonetheless, (adult L2) acquisition appears to be guided by internal mechanisms that suggest the reliance of (L2) grammars on a domain-specific language processing module (Dekydtspotter & Sprouse, 2001). Additionally, there is evidence that learning routes differ as a function of the first language (L1) grammar. Even if adult L2 acquisition depends on Universal Grammar (UG)-constrained mechanisms, not all learners are expected to arrive at the same analysis of the input grammar given the role of the L1 as a kind of filter in L2 acquisition. The morphological variability observed in L2 performance has been the source of a great deal of research. Recently, the debate has shifted to the question of the activation of features in the L2 grammar. Some researchers (e.g., Franceschina & Hawkins, 2003; Hawkins & Casillas, 2008; Hawkins & Chan, 1997; Hawkins & Liszka, 2003; Tsimpli & Dimitrakopoulou, 2007) argue that features not selected by the L1 grammar are not available in L2 acquisition. In contrast, other researchers (e.g., Hazdenar & Schwartz, 1997; Lardiere, 2005, 2008, 2009; McCarthy, 2007, 2008; Prévost & White, 2000) argue that all features are available in the L2 but that other factors, such as communication pressures, contribute to the observed morphological variability. This study aims at further examining the conditioning factors that trigger morphophonological agreement by investigating the acquisition of gender in L2 French. English learners at three levels of proficiency along with French native speakers as a control group completed a judgment task in a self-paced moving-window format. Data thus consisted of acceptance rates and reading times (RTs), which provided a window into the mechanisms that L2 grammars rely on when processing the gender feature.

### 1.2. The narrow structure of L2 representations

From the perspective of the Minimalist Program (e.g., Chomsky, 2001), features, such as number and gender, are core elements in the implementation of the sound-meaning mapping in languages. The set of features is arguably universal; however, not all languages select all features or make identical use of the selected features. Chomsky (1995) argued that two types of features are necessary in the grammar: (a) interpretable features, such as Gender, and (b) counterpart uninterpretable features, such as *u*Gender. Interpretable features are associated with lexical categories and semantic information (i.e., gender of nouns). For example, in French, the synonyms *vélo* and *bicyclette* “bike” differ in the value of the interpretable gender feature: *vélo* carries the underspecified gender masculine, [Gender: Ø], whereas *bicyclette* is specified for gender, [Gender: Feminine]. This is reflected on the agreeing article, *le* “the-MASC” and *la* “the-FEM” for *vélo* and *bicyclette*, respectively. Uninterpretable features are usually associated with functional categories (i.e., tense, determiner) and are deleted under match

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during computation. For instance, in French, verbs not only carry an interpretable feature for verb (i.e., [V]) but also additional uninterpretable features for computations involving verbs, as in the case of gender agreement on the past participles. In sentences such as *la lettre, les femmes l'ont écrite* “the letter, the women wrote it,” the interpretable gender feature of the noun *lettre* “letter,” [Gender: Feminine], values the uninterpretable gender feature of the past participle, [*u*Gender: Feminine], which deletes. Crucially, all features must enter into a checking relation (i.e., an interpretable feature F values its uninterpretable counterpart *u*F) via the Agree operation (e.g., Chomsky, 1995). Because L2 acquisition is assumed to be constrained by UG, a derivation needs to converge at logical form (LF) and phonological form (PF) to satisfy Full Interpretation: All uninterpretable features need to be checked at spell-out.

In line with the principles and parameters framework (e.g., Chomsky, 1981), features have either marked or default values. Moreover, features are modeled in hierarchical geometries (e.g., Harley & Ritter, 2002). Thus, the value [Feminine] depends on the individuating feature [Gender], whereas the feature [Masculine] is not part of underlying representations of feature matrices. (Note that the noun *vélo* “bike” for instance carries an underspecified gender [Gender: Ø] and not a marked masculine gender of the type [Gender: Masculine].) The value [Masculine] is possibly supplied as a value via a default redundancy rule of insertion in morphophonological representations. This dependence of masculine and feminine on the notion gender requires that the feature Gender and its uninterpretable counterpart *u*Gender mediate the [Feminine] and [Masculine] gender agreements in French. UG constrains this dependency via Agree.

Such a feature-geometry account has direct consequences in the computation of agreement. In the case of gender agreement on past participles in French, in a feminine context, there are thus two potential candidates: (a) the past participle *écrite* “written,” whose uninterpretable feature *u*Gender has the gender value [Feminine]; or (b) the past participle *écrit* “written,” which is underspecified for gender. If no other form of the past participle that is fully specified exists in the grammar, the underspecified morphophonological form *écrit* may be inserted in a feminine context because it does not create a feature clash (see e.g., McCarthy, 2007).

## 2. Features in L2 morphosyntax

### 2.1. Interpretability hypotheses

For some researchers, morphological variability in L2 acquisition reflects the unavailability of features (e.g., Franceschina & Hawkins, 2003; Hawkins & Casillas, 2008; Hawkins & Chan, 1997; Hawkins & Liszka, 2003; Tsimpli & Dimitrakopoulou, 2007). First, Hawkins and Chan suggested that features not instantiated in the L1 grammar are unavailable during L2 acquisition—the failed functional features hypothesis. Later, Tsimpli and Dimitrakopoulou refined this proposal: Only uninterpretable features not instantiated in the L1 grammar are unavailable for grammatical operations in L2 acquisition. More recently, Hawkins and Casillas proposed the contextual complexity hypothesis, which states that all learners’ grammars initially only rely on context-sensitive strategies based on distributional regularities in the input. If the features involved are part of the L1 grammar, the L2 grammar will rely on UG-constrained operations. This would be the case for the Number feature for English learners of French. However, for those features that are absent from the L1 grammar (such as Gender for English learners of French), L2 grammars will continue to rely on rules of co-occurrences. Such a position has been contested by Lardiere (2009) on the basis that, if “features reflect ‘the grammaticalization of fundamental cognitive categories’ (Harley & Ritter, 2002: 482), there is little reason to think that the categories encoded by features are substantially different crosslinguistically or especially that they are ultimately inaccessible to adult learners” (p. 46).

### 2.2. Mapping problems

#### 2.2.1. Missing surface inflection hypothesis

Another group of researchers argues instead that L2 morphological variability reflects the cost of feature calculations and the use of defaults to mitigate such costs (e.g., Hazdenar & Schwartz, 1997; Lardiere, 2005, 2008, 2009; McCarthy, 2007, 2008; Prévost & White, 2000). Based on the distributed morphology framework (e.g., Halle & Marantz, 1993), proponents of the missing surface inflection

hypothesis (Hazdenar & Schwartz; Prévost & White) claimed that production pressures lead to insertion of underspecified forms, even though specifications of functional categories are acquired. L2 grammars are thus believed to rely on all functional categories and values related by Agree. McCarthy (2007) extended this account to comprehension data with the morphological underspecification hypothesis because similar asymmetries suggestive of underspecified lexical representations were found. Based on her findings in L2 Spanish, McCarthy (2008) argued that learners' grammars can allow underspecified forms (which trigger a lesser processing cost) to be inserted but reject cases of feature clash (which trigger a greater processing cost). Therefore, the distinction between underspecified forms (i.e., default forms—reflecting underspecified values of features—that may be inserted instead of a fully specified form under certain conditions in which reducing cost is more important than satisfying feature matching) versus cases of feature clash (i.e., forms that, due to the mismatched values of features, are ungrammatical) forms the core of the morphological underspecification hypothesis.

More recently, Lardiere further refined these proposals with the feature reassembly hypothesis (Choi & Lardiere, 2006a, 2006b; Lardiere, 2005, 2008, 2009). Couched within the Minimalist framework, Lardiere argued that L2 acquisition first involves the identification or detection of features. The most challenging task for the L2 learners is the (re)assembly of features into matrices of functional categories and lexical items.

### 2.2.2. *The feature reassembly hypothesis and the universal parser*

Because Lardiere does not discuss the mechanisms that constrain L2 acquisition, it is argued here that a universal parser constrains the development of interlanguage grammars (Renaud, 2010, 2011). Indeed, if processing is a prerequisite for acquisition (Fodor, 1998), then it follows that what cannot be parsed cannot lead to grammatical development. Crucially, to trigger a UG-constrained grammatical change, the parser needs to minimally be UG-compatible. If a grammar results from the interaction of a UG-governed computational space and a language specific lexicon, it follows that, for a L2, the initial state of acquisition is the UG-governed computational space augmented with language-specific information acquired in L1 acquisition (Schwartz & Sprouse, 1994, 1996). Interlanguage grammars therefore arise within the constraints of UG: In particular, UG constrains access to grammatical features relevant to parse the input. Following Lardiere (2009), the development of new feature matrices for functional categories and lexical items presents a serious challenge given the complexity of the relations involved, in part because of the influence of the feature organization of the L1 grammar.

I assume, following Dekydtspotter (2001), that the universal parser provides the essential learning mechanism that constrains L2 acquisition. The contents of the parser are presumably provided by UG, increased by a language-specific lexicon (Crocker, 1996; Dekydtspotter; Schwartz, 1999); thus, in principle, a UG-sanctioned syntactic analysis can be achieved by any learner. Additionally, it is assumed that learning is failure driven: A parse that is required by the input but unlicensed by the current grammar will thus trigger a change (Fodor, 1998). Therefore, the interlanguage grammar presumably develops as a result of the need to fully structure the input with greater efficiency. In this way, the structure of the representations themselves narrowly constrains the range of features relevant to the analysis of the input. Due to the role of the parser in learning, it is expected that feature (re)assembly would occur in the parser before it is reflected in the grammar. In other words, effects should be observed in processing (e.g., in RTs) before they are observed in grammatical knowledge (e.g., in acceptance rates).

On this view, (L2) acquisition proceeds in the following manner: A (gender) agreement relation is detectable due to morphological alternations, such as *vert* versus *verte* “green” or *écrit* versus *écrite* “written,” because the parser must fully interpret the input. This morphophonological alternation between forms needs to be accommodated via a morphosyntactic dependency, under UG-constrained operations (i.e., Agree and Move), if possible. As a result, the structure of the sentence itself determines the features relevant to the parse of dependent forms. In other words, the parse assigned to the input must be within the limits of UG, which specifies Agree as a valuation or matching relation between a feature F and an unvalued uninterpretable feature *uF* in a c-command relation. This parse determines the nature of the representations to be stored in the lexicon. The (functional) interlanguage

lexicon is then updated to reflect parses that are necessitated by the input but not grammatically licensed.

### 3. Predictions

Note that all hypotheses—the interpretability hypotheses (e.g., Hawkins & Casillas, 2008; Hawkins & Chan, 1997; Tsimpli & Dimitrakopoulou, 2007) and the feature reassembly hypothesis augmented by a universal parser (see, e.g., Lardiere, 2009; Renaud, 2010, 2011)—argue that feature detection is possible but they differ as to the mechanisms on which interlanguage grammars rely to reassemble the selected features. Because not all feature systems have the same processing consequences (Dekydspotter & Renaud, 2009), different processing profiles are expected to be found in RTs.

For the proponents of the interpretability hypotheses (e.g., Hawkins & Chan, 1997; Tsimpli & Dimitrakopoulou, 2007), phonological realizations of dependencies are thus expected to be “identified as recurrent and stable phonological strings in the input” (Hawkins & Casillas, 2008, p. 602). This is the case because “their representation in the Vocabulary is in the form of context-sensitive rules specifying the nodes with which they cooccur” (Hawkins & Casillas, p. 602). That is to say that there should be evidence for domain-general rules of co-occurrences in the input: Faster RTs on and high acceptance rates of cases of matching features versus slower RTs on and low acceptance rates of mismatching features. Additionally, the interpretability hypotheses also predict the simultaneity of processing of agreement relations and of knowledge of co-occurrences: Effects should be observed in both RTs and acceptance rates at (approximately) the same time.

In contrast, the hypothesis of a parsing-to-learn mechanism, or universal parser (Dekydspotter & Renaud, 2009; Renaud, 2010, 2011), based on Lardiere’s (e.g., 2009) feature reassembly hypothesis, would expect to find evidence in learners’ processing of a specific calculus of features that mediates the lexical encoding of morphosyntactic contrasts—that is, reflexes of the cost of feature checking and reflexes of underspecification of morphological forms as well as of clashing forms. RTs asymmetries would thus be threefold: (a) shortest RTs on default or underspecified forms, (b) long RTs on matching or agreeing features, and (c) longest RTs on clashing forms. Additionally, if acquisition is guided by the universal parser, as this proposal assumes, a dissociation between processing and grammatical knowledge is expected: evidence would be found in processing (RTs) before it appears in grammatical knowledge (acceptance rates).

### 4. Gender in French grammar

The gender feature is examined because it is not part of the L1 grammar of the English-speaking learners. Additionally, the gender feature involves local agreement relations between an interpretable feature and its uninterpretable counterpart. The use of distinct contexts of gender agreement (e.g., the nominal and the verbal domains) allows the investigation of whether feature representations are context-dependent (based on rules of co-occurrence) or context-independent (resulting from UG-constrained representations).

#### 4.1. Interpretable feature: Pronouns and matching in the discourse

The resolution of pronouns as co-referent with referential expressions (R-expressions) is presumably similar in English (e.g., *the girl...she*) and in French (e.g., *la fille...elle*). The use of pronouns relies on two components: (a) the identification of a referent in discourse to establish a dependency at the discourse-semantics interface (which also depends on gender matching; see Kamp, 1981) and (b) the syntactic licensing by binding theory (Chomsky, 1981). Binding theory requires the compatibility of the indexation of the pronoun with the referent identified from the discourse and the checking of the  $\phi$  features of the pronouns in the relevant domain. Pronouns are thus computed in a two step process: automatic co-indexing of features with a referent and semantic association with the discourse representation at the discourse level. In the sentences in (1a) and (2a), gender between the referent and the pronoun matches, and the pronoun is free within its governing category; the automatic co-indexation process is therefore satisfied.

- (1) a. *Les enfants ont oublié le vélo gris. Il est encore dans le garage.*  
 The children have forgotten the bike-MASC grey. it-MASC is still in the garage.  
 b. \**Les enfants ont oublié le vélo gris. Elle est encore dans le garage.*  
 The children have forgotten the bike-MASC grey. it-FEM is still in the garage.  
 “The children forgot the grey bike. It is still in the garage.”
- (2) a. *Les enfants ont oublié la bicyclette grise. Elle est encore dans le garage.*  
 The children have forgotten the bike-FEM grey. it-FEM is still in the garage.  
 b. \**Les enfants ont oublié la bicyclette grise. Il est encore dans le garage.*  
 The children have forgotten the bike-FEM grey. it-MASC is still in the garage.  
 “The children forgot the grey bike. It is still in the garage.”

However, in sentences (1b) and (2b), because of the gender mismatch between the pronoun and the referent, a referential dependency cannot be established nor can the  $\phi$  features of the pronouns be checked. See Rigalleau and Caplan (2000) and Rigalleau, Caplan, and Baudiffier (2004) for further evidence on the role of gender in pronoun resolution following animate referents in English and French, respectively.

Note that the referents in (1) and (2) are synonyms that differ only in their gender assignment. In other words, both *vélo* and *bicyclette* denote the same entity, a bike. It could be argued that there is a way of associating discourse referents with entities in the model. Assuming a feature-geometric proposal (Harley & Ritter, 2002), feminine and masculine are in a hierarchy configuration in which feminine is more specified than masculine. Therefore, it is possible that the less specified masculine form of the pronoun allows for co-indexation to occur with a feminine referent, as the features do not clash—although matching is preferred. Upon hearing a sentence as in (2b) in a context in which the bike is the only possible referent for the pronoun, a listener would presumably accommodate the underspecified gender of the pronoun. Such an accommodation would likely result in an additional processing cost. In contrast, because the value of the feminine pronoun clashes with that of the masculine noun, the derivation of sentence (1b) is expected to be rejected as ungrammatical due to feature clash. Such a finding would be consonant with the results of McCarthy (2008).

#### 4.2. Uninterpretable feature: The verbal and nominal domains

##### 4.2.1. Past participle agreement

French and English select similar feature matrices on T for subject-verb agreement. However, only in French does the T node include  $u$ Gender because there is both subject- and object-verb agreement on the past participles. For a sentence as in (3), following from the inclusiveness condition (Chomsky, 1981), the local properties of the input (i.e., the features of the topic and of the clitic) constrain the features relevant for the past participle under the analysis in (4).

- (3) *La belle lettre, Pierre l' a écrite.*  
 The beautiful-FEM letter-FEM, Pierre it-FEM has written-FEM
- (4)  $[_{TopP} [_{DP} \text{ la belle lettre}] [_{FinP} [_{TP} \text{ Pierre } [_{VP} [_{DP} \text{ l'}] [_{VP} \text{ a } [_{V} \text{ écrite } \langle \text{la} \rangle ]]]]]]]]$

The analysis of the past participle depends on the establishment of a checking relation in a Spec-head configuration (between the moved object clitic and the  $v$ -head hosting the past participle). The candidate set for F is restricted by the local properties of the input to a D-feature in the interlanguage; it must be [Gender] and [ $u$ Gender].

##### 4.2.2. Adjective agreement

French nouns are assumed to have an interpretable gender feature that is either lexically specified as [feminine] or is lexically underspecified and may receive a [masculine] value by default rules. In contrast, (determiners and) adjectives carry uninterpretable features that are valued via the Agree operation by spell out (Harris, 1991; McCarthy, 2007). It is assumed that (a)  $u$ Gender is implicitly part of the grammatical state of the English learner of French—it is inherent in the universal component—

and (b) *u*Gender is not explicitly part of knowledge of English—it is not part of the Lexicon. To process a noun phrase (NP) as in (5), it is hypothesized that the features of the NP constrain the features relevant for the adjective via the Agree relation (between the moved noun and the adjective) under the analysis in (6).

- (5)      *La*            *robe*            *verte*  
             The-FEM dress-FEM green-FEM
- (6)      [DP *la* [<sub>NumP</sub> *robe* [<sub>NP</sub> [<sub>AP</sub> *verte* ] <*robe*> ]]]

This operation occurs within a local configuration and relies on a dependency between a feature F and its uninterpretable counterpart *u*F, which are in a c-command relation. Because all uninterpretable features must be valued at spell out, and given the agreement relation in this case, the candidate set for F is gender and number in the interlanguage grammar of English learners of French. For the derivation to succeed, the features of the probe and the goal need to be compatible. An incompatible value would block the insertion of a lexical item because its uninterpretable feature could not be checked at spell out.

## 5. The Study

### 5.1. Participants

American learners of French from three different proficiency levels participated in this study: 24 second-semester (mean age = 20, range = 17-39), 26 fourth-semester (mean age = 20, range = 17-23), and 15 advanced learners (mean age = 27, range = 22-32). The low-proficiency learners were all undergraduate students at a large Midwestern university, whereas the advanced learners were graduate students pursuing degrees in French literature or linguistics at the same university. An independent measure of proficiency, a c-test, confirmed the division of the learners into three proficiency groups. A control group of 15 French native speakers (mean age = 23, range = 20-42) also completed the experiment. The group of French native speakers that participated in these experiments was recruited at a French university; all of these French natives were majoring in English and in their second year at the university level at the time of data collection.

### 5.2. Task

After completing a short background questionnaire, participants completed a judgment task on a computer in a non-cumulative self-paced moving-window format. The three conditions discussed here were presented along with four other conditions in an experiment that contained 134 experimental items. Each condition served as the filler items for the other conditions: For instance, the nominal conditions served as distractors for the verbal conditions and for the referential condition, and vice versa. For each experimental item, a context first appeared on the screen, which was paired with a sentence in which the gender had been manipulated. Participants thus first read the entire context sentence and then the second sentence in segments, as shown in the examples. Note that slashes are used in the examples to indicate the segmentation of the test items. At the end of each item, participants were to indicate whether, in their opinion, the second sentence was a good follow-up to the first sentence (i.e., there was no explicit focus on grammar), by pressing *J* for YES or *F* for NO on the keyboard. They also had the option to answer *Je ne sais pas* “I don’t know” by pressing the spacebar.

#### 5.2.1. Interpretable grammatical gender condition

To investigate whether learners are sensitive to the nature of features, a condition that targeted the interpretable gender feature in the referential domain was included. The synonym pairs *vélo-bicyclette* “bike,” *ballon-balle* “ball,” *soulier-chaussure* “shoe,” *gazon-pelouse* “grass,” and *magasin-boutique* “shop” were selected because they were as close to true synonyms as possible and because these words were likely to be known by low-proficiency learners. The frequency of the pairs of synonyms was also checked against the Lexique database (New, Pallier, Brysbaert, & Ferrand, 2004; New, Pallier, Ferrand, & Matos, 2001). A total of 20 experimental items were included in this condition: 10 with a

masculine context and 10 with a feminine context. The context sentence contained a noun and adjective sequence, which specified the gender of the noun. An example of experimental item is provided in (7).

- (7) a. Masculine referent and masculine pronoun  
*Les enfants ont oublié le vélo gris.*  
 The children have forgotten the bike grey-MASC  
*Il / est / encore / dans / le garage.*  
 it-MASC is still in the garage.
- b. Masculine referent and feminine pronoun  
*Les enfants ont oublié le vélo gris.*  
 The children have forgotten the bike grey-MASC  
*Elle / est / encore / dans / le garage.*  
 it-FEM is still in the garage.
- c. Feminine referent and masculine pronoun  
*Les enfants ont oublié la bicyclette grise.*  
 The children have forgotten the bike grey-FEM  
*Il / est / encore / dans / le garage.*  
 it-MASC is still in the garage.
- d. Feminine referent and feminine pronoun  
*Les enfants ont oublié la bicyclette grise.*  
 The children have forgotten the bike grey-FEM  
*Elle / est / encore / dans / le garage.*  
 it-FEM is still in the garage.
- “The children have forgotten the grey bike. It is still in the garage.”

### 5.2.2. Overt past participle agreement with a clitic

In the verbal domain, 10 experimental items in a 2x2 design investigated knowledge of gender past-participle agreement with a clitic in a raised position. In this condition, gender agreement is optional, which makes this the least robust type of agreement in this study. Nevertheless, all of the past participles were selected because they mark gender phonologically. An experimental quadruple is provided in (8).

- (8) a. Masculine context and masculine sentence  
*La grand-mère a demandé un paragraphe amusant.*  
 The grand-mother has asked for one paragraph funny-MASC-SING.  
*Les femmes / l' / ont / donc / écrit / tranquillement / le lundi.*  
 The women it-SING have thus written-MASC-SING quietly on Monday  
 “The grand-mother asked for a funny paragraph. The women thus wrote it quietly on Monday.”
- b. Masculine context and feminine sentence  
*La grand-mère a demandé un paragraphe amusant.*  
 The grand-mother has asked for one paragraph funny-MASC-SING.  
*Les femmes / l' / ont / donc / écrite / tranquillement / le lundi.*  
 The women it-SING have thus written-FEM-SING quietly on Monday  
 “The grand-mother asked for a funny paragraph. The women thus wrote it quietly on Monday.”
- c. Feminine context and masculine sentence  
*La grand-mère a voulu une belle lettre.*  
 The grand-mother has asked for one beautiful-FEM-SING letter.  
*Les femmes / l' / ont / donc / écrit / tranquillement / le lundi.*  
 The women it-SING have thus written-MASC-SING quietly on Monday  
 “The grand-mother asked for a nice letter. The women thus wrote it quietly on Monday.”

## d. Feminine context and feminine sentence

*La grand-mère a voulu une belle lettre.*

The grand-mother has asked for one beautiful-FEM-SING letter.

*Les femmes / l' / ont / donc / écrite / tranquillement / le lundi.*

The women it-SING have thus written-FEM-SING quietly on Monday

“The grand-mother asked for a nice letter. The women thus wrote it quietly on Monday.”

## 5.2.3. Overt adjective agreement in a superlative construction

In the nominal domain, 10 experimental quadruples scrutinized adjective agreement in a superlative construction. In the context sentence, the gender of the noun was only marked on the adjective. Note that the feminine form of all the adjectives selected was phonologically distinct from the masculine form. Each follow-up sentence contained a superlative form, *le plus* “the most” or *le moins* “the least,” which included the article marked for the gender of the noun. An example of an experimental quadruple is shown in (9).

## (9) a. Masculine context and masculine form

*Après avoir examiné les pantalons les plus grands,*

After having examined the pants-MASC the biggest-MASC

*Marie / a / finalement / choisi / le / moins / vert / pour sortir / au bal.*

Marie has finally chosen the-MASC least green-MASC to go to the bal

“After having examined the biggest pants, Marie has finally chosen the least green to go to the dance.”

## b. Masculine context and feminine form

*Après avoir examiné les pantalons les plus grands,*

After having examined the pants-MASC the biggest-MASC

*Marie / a / finalement / choisi / le / moins / verte / pour sortir / au bal.*

Marie has finally chosen the-MASC least green-FEM to go to the bal

“After having examined the biggest pants, Marie has finally chosen the least green to go to the dance.”

## c. Feminine context and masculine form

*Après avoir examiné les robes les plus grandes,*

After having examined the dresses-FEM the biggest-FEM

*Marie / a / finalement / choisi / la / moins / vert / pour sortir / au bal.*

Marie has finally chosen the-FEM least green-MASC to go to the bal

“After having examined the biggest dresses, Marie has finally chosen the least green to go to the dance.”

## d. Feminine context and feminine form

*Après avoir examiné les robes les plus grandes,*

After having examined the dresses-FEM the biggest-FEM

*Marie / a / finalement / choisi / la / moins / verte / pour sortir / au bal.*

Marie has finally chosen the-FEM least green-FEM to go to the bal

“After having examined the biggest dresses, Marie has finally chosen the least green to go to the dance.”

## 5.2.4. Analysis

For each experimental item, final acceptability judgments and RTs (reported in ms) on the target segment (the pronoun, the adjective, or the past participle) were recorded and analyzed. The segment that immediately follows the critical segment was systematically included in the analysis to check for any delayed, or spill-over, effects, which have been found in L2 acquisition research. The data was coded with SPSS, and extreme RTs (e.g., at two standard deviations from the mean) were eliminated and replaced with the mean for all participants

For each condition, repeated measures 2x2x4 ANOVAs were run on acceptance rates and RT data with context or referent (masculine or feminine) and agreement (masculine or feminine) as within-subjects factor and group (second-semester, fourth-semester, advanced learners, and natives) as between-subjects factor. Note that the masculine and the feminine forms systematically differed in length: for pronouns, two and four letters for the masculine and feminine form, respectively, and for

adjectives and past participles, an additional letter on feminine forms compared to the masculine forms. Therefore, to avoid any effects resulting from the length difference in RTs, residuals were calculated to adjust for any effects attributed to this letter difference. ANOVAs for these segments (i.e., the pronoun, the adjective, and the past participles) were thus run on the adjusted means. The significance level was set at .05 for planned *t*-tests.

## 6. Results

### 6.1. Interpretable grammatical gender

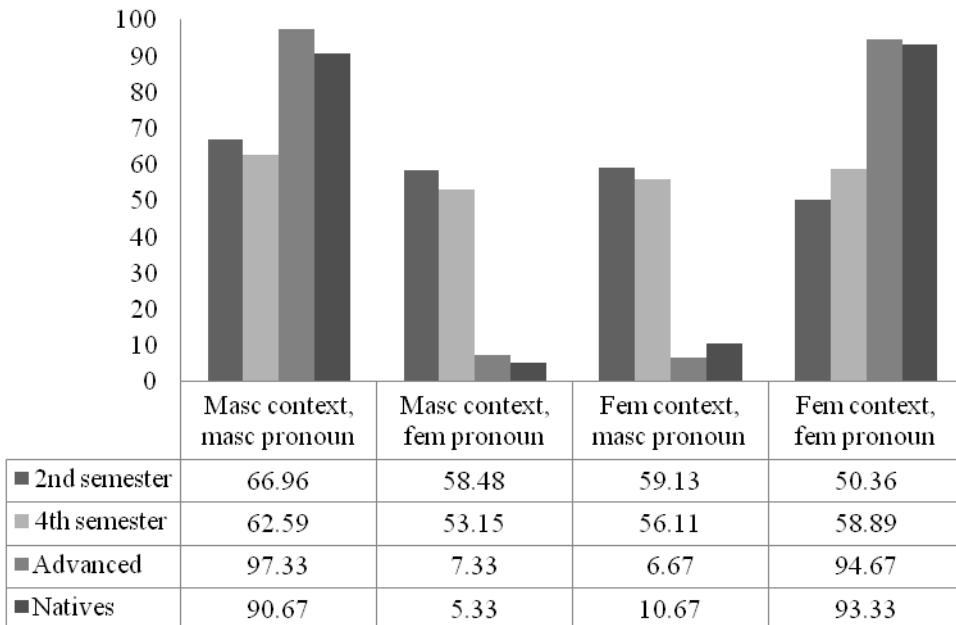
In this condition, learners were presented with experimental items as in (10) in which the referent introduced had a synonym that differed in gender and in which the pronoun either matched or mismatched the gender of the referent.

- (10) *Les enfants ont oublié le vélo gris/la bicyclette grise. Il/Elle est encore dans le garage.*  
 “The children have forgotten the grey bike. It is still in the garage.”

#### 6.1.1. Acceptance rates

Figure 1 provides the results of the acceptance rates in percentages by group for each condition. An ANOVA revealed a significant interaction of referent and agreement,  $F(76, 1) = 299.011, p < .001$ , which was also mediated by group,  $F(76, 3) = 86.960, p < .001$ . The acceptance rates yielded two profiles. The second- and fourth-semester learners seemed to accept all forms of the pronouns at chance in all conditions, whereas the advanced learners behaved like the native speakers, rejecting the mismatched pronouns and accepting the matched pronouns. The seemingly poorer performance of the native speakers (compared to the advanced learners) may be due to their completing the task more quickly overall, which may have caused them to make a greater number of errors (e.g., responding by pressing “no” instead of “yes”) or to answer with more “I don’t know” answers.

Figure 1. Acceptance Rates (in %)



#### 6.1.2. RTs

As noted earlier, due to the different length of the masculine and the feminine form, an ANOVA was run on the corrected RT means for the pronoun segment. It did not reveal any significant

differences. To detect any spill-over effects, the verb and the adverb segments were scrutinized. An ANOVA on the verb segment revealed a main effect of context,  $F(76, 1) = 8.937, p < .005$ . There were also three significant interactions: Agreement x Group,  $F(76, 3) = 4.757, p < .005$ , Referent x Agreement,  $F(76, 1) = 32.133, p < .0001$ , and Referent x Agreement x Group,  $F(76, 3) = 3.331, p < .05$ . On the adverb segment, an ANOVA yielded a significant main effect of agreement,  $F(76, 1) = 4.785, p < .05$ , and a significant interaction of referent and agreement,  $F(76, 1) = 5.404, p < .05$ .

On the verb segment, the second-semester learners were found to slow down in mismatched conditions (masculine context,  $t(22) = 2.280, p < .05$ , and feminine context,  $t(22) = 3.849, p < .001$ ), which suggests that these learners compute the agreeing features. On the adverb segment, these learners also read the adverb segment more slowly in mismatched conditions (masculine context,  $t(22) = 2.244, p < .05$ , and feminine context,  $t(22) = 2.426, p < .05$ ). The fourth-semester learners slowed down on the adverb following a feminine pronoun paired with a masculine noun compared to following a masculine pronoun paired with a feminine noun,  $t(26) = 2.301, p < .05$ . In other words, these learners' processing seems to distinguish between feature clash (long RTs) and underspecification (similar RTs as the matched form). The advanced learners exhibited slower RTs on the verb segment following a feminine pronoun than following a masculine pronoun with a masculine noun,  $t(14) = 3.102, p < .005$ . Such a spike in RTs also seems to reflect a reaction to the clashing feminine feature on the pronoun. The French native speakers' data reflected spill-over effects consistent with morphological expectations (masculine,  $t(14) = 2.855, p < .05$ , and feminine,  $t(14) = 2.737, p < .05$ ). On the verb segment, they slowed down when a feminine pronoun followed a masculine noun,  $t(14) = 4.292, p < .001$ . Additionally, the natives slowed down after a feminine pronoun with a masculine noun compared to after a masculine pronoun with a feminine noun on both the verb,  $t(14) = 4.513, p < .0001$ , and the adverb segments,  $t(14) = 2.633, p < .05$ . The RT data thus revealed that all learners were sensitive to the gender feature: Asymmetries between matched and mismatched forms were found in all groups.

## 6.2. Overt past participle agreement with clitics

In the verbal domain, participants were presented with experimental items in which the past participle agrees with a raised clitic. An example of a masculine context paired with a masculine past participle is provided in (11).

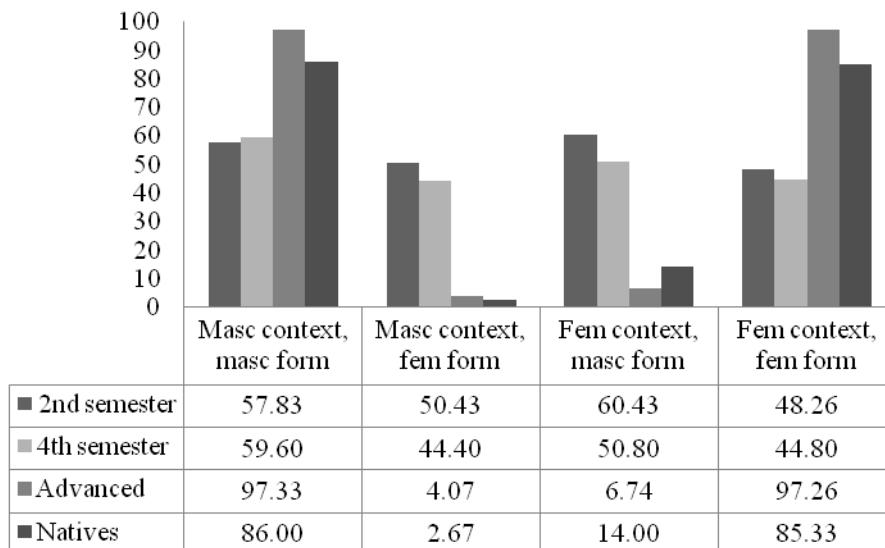
- (11) *La grand-mère a demandé un paragraphe amusant.*  
 The grand-mother has asked for one paragraph funny-MASC-SING.  
*Les femmes /l' /ont /donc /écrit /tranquillement /le lundi.*  
 The women it-SING have thus written-MASC-SING quietly on Monday  
 "The grand-mother asked for a funny paragraph. The women thus wrote it quietly on Monday."

### 6.2.1. Acceptance rates

The acceptance rates are provided in Figure 2. An ANOVA yielded two significant interactions: Agreement x Context,  $F(74, 3) = 510.240, p < .0001$ , and Context x Agreement x Group,  $F(74, 3) = 163.701, p < .0001$ . The low-proficiency learners once again seemed to accept all forms at fairly high rates. Paired-samples  $t$  tests indicated that second-semester learners accepted more masculine than feminine forms in a feminine context,  $t(22) = 2.166, p < .05$ . Fourth-semester learners were found to accept the masculine form of the past participle more often than the feminine form in a masculine context,  $t(24) = 2.532, p < .05$ . In contrast, the acceptance rate pattern from the advanced learners, like that of the native speakers, reflected morphological expectations.

It is a bit unclear as to why the native speakers' overall performance is lower than that of the advanced speakers, but it may be due to a greater number of "I don't know" answers, which required pressing the same button (i.e., the spacebar) as the one to keep on reading. Thus, the native speakers may have skipped some judgments because they were completing the task more quickly and inadvertently pressed the spacebar instead of the *J* or *F* keys. It is also possible that the native speakers rejected some sentences because they found them to be a bit unnatural or not the best follow-up to the context sentence.

Figure 2. Acceptance Rates (in %)



### 6.2.2. RTs

The ANOVA was conducted on the corrected mean RTs on the past participle segment revealed a significant interaction of agreement and group,  $F(74, 3) = 5.177, p < .005$ . To check for any delayed effects, the RTs on the adverb segment were also analyzed. An ANOVA yielded a significant main effect of context,  $F(74, 1) = 7.892, p < .01$ , as well as a significant interaction of context and group,  $F(74, 3) = 2.810, p < .05$ , and one of agreement and group,  $F(74, 3) = 6.701, p < .0001$ .

Paired-samples *t*-tests indicated that second-semester learners read the past participle more quickly when it was matching the feminine context than when it was in the masculine form,  $t(22) = 2.131, p < .05$ . Additionally, these learners also read the adverb segment much more slowly after a masculine form in a feminine context than after a feminine form in a masculine context,  $t(22) = 3.504, p < .005$ . Fourth-semester learners were found to read the feminine form much more slowly than the masculine form in a feminine context,  $t(24) = 2.355, p < .05$ . Similarly, they read the adverb segment much more slowly in a feminine context when it followed a feminine form compared to a masculine form,  $t(24) = 3.049, p < .01$ . For the advanced learner, the RTs on the past participle segment were faster on the feminine than on the masculine form in the feminine context,  $t(14) = 2.557, p < .05$ . The native speakers read the feminine form of the past participle much more slowly than the masculine form in a feminine context,  $t(14) = 2.536, p < .05$ . In a masculine context, the RTs of the native speakers on the adverb segment suggest the computation of the agreeing form versus the dismissal of feature clash,  $t(14) = 3.596, p < .005$ , and the longer consideration of underspecified forms versus feature clash,  $t(14) = 3.094, p < .01$ . In sum, all learners exhibited RT asymmetries suggestive of feature computations. Fourth-semester learners patterned like the natives and reacted to the feature mismatch, whereas the second-semester and the advanced learners showed evidence of the fastest computation of the underspecified masculine form.

### 6.3. Adjectives in superlative constructions

In this condition, the gender of the noun was only marked on an adjective in the context sentence, and both the article and the adjective in a superlative form were marked for the gender of the noun in the follow-up sentence. An example of experimental item with a masculine noun followed by an agreeing masculine adjective is provided in (12).

## (12) a. Masculine context and masculine form

*Après avoir examiné les pantalons les plus grands,*

After having examined the pants-MASC the biggest-MASC

*Marie / a / finalement / choisi / le / moins / vert / pour sortir / au bal.*

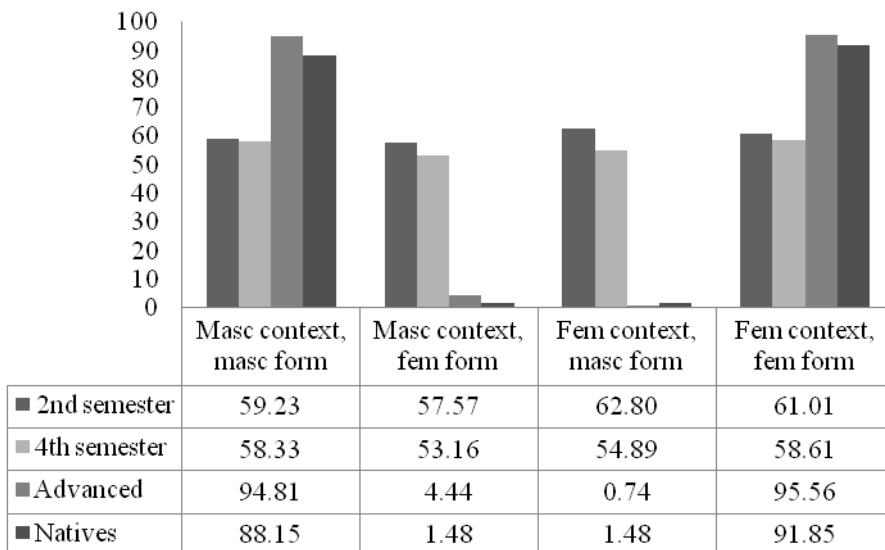
Marie has finally chosen the-MASC least green-MASC to go to the bal

“After having examined the biggest pants, Marie has finally chosen the least green to go to the dance.”

## 6.3.1. Acceptance rates

Figure 3 presents the mean acceptance rates by group for each context. An ANOVA revealed a significant interaction of context and agreement,  $F(75, 1) = 359.024, p < .0001$ , which was also mitigated by group,  $F(75, 3) = 108.732, p < .0001$ . The second- and fourth-semester learners accepted all forms at chance and independently of context, whereas the advanced learners and the native speakers' data follow morphological expectations: They accepted more masculine forms with a masculine noun and more feminine adjectives with a feminine noun ( $p < .0001$ ).

Figure 3. Acceptance Rates (in %)



## 6.3.2. RTs

An ANOVA conducted on the adjusted means of the adjective segment yielded a significant interaction of context, agreement, and group,  $F(75, 3) = 3.761, p < .05$ . To check for spill-over effects, an ANOVA was run on the segment following the adjective. It yielded two significant interactions: Context x Group,  $F(75, 3) = 2.960, p < .05$ , and Agreement x Group,  $F(75, 3) = 3.114, p < .05$ . Paired-samples  $t$ -tests indicated that second-semester learners slowed down on the segment following the adjective after a feminine, mismatched form compared to after a masculine form in a masculine context,  $t(22) = 3.734, p < .001$ . Additionally, these learners also slowed down after a feminine form in a masculine context compared to after a masculine form in a feminine context,  $t(22) = 3.472, p < .005$ . That is to say, the second-semester learners exhibited longer RTs on the clashing forms compared to the agreeing and the underspecified forms. Fourth-semester learners were found to read the masculine adjective more slowly than the feminine form in a masculine context,  $t(25) = 2.754, p < .05$ . In other words, these learners showed longer RTs on the matched form compared to the mismatched form, suggestive of the cost of computing agreement. The advanced learners showed a different pattern: They read the feminine adjective more slowly than the masculine adjective in the masculine context,  $t(14) = 3.965, p < .001$ . In the masculine context, the native speakers slowed down on the segment following a masculine adjective compared to after a feminine adjective,  $t(14) = 3.201, p < .01$ . They

also read the segment following a masculine adjective in a feminine context more slowly than when it followed a feminine adjective in a masculine context,  $t(14) = 4.903, p < .0001$ .

In sum, two profiles emerged from the processing data: The second-semester and the advanced learners exhibited longer RTs on clashing forms, whereas the fourth-semester learners slowed down on the agreeing adjective in the masculine context; a similar effect was found on the following segment in the native-speaker data.

## 7. Discussion

### 7.1. Gender matching in discourse

Two profiles emerged in the acceptance rates of the participants when presented with sentences in which the referent introduced in the context has a synonym of a different gender, as in *le vélo gris, il* “the grey bike, it.” The second- and fourth-semester learners accepted all forms independently of the context at fairly high rates (between 50 and 67%). Such a finding seems to contradict McCarthy’s (2007, 2008) proposal or a feature-geometric model (see, e.g., Harley & Ritter, 2002) because cases of feature clash are allowed as much as agreeing or underspecified forms. In contrast, the advanced learners and the native speakers accepted the matched forms almost exclusively while rejecting the mismatched forms. However, in processing, delayed effects suggestive of the computation of the gender feature were obtained in all groups. The second-semester learners and the native speakers were found to read the mismatched forms more slowly than the matched forms; this suggests the computation of the agreeing relation. The fourth-semester and the advanced learners, like the native speakers, treated the underspecified form similarly to an agreeing form but slowed down on a clashing feature, which is suggestive of the crash in the derivation. Note that these reactions to feature clash in processing are consistent with McCarthy’s proposal. Effects of grammatical gender as a condition of the relation between pronouns and their antecedents were thus found in processing in advance of grammatical knowledge. This dissociation between processing and lexical knowledge is not predicted by interpretability hypotheses (recall that grammar and parsing should go hand-in-hand) but are supported in an account such as the feature reassembly hypothesis (e.g., Lardiere, 2009) augmented by a universal parser (Renaud, 2010). Such a dissociation is also consonant with the findings of Tokowicz and MacWhinney (2005) who investigated knowledge of agreement relations in an event-related brain potential (ERP) study of English learners of Spanish.

### 7.2. Feature calculations

The acceptance rates in the verbal and the nominal conditions revealed two profiles: The second- and fourth-semester learners accepted all forms independently of context or showed a preference for the masculine form, whereas the advanced learners behaved like the native speakers. The high acceptance rates of the clashing forms by the low-proficiency learners are difficult to explain unless it is assumed that the universal parser triggers grammatical changes. In this case, effects are expected to occur in processing before they appear in lexical knowledge, which seems to be the case for the second- and fourth-semester learners in this study (Dekydspotter & Renaud, 2009; Renaud, 2010, 2011) and for the learners in Tokowicz and MacWhinney’s (2005) study.

In processing, however, a single profile emerged: All learners were found to be sensitive to gender agreement in the nominal and in the verbal domains as reflected by the RT asymmetries. In the case of the interpretable gender feature of the pronoun in discourse, asymmetries between the matching and the mismatching forms were observed. The data from the conditions examining the uninterpretable gender feature (i.e., past participle agreement with a raised clitic and adjective agreement in a superlative construction) revealed asymmetries suggestive of the computation of that uninterpretable feature. Not only were asymmetries observed between the clashing forms on the one hand and the agreeing and underspecified forms on the other, but learners also seemed to distinguish between agreeing and underspecified forms. In other words, the findings appear to go beyond an account that only distinguishes between feature clash versus no-clash. Such a processing pattern suggests that the L2 grammar relies on a domain-specific operations constrained by UG. It is interesting to note that instead of systematically finding long RTs in cases of feature clash as predicted by the hypothesis of a parsing-to-learn mechanism based on the feature reassembly hypothesis (see, e.g., Lardiere, 2009;

Renaud, 2010), these forms were most often quickly dismissed, which seems to reflect knowledge of morphophonological expectations.

## 8. Conclusions

The type of asymmetries found in the learner data provides evidence to support the computation of the agreement feature based on domain-specific operations, as proposed by the feature reassembly hypothesis combined with a universal parser (see, e.g., Dekydtspotter & Renaud, 2009; Lardiere, 2009; Renaud, 2010, 2011). The differences in processing between matched and mismatched forms as well as between underspecified forms and clashing forms are not predicted under the interpretability hypotheses (see Hawkins & Casillas, 2008). In contrast, these asymmetries follow naturally from a hierarchy of feature specifications as well as from the computation of agreement via the Agree operation by spell out. In other words, the computations of features were found to occur independently of context or of frequency in the input (cf. Hawkins & Casillas). Another important finding is the dissociation between lexical knowledge and processing. Indeed, effects of feature computation were found in RTs, whereas acceptance rates did not show any evidence of grammatical knowledge. Learning thus appears to be failure driven: The parsing of the input thus seems to constrain the development of the interlanguage grammar (see, e.g., Dekydtspotter, 2001; Schwartz, 1999).

Although the present study can only provide the beginning of an answer to the mechanisms that constrain the acquisition of agreement relation, it indicates that L2 learners at all levels of proficiency appear to rely on domain-specific feature computations, including in cases when features are absent in their L1 grammar. It seems that, in early stages of development, these computations act as the triggers of feature reassembly. Such a finding further highlights the role of the parser in L2 acquisition as a central learning tool. Finally, the results of the present study suggest that core grammatical mechanisms are involved, as reflected by the effects found in processing, but that such mechanisms may not be observed in performance in all contexts. In other words, tests of grammatical knowledge typically found in the L2 classroom may not reflect the full competence of learners.

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# Selected Proceedings of the 2010 Second Language Research Forum: Reconsidering SLA Research, Dimensions, and Directions

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