Gradience in the grammar of agreement: the case of French coordination

Aixiu An[1] Anne Abeillé[2] Roger Levy[1]

[1] Department of Brain and Cognitive Sciences, MIT

[2] LLF, Université de Paris

Gradience in the grammar of agreement: the case of French coordination

Abstract

Typological patterns of grammar across language can manifest within a single language as gradient preferences. Here we show that the agreement hierarchy posited by Corbett (1979) manifests in preferences among three strategies for agreement with coordinate structures in French: closest conjunct agreement, early agreement, and resolution agreement. We develop a quantitative model of gradient agreement preferences within a framework similar to Harmonic Grammar and Linear Optimality Theory, and test the model using data from eleven acceptability judgment experiments. We find that a wide range of native speaker judgments can be captured with six constraints whose weights reflect features of the agreement hierarchy. We additionally find that constraint weights optimized to predict preferences for agreement with conjunctions largely generalize to accurately predict agreement with disjunctions, albeit with a weaker penalty for violation of the resolution agreement strategy.[1]

keywords: agreement, acceptability, gradience, coordination, modeling, grammatical gender, number

1 Introduction

A chief insight arising from the study of language variation in recent decades is that patterns in how categorical constraints vary across languages also manifest *within* a single language as gradient preferences. For example, across many languages the person hierarchy (1st, 2nd ≻ 3rd) interacts with the hierarchy of grammatical functions to categorically block sentences in which the subject argument would be lower on the person hierarchy than a non-subject argument (Silverstein, 1976; Dixon, 1994). Jelinek and Demers (1983) report that this restriction holds in Lummi, for instance, so that the transitive sentence (1a) is acceptable whereas reversing the arguments as in (1b) would render it unrealizable. Instead, that meaning is realized by a passive, as in (1c):

(1) a. x̣čі-t-sən cə swəyʔqəʔ
know-TR-1.SG.NOM the man
'I know the man'

b. *___
'The man knows me'

c. x̣čі-t-ŋ-sn ə cə swəyʔqəʔ
know-TR-PASS-1.SG.NOM by the man
'I am known by the man'

In English, the person hierarchy is not reflected in any categorical constraints on argument realization; hence the translations of all examples in (1) are acceptable. However, Bresnan et al. (2001) showed that the person hierarchy is reflected non-categorically in spoken English: sentences in which the patient outranks the agent are more likely to be passive than sentences in which the agent outranks the patient. The distribution of categorical constraints across many languages (the person–argument associations that are ruled out reflect an alignment of person and grammatical function hierarchies; Aissen, 1999) can also be reflected within individual languages as a gradient preference.

In the present paper we use experimental and modeling data to show that this insight—that within-language gradient preference can mirror cross-linguistically attested constraints—generalizes to an apparently very different case, namely agreement with coordinate phrases in French. Coordination both exemplifies and challenges the centrality of hierarchy in natural language syntax (Peterson, 2004; Borsley, 2005; Townsend et al., 2018; Chomsky, 2017). In general, morphosyntactic agreement reflects hierarchical structure: for example, in the English sentences of (2), the verb—the TARGET of agreement—must agree with the head noun of the subject—the CONTROLLER of agreement—as in (2a); agreement with the linearly local noun as in (2b), though it occurs in language production (Bock and Miller, 1991), is generally understood to be a grammatical error.

(2) a. The key to the cabinets is on the table.

b. *The key to the cabinets are on the table.

However, when the controller of agreement is a coordinate structure, no unique head word of the structure determines the form of the target. Rather, multiple agreement STRATEGIES are observed. In English, in conjunctive coordination (using the word *and*), a semantically motivated RESOLUTION rule determines the number of the coordinate phrase as a whole to be plural. For example, (3a), where the agreement target verb is singular, is ungrammatical even though every individual noun in the agreement-controlling subject phrase is singular. Rather, the target verb must be plural, as in (3b).

(3) a. *The key and the coin is on the table.
b. The key and the coin are on the table.

In other languages, a different strategy, namely agreement with the linearly closest noun (closest conjunct agreement, henceforth CCA), can be observed. For instance, in Moroccan Arabic (Aoun et al. 1994) and Welsh (Sadler 1999; Borsley 2009), when the verb appears before the subject, agreement with the closest conjunct is mandatory, as in (4). Here, plural agreement would be ungrammatical.

(4) Mša/*Mšaw ʕumar w ʕali
leave.PST.M.SG/leave.PST.M.PL Omar and Ali
'Omar and Ali left' (Moroccan Arabic, Aoun et al. 1994)

Not only do different strategies exist cross-linguistically, but they can also coexist within a single language. Similar to the above example regarding person hierarchy, agreement strategies can manifest in some languages as a preference rather than a categorical constraint, as demonstrated by examples from Slovenian (Willer-Gold et al., 2017), and French (Curat, 1999; An and Abeillé, 2019, 2021a). In French, empirical data presented by An and Abeillé (2019) reveal that in examples like (5) determiner number can exhibit either resolution agreement (*vos*) or agreement with a single conjunct (*votre*).

(5) **votre/vos** nom et prénom
your.SG/your.F.PL name.M.SG and first-name.M.SG
'your first and last name' (An and Abeillé 2019, p. 34)

The cross-linguistic distribution of agreement strategies has been characterized by Corbett (1979, 1991, 2023) through the AGREEMENT HIERARCHY. The agreement hierarchy consists of four principal target positions: attributive, predicate, relative pronoun and anaphoric personal pronoun. According to the agreement hierarchy, in cases of agreement with coordination phrases, the likelihood of resolution agreement increases monotonically as we move rightwards along the hierarchy whereas the likelihood decrease. Furthermore, Corbett (1991) presents another typological constraint stating that that CCA is more acceptable when the target precedes the controller.

(6) attributive > predicate > relative pronoun > personal pronoun

⟵ non-resolution – – resolution ⟶

However, variation in agreement strategy preferences within a language has been less extensively studied. Previous studies have been tightly focused on individual morphosyntactic contexts for agreement: attributive (e.g., Le Bruyn and de Swart, 2014), predicative elements (e.g., Nevins and Weisser, 2019), number (e.g., Keung and Staub, 2018) or gender agreement (e.g., Willer-Gold et al., 2017; Marušič et al., 2015). Here, our goal is to develop a more comprehensive model that can account for the variation in agreement strategy preferences across wide-ranging contexts involving coordination phrases—both conjunction and disjunction—in French. French is a particularly suitable language for this goal because it has both number and gender agreement in both attributive and predicative domains. Determiners, attributive adjectives, participles, and predicative adjectives are marked for both gender and number, and verbs are marked for number. As we will see, agreement strategy preferences are GRADIENT: for a given structural context, multiple strategies are possible, but there are preferences—often varying in strength—among them. Corbett's cross-linguistic agreement hierarchy turns out to have strong predictive power for these gradient agreement preferences within French.

We use a simple approach to modelling gradient preferences (fig. 1), closely related to to the Maximum Entropy models of phonotactics described by Hayes and Wilson (2008) and Linear Optimality Theory (Keller, 2000). In our approach, grammatical constraints are binary—a constraint is either ACTIVE or INACTIVE for a given structural configuration—and each has its own associated WEIGHT. The higher the weight of a constraint, the greater the preference to avoid violating it. Variation and gradient preferences thus arise from differences in constraint weights.

We define a space of logically possible grammatical constraints from a set of basic elements across four dimensions: controller, target, domain (attributive/predicative), and feature (number/gender). We estimate the weights of these constraints from empirical data obtained across 11 acceptability judgment experiments in French (e.g., An and Abeillé 2019, 2021a,b), giving us a model of gradient acceptability of coordination agreement in French. We evaluate this model in two ways: leave-one-out cross validation and generalisation to new unseen agreement patterns. Additionally, we use model simplification strategies and find that the full range of agreement preferences in our experiments can be well captured with just six differently-weighted constraints.

Furthermore, the resulting weighted constraint set for French coordination agreement aligns closely with the agreement hierarchy that Corbett proposed to capture cross-linguistic generalizations, for both gender and number agreement. However, we also find subtle variations between gender and number agreement. While we find CCA more acceptable in the attributive domain compared to the predicative domain for both gender and number, we also find that CCA is more acceptable for the less semantically interpretable feature of gender than for the more semantically interpretable feature of number. We also find that agreement strategy

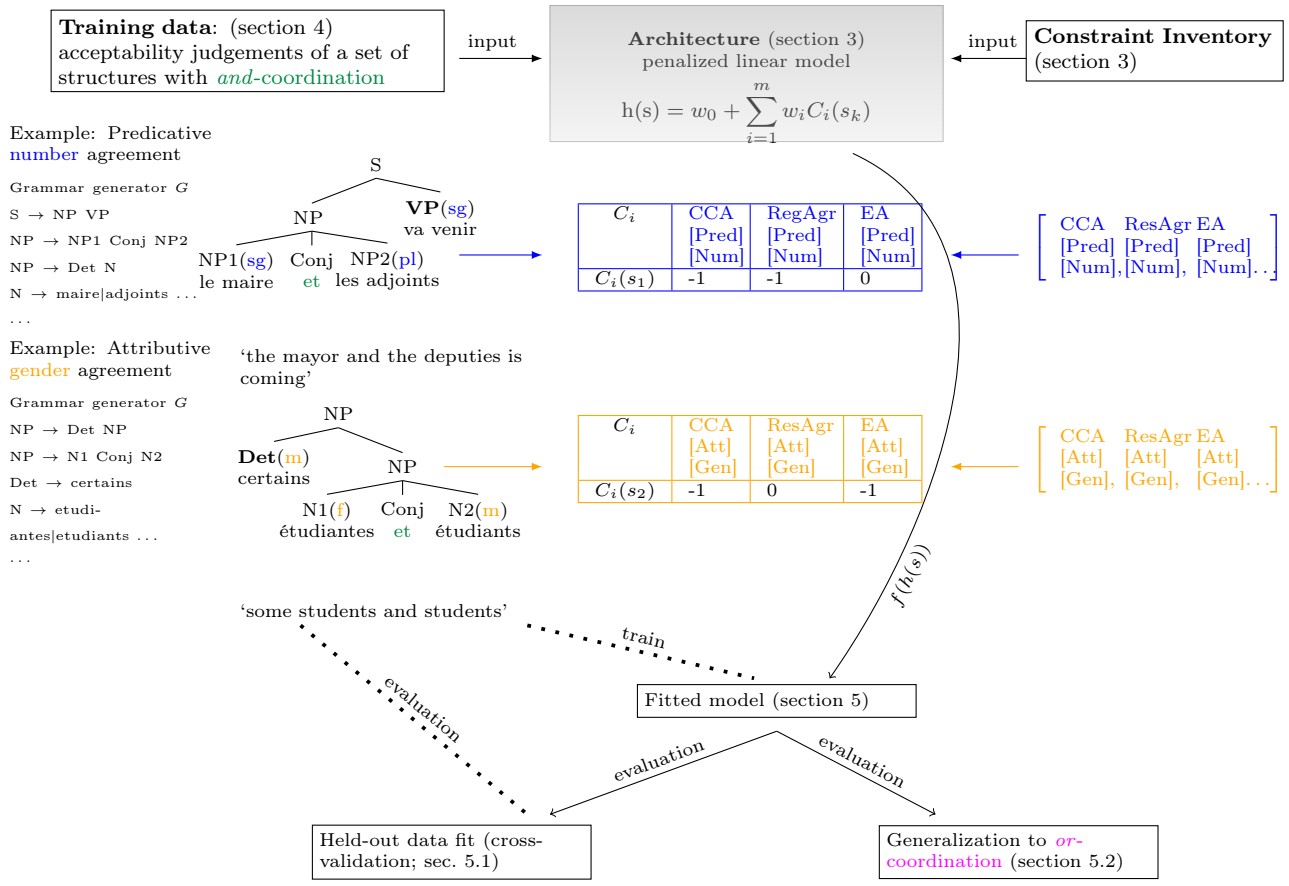


Figure 1: The figure presents an overview of the model, which is trained on human acceptability judgments of *and*-coordination agreement. The model takes as input an agreement structure involving a coordination phrase s and assigns an harmony score $h(s)$ to it. The model consists of constraints C_i with associated weights w_i, where each C_i includes an agreement strategy (closest conjunct agreement (CCA), resolution agreement (ResAgr), or early agreement (EA)), an agreement domain (predicative (Pred) or attributive (Att)), and an agreement feature (number (Num) or gender (Gen)). Acceptability judgment predictions are determined by applying a monotonic linking function $f(\cdot)$ (in this paper, the identity function) to the harmony score. The model is evaluated through leave-one-out cross-validation on a training set and tested for generalization to new agreement data, including both *and*-coordination and *or*-coordination.

preferences for *and*-coordination largely generalize to *or*-coordination, with one important exception: the strength of resolution agreement in *or*-coordination is weaker than in *and*-coordination.

This article is organized as follows. We elaborate on the syntactic status of coordination agreement in section 2. Section 3 describes our model architecture and constraint inventory. Section 4 presents new experimental evidence obtained from 11 acceptability experiments where the agreement controller involves a coordination phrase. This phrase varies in number and gender properties, as well as in position (predicative vs. attributive). In section 5, we report our sum-weighted model for *and*-coordination based on the experimental evidence, alongside different evaluation methods such as leave-one-out cross-validation and generalizations to *or*-coordination structures. Finally, in section 6, we discuss the underlying theories and studies revealed by the model results. We anticipate that the research strategy and methods developed

here will be more broadly applicable to a variety of cases of variation and gradient acceptability in natural language morphosyntax.

2 Agreement with Coordination Structures

Coordination is generally regarded as exceptional from a syntactic perspective, displaying several unique characteristics. According to some researchers, coordination has a flat structure (fig. 2a, Dalrymple and Kaplan, 2000; King and Dalrymple, 2004). Alternatively, other researchers suggest that coordination is headed by a conjunction that lacks most agreement features (see fig. 2b, Kayne, 1994; Johannessen, 1998). Yet another perspective suggests coordination can be seen as hierarchical but unheaded (see fig. 2c, Borsley, 2005; Chaves, 2013). For the remainder of this paper, we adopt a flat structure for coordinations for the sake of simplicity, but nothing relies on this assumption (see Abeillé and Chaves (2021) for arguments in favor of a hierarchical structure).

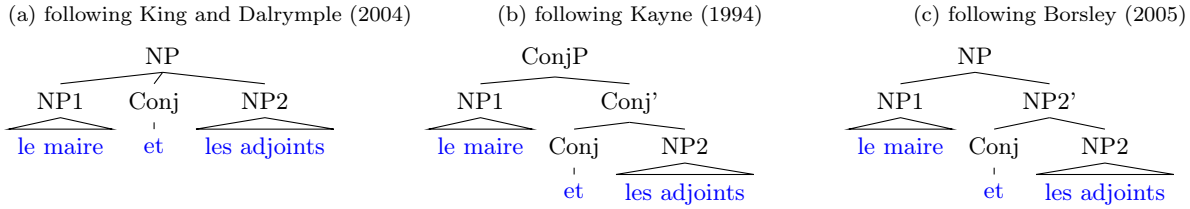


Figure 2: Three possible structures for the coordination phrase *the mayor and the deputies*

2.1 Three Agreement Strategies with *and*-Coordination

Resolution Agreement The term 'resolution rule' (ResAgr), introduced by Givón (1970), describes agreement with conflicting features in coordinate noun phrases. Corbett (1983, 1991) developed resolution rules for person, number, and gender agreement. According to Corbett (1991), in languages like French, number agreement resolution necessitates plural agreement in the coordination of non-coreferential singular nouns ((7), also shows gender resolution), or a combination of singular and plural nouns. For grammatical gender in French, a mixed gender of masculine and feminine is resolved to the masculine (7), while feminine agreement is required when both conjuncts are feminine (8).

(7) un savoir et une adresse **merveilleux**.
a.M.SG knowlege.M.SG and a.F.SG skill.F.SG marvellous.M.PL
'a marvellous knowledge and skill' (Corbett, 1991, p. 186)

(8) Les chaises et les tables sont **mises** à disposition.
the.F.PL chair.F.PL and the.F.PL table.F.PL are put.F.PL to disposition
'Chairs and tables are available.'

Closest Conjunct Agreement Apart from resolution rules, agreement may occur with the closest conjunct (CCA).[2] Crosslinguistically, CCA is quite common, especially when the verb agrees with postverbal conjoined subjects. CCA is also observed in Romance languages, for gender and number agreement of attributive adjectives in Portuguese (Villavicencio et al., 2005), for number agreement of determiners and attributive adjectives in Spanish (Demonte and Perez-Jimenez, 2012).

According to most existing literature, French does not allow for number CCA with *and*-coordination ((9a); see Heycock and Zamparelli, 2005). Few French grammar books (Curat, 1999; Grevisse and Goosse, 2011) mention gender CCA with attributive adjectives. Recently, An and Abeillé (2021a) conducted a study which demonstrates that not only does gender CCA exist in French attributive agreement, but it is also more acceptable for the prenominal attributive adjective (10a) than for the postnominal one (10b).

(9) a. ***Ce** marin et soldat sont souvent ensemble.
this.SG sailor.SG and soldier.SG are often together
'this sailor and soldier are often together' (Heycock and Zamparelli 2005, p. 205)

(10) a. les **différentes** villes et pays
the.PL different.F.PL city.F.PL and country.M.PL
'different cities and countries.' (An and Abeillé 2021a, p. 9)

b. les objectifs et caractéristiques **essentielles**
the.PL objective.M.PL and characteristic.F.PL essential.F.PL
'the essential objectives and characteristics' (An and Abeillé 2021a, p. 9)

Early Agreement We employ the term "early agreement" (EA) (An and Abeillé, 2021a) instead of "first conjunct agreement" (see Aoun et al., 1994; Munn, 1999) or "highest conjunct agreement" (see Marušič et al., 2015; Willer-Gold et al., 2017), drawing on incremental processing theory (see Tanenhaus et al. 1995; Levy 2008). Early agreement refers to the phenomenon where the agreement occurs with the first conjunct when the target precedes the controller (11a). In such cases, the speaker may not have complete information about the features of the whole controller when determining the target agreement. Consequently, they might rely solely on the first noun to establish agreement. However, when the target follows the controller (11b), they possesses knowledge of all the features of the conjuncts before determining the target agreement.

Part of our motivation for distinguishing an Early Agreement (EA) strategy from CCA is Corbett (1991)'s observation that agreement with the linearly closest conjunct is more frequent when the agreement target precedes the controller. Willer-Gold et al. (2017) explain this asymmetry by assuming a hierarchical structure for coordination (fig. 3a): in VS order, the closest noun (N1) occupies a higher hierarchical position, whereas in SV order, the closest noun (N2) is in a lower hierarchical position. Distinguishing EA and CCA strategies makes this asymmetry explainable regardless of assumptions about the internal structure of coordinate phrases: when the controller precedes the target, agreement with the linearly closest (i.e., first) conjunct satisfies both strategies, whereas when the controller follows the target, agreement with the linearly closest (i.e., last) conjunct satisfies only CCA. The magnitude of the asymmetry can then be captured by the relative

strengths of preference for the two agreement strategies.

(11) a. Jučer su **odštampane** molbe i rješenja
yesterday were printed.F.PL requests.F.PL and decisions.N.PL
'Yesterday, requests and decisions are printed out.'

b. Molbe i rješenja su **odštampana** jučer.
requests.F.PL and decisions.N.PL were printed.N.PL yesterday
'Requests and decisions are printed out yesterday.'

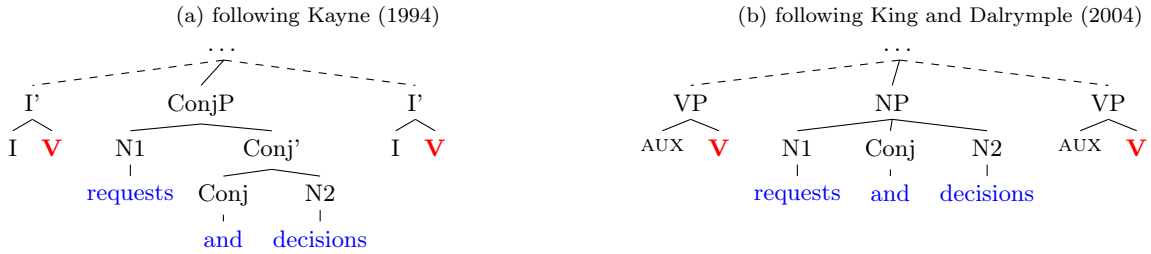


Figure 3: Illustration of word order asymmetry in different coordination structures

2.2 Agreement Strategies with *or*-coordination

The existence of a resolution rule in *or*-coordination has been debated (Peterson 1986; Morgan 1972). In English, as in many languages, a disjunction of singular nouns usually triggers singular agreement on the verb, i.e., *I wonder whether John or Mary is/?are coming.* Foppolo and Staub (2020) provide experimental evidence showing that plural agreement is licensed with an inclusive reading (12a), but also with an exclusive reading (12b), with only a small penalty compared to singular agreement.

(12) a. The lawyer or the accountant is/are coming to the meeting.

b. The lawyer or the accountant is/are going to become the next CEO of the company.

In French, Grevisse and Goosse (2011) and An and Abeillé (2021b) point out that *ou* (or) coordination can trigger plural (13a) or singular agreement (with only one conjunct) (13b).

(13) a. Je ne serais pas étonné que son père ou sa mère **fussent alcooliques**
I NEG would be NEG surprised if his father.M.SG or his mother.F.SG were alcoholic.PL
'I wouldn't be surprised if his father or mother were alcoholics.' (Barrès, cited by Grevisse and Goosse 2011, p. 441)

b. A quoi **tenait** cette certitude, ou cette illusion?
to what applied.SG this certainty.F.SG or this illusion.F.SG
'On what did this certainty or this illusion apply?' (Lavedan, cited by Grevisse and Goosse 2011, p. 445)

In case of a disjunction of a singular and a plural noun, some experimental studies show that in English, more singular verbs are produced when the closest noun is singular (Haskell and MacDonald 2003; Keung and Staub 2018). Fowler and Aaron (2001) prescriptively recommends that "when one part of the subject is singular and the other plural, avoid awkwardness by placing the plural part closer to the verb so that the verb is plural". In (14a), the verb cannot satisfy at the same time the requirement of linear proximity and plural resolution, and as a consequence of this, the construction is not perfectly well-formed. However, in (14b) when the closest noun is plural, the plural verb satisfies both the requirements from the closest conjunct and plural resolution rules, thus it is well-formed (see the discussion by Zwicky 2009).

(14) a. awkward: The cats or the dog have eaten all the daisies.
b. revised: The dog or the cats have eaten all the daisies.

Regarding gender agreement in French, masculine agreement is used with disjoined masculine nouns and feminine agreement with disjoined feminine nouns. In case of mixed gender nouns, agreement can be resolved to the masculine (15a) or CCA (15b), which favours feminine agreement.

(15) a. un sentiment ou une expression **original**
a.M feeling.M.SG or a.F.SG expression.F.SG original.M.SG
'an original feeling or expression.' (Desnos, cited in Grevisse and Goosse 2011, p. 450)

b. celui ou celle qui était **restée** à écrire
this.M or this.F who was remained.F.SG to write
'the one who remained to write.' (Proust, cited in Grevisse and Goosse 2011, p. 450)

Reis (1974) and Peterson (1986) argue that agreement with disjoined NPs is a "patch up" strategy: syntax does not provide agreement principles, and speakers can only resort to variable and unstable strategies: (semantic) plural, (perceptual) proximity or first conjunct. Reis (1974) distinguishes "patch up" strategies from core syntactic rules. Similarly, Foppolo and Staub (2020) propose that agreement with disjunction is a "lacuna of the grammar", which means that the grammar provides no means of valuing the verb's number feature when the subject is a disjunction of singulars, and speakers can freely use different strategies. However, we argue in this paper for the existence of resolution rule in *or*-coordination, but with a different weight compared to *and*-coordination (see section 5.2 below for details).

3 Model Architecture

In this section, we present a simple framework of gradient well-formedness and acceptability, which we exemplify with a model for canonical agreement theory as applied to coordinate structures. Within this model, three distinct agreement strategies are relevant to the well-formedness of a sentence involving agreement with a coordinate phrase: resolution agreement (ResAgr), closest conjunct agreement (CCA), and early agreement (EA). Within the model there is a maximal degree of well-formedness, which is achieved by sentences that

violate none of these agreement strategies. However, any violation of these strategies results in a decrease in well-formedness, with the severity of the penalty being determined by several factors such as the type of agreement domain (attributive or predicative), the agreement features (number/gender), and the conjunctions used (and/or). The quantitative rating of a sentence in an acceptability judgment study is predicted to bear a linear relationship with its well-formedness within the model.

Similar to Harmonic Grammar (Legendre et al., 1990) and Linear Optimality Theory (Keller, 2000), our model (Figure 1) consists of a formal grammar fragment G producing candidate structures s, a constraint evaluation function C whose input is a candidate structure s and whose output is a fixed-length constraint violation profile vector $C(s)$, a non-negative weight vector w characterizing the strength of the constraints, and a linking function f connecting a structure's well-formedness to speaker judgments of the corresponding sentence's acceptability.

Formal Grammar Fragment We assume some formal generative grammar that licenses a set of hierarchically organized and linearly ordered structures $\{s\}$. For illustrative purposes here, we use a context-free grammar (CFG), though we note that other models such as dependency grammar could also be used. The grammar rules to produce coordination structures used in this work are summarized in fig. 4a and referred to as G. Figures 4b to 4d depict examples of parse trees generated by the grammar G. Specifically, fig. 4b and the second fig. 4c, exemplify determiner attributive agreement for gender and number respectively; while the third figure, fig. 4d, demonstrates verb predicative agreement for number. Note that within our framework, the grammar fragment itself does directly impose agreement requirements; these requirements take the form of weighted constraints that are evaluated against the structures generated by the grammar, as we now proceed to describe.

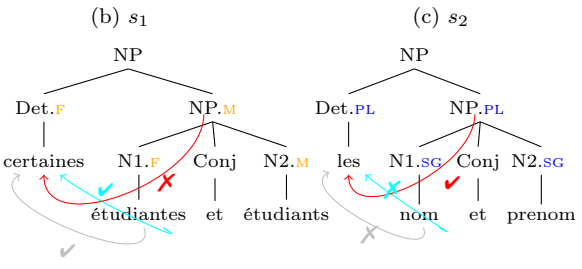
Constraint Inventory Formally, a grammatical constraint C is a function whose input is a structure s generated by the grammar G and whose output is a negative number (generally -1, though see Section 5.2) if the constraint is violated by s, otherwise 0.[3]

In this paper, we focus on constraints relevant to agreement. We follow Corbett (2006)'s canonical agreement theory, in which a complete description of agreement requires four components: controller, target, domain, and features, which is applicable across languages and constructions. Following this terminology, our constraint inventory distinguishes two subgroups: one for number agreement and one for gender agreement. For each subgroup j, the constraint is built up with one agreement strategy (CCA/ResAgr/EA), one domain value (attributive (Att)/predicative (Pred))and one feature value (number (Num)/gender (Gen)), thus resulting in 6 possible constraints for each subgroup (fig. 4e).

Harmony score A structure's WELL-FORMEDNESS SCORE, or HARMONY SCORE, $h(s)$ is determined by subtracting the weights of the violated constraints from the starting value w_0 (which would be assigned to a structure that violates no constraints):

(a) Grammar G

S	→	NP VP
S	→	VP NP
NP	→	NP Conj NP
NP	→	N′
NP	→	Det N′
NP	→	NP A
N′	→	N′ Conj N′
N′	→	N
Det	→	la | certaines | . . .
Conj	→	et | ou
N	→	étudiantes | . . .
A	→	nouvelle | . . .



(e)

Constraint Inventory			w
starting well-formedness w_0			10
ResAgr	[Att]	[Num]	3
ResAgr	[Pred]	[Num]	4
EA	[Att]	[Num]	2
EA	[Pred]	[Num]	1
CCA	[Att]	[Num]	1
CCA	[Pred]	[Num]	1
ResAgr	[Att]	[Gen]	3
ResAgr	[Pred]	[Gen]	2
EA	[Att]	[Gen]	2
EA	[Pred]	[Gen]	1
CCA	[Att]	[Gen]	1
CCA	[Pred]	[Gen]	1

(f) $h(s_1)$

$C(s_1)$	$C(s_1)w$
1	10
0	3
0	4
0	2
0	1
0	1
0	1
-1	3
0	2
0	2
0	1
0	1
0	1
Well-formedness	7

(g) $h(s_2)$

$C(s_2)$	$C(s_2)w$
1	10
0	3
0	4
-1	2
0	1
-1	1
0	1
0	3
0	2
0	2
0	1
0	1
0	1
Well-formedness	7

(h) $h(s_3)$

$C(s_3)$	$C(s_3)w$
1	10
0	3
-1	4
0	2
0	1
0	1
-1	1
0	3
0	2
0	2
0	1
0	1
0	1
Well-formedness	5

Figure 4: **(a)** the CFG grammar fragment used for this work; **(b-d)** example candidate structures s that it generates. For concision, VP rewrite rules are omitted, and only example rewrites are given for preterminal categories Det, Conj, N, A; **(e)** constraint inventory in this work; and **(f-h)** calculation of $h(s)$ score for the structure s_1, s_2,s_3, respectively, where the coefficients w_i are purely fictional and used solely for the purpose of illustration.

$$h(s) = w_0 + \sum_{i=1}^{m} w_i C_i(s) \tag{1}$$

Each constraint function C_i has an associated non-negative weight w_i, with higher weights indicating a stronger effect in decreasing the well-formedness of a structure. Effects of constraint are cumulative in our model: multiple violations of lower-weighted constraints may have a greater impact on overall acceptability than a single violation of a higher-weighted constraint. In contrast to Optimality Theory (OT), our model does not aim to select the best outcome from a set of candidates. Instead, our model assigns to each individual structure a numerical score indicating its acceptability.

Figures 4f to 4h illustrate the computation of harmony scores for three structures s_1, s_2, s_3 generated by grammar G. In fig. 4f, the use of the feminine determiner "certaines" results in a violation of the gender resolution agreement in the attributive domain. This leads to the annotation of the constraint ResAgr [Att][Gen] with -1, indicating the breach of agreement. The plural determiner in fig. 4g violates the constraints CCA [Att][Num] and EA [Att][Num], resulting in a penalty proportional to their respective weights. The score $h(s)$ is computed by summing up the constraint violations, where each violation is multiplied by a corresponding weight. On the other hand, using a singular verb with a coordination of a singular noun and plural noun in fig. 4h induces a violation of ResAgr [Pred][Num] and CCA [Pred][Num]

constraints, which also incurs a penalty proportional to their respective weights and reduces the acceptability of the sentence.

Linking function In practice, we wish to relate the harmony scores for generated structures to empirically obtained acceptability judgments. To do so we use a monotonic LINKING FUNCTION f suitable for the response scale used to obtain acceptability judgments. In our studies, we use quantitatively graded acceptability judgments ranging numerically from 0 to 10; as will be seen in Section 5, the identity function for f turns out to be sufficient for good quantitative fits. For other response scales, different linking functions may be more appropriate; for example, binary acceptability judgments might suggest a logistic linking function.

In the following sections, we will demonstrate how to use acceptability data obtained from the acceptability judgment experiment (section 4) to estimate constraint weights (section 5). Our method involves using linear regression, minimizing the objective function of mean squared error (MSE) between the mean acceptability judgment of native-speakers and the model's prediction. We will then iteratively merge constraint pairs that can be combined without significantly reducing model fit. To assess the ability of our model to accurately predict acceptability judgments for new structural configurations, we employ leave-one-out cross-validation, a technique where each data point is held out as a test set, and the model is trained on the remaining data points.

4 Experimental Data

Our data come from acceptability judgment experiments including both *and*-coordination and *or*-coordination, gender agreement and number agreement. Gathering data on each possible combination of agreement features would result in an impractically high number of conditions. Most of our test conditions include cases in which different agreement strategies conflict. Where possible, we use existing experimental results (e.g., Abeillé et al. 2018; An and Abeillé 2021a for attributive gender agreement) or conduct new experiments by adapting materials from the existing literature (e.g., An and Abeillé 2019 for attributive number agreement).

We ran eight further acceptability experiments:[4] five for number agreement and three for gender. We also use the available data from three existing experiments (see all the conditions in table 1). Their design and procedure are the same. The experiments were conducted online using the Ibex Farm platform (Drummond 2013). Participants were asked to rate sentences from 0 to 10 (from fully unacceptable to fully acceptable). Each experiment features 24 experimental items (half with human nouns, half with non-human nouns, in order to control for animacy). Participants are asked to rate the acceptability of each sentence. Some experimental items are followed by a yes/no comprehension question. In each experiment, filler items from other experiments about island constructions are included (Abeillé et al., 2020). Number and gender are tested in separate experiments. In number experiments, all nouns are of the same gender (m/f), and all nouns in the gender experiments are plurals. We also included (grammatical and ungrammatical) control items to test the difference between CCA and attraction errors (Bock and Miller 1991; Fayol et al. 1994).

	Number		Gender	
Domains	*and*-coordination	*or*-coordination	*and*-coordination	*or*-coordination
attributive	D N1sg et N2sg N1sg et N2sg A D N1sg et N2pl D N1pl et N2pl	D N1sg ou N2sg N1sg ou N2sg A D N1sg ou N2pl	D N1f et N2m D N1m et N2f A N1m et N2f N1f et N2m A	
predicative	NP1sg et NP2sg V NP1pl et NP2sg V NP1sg et NP2pl V NP1pl et NP2pl V	NP1sg ou NP2sg V V NP1sg ou NP2sg NP1pl ou NP2sg V V NP1sg ou NP2pl NP1sg ou NP2pl V V NP1pl ou NP2sg	NP1m et NP2f V V NP1f et NP2m NP1f et NP2m V V NP1m et NP2f	NP1m ou NP2f V V NP1f ou NP2m NP1f ou NP2m V V NP1m ou NP2f

Table 1: Conditions on French agreement with coordinated NPs used for training and testing. The colors represent the agreement features: blue for number and orange for gender. The shade of the color signifies different number/gender conjuncts sequences. The lighter color signifies that the closest noun is singular/feminine.

4.1 Experiments on French Number Agreement

We use the available data for predicate number agreement from An and Abeillé (2021b). We also ran 5 experiments for number, two for attributive agreement and three for predicative agreement, testing both *et* (and) and *ou* (or), as well as directionality.

4.1.1 Attributive Number Agreement

In attributive position, we tested the impact of determiner agreement and post-nominal adjective agreement.[5] We ran three experiments, two for determiner agreement (Experiment I and II) and the other for postnominal adjectives (Experiment III), by adapting items from An and Abeillé (2019). As illustrated in table 2 (fig. 5), three combinations were tested for determiner agreement (`N1sg + N2sg, N1sg + N2pl,N1pl + N2pl`) and only one for post-nominal adjectives (`N1sg + N2sg`).

We recruited 99 participants for Experiment I, 40 participants for Experiment II and 64 for Experiment III. Participants for Experiment I and III were recruited from the platform `http://crowdpanel.io/`, while participants for Experiment II were recruited from Prolific `https://app.prolific.co/`. Experiments lasted 15 minutes and were performed online. Each participant received 4 euros after participation. We excluded participants with comprehension accuracy below 75% and those whose averaged median score for ungrammatical control sentences was equal or higher than that for grammatical control sentences. Following exclusions, the usable data from Experiment I comprised a sample of 81 monolingual French native speakers. Similarly, the data obtained from Experiment II consisted of 37 native speakers, while the usable data from Experiment III included 53 monolingual native French speakers.

The results are reported in fig. 5. In general, the experimental items are rated higher than the ungrammatical controls, but lower than the grammatical controls (figs. 5c and 5f). In *and*-coordination(fig. 5a), if the second noun (N2) is in the plural form (`D N1sg et N2pl`, `D N1pl et N2pl`), the plural determiner `Dpl`

Resources	Conditions	Examples
Exp I	`D N1sg et/ou N2pl` `D N1sg et/ou N2sg`	1. Il faudrait pouvoir prévenir **le/les** (SG/PL) directeur (SG) et/ou sous-directeurs (PL) de l'établissement. 2. Il faudrait pouvoir prévenir **le/les** (SG/PL) directeur (SG) et/ou sous-directeur (SG) de l'établissement. *"One should warn the director and/or assistant director of the establishment."*
Exp II	`D N1pl et N2pl`	1.Il faudrait pouvoir prévenir **le/les** (SG/PL) directeurs (PL) et sous-directeurs (PL) de l'établissement. *"One should warn the directors and assistant directors of the establishment."*
Exp II	`N1sg et/ou N2sg A`	1. Cette formation gratuite vous prépare au mieux à la fonction de directeur (SG) et/ou sous-directeur (SG) **administratif/administratifs** (SG/PL). *"This free training optimally prepares you for the position of administrative director and/or assistant director."*
	control	La mère (SG) des enfants (PL) **ira/iront** (SG/PL) à l'école demain. *"The mother of the children is/are going to school tomorrow."*

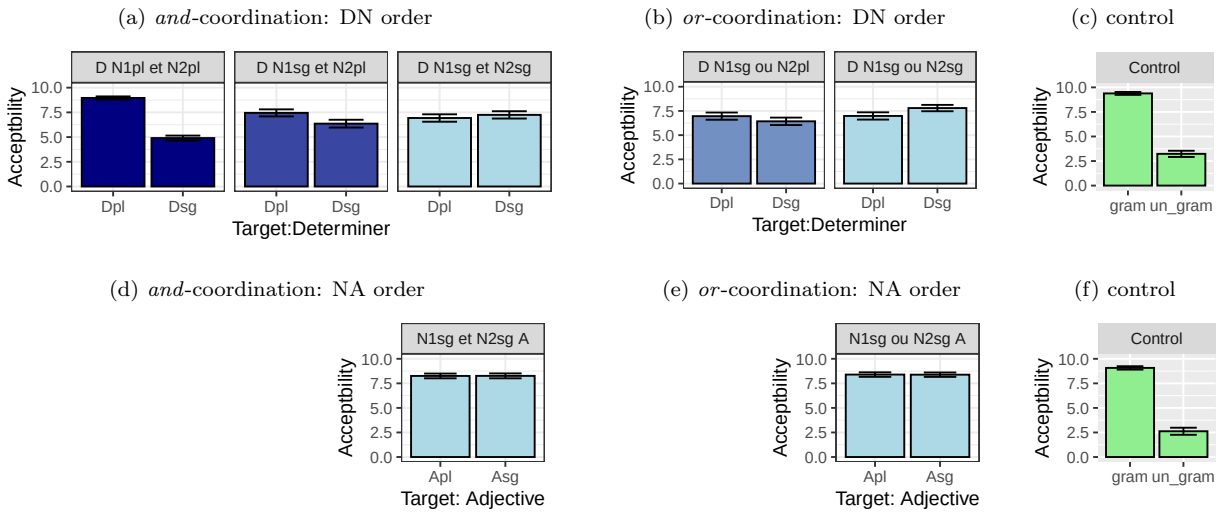


Figure 5: The table above gives an example of conditions in attributive number agreement experiments. The figure illustrates the results: with *and*-coordination on the left, *or*-coordination in the middle and control conditions on the right. The first row corresponds to the determiner experiment, while the second row corresponds to the adjective experiment. The subfigures are aligned vertically according to the number sequences. Bars are filled with colors representing the conjuncts' number: blue if the closest noun is singular and the other noun is plural; and light blue if both are singular, while light blue means that both are singular. Error bars in all figures of this paper correspond to 95% confidence intervals based on raw individual observations.

is preferred over the singular determiner `Dsg`. Furthermore, this preference for `Dpl` is even greater when the first noun (N1) is also in the plural form (`D N1pl et N2pl`). On the contrary, `Dsg` is preferred when N2 is singular (`D N1sg et N2sg`). For *or*-coordination (fig. 5b), `Dpl` is also more acceptable when N2 is plural in the `D N1sg ou N2pl` sequence, but the difference between `Dsg/Dpl` is smaller than that in *and*-coordination. `Dsg` is preferred in the `D N1sg ou N2sg` sequence.

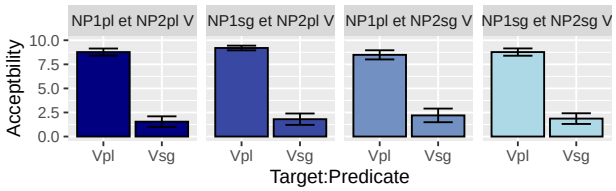
For post-nominal adjective agreement, no significant effects are observed. Both `Asg` and `Apl` are acceptable for *and*-coordination (fig. 5d) and *or*-coordination (fig. 5e). Compared to (prenominal) determiner agreement (`D N1sg Conj N2sg`), plural agreement is rated as more acceptable when the target is after the controller, for both *et* ('and') and *ou* ('or').

4.1.2 Predicative Number Agreement

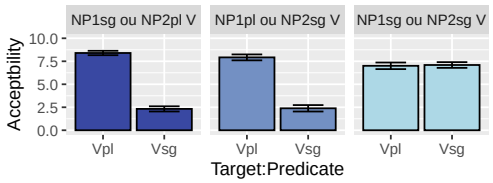
Resources	Conditions	Examples
An and Abeillé 2021b	`NP1sg ou NP2sg V` `V NP1sg ou NP2sg`	1. Je me demande où le maire (SG) ou l'adjoint (SG) **va/vont** (SG/PL) aller. 2. Je me demande où **va/vont** (SG/PL) aller le maire (SG) ou l'adjoint (SG). *"I wonder where (**is/are** going) the mayor or the deputy **is/are** going."*
Exp III	`NP1pl ou NP2sg V` `V NP1pl ou NP2sg`	1. Je me demande où les adjoints (PL) ou le maire (SG) **va/vont** (SG/PL) aller. 2. Je me demande où **va/vont** (SG/PL) aller les adjoints (PL) ou le maire (SG). *"I wonder where (**is/are** going) the deputies or the mayor **is/are** going."*
Exp IV	`NP1sg ou NP2pl V` `V NP1sg ou NP2pl`	1. Je me demande où le maire (SG) ou les adjoints (PL) **va/vont** (SG/PL) aller. 2. Je me demande où **va/vont** (SG/PL) aller le maire (SG) ou les adjoints (PL). *"I wonder where (**is/are** going) the mayor or the deputies **is/are** going."*

Exp V	`NP1sg et NP2sg V`
	`NP1pl et NP2sg V`
	`NP1sg et NP2pl V`
	`NP1pl et NP2pl V`
		1. Je me demande où le maire (SG) et l'adjoint (SG) **va/vont** (SG/PL) aller.
		2. Je me demande où les adjoints (PL) et le maire (SG) **va/vont** (SG/PL) aller.
		3. Je me demande où le maire (SG) et les adjoints (PL) **va/vont** (SG/PL) aller.
		4. Je me demande où les maires (PL) et les adjoints (PL) **va/vont** (SG/PL) aller.
		"I wonder where the mayors and the deputies is/are going."

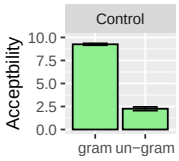
(a) *and*-coordination: SV order



(b) *or*-coordination: SV order



(c) Control



(d) *or*-coordination: VS order

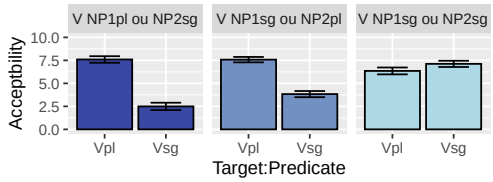


Figure 6: Conditions (table) and results (figure) of predicative number agreement experiments. The panels of the subfigures in the result are aligned vertically according to the number combinations. Color lightness represents difefrent number combinations, the lightest for a closest NPsg.

We use the available data for subject-verb number agreement with two singular disjoined nouns from An and Abeillé (2021b) (`NP1sg or NP2sg V`, `V NP1sg or NP2sg` conditions). We ran two other experiments by adapting the stimuli of An and Abeillé (2021b): one for `N1sg or N2pl` and one for `N1pl or N2sg`. Two word orders are tested for each combination: subject-verb, verb-subject (fig. 6). We ran only one experiment for *and*-coordination. VS order was not tested for *and*-coordination because we do not expect any difference with SV order. The coordination of two plural nouns was not tested for *or*-coordination since it only yields plural agreement.

The protocol is the same as in the previous experiment. We recruited 48 participants for the `NP1pl ou NP2sg` experiment (data from 39 participants retained after applying exclusion criteria as above) and 54 participants for the `NP1sg ou NP2pl` experiment (data from 50 participants retained after applying exclusion criteria). 26 participants were recruited for the *and*-coordination experiments (22 kept after exclusion

criteria). Participants were recruited on RISC, a French platform for recruiting experiment participants, and their participation was voluntary.

In order to be able to compare results across conditions, the results of all the experiments are illustrated in fig. 6. There are clear distinctions between target `Vsg/Vpl` for *and*-coordination (fig. 6a). For *or*-coordination (figs. 6b and 6d), when there is a plural conjunct, only the plural verb is acceptable, regardless of whether the closest noun is singular or plural.

With two singular disjoined NPs, both singular and plural verb forms are acceptable. An and Abeillé (2021b) show that there is a significant interaction between number agreement and word order. This effect is mainly caused by plural verbs, which are rated lower in the `V NP1sg ou NP2sg` sequence than in the `NP1sg ou NP2sg V` sequence. Directionality has a little effect on singular verbs.

If we compare SV and VS orders when the closest noun is singular (`NP1pl ou NP2sg V` vs. `V NP1sg ou NP2pl`), plural verbs, which violate CCA, are rated slightly lower in VS order than in SV order. However, singular verbs are rated higher in VS order than in SV order. When the closest noun is plural (`NP1sg ou NP2pl V` vs. `V NP1pl ou NP2sg`), `Vpl` is also rated lower in VS order than in SV order, whereas `Vsg` is rated similarly in SV and VS orders.

4.2 Experiments on French Gender Agreement

To investigate grammatical gender agreement in coordinated structures, we draw on five experiments: two existing studies (Abeillé et al., 2018; An and Abeillé, 2021a) and three new experiments. Three experiments tested attributive agreement, and two tested predicative agreement.

4.2.1 Attributive Gender Agreement

We use experimental results from Abeillé et al. (2018) which test determiner gender agreement with *and*-coordination, with the determiner *certains/certaines*(some.M.PL/F.PL),[6] as well as results for adjective agreement in prenominal and post-nominal position (An and Abeillé, 2021a). They show that agreement with the closest conjunct is preferred when the adjective is prenominal, while for postnominal adjectives, both CCA and the resolution rule are acceptable (fig. 7c).

We ran one additional experiment by inverting the word order of Abeillé et al. (2018) for determiner agreement so that the closest noun is masculine. The goal was to test whether feminine agreement is acceptable when the closest noun is masculine. We recruited 21 native French speakers, and removed 3 who rated the ungrammatical controls higher than the grammatical controls (leaving data from 18 participants for analysis).

We compare our results for `D N1m et N2f` and `D N1f et N2m` (fig. 7a). When the closest one is masculine, the `Dm` is clearly preferred. This shows that the closest noun plays a very important role for attributive gender agreement: when the closest noun is feminine, the `Df` is preferred, and `Dm` is preferred when the closest noun is masculine.

Resources	Conditions	Sentences
Exp VI	`D N1m et N2f`	**Certains/Certaines** (M/F) animateurs (M) et célébrités (F) de la télévision ont des salaires beaucoup trop élevés. *"Some hosts and celebrities of the TV have far too high salaries."*
Abeillé et al. 2018	`D N1f et N2m`	**Certains/Certaines** (M/F) célébrités (F) et animateurs (M) de la télévision ont des salaires beaucoup trop élevés. *"Some celebrities and hosts and of the TV have far too high salaries."*
An and Abeillé 2021a	`A N1m et N2f` `N1f et N2m A`	1. De **nouveaux/nouvelles** (M/F) étudiantes (F) et étudiants (M) sont déjà en stage. 2. Des étudiants (M) et étudiantes (F) **nouveaux/nouvelles** (M/F) sont déjà en stage. *"Some new students are already doing an internship."*
	control	Le fils (M) de la voisine (F) est **content/contente** (M/F) d'aller à l'école. *"The son of the neighbor is happy to go to school. "*

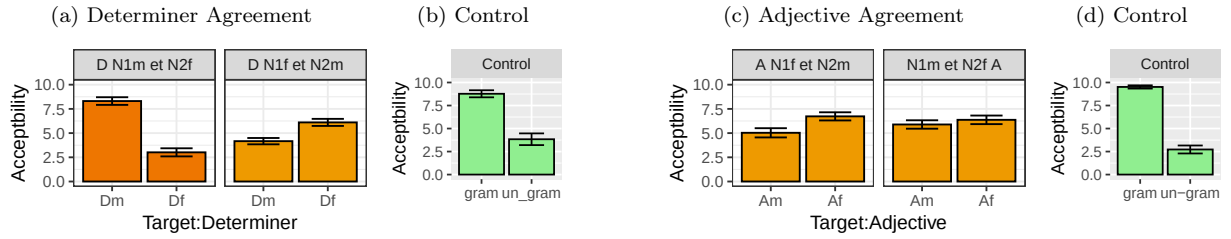


Figure 7: Conditions (table) and results (figure) of determiner and adjective agreement experiments. The color varies according to the conjuncts' gender: dark orange means that the closest noun is masculine while the other noun is feminine; light orange means that the closest noun is feminine while the other noun is masculine.

4.2.2 Predicative Gender Agreement

We tested coordinations with gender mismatch (`NP1f et/ou NP2m` and `N1m et/ou NP2f`) for *and*-coordination and *or*-coordination, with both SV order and VS order (table in fig. 8). Conditions for *and*-coordination (Experiment VII) and those for *or*-coordination (Experiment VIII) were tested in two separate experiments. Each experiment included 24 experimental items: 12 control items which were the same as for attributive gender agreement, as well as 24 fillers from an independent experiment about islands [reference withheld for anonymity] the same as in the previous experiments. 127 participants completed the *and*-coordination experiment (Experiment VII). We kept for analysis only the participants whose comprehension accuracy was higher than 75% and whose average median for the grammatical controls was higher than for the ungrammatical controls, as we did in earlier experiments. Data from 79 participants was retained.[7] In the *or*-coordination experiment (Experiment VIII), 128 participants completed the experiment with data for 84 participants retained after exclusion criteria.

The results are reported in fig. 8. In general, masculine agreement is rated higher than feminine agreement, regardless of the gender of conjuncts and word order; ratings for both gender agreements are between the grammatical and the ungrammatical controls (figs. 8c and 8e).

Masculine predicate agreement is rated similarly across all conditions. On the other hand, feminine agreement is rated higher when the closest noun is feminine than when the closest noun is masculine in both *and*-coordination (figs. 8a and 8b) and in *or*-coordination (figs. 8d and 8e). These results illustrate that the closest noun's gender plays a role in predicative gender agreement.

Conditions	Resources	Examples
Exp VII	NP1f et NP2m V NP1m et NP2f V V NP1f et NP2m V NP1m et NP2f	1. Je me demande où les étudiantes (F) et les étudiants (M) seront **conduits/conduites** (M/F). 2. Je me demande où les étudiants (M) et les étudiantes (F) seront **conduits/conduites** (M/F). 3. Je me demande où seront **conduits/conduites** (M/F) les étudiantes (F) et les étudiants (M). 4. Je me demande où seront **conduits/conduites** (M/F) les étudiants (M) et les étudiantes (F). *"I wonder where (will be taken.M/F) the students.M and the students.F will be taken.M/F."*
Exp VIII	NP1f et NP2m V NP1m ou NP2f V V NP1f ou NP2m V NP1m ou NP2f	1. Je me demande où les étudiantes (F) ou les étudiants (M) seront **conduits/conduites** (M/F). 2. Je me demande où les étudiants (M) ou les étudiantes (F) seront **conduits/conduites** (M/F). 3. Je me demande où seront **conduits/conduites** (M/F) les étudiantes (F) ou les étudiants (M). 4. Je me demande où seront **conduits/conduites** (M/F) les étudiants (M) ou les étudiantes (F). *"I wonder where (will be taken.M/F) the students.M or the students.F will be taken.M/F."*

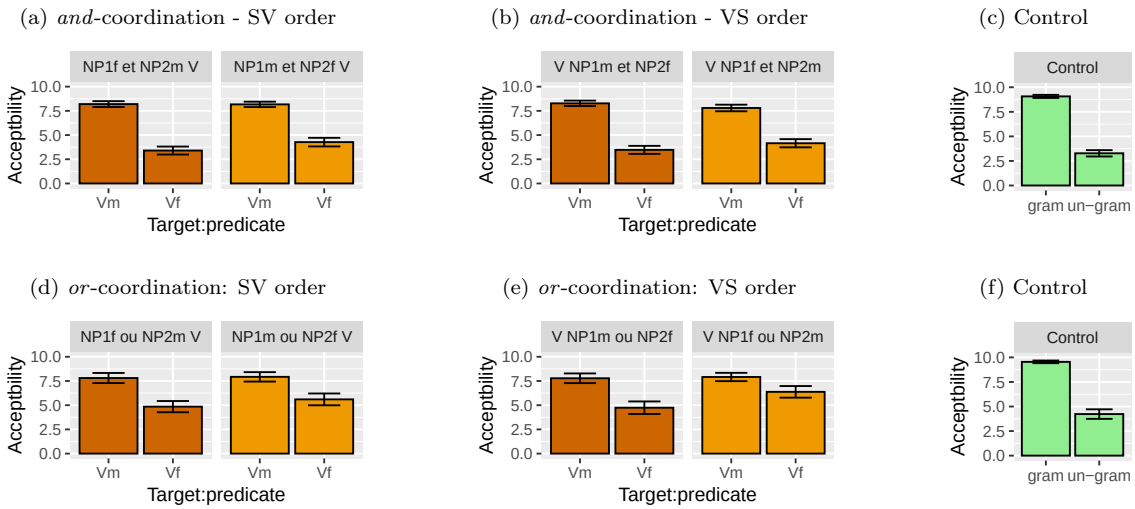


Figure 8: Conditions (table) and results (figure) of predicative gender agreement experiments

In sum, for gender agreement, CCA is less acceptable than masculine resolution in predicative agreement, unlike in attributive agreement. There is a preference for masculine agreement in the predicative domain in general for both *and* and *or*. The differences between masculine and feminine agreement are more important for *and* than for *or*. We only observe the effect of ordering in attributive agreement: masculine agreement (with a closest Nf) is less acceptable when the target is before the controller. In predicate gender agreement, we don't find such ordering effects.

5 Model Fitting

We trained the model on the 28 *and*-coordination conditions obtained from the previous experiments, comprising 14 for number agreement and 14 for gender agreement. The response variable was the mean acceptability rating averaged across participants and items for each condition. The predictor variables are based on the constraints defined in section 3, as applied to the differing experimental conditions (see Appendix section A.1 for complete condition–constraint information).

5.1 Parameter Estimation: *and*-coordination

Our model fitting follows two goals: (1) estimating and theoretically interpreting weights for the full inventory of constraints shown in Figure 4e; (2) merging constraints to find a minimally complex constraint inventory that preserves good predictive power.

We first estimate weights for the full constraint inventory of Figure 4e using simple linear regression. The results are shown in fig. 9a, with significance levels reflecting F tests among constraint pairs or sets. Two key linguistic patterns are revealed: one is the contrast between gender and number agreement; the other is the contrast between attributive and predicative domains.

The first pattern, a contrast between gender and number agreement, is that gender is more sensitive to closest conjunct agreement (CCA) than number in the nominal domain, whereas number is more sensitive to the resolution agreement (ResAgr) in the verbal domain. This can be seen in particular in the significant difference between number and gender for the constraint CCA [Att] and ResAgr [Pred]. In attributive agreement, the coefficient of the constraint CCA [Att] is larger for gender than for number. CCA violation has a bigger penalty on gender than on number agreement. This difference predicts for instance that the structure `Dpl N1sg et N2sg` should be more acceptable than the structure `Dm N1f et N2m`. In the verbal domain, the coefficient of the constraint ResAgr [Pred] is bigger for number. That is to say, ResAgr violation has a higher penalty on number than on gender agreement, which implies for instance that the structure `NP1sg et NP2sg Vsg` is less acceptable than the structure `NP1m et NP2f Vf`. However, we do not find differences between number and gender for CCA [Pred], EA [Att] or ResAgr [Att]. The constraint EA [Pred][Num] is not evaluated due to insufficient data.

The second pattern, a contrast between attributive and predicative domains, violation of ResAgr is more strongly penalized in the predicative domain than in the attributive domain; whereas violations of CCA is more strongly penalized in the attributive domain than in the predicative domain. This can be seen by comparing the coefficients for ResAgr [Pred] and ResAgr [Att], as well as CCA [Pred] and CCA [Att]. When compared respectively for both gender and number, the difference between ResAgr [Pred] and ResAgr [Att] is significant for both, while the difference is only significant for gender in the case of CCA. However, the insignificant difference for number in CCA may be attributed to the small effect size. Crucially, this result confirms the agreement hierarchy proposed by Corbett (1991): likelihood of ResAgr increases from attributive to predicative agreement while the the likelihood of CCA decreases. Our data supports this generalization for both number and gender for ResAgr, whereas it only holds true for gender in the case of CCA.

We simplify the constraint inventory by iteratively merging constraints that do not differ at the $p < 0.05$ level in the following order: (1) constraints matching in agreement strategy and domain that differ only in number vs. gender feature type; (2) constraints matching in agreement strategy but not domain. We then drop constraints whose weights do not significantly differ from 0. This leaves us with just six constraints

from the original 12:

- Closest conjunct agreement in the attributive domain for number;
- Closest conjunct agreement in the attributive domain for gender;
- Early agreement (feature and domain merged);
- Resolution agreement in the attributive domain;
- Resolution agreement in the predicative domain for number;
- Resolution agreement in the predicative domain for gender.

We then fit a new set of weights for this constraint inventory; the results are shown in fig. 9b.

We then test both the original and simplified model for their held-out generalization performance using leave-one-out cross-validation. The results are shown in Figure 9c and Figure 9d (see also Appendix table 3). For a model with perfect prediction, all 28 data points would fall on the $y = x$ line. Both models show good held-out generalization performance; the reduced six-constraint model has even better mean squared error (MSE) of 0.25 than the starting model (MSE=0.28), suggesting that this simple model captures broad variation in *and*-coordination agreement preferences across domains and feature types.

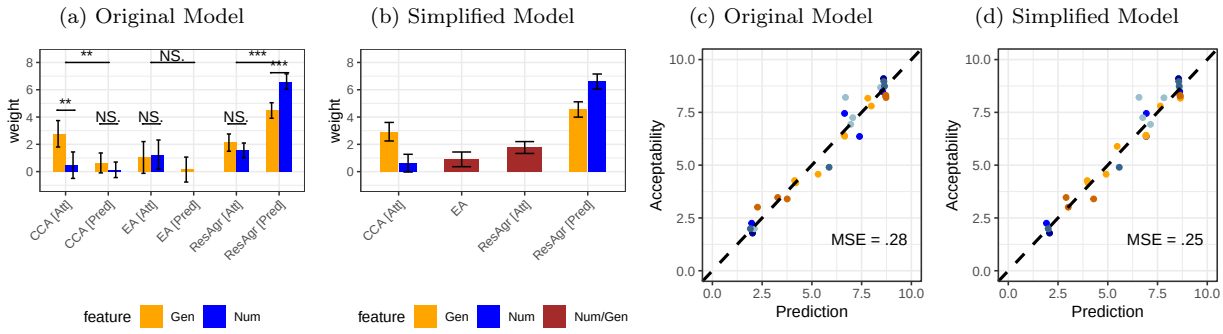


Figure 9: Model results for *and*-coordination. Figure **a** and **b** display the **estimated coefficients** for the original model and simplified model, including F-test statistics for select constraint pairs. Error bars indicate 95% confidence intervals. NS. denotes non-significant results, while * indicates significant findings. Figure **c** and **d** illustrates the **leave-one-out cross-validation** results for the original model and simplified model, where the x axis represents the prediction of the model with the same parameters trained without this condition, and the y axis shows the human acceptability judgments obtained in previous experiments. The perfect performance of the model would correspond to all points on the black dashed line $y = x$, with greater deviation from the line indicating less accurate predictions of human acceptability.

5.2 Generalisations to *or*-coordination: comparing candidate resolution rules

With our six-constraint fitted model for *and*-coordination in hand, we further test our overall approach to coordination agreement preferences by testing the model against new *or*-coordination data. We make

the simple assumption that the same three strategies outlined in Section 2 for *and*-coordination—resolution agreement, closest conjunct agreement, and early agreement—are operative in *or*-coordination. However, we leave the question of how resolution agreement applies to *or*-coordination open for the model to adjudicate. We compare three hypotheses.

1. ***and*-like resolution**: Resolution agreement works the same for *or*-coordination as for *and*-coordination;
2. **unconstrained resolution**: there are no resolution rules constraining agreement in *or*-coordination; akin to the 'lacuna of grammar' view (Reis, 1974; Peterson, 1986; Foppolo and Staub, 2020);
3. **weakly-constrained resolution**: Resolution agreement works the same for *or*-coordination as for *and*-coordination, but violations impact acceptability less than for *and*-coordination.

We implement these models by leaving the fitted weights of the *and*-resolution model unchanged, but modifying the constraint function for *or*-resolution so that it always returns 0 for the unconstrained resolution model, and returns $-\frac{1}{2}$ for violations of the resolution agreement rule in the weakly constrained resolution model. The constraint functions for these three models are depicted in Table 2.

	and-like resolution			unconstrained resolution			weakly-constrained resolution		
	CCA [Pred]	ResAgr [Pred]	EA [Pred]	CCA [Pred]	ResAgr [Pred]	EA [Pred]	CCA [Pred]	ResAgr [Pred]	EA [Pred]
`Vsg NP1sg ou NP2sg`	0	**-1**	0	0	**0**	0	0	**-0.5**	0
`Vpl NP1sg ou NP2sg`	-1	**0**	-1	-1	**0**	-1	-1	**0**	-1
`Vsg NP1pl ou NP2sg`	-1	**-1**	-1	-1	**0**	-1	-1	**-0.5**	-1
`Vpl NP1pl ou NP2sg`	0	**0**	0	0	**0**	0	0	**0**	0
`Vsg NP1sg ou NP2pl`	0	**-1**	0	0	**0**	0	0	**-0.5**	0
`Vpl NP1sg ou NP2pl`	-1	**0**	-1	-1	**0**	-1	-1	**0**	-1

Table 2: Illustration of constraint annotation for agreement with disjoined NPs in the three compared models

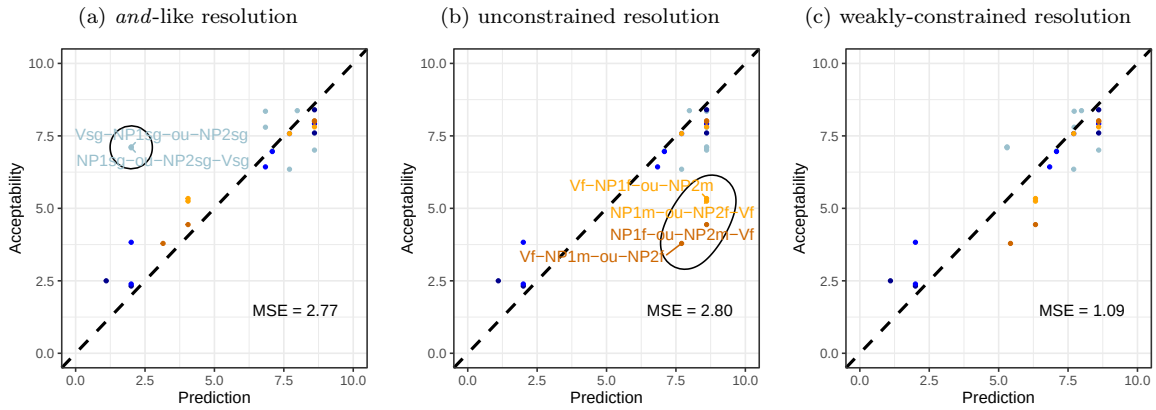


Figure 10: Prediction error in the three compared models, with annotations indicating conditions where the squared prediction error is greater than 4.

The performance of these models on predicting experimental *or*-coordination acceptability judgments is shown in Figures 10a–10c. All three models do a fairly good job predicting acceptability in most experimental

conditions. However, the *and*-like and unconstrained resolution models each badly fail to predict acceptability for a subset of conditions. The *and*-like resolution model badly underpredicts the acceptability of singular verbs agreeing with disjoined NP subjects both of whose conjuncts are singular. The unconstrained-resolution model, in contrast, badly overpredicts the acceptability of feminine verbs agreeing with disjoined NP subjects that have a masculine noun. The weakly-constrained resolution model suffers from neither of these severe prediction errors and yields the best mean-squared error of the three models—less than half that of the other two.

To summarize, section 5.2 examines three hypotheses that compare the resolution rule of *or*-coordination using different constraint annotations. We find the best empirical support for WEAKLY-CONSTRAINED RESOLUTION in *or*-coordination, implemented by a penalty for violating the resolution rule that is 50% of the penalty that would be applied for *or*-coordination. This view implies that *or*-coordination is not a "grammatical lacuna", but that resolution agreement is quantitatively less constraining of *or*-agreement violations than of *and*-agremeent violations.

6 Discussion

Three key generalizations stand out from our experimental and modeling results. First, both number and gender agreement follow the agreement hierarchy (Corbett, 1991), with predicative (verbal) domain favoring ResAgr (masculine, plural) and attributive (nominal) domain favoring CCA. Second, gender agreement is more sensitive to linear proximity than number agreement is. Third, *or*-coordination is best characterized in our model by the same resolution rule as for *and*-agreement, but the penalty for violating the resolution rule is weaker for *or* than for *and*. In the following subsections we discuss each of these in turn.

6.1 Agreement Domain–agreement hierarchy

Our results (see fig. 9 in section 5.1), provide quantitative within-language support for Corbett's agreement hierarchy (see example (6) in section 1). Specifically, our modeling estimates suggest that violation of CCA is more heavily penalized in the attributive domain than in the predicative domain, for both number and gender agreement. Conversely, violation of resolution agreement is more heavily penalized in the predicative domain than in the attributive domain, for both number and gender agreement. We find that early agreement, in contrast, is not sensitive to the predicative–attributive domain contrast.

Corbett's agreement hierarchy may also have a basis in syntactic tree-structural locality considerations. In attributive agreement, both the determiner and the attributive adjectives belong to the same NP domain as the coordinated nouns (fig. 11a). However, this is not the case for predicative agreement, as they belong to a different VP domain than the subject coordinated nouns, as shown in fig. 11b. Regarding linear distance, the subject and predicate may be separated by a copula or an auxiliary, while determiner and attributive adjective are typically adjacent to the noun, as was the case in our experiments. In terms of structural

distance, although different syntactic theories may have varying syntactic representations, the number of intervening nodes between a subject and a verb/predicate is usually greater than that between a noun and a determiner/attributive adjective. This can possibly elucidate why proximity assumes a more significant role in the attributive domain, as agreement in the attributive domain is relatively more local.

Figure 11: Comparison of (simplified) syntactic structures for attributive and predicative agreement with coordination phrases

6.2 Differences in number versus gender agreement preferences

The findings presented in Section 5.1 reveal an asymmetry in the agreement patterns between gender and number. Specifically, within the nominal domain, violating the constraints of CCA incurs a greater penalty for gender agreement than for number agreement. Conversely, within the verbal domain, violating the constraints of ResAgr incurs a greater penalty for number agreement than for gender agreement. This pattern has been noted in other Romance languages as well. For example, in a corpus study of Portuguese conducted by Villavicencio et al. (2005), it was found that while CCA is the only option for gender agreement with prenominal attributive adjectives, both CCA and resolution rules are possible for number agreement in the same context. Similarly, in South Slavic languages, research by Marušič et al. (2007); Bošković (2009); Marušič et al. (2015) indicates that CCA occurs in gender predicate agreement, but not in number predicate agreement. They argue that while the *and*-coordination phrase has a number feature, it does not have a gender feature, thus allowing the target to conform to plural number agreement while searching for the gender feature among its conjuncts, thereby permitting the possibility of CCA for gender agreement.

This evidence suggests the following alignment of features with agreement strategies in coordination:

(16)

gender	>	number
CCA ⟵		⟶ ResAgr

Note that this generalization is independent of Corbett's agreement hierarchy in (6), which predicts that CCA is more acceptable in the attributive than in the predicative domain, for both gender and number agreement.

We suggest the following explanation for this generalization. Note that number is a feature that can be easily interpreted, whereas the meaning of grammatical gender is less transparent. Specifically, coordination, especially *and*-coordination, may imply reference to a group. Groups are semantically plural and the number resolution rule reflects this. In contrast, grammatical gender is usually deemed uninterpretable for non-human

nouns. For instance, "table" is feminine in French but masculine in South Slavic, with no apparent difference in meaning between these languages.[8] When nouns differing in gender are conjoined, the resolution rule is thus arbitrary in a way that the resolution rule for number is not. It is unsurprising that a more arbitrary resolution rule would be less prominent (within our framework, evoke a smaller penalty when it is violated) than a more semantically motivated resolution rule.

6.3 *and*-coordination Agreement vs *or*-coordination Agreement

In a majority of prior studies, agreement with coordination and disjunction have been analyzed independently and have been considered to follow distinct agreement strategies. We, in contrast, find substantial shared characteristics between *and*- and *or*-coordination. Our model optimized for predicting acceptability of *and*-coordinations required only a slight adaptation to make accurate predictions for *or*-coordination, namely reducing the weight of the resolution agreement strategy. On this basis, we argue against the "lacuna of the grammar" view of agreement with disjoined NPs argued for by Reis (1974); Peterson (1986); Foppolo and Staub (2020). Rather, within a single language, such as French, multiple agreement strategies can be available, and acceptability is gradient and determined by which strategies (if any) are violated and the contextually conditioned penalties for their violation. The same strategy can be completely acceptable in one construction, such as resolution with *and*-coordination in the predicative domain, while being unacceptable in another, such as in the attributive domain. Looking beyond coordination, we anticipate that similar findings would likely be obtained for other agreement phenomena exhibiting variation, such as agreement with collective nouns (e.g., "this/*these committee has/have decided"). This is also predicted typologically by Corbett (1991)'s agreement hierarchy and the feature generalization we introduced in Section 6.2.

7 Conclusions

The current study presents a sum-weighted model that addresses the gradience of agreement with coordination phenomena. Drawing inspiration from harmonic grammar (Hayes and Wilson, 2008) and Linear Optimality Theory (Keller, 2000), this model incorporates linguistically interpretable structural constraints based on grammatical context and estimates constraint violation penalties, or weights, from experimental data.

Together, our model and experimental data achieve considerable unification among constraints involving different agreement parameters, namely domain, features, and target. The constraint weights estimated from French turn out to reflect the typologically motivated agreement hierarchy of Corbett (1991). We find that both number and gender follow this hierarchy, with attributive agreement favoring closest conjunct agreement (CCA) and predicative agreement favoring resolution agreement. On this basis we propose the generalization that more semantically interpretable features, such as number, are less influenced by linear proximity compared to less interpretable features like grammatical gender.

Our model also achieves considerable unification of *and*- and *or*-coordination phenomena. Training our model on *and*-coordination we find that it generalizes well to *or*-coordination with only minimal adaptation, challenging the assumption that there is no resolution rule for disjunction.

Although we focused here on agreement with coordinate phrases, our general approach has potentially much broader applicability for quantitative modeling of acceptability both within and across languages. Here we found that quantitative modeling of linguistic acceptability revealed regularities within a single language that reflect broader typological generalizations; it remains to be seen in future work whether this pattern will be seen in a wider variety of languages and constructions.

Notes

1. Code and materials can be found at `https://osf.io/6drxh/?view_only=0b50d70c4107445daa04454c06a283d9`.

2. This term is sometimes called PARTIAL AGREEMENT (e.g., Aoun et al., 1994; Johannessen, 1996) or PROXIMITY AGREEMENT (e.g., Peterson, 1986)

3. Alternatively, we could take C to be sensitive to the number of times that s violates the constraint. For the experimental materials used in this paper, no sentence violates any constraint more than once, but future work may adjudicate between these alternatives.

4. In this paper, the participants of some experiments were recruited on a free platform where participants volunteer to complete experiments [identifying information withheld for double-blind peer review]. Since the number of volunteers on this platform was limited, we used `http://crowdpanel.io/` and Prolific `https://app.prolific.co/` to recruit participants for a subset of the experiments, where they were paid 4 euros for each experiment. However, we found that participants recruited from `http://crowdpanel.io/` were generally less attentive, as can be seen by the higher proportion of excluded participants.

5. We did not test prenominal adjectives, which behave like determiners ("les nouveaux étudiant et chercheur" *the*.PL *new*.PL *student*.SG *and researcher*.SG). For postnominal adjectives, the combination of nouns of mixed numbers (`N1sg et N2pl` and `N1pl et N2sg`) was not tested either since they are very rare.

6. We reanalysed their data by removing participants that do not correspond to the criteria defined above, so that only the results of 28 participants were kept for analysis.

7. 4 participants participated twice in the *and*-coordination experiment, and two participants participated twice in the *or*-coordination experiment. For each of these participants we discarded their second attempt.

8. See however Jakobson (1959) and Boroditsky et al. (2003) for suggestions that grammatical gender might have an effect on the interpretation of some inanimates.

References

Abeillé, A., An, A., and Shiraïshi, A. (2018). L'accord de proximité du déterminant en français. *Discours. Revue de linguistique, psycholinguistique et informatique. A journal of linguistics, psycholinguistics and computational linguistics*, (22).

Abeillé, A. and Chaves, R. P. (2021). Coordination. *Head-driven phrase structure grammar: The handbook*, pages 725–776.

Abeillé, A., Hemforth, B., Winckel, E., and Gibson, E. (2020). Extraction from subjects: Differences in acceptability depend on the discourse function of the construction. *Cognition*, 204:104293.

Aissen, J. (1999). Agent focus and inverse in tzotzil. *Language*, pages 451–485.

An, A. and Abeillé, A. (2019). Number Agreement in French Binomials. In Piñón, C., editor, *Empirical Issues in Syntax and Semantics 12*, pages 31–60.

An, A. and Abeillé, A. (2021a). Closest conjunct agreement with attributive adjectives. *Journal of French Language Studies*. accepted.

An, A. and Abeillé, A. (2021b). L'accord sujet-verbe avec *ou* et avec *ni* en français: une approche expérimentale. *Langages*, (3):43–60.

Aoun, J., Benmamoun, E., and Sportiche, D. (1994). Agreement, word order, and conjunction in some varieties of Arabic. *Linguistic inquiry*, pages 195–220.

Bock, K. and Miller, C. A. (1991). Broken agreement. *Cognitive psychology*, 23(1):45–93.

Boroditsky, L., Schmidt, L. A., and Phillips, W. (2003). Sex, syntax, and semantics. *Language in mind: Advances in the study of language and thought*, pages 61–79.

Borsley, R. D. (2005). Against ConjP. *Lingua*, 115(4):461–482.

Borsley, R. D. (2009). On the superficiality of Welsh agreement. *Natural Language & Linguistic Theory*, 27(2):225–265.

Bošković, Ž. (2009). Unifying first and last conjunct agreement. *Natural Language & Linguistic Theory*, 27(3):455–496.

Bresnan, J., Dingare, S., and Manning, C. D. (2001). Soft constraints mirror hard constraints: Voice and person in english and lummi. In *Proceedings of the LFG01 Conference*, pages 13–32. Stanford: CSLI Publications.

Chaves, R. (2013). An expectation-based account of subject islands and parasitism. *Journal of Linguistics*, 49(2):297–344.

Chomsky, N. (2017). The language capacity: architecture and evolution. *Psychonomic bulletin & review*, 24:200–203.

Corbett (1991). *Gender*. Cambridge University Press.

Corbett, G. G. (1979). The agreement hierarchy. *Journal of linguistics*, 15(2):203–224.

Corbett, G. G. (2006). *Agreement*, volume 109. Cambridge University Press.

Corbett, G. G. (2023). The agreement hierarchy and (generalized) semantic agreement. *Glossa: a journal of general linguistics*, 8(1).

Curat, H. (1999). *Les déterminants dans la référence nominale et les conditions de leur absence: essai de sémantique grammaticale II*, volume 2. Librairie Droz.

Dalrymple, M. and Kaplan, R. M. (2000). Feature indeterminacy and feature resolution. *Language*, pages 759–798.

Demonte, V. and Perez-Jimenez, I. (2012). Closest conjunct agreement in Spanish DPs: Syntax and beyond. *Folia linguistica*, 46(1):21–73.

Dixon, R. M. (1994). *Ergativity*. Cambridge University Press.

Drummond, A. (2013). Ibex farm. *Online server: http://spellout. net/ibexfarm*.

Fayol, M., Largy, P., and Lemaire, P. (1994). Cognitive overload and orthographic errors: When cognitive overload enhances subject–verb agreement errors. a study in French written language. *The Quarterly Journal of Experimental Psychology*, 47(2):437–464.

Foppolo, F. and Staub, A. (2020). The puzzle of number agreement with disjunction. *Cognition*, 198:104161.

Fowler, H. R. and Aaron, J. E. (2001). *The little, brown handbook*. HarperCollins, Eighth edition.

Givón, T. (1970). Notes on the semantic structure of English adjectives. *Language*, 46(4):816–837.

Grevisse, M. and Goosse, A. (2011). *Le bon usage*. De Boeck, Duculot.

Haskell, T. R. and MacDonald, M. C. (2003). Conflicting cues and competition in subject–verb agreement. *Journal of Memory and Language*, 48(4):760–778.

Hayes, B. and Wilson, C. (2008). A maximum entropy model of phonotactics and phonotactic learning. *Linguistic inquiry*, 39(3):379–440.

Heycock, C. and Zamparelli, R. (2005). Friends and colleagues: Plurality, coordination, and the structure of DP. *Natural language semantics*, 13(3):201–270.

Jakobson, R. (1959). On linguistic aspects of translation. In *On translation*, pages 232–239. Harvard University Press.

Jelinek, E. and Demers, R. A. (1983). The agent hierarchy and voice in some Coast Salish languages. *International Journal of American Linguistics*, 49(2):167–185.

Johannessen, J. B. (1996). Partial agreement and coordination. *Linguistic Inquiry*, pages 661–676.

Johannessen, J. B. (1998). *Coordination*. Oxford University Press.

Kayne, R. S. (1994). *The antisymmetry of syntax*. MIT Press.

Keller, F. (2000). *Gradience in grammar: experimental and computational aspects of degrees of grammaticality*. PhD thesis, University of Edinburgh.

Keung, L.-C. and Staub, A. (2018). Variable agreement with coordinate subjects is not a form of agreement attraction. *Journal of Memory and Language*, 103:1–18.

King, T. H. and Dalrymple, M. (2004). Determiner agreement and noun conjunction. *Journal of Linguistics*, 40(1):69–104.

Le Bruyn, B. and de Swart, H. (2014). Bare coordination: the semantic shift. *Natural Language & Linguistic Theory*, 32(4):1205–1246.

Legendre, G., Miyata, Y., and Smolensky, P. (1990). *Harmonic grammar: A formal multi-level connectionist theory of linguistic well-formedness: Theoretical foundations*. Citeseer.

Levy, R. (2008). Expectation-based syntactic comprehension. *Cognition*, 106(3):1126–1177.

Marušič, F., Nevins, A., and Saksida, A. (2007). Last-conjunct agreement in Slovenian. In *Formal Approaches to Slavic Linguistics*, volume 15, pages 210–227.

Marušič, F., Nevins, A. I., and Badecker, W. (2015). The grammars of conjunction agreement in Slovenian. *Syntax*, 18(1):39–77.

Morgan, J. L. (1972). Verb agreement as a rule of English. In *Papers from the eighth regional meeting, Chicago Linguistic Society*, pages 278–286. Chicago Linguistic Society Chicago.

Munn, A. (1999). First conjunct agreement: Against a clausal analysis. *Linguistic inquiry*, 30(4):643–668.

Nevins, A. and Weisser, P. (2019). Closest conjunct agreement. *Annual Review of Linguistics*, 5:219–241.

Peterson, P. G. (1986). Establishing verb agreement with disjunctively conjoined subjects: Strategies vs principles. *Australian Journal of Linguistics*, 6:231—249.

Peterson, P. G. (2004). Coordination: consequences of a lexical-functional account. *Natural Language & Linguistic Theory*, 22(3):643–679.

Reis, M. (1974). Patching up with counterparts. *Foundations of Language*, 12(2):157–176.

Sadler, L. (1999). Non-distributive features in Welsh coordination. In *Proceedings of LFG*.

Silverstein, M. (1976). Hierarchy of features and ergativity. In Dixon, R., editor, *Grammatical Categories in Australian Languages*, pages 112–171. Australian Institute of Aboriginal Studies, Canberra.

Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., and Sedivy, J. C. (1995). Integration of visual and linguistic information in spoken language comprehension. *Science*, 268(5217):1632–1634.

Townsend, S. W., Engesser, S., Stoll, S., Zuberbühler, K., and Bickel, B. (2018). Compositionality in animals and humans. *PLoS Biology*, 16(8):e2006425.

Villavicencio, A., Sadler, L., and Arnold, D. (2005). An HPSG Account of Closest Conjunct Agreement in NP Coordination in Portuguese. *Proceedings HPSG Conference*, pages 427–447.

Willer-Gold, J., Arsenijević, B., Batinić, M., Becker, M., Čordalija, N., Kresić, M., Leko, N., Marušič, F. L., Milićev, T., Milićević, N., et al. (2017). When linearity prevails over hierarchy in syntax. *Proceedings of the National Academy of Sciences*, page 201712729.

Zwicky, A. (2009). Agreement with disjunctive subjects. `https://languagelog.ldc.upenn.edu/nll/?p=1293`.

Appendices

A Additional Results for *and-coordination* Model

A.1 Summary of Acceptability Rating and Constraint Annotations

	Condition				mean	CCA [Att]	ResAgr [Att]	EA [Att]	CCA [Pred]	ResAgr [Pred]	EA [Pred]
1		NP1sg	et NP2pl	Vpl	9.10	0	0	0	0	0	0
2		NP1sg	et NP2pl	Vsg	1.78	0	0	0	-1	-1	0
3		NP1sg	et NP2sg	Dpl	8.68	0	0	0	-1	0	0
4		NP1sg	et NP2sg	Vsg	1.99	0	0	0	0	-1	0
5		NP1pl	et NP2sg	Vpl	8.48	0	0	0	-1	0	0
6		NP1pl	et NP2sg	Vsg	2.25	0	0	0	0	-1	0
7		NP1pl	et NP2pl	Vpl	8.74	0	0	0	0	0	0
8		NP1pl	et NP2pl	Vsg	1.99	0	0	0	-1	-1	0
9		N1sg	et N2sg	Asg	8.21	0	-1	0	0	0	0
10		N1sg	et N2sg	Apl	8.19	-1	0	0	0	0	0
11	Dpl	N1sg	et N2pl		7.45	-1	0	-1	0	0	0
12	Dsg	N1sg	et N2pl		6.36	0	-1	0	0	0	0
13	Dpl	N1sg	et N2sg		6.93	-1	0	-1	0	0	0
14	Dsg	N1sg	et N2sg		7.25	0	-1	0	0	0	0
15	Dpl	N1pl	et N2pl		8.96	0	0	0	0	0	0
16	Dsg	N1pl	et N2pl		4.90	-1	-1	-1	0	0	0

(a) Number agreement

	Condition				mean	CCA [Att]	ResAgr [Att]	EA [Att]	CCA [Pred]	ResAgr [Pred]	EA [Pred]
17		NP1f	et NP2m	Vf	3.40	0	0	0	-1	-1	0
18		NP1f	et NP2m	Vm	8.20	0	0	0	0	0	0
19		NP1m	et NP2f	Vf	4.27	0	0	0	0	-1	0
20		NP1m	et NP2f	Vm	8.17	0	0	0	-1	0	0
21	Vf	NP1f	et NP2m		4.16	0	0	0	0	-1	0
22	Vm	NP1f	et NP2m		7.80	0	0	0	-1	0	-1
23	Vf	NP1m	et NP2f		3.47	0	0	0	-1	-1	-1
24	Vm	NP1m	et NP2f		8.28	0	0	0	0	0	0
25		N1m	et N2f	Af	6.37	0	-1	0	0	0	0
26		N1m	et N2f	Am	5.89	-1	0	0	0	0	0
27	D(A)m	N1f	et N2m		4.57	-1	0	-1	0	0	0
28	D(A)f	N1f	et N2m		6.42	0	-1	0	0	0	0
29	D(A)m	N1m	et N2f		8.31	0	0	0	0	0	0
30	D(A)f	N1m	et N2f		3.01	-1	-1	-1	0	0	0

(b) Gender agreement

A.2 Results of Leave-One-Out Cross-Validation

	Condition				mean	Simplified Model		Original Model	
						prediction	SE	prediction	SE
1		NP1sg	et NP2pl	Vpl	9.10	8.55	0.30	8.60	0.25
2		NP1sg	et NP2pl	Vsg	1.78	2.08	0.09	2.02	0.06
3		NP1sg	et NP2sg	Dpl	8.68	8.60	0.01	8.45	0.05
4		NP1sg	et NP2sg	Vsg	1.99	2.01	0.00	2.11	0.01
5		NP1pl	et NP2sg	Vpl	8.48	8.62	0.02	8.55	0.01
6		NP1pl	et NP2sg	Vsg	2.25	1.92	0.11	1.97	0.08
7		NP1pl	et NP2pl	Vpl	8.74	8.59	0.02	8.65	0.01
8		NP1pl	et NP2pl	Vsg	1.99	2.01	0.00	1.91	0.01
9		N1sg	et N2sg	Asg	8.21	6.57	2.69	6.69	2.32
10		N1sg	et N2sg	Apl	8.19	7.82	0.13		
11	Dpl	N1sg	et N2pl		7.45	6.94	0.26	6.64	0.65

12	Dsg	N1sg	et	N2pl		6.36	6.93	0.33	7.40	1.07
13	Dpl	N1sg	et	N2sg		6.93	7.15	0.05	6.95	0.00
14	Dsg	N1sg	et	N2sg		7.25	6.76	0.24	7.06	0.04
15	Dpl	N1pl	et	N2pl		8.96	8.57	0.15	8.62	0.12
16	Dsg	N1pl	et	N2pl		4.90	5.58	0.46	5.87	0.93
17		NP1f	et	NP2m	Vf	3.40	4.29	0.79	3.76	0.13
18		NP1m	et	NP2f	Vm	8.20	8.64	0.20	8.73	0.28
19		NP1m	et	NP2f	Vf	4.27	3.97	0.09	4.13	0.02
20		NP1m	et	NP2f	Vm	8.17	8.65	0.23	7.81	0.13
21	Vf	NP1f	et	NP2m		4.16	4.01	0.02	4.19	0.00
22	Vm	NP1f	et	NP2m		7.80	7.64	0.02	7.99	0.04
23	Vf	NP1m	et	NP2f		3.47	2.91	0.32	3.28	0.04
24	Vm	NP1m	et	NP2f		8.28	8.64	0.13	8.71	0.19
25		N1m	et	N2f	Af	6.37	6.93	0.31	6.65	0.08
26		N1m	et	N2f	Am	5.89	5.47	0.17		
27	D(A)m	N1f	et	N2m		4.57	4.92	0.12	5.31	0.55
28	D(A)f	N1f	et	N2m		6.42	6.92	0.25	6.62	0.04
29	D(A)m	N1m	et	N2f		8.31	8.63	0.10	8.71	0.16
30	D(A)f	N1m	et	N2f		3.01	3.01	0.00	2.27	0.55

B Additional Results for *or-coordination* Model

B.1 Summary of Acceptability Rating and Constraint Annotations in Model I, II, III

	Condition			mean	CCA [Att]			ResAgr [Att]			EA [Att]			CCA [Pred]			ResAgr [Pred]			EA [Pred]		
					I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1	Vsg	NP1sg ou NP2sg		7.12	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-0.5	0	0	0
2	Vpl	NP1sg ou NP2sg		6.35	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	-1	-1	-1
3		NP1sg ou NP2sg	Vpl	7.01	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	0	0	0
4		NP1sg ou NP2sg	Vsg	7.09	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-0.5	0	0	0
5		N1sg ou N2sg	Asg	8.35	0	0	0	-1	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0
6		N1sg ou N2sg	Apl	8.37	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Dpl	N1sg ou N2sg		6.98	-1	-1	-1	0	0	0	-1	-1	-1	0	0	0	0	0	0	0	0	0
8	Dsg	N1sg ou N2sg		7.80	0	0	0	-1	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0
9		NP1sg ou NP2pl	Vpl	8.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10		NP1sg ou NP2pl	Vsg	2.32	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	0	-1	0	0	0
11	Vpl	NP1sg ou NP2pl		7.58	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	-1	-1	-1
12	Vsg	NP1sg ou NP2pl		3.83	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-1	0	0	0
13		NP1pl ou NP2sg	Vpl	7.92	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	0	0	0
14		NP1pl ou NP2sg	Vsg	2.39	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-1	0	0	0
15	Vpl	NP1pl ou NP2sg		7.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Vsg	NP1pl ou NP2sg		2.50	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	0	-1	-1	-1	-1
17	Dpl	N1sg ou N2pl		6.96	-1	-1	-1	0	0	0	-1	-1	-1	0	0	0	0	0	0	0	0	0
18	Dsg	N1sg ou N2pl		6.43	0	0	0	-1	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0

(a) Number Agreement

	Condition			mean	CCA [Att]			ResAgr [Att]			EA [Att]			CCA [Pred]			ResAgr [Pred]			EA [Pred]		
					I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
19		NP1f ou NP2m	Vf	4.44	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	0	-0.5	0	0	0
20		NP1f ou NP2m	Vm	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21		NP1m ou NP2f	Vf	5.25	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-0.5	0	0	0
22		NP1m ou NP2f	Vm	7.81	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	0	0	0
23	Vf	NP1f ou NP2m		5.34	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-0.5	0	0	0
24	Vm	NP1f ou NP2m		7.58	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	0	-1	-1	-1
25	Vf	NP1m ou NP2f		3.79	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	0	-0.5	-1	-1	-1
26	Vm	NP1m ou NP2f		8.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

(b) Gender Agreement

B.2 Results of Prediction

	Condition				Mean	Model I		Model II		Model III	
						prediction	SE	prediction	SE	prediction	SE
1	Vsg	NP1sg ou NP2sg			7.12	2.00	26.19	8.60	2.20	5.30	3.30
2	Vpl	NP1sg ou NP2sg			6.35	7.70	1.83	7.70	1.83	7.70	1.83
3		NP1sg ou NP2sg	Vpl		7.01	8.60	2.54	8.60	2.54	8.60	2.54
4		NP1sg ou NP2sg	Vsg		7.09	2.00	25.88	8.60	2.29	5.30	3.19
5		N1sg ou N2sg	Asg		8.35	6.84	2.29	8.60	0.06	7.72	0.40
6		N1sg ou N2sg	Apl		8.37	7.98	0.15	7.98	0.15	7.98	0.15
7	Dpl	N1sg ou N2sg			6.98	7.08	0.01	7.08	0.01	7.08	0.01
8	Dsg	N1sg ou N2sg			7.80	6.84	0.93	8.60	0.65	7.72	0.01
9		NP1sg ou NP2pl	Vpl		8.40	8.60	0.04	8.60	0.04	8.60	0.04
10		NP1sg ou NP2pl	Vsg		2.32	2.00	0.10	2.00	0.10	2.00	0.10
11	Vpl	NP1sg ou NP2pl			7.58	7.70	0.02	7.70	0.02	7.70	0.02
12	Vsg	NP1sg ou NP2pl			3.83	2.00	3.34	2.00	3.34	2.00	3.34
13		NP1pl ou NP2sg	Vpl		7.92	8.60	0.47	8.60	0.47	8.60	0.47
14		NP1pl ou NP2sg	Vsg		2.39	2.00	0.15	2.00	0.15	2.00	0.15
15	Vpl	NP1pl ou NP2sg			7.60	8.60	1.01	8.60	1.01	8.60	1.01
16	Vsg	NP1pl ou NP2sg			2.50	1.10	1.95	1.10	1.95	1.10	1.95
17	Dpl	N1sg ou N2pl			6.96	7.08	0.02	7.08	0.02	7.08	0.02
18	Dsg	N1sg ou N2pl			6.43	6.84	0.17	6.84	0.17	6.84	0.17
19		NP1f ou NP2m	Vf		4.44	4.05	0.15	8.60	17.34	6.33	3.56
20		NP1f ou NP2m	Vm		8.00	8.60	0.36	8.60	0.36	8.60	0.36
21		NP1m ou NP2f	Vf		5.25	4.05	1.44	8.60	11.25	6.33	1.16
22		NP1m ou NP2f	Vm		7.81	8.60	0.63	8.60	0.63	8.60	0.63
23	Vf	NP1f ou NP2m			5.34	4.05	1.66	8.60	10.65	6.33	0.97
24	Vm	NP1f ou NP2m			7.58	7.70	0.02	7.70	0.02	7.70	0.02
25	Vf	NP1m ou NP2f			3.79	3.15	0.41	7.70	15.32	5.43	2.68
26	Vm	NP1m ou NP2f			8.02	8.60	0.34	8.60	0.34	8.60	0.34