



## Original articles

## The puzzle of number agreement with disjunction

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## ABSTRACT

In English, when two nouns in a disjunctive subject differ in number (e.g., *the dogs or the cat*), the verb tends to agree with the number of the nearer noun. This is exceptional, as a noun's linear proximity to the verb does not generally play a role in agreement. In the present study, we investigate a further puzzle about agreement with disjunction, namely, the existence of a pattern in which two singular disjuncts trigger plural agreement (e.g., *The lawyer or the accountant are...*). Two eyetracking studies in English show that plural agreement with a disjunction of singulars does not reliably disrupt readers' eye movements, in contrast to the immediate disruptive effect of other agreement violations. Three off-line rating studies in English show that plural agreement results in only a small decrement in acceptability, compared to other agreement violations, and that in some structural configurations there is no decrement at all. On the whole, the data do not support the hypothesis that plural agreement is licensed only when *or* has an inclusive reading; even when it has an exclusive reading, there is only a small penalty for plural agreement. Finally, we explored this issue in Italian, which has a richer system of inflectional morphology. Italian speakers showed a plural preference in a completion experiment, and singular and plural agreement did not differ in acceptability in a rating experiment. We conclude that agreement with disjunction is a grammatical lacuna or gap, in the sense that speakers' grammar simply does not prescribe a verb number following a disjunctive subject.

## 1. Introduction

Subject-verb agreement, in English and other languages, is notoriously prone to error in both production and comprehension. Speakers sometimes produce a verb that agrees in number with a noun intervening between the head of the subject phrase and the verb, as in (1a), a phenomenon known as *agreement attraction* (e.g., Bock & Miller, 1991). The presence of an intervening attractor can also make an agreement error less salient in comprehension (e.g., Wagers, Lau, & Phillips, 2009). Examples of error types in other structural configurations are in (1b; e.g., Bock & Miller, 1991; Staub, 2010) and (1c; Dillon, Staub, Levy, & Clifton Jr, 2017).

- (1) a. \*The key to the cabinets are on the table.  
 b. \*The cabinets that the key open are in the laboratory.  
 c. \*Which keys are the scientist using?

Agreement attraction is usually attributed to the processor rather than to the grammar. The use of a plural verb in (1) does not seem to reflect dialectal variation, or a gradient or indeterminate grammar. In all of these cases the verb should agree in number with the head of the

syntactic subject (*key* in 1a and 1b, *scientist* in 1c); a speaker who produces one of these errors will generally agree, upon reflection, that the verb should be singular. Because these are regarded as processing errors, investigation of their causes has taken place within the psycholinguistic literature, which contains a variety of mechanistic accounts (Eberhard, Cutting, & Bock, 2005; Staub, 2009; Wagers et al., 2009).

However, other forms of variable agreement behavior may be attributed to optionality, indeterminacy, or variability in the grammar, rather than to errors in the cognitive processes underlying sentence production or comprehension. The influence of notional number on agreement gives rise to one class of examples. Subject nouns that are grammatically singular but denote a collective, such as *family*, sometimes trigger plural agreement in American English (e.g., Bock, Nicol, & Cutting, 1999; Humphreys & Bock, 2005), and generally trigger plural agreement in British English (Bock et al., 2006), and this variability has not usually been interpreted as reflecting processing error.

Agreement variability also arises when the syntactic subject is a coordinated phrase, headed by *and* or *or*, and this too has generally received an explanation in grammatical rather than processing terms. A widely observed tendency, cross-linguistically, is for the verb to agree

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in gender, number, or other features with the nearer conjunct or disjunct, a phenomenon known as *closest conjunct agreement*. This tendency is at odds with the general observation that nouns that are linearly close to the verb do not have a particular influence on agreement with non-coordinated subjects (i.e., the number attraction effect as in (1a) is not attributable to the proximity of the attractor and the verb; Franck, Vigliocco, & Nicol, 2002; Keung & Staub, 2018), and has important theoretical implications that go beyond the scope of this paper; see Nevins and Weisser (2018) for a recent review, and for a discussion of implications of closest conjunct agreement for the syntactic analysis of coordinate structures in terms of the structural relations inside the conjunction phrase and of the phases involved in agreement operations. A possibility is that closest conjunct agreement arises because the head of the subject phrase, the connective *or* or *and*, lacks a morphosyntactic number feature that can directly value the verb (Nevins & Weisser, 2018). However, this agreement pattern is often if not always optional, co-existing within a language, or within an individual speaker, with the use of other agreement paradigms; see Willer et al. (2018) for recent empirical work demonstrating this optionality within and across dialects.

In English, the tendency for the verb to agree in number with the nearer noun is most easily observed when the subject is a disjunction. Prescriptive style guides (e.g. Fowler & Aaron, 2007) enforce the rule that if the subject is preverbal, the verb should agree in number with the second noun, giving rise to the patterns in (2):

- (2) a. The cat or the dogs \*is/are going to leave.  
b. The dogs or the cat is/<sup>2</sup>are going to leave.

Using an elicited production task, Haskell and MacDonald (2005) confirmed that speakers do generally follow this rule, producing a singular verb 2% of the time in cases like (2a), compared to 72% of the time in cases like (2b). Keung and Staub (2018) replicated this pattern in a task requiring subjects to make a speeded choice of verb form after reading a subject phrase presented one word at a time; a singular verb was chosen on about 20% and 60% of trials in the two conditions, respectively. There is an asymmetry here, as in both data sets the ‘agree nearest’ rule is more consistently applied when the nearer noun is plural; in both Haskell and MacDonald (2005) and Keung and Staub (2018), plural verbs were more common after *plural-or-singular* subjects than were singular verbs after *singular-or-plural* subjects. We assume that this may be due to the markedness of the plural feature, which plays an important role in determining patterns of agreement attraction (Bock & Miller, 1991; Eberhard, 1997). Many theorists have proposed a ‘privative’ account of grammatical number, with singular being an unmarked or default value, and only plural marking involving the presence of a distinct feature. The same asymmetry is implied by the prescriptive advice in Fowler & Aaron, 2007, who suggest reordering a *plural-or-singular* disjunction in favor of *singular-or-plural*, on the grounds that there is no fully satisfactory agreement pattern in the former case.

The ‘agree nearest’ rule clearly implies that when the subject is a disjunction of singulars, the verb should be singular. Zwicky (2009) writes that this prescription is “utterly uncontroversial,” and he doubts that “anyone needs to be told what to do when confronted by disjunctive subjects of the same number.” Zwicky (2009) (see also McCawley, 1998) proposes that the general principle governing agreement with disjunction is that the verb must agree with *each* of the disjuncts, and that agreement with the nearer disjunct is deployed as a resolution principle only in cases where this basic principle cannot be applied, because the disjuncts differ in number. When both disjuncts have the same number, the grammar is unambiguous.

However, the starting point of the present study is the observation that variability in agreement with disjunctive subjects does not appear to be restricted to cases in which the two nouns differ in number. An informal search of the Corpus of Contemporary American English

(COCA; Davies, 2008) confirms that singular agreement is more common than plural when the subject is a disjunction of singulars, but turns up several examples of plural agreement. Shown in (3) are three examples from COCA; several additional examples are reported in Ivlieva (2012):

- (3) a. It would be implausible to maintain that either the assumption or the implication are wholly wrong, but I do not believe they are wholly right, either.  
b. That understanding is gained long before the patient or the surgeon have entered the operating room.  
c. I think the economy’s going to turn around in any case, regardless of what the administration or the president do.<sup>1</sup>

Plural agreement with a disjunction of singulars has also been attested in the laboratory. In the speeded choice task used by Keung and Staub (2018), subjects selected a plural verb about 20% of the time after a disjunction of singular noun phrases such as *the maid or the butler*. This pattern cannot be attributed simply to task demands or inaccurate responding; subjects selected a singular verb only about 5% of the time after a disjunction of plurals, and selected a plural verb only about 3% of the time when a singular subject was followed by a singular noun in a prepositional phrase, e.g., *the helicopter for the flight*. It appears that speakers do not actually treat a *singular-or-singular* subject phrase as unequivocally singular, for the purpose of computing verb agreement.

In fact, the linguistic literature has noted the use of plural agreement with a disjunction of singulars. Peterson (1986) reports that speakers differ in whether they accept singular or plural agreement, and also that “some speakers [accept] both at different times” (Peterson, 2004, p. 670; see also Eggert, 2002; Morgan, 1985). Here we investigate this phenomenon in detail. One possibility is that naturally occurring instances of plural agreement with disjunction like those in (3) are simply errors, on a par with attraction errors, and that the 20% plural responding obtained by Keung and Staub (2018) is due to the demands of a speeded, and unnatural, laboratory task. If so, then plural agreement with a disjunction of singulars will be unacceptable for most English speakers, and will be processed as an agreement error, at least most of the time. However, there are other salient possibilities, which do not presuppose that plural agreement with disjunction is ruled out by speakers’ grammar. One possibility is that there is systematic individual variation in agreement preference with disjoined subjects, with some speakers requiring singular, more-or-less categorically, and other speakers requiring plural. But it is also possible that *both* singular and plural are somewhat degraded, for a given speaker, or that *neither* is degraded, i.e., both are acceptable. These last two potential patterns are especially interesting, as they would suggest that agreement with disjunction is a grammatical lacuna or gap, in the sense that a speaker’s grammar simply does not prescribe a determinate verb number when the subject is a disjunction of singulars.

A further goal of the present work is to evaluate a specific hypothesis about a factor that may modulate the acceptability or processing of plural agreement with disjunction. According to this hypothesis, the notional number of a disjunctive subject determines the use and acceptability of plural agreement. This hypothesis builds on the fact that disjunction is notionally singular if interpreted *exclusively*, but may be notionally plural if interpreted *inclusively*.

<sup>1</sup> Quotations in (3) are from the following sources: Collini, S. (1999). Before another tribunal: The idea of the “nonspecialist public”. *Raritan*, 19(1), 77; Harner, S. G., & Leonetti, J. P. (1996). Iatrogenic facial paralysis prevention. *Ear, Nose, & Throat Journal*, 75(11), 715–718; CNN Moneyline, December 23, 1991. We do not attempt to formally assess the relative corpus frequency of singular and plural agreement in COCA; the limited syntactic annotation of COCA makes this corpus not ideally suited for this purpose.

To introduce this hypothesis, it is necessary to provide minimal background regarding the semantics and pragmatics of disjunction. These issues are discussed in detail from a theoretical perspective in Chierchia (2013), and have recently been explored experimentally in a variety of studies with children and adults (see Sauerland & Yatsushiro, 2018, for an alternative account and an overview of experimental studies). Natural language *or* is, in a typical or positive context, interpreted exclusively. For example, the speaker of (4a) would be interpreted as asserting that Chuck will meet with Brian or Lyn, but not both. This interpretation is often attributed to a Gricean (Grice, 1991) process of pragmatic inference, in which the logical, inclusive meaning of *or* is strengthened to an exclusive interpretation. However, a disjunction that occurs in certain contexts, such as in the antecedent of a conditional (4b) or in the scope of negation (4c), receives an inclusive interpretation according to which both disjuncts might be true at the same time.

- (4) a. Chuck will meet with Brian or Lyn after lunch.  
 b. If Chuck meets with Brian or Lyn after lunch, he'll miss the colloquium.  
 c. Chuck won't meet with Brian or Lyn after lunch.

In (4b), the speaker is naturally understood as asserting that Chuck will miss the colloquium if he meets with Brian, with Lyn, or with *both*. In (4c), the speaker is understood as asserting (at least in English; cf. Szabolcsi & Haddican, 2004, for evidence of cross-linguistic variation) that Chuck will not meet with Brian, he will not meet with Lyn, and he will not meet with *both*. These contexts, in which the pragmatic strengthening of *or* is cancelled or suspended, are known as *downward entailing contexts*, for reasons that go beyond the scope of the present paper.

It has been pointed out by several previous authors that a disjunction of singulars may trigger a plural verb when the disjunction occurs in a downward entailing context, and is therefore interpreted inclusively rather than exclusively. Ivlieva (2012) reports the following intuitive contrast in Russian, in which plural agreement is acceptable only when a disjunctive subject is embedded under negation, in which case singular may be degraded:

- (5) a. Petja ili Vasja prišēl<sub>[+sing]</sub> /<sup>?</sup>prišli<sub>[+plu]</sub> [Petja or Vasja came].  
 b. Ja ne dumaju, čto Petja ili Vasja <sup>?</sup>prišēl<sub>[+sing]</sub>/prišli<sub>[+plu]</sub> [I don't think that Petja or Vasja came]

Morgan (1985) conjectures that a similar contrast exists in English.

- (6) a. John or Bill is/\*are going to win the race.  
 b. I don't think that John or Bill are/<sup>?</sup>is going to win the race.

Peterson (1986) reports data from a small survey that confirms these intuitions, with a majority of respondents preferring singular in (6a) and plural in (6b).

To recap, plural agreement with a disjunction of singulars may be used by speakers, and may be acceptable to comprehenders, primarily when the disjunction has an inclusive reading. This would suggest that agreement with disjunction is sensitive to the subject's notional number, and that when a disjunction receives an inclusive reading, it is interpreted as notionally plural, at least for the purpose of computing agreement. One possible variant of this hypothesis, which we also test in the present study, would hold that the verb's number is actually used by comprehenders as a cue to the interpretation of a disjunctive subject as exclusive or inclusive.

Finally, yet a third issue that we address here is the extent to which indeterminate or variable agreement with disjunction is present cross-linguistically. It is possible that the apparent indeterminacy of agreement with disjunction in English is due, at least in part, to the fact that English has relatively impoverished inflectional morphology, and subject-verb number agreement in English does not play an important role

in determining either a syntactic analysis of the sentence or the identity of the subject. We examine Italian, which has richer system of agreement morphology than does English, with all verbs in Italian being inflected for number. Number agreement production in Italian has been investigated in the psycholinguistic literature (e.g., Franck, Lassi, Frauenfelder, & Rizzi, 2006; Vigliocco, Butterworth, & Semenza, 1995), although no study has investigated coordinated subjects. Agreement morphology arguably plays a critical role in syntactic and referential processing in Italian. Unlike in English, the subject is not obligatorily expressed in Italian, as it is a *pro*-drop language, and as a result the verb's number is in some circumstances informative about the identity of the subject. Because of these features, Italian speakers might be more sensitive to subject-verb number agreement, and might have more definitive number agreement preferences.<sup>2</sup>

Interestingly, informal canvassing of Italian native speakers reveals both no knowledge of any prescriptive rule for agreement with disjunction, and variability both within and between speakers in their preferences. This variability can be observed in written translations. Consider two different translations of the clause in (7a) below, from *Alice's Adventures in Wonderland* (Carroll, 1865). Because all verb forms are marked for number, the option of an unmarked form, like the English *had*, is not available in Italian. In one translation (7b) the verb is singular, while in the other (7c) it is plural<sup>3</sup>:

- (7) a. (...) as if a dish or kettle had been broken to pieces.  
 b. (...) come se un piatto o una caldaia andasse<sub>[+sing]</sub> in pezzi.  
 c. (...) come se un piatto o una caldaia andassero<sub>[+plu]</sub> in pezzi.
- (8) a. The European Parliament or the Council can seek the opinion of the Board during the entire procedure.  
 b. Il Parlamento europeo o il Consiglio può<sub>[+sing]</sub> chiedere il parere della Commissione durante tutta la procedura.  
 c. Il Parlamento europeo o il Consiglio possono<sub>[+plu]</sub> chiedere il parere della Commissione durante tutta la procedura.

We report seven experiments addressing these issues. We note before proceeding that there are a number of previous attempts to address the issue of subject-verb agreement with disjunctive subjects in rating or judgment studies, including Peterson (1986), Eggert (2002), Morgan and Green (2005), and Garley (2008). These studies have made use of very small samples, mostly of linguistics students. We regard the present study as the first to investigate these questions using modern psycholinguistic methods. Two of the present experiments (Experiments 1 and 3) are English eyetracking-during-reading experiments that investigate the processing of agreement with a disjunction of singulars during online comprehension. Three (Experiments 2, 4, and 5) are English rating experiments that investigate whether speakers' off-line judgments show sensitivity to agreement with a disjunction of singulars. In the last two experiments we turn to Italian; we present one sentence continuation study (Experiment 6), and one rating study (Experiment 7).

To anticipate our empirical conclusions, we find that in English,

<sup>2</sup> The richness of inflectional morphology in Italian also extends beyond number, as nouns are also marked for gender, and verbs are marked for gender on the past-participle forms following the auxiliary *to be* (e.g. *Il re/la regina è morto/a*, *The king/the queen is dead*). Some previous experimental work has tested conjunct agreement by manipulating gender features on the verb following two conjuncts that differed in gender (see for example Marušič, Nevins, & Badecker, 2015, for Slavic languages). In the present work we focus on number, a feature that is common to English and Italian. Extending the paradigm used by Marušič et al. (2015) to disjunctive subjects in Italian might be an interesting direction for future work.

<sup>3</sup> Translations by Silvio Spaventa Filippi, Clap Publishing, 2017, ISBN: 9781944333867, p. 36 (7b); by Siria Maltese, Dario Abate Editore, 2015, ISBN 9788899356170 (7c).

there is no reliable penalty for plural agreement with a disjunction of singulars in on-line reading measures, and only a small penalty in off-line ratings. We also find that both ratings and eye movements seem to be affected only very little, if at all, by factors that might encourage or discourage an inclusive reading of a disjunctive subject. Finally, we find that in Italian, which lacks a prescriptive rule in this regard, there is a preference for plural agreement following a disjunction of singulars in speakers' completions, but no clear preference for singular or plural agreement is expressed in ratings.

## 2. Experiment 1

Experiment 1 is an English eyetracking-during-reading study examining readers' sensitivity to number agreement when the matrix subject is a disjunction of singular definite noun phrases. We created a total of 12 experimental conditions, by manipulating subject type (disjunctive; conjunctive; singular; plural) and verb number (singular; plural; unmarked), as in (9):

- (9) a. The lawyer or the accountant is coming/are coming/will come to the meeting.  
 b. The lawyer and the accountant is coming/are coming/will come to the meeting.  
 c. The lawyer is coming/are coming/will come to the meeting.  
 d. The lawyers is coming/are coming/will come to the meeting.

Based on the previous literature (e.g., Braze, Shankweiler, Ni, & Palumbo, 2002; Pearlmutter, Garnsey, & Bock, 1999), we expected that an agreement violation after a non-coordinated subject, either singular or plural, would result in relatively immediate disruption in the eye movement record. However, based on recent results from Keung and Staub (2018, Experiment 3), we expected only modest disruption when a singular verb followed a conjunction of singular definites. Keung and Staub tested items in which the first conjunct was plural, and the second was either plural or singular. A singular verb following two plural conjuncts elicited both increased reading times and increased regressive eye movements. But when the second conjunct was singular, this disruption was much reduced. Keung and Staub interpreted this result as reflecting the unique influence of the number of the nearer noun on agreement processing with coordinate subjects. This influence of the nearer noun would not, however, explain lack of sensitivity to an agreement violation when a disjunction of singulars is followed by a plural verb.

### 2.1. Methods

#### 2.1.1. Participants

All participants were students at UMass Amherst who received course credit for their participation. All were speakers of English as a first language, and none reported any history of reading or language disorder. Sixty participants were run, of whom ten were excluded based on either poor performance on comprehension questions or excessive blinking or track loss (as defined below), leaving final  $N = 50$ .

#### 2.1.2. Procedure

Movements of the right eye were recorded, sampling at 1000 Hz, using an EyeLink 1000 (SR Research, Toronto, ON, Canada) eyetracker, interfaced with a PC computer. Sentences were displayed on a CRT monitor 55 cm from subjects. The resolution of the eyetracker was less than one character. All sentences were displayed on a single line in 11-point Monaco font.

Subjects were instructed to read for comprehension. A three-point calibration procedure was performed at the start of the experiment and as needed between trials. Each sentence appeared on the screen when the subject fixated a box at the left edge of the monitor. Each session lasted approximately 40 min. The experiment was implemented with

the EyeTrack software, and initial stages of data analysis were carried out with Robodoc and EyeDry (<http://blogs.umass.edu/eyelab/software/>).

One subject was excluded due to poor performance (69%) on the comprehension questions that followed filler trials. All others achieved at least 80% correct. Trials were excluded if there was a blink or track loss during first pass reading of the critical region; see below for region definition. Nine subjects lost > 20% of trials on this basis, and were excluded from subsequent analysis. For the remaining subjects, the trial exclusion criteria resulted in removal of 5.5% of trials. In addition, 10 trials were excluded due to an error in the experimental script. As described below, analyses focused on processing of the critical region on the first pass through the sentence. This region was skipped by the eyes on first pass reading on 30 trials overall, which were excluded from analysis, leaving a total of 2228 trials. Individual eye fixations < 80 ms in duration and within one character of a previous or subsequent fixation were incorporated into this neighboring fixation.

#### 2.1.3. Materials

A total of 48 items like those in (9) were created, so that each subject read four items in each of the twelve conditions. We attempted to ensure that the referents of the noun phrases would be interpreted as clearly distinct, avoiding cases in which *or* might have been used to express lexical uncertainty (Potts & Levy, 2015). We also ensured that the predicate was one that could, in principle, be true of the two disjuncts simultaneously, avoiding predicates such as *was the winner* or *is the President of the United States*. (The potential role played by this restriction was explicitly tested in Experiment 5). In half of the items, the number marked verb forms were in the present progressive, and the unmarked form was in the future tense (as in (9)); in the other half, the number marked forms were in the imperfect, and the unmarked forms were in the simple past (e.g., "The clerk or/and the secretary was/were updating/updated the list of guests.")<sup>5</sup>

These 48 items were intermixed with 34 unrelated items from an experiment on syntactic ambiguity resolution (Staub, Foppolo, Donati, & Cecchetto, 2018, Experiment 3), as well as 50 filler items of varying structures. The filler items, but not the experimental items, were followed by two-alternative comprehension questions, which appeared on the screen after the sentence was removed and which the subject responded to by button press. The 132 sentences were intermixed in an individually randomized order and presented after eight practice trials.

We analyzed eye movements on a critical region that consisted of an auxiliary followed by a participle or nonfinite verb form (e.g., The lawyer or the accountant *is coming/are coming/will come* to the meeting), with one exception: The half of items that were in the past tense used the simple past for the non-number-marked condition, in which case the critical region was only the past tense verb (e.g., The musician or the actor *signed* a contract with the agent). Keung and Staub (2018) employed a very similar critical region to the one employed in the present experiment, and found that agreement violation effects were consistently observed in this region.

We report three standard eye movement measures: *first pass time*, which is the sum of all eye fixation durations on the region on the reader's first pass, i.e., before leaving the region to the left or right; *go-past time*, which is the sum of all fixation durations beginning with the first on the region, but including all fixations before the reader exits the region to the right, thereby including any regressive re-reading of earlier material and any re-reading of the critical region itself; and *regression probability*, which is simply the probability that first pass saccade of the critical region ended with a regressive (i.e., leftward) saccade out of the region, rather than a forward saccade. In Keung and Staub (2018), significant effects of verb grammaticality appeared in the

<sup>5</sup> All materials and data for this project are publicly available at the following link: [https://osf.io/qf2tk/?view\\_only=4fb145d06e61407fb7447fbde710246e](https://osf.io/qf2tk/?view_only=4fb145d06e61407fb7447fbde710246e)

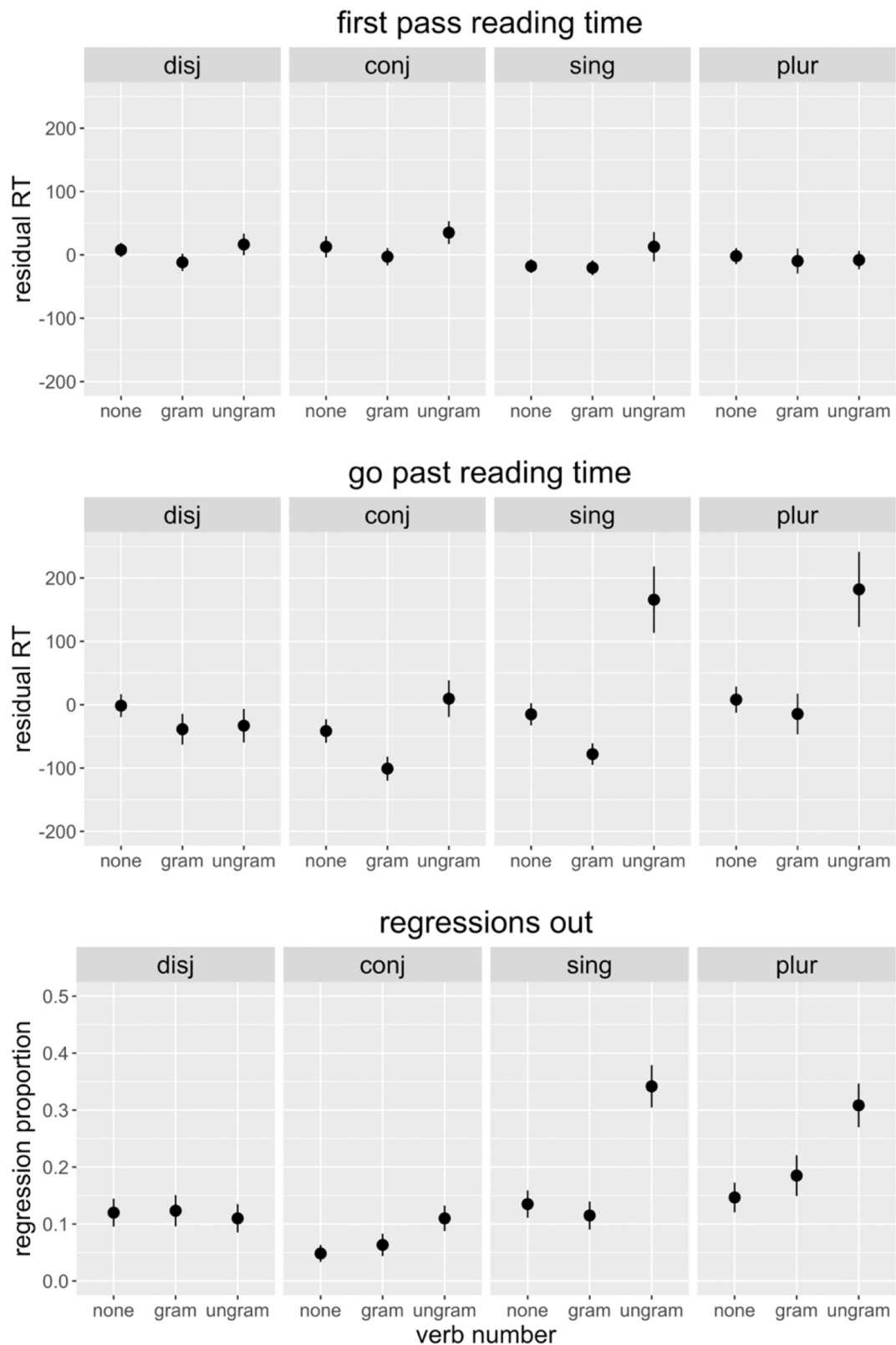


Fig. 1. Experiment 1 condition means and standard errors, by subject, for each eye movement measure; *none* corresponds to an unmarked verb; *gram* to singular for the disjunctive and singular subjects, and to plural for the conjunctive and plural subjects; *ungram* corresponds to plural for the disjunctive and singular subjects, and to singular for the conjunctive and plural subjects.

go-past and regression measures. Because of the length differences in the critical region between conditions (e.g., the plural verb is always one character longer than the corresponding singular), all analyses of reading times include region length as a covariate.

## 2.2. Results and discussion

Condition means for each measure are shown in Fig. 1. Statistical analysis of the reading time measures and regression probability was

**Table 1**  
Experiment 1 mixed-effects model results. Significant effects ( $p < .05$ ) are in bold.

Effect	Estimate	SE	df	t/z-value	p value
First pass reading time					
INTERCEPT	370.97	9.97	61.31	<b>37.21</b>	< <b>0.001</b>
REGION.LENGTH	19.82	2.56	223.67	<b>7.73</b>	< <b>0.001</b>
SUBJECT.NUMBER	2.62	7.13	2141.67	0.37	0.71
SUBJECT.COORD	-13.75	7.17	2163.64	-1.92	0.06
VERB.GRAM	-19.66	8.68	1516.18	<b>-2.27</b>	<b>0.02</b>
VERB.MARKING	10.50	12.18	738.26	0.86	0.39
SUBJECT.NUMBER:SUBJECT.COORD	-6.09	14.33	2158.46	-0.43	0.67
SUBJECT.NUMBER:VERB.GRAM	8.47	15.67	2154.53	0.54	0.59
SUBJECT.NUMBER:VERB.MARKING	1.49	17.67	2163.70	0.08	0.93
SUBJECT.COORD:VERB.GRAM	4.79	15.17	2134.63	0.32	0.75
SUBJECT.COORD:VERB.MARKING	-3.36	17.44	2134.12	-0.19	0.85
SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM	45.95	30.25	2139.22	1.52	0.13
SUBJECT.NUMBER:SUBJECT.COORD:VERB.MARKING	17.23	34.93	2139.43	0.49	0.62
Go past reading time					
INTERCEPT	484.60	18.92	63.28	<b>25.61</b>	< <b>0.001</b>
REGION.LENGTH	30.52	4.77	248.38	<b>6.40</b>	< <b>0.001</b>
SUBJECT.NUMBER	-1.25	12.95	2139.44	-0.10	0.92
SUBJECT.COORD	75.02	13.03	2161.30	<b>5.76</b>	< <b>0.001</b>
VERB.GRAM	-115.24	15.85	1541.85	<b>-7.27</b>	< <b>0.001</b>
VERB.MARKING	38.49	22.55	774.71	1.71	0.09
SUBJECT.NUMBER:SUBJECT.COORD	60.48	26.01	2155.89	<b>2.33</b>	<b>0.02</b>
SUBJECT.NUMBER:VERB.GRAM	-25.40	28.49	2157.08	-0.89	0.37
SUBJECT.NUMBER:VERB.MARKING	-9.90	32.09	2162.59	-0.31	0.76
SUBJECT.COORD:VERB.GRAM	-165.68	27.44	2132.88	<b>-6.04</b>	< <b>0.001</b>
SUBJECT.COORD:VERB.MARKING	6.36	31.65	2132.40	0.20	0.84
SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM	125.02	54.91	2137.20	<b>2.28</b>	<b>0.02</b>
SUBJECT.NUMBER:SUBJECT.COORD:VERB.MARKING	-60.36	63.41	2137.43	-0.95	0.34
Regressions out					
INTERCEPT	-2.01	0.12		<b>-16.60</b>	< <b>0.001</b>
SUBJECT.NUMBER	-0.28	0.13		<b>-2.08</b>	<b>0.04</b>
SUBJECT.COORD	0.91	0.14		<b>6.63</b>	< <b>0.001</b>
VERB.GRAM	-0.72	0.14		<b>-5.36</b>	< <b>0.001</b>
VERB.MARKING	-0.06	0.18		-0.36	0.72
SUBJECT.NUMBER:SUBJECT.COORD	0.82	0.27		<b>3.05</b>	< <b>0.01</b>
SUBJECT.NUMBER:VERB.GRAM	-0.16	0.27		-0.61	0.54
SUBJECT.NUMBER:VERB.MARKING	-0.32	0.35		-0.91	0.36
SUBJECT.COORD:VERB.GRAM	-0.84	0.27		<b>-3.12</b>	< <b>0.01</b>
SUBJECT.COORD:VERB.MARKING	0.10	0.35		0.28	0.78
SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM	1.35	0.54		<b>2.50</b>	<b>0.012</b>
SUBJECT.NUMBER:SUBJECT.COORD:VERB.MARKING	-0.31	0.70		-0.44	0.66

carried out using mixed-effects linear and logistic regression models, respectively, as shown in Table 1. In all models, the fixed effects structure was as follows. Subject type was coded by means of two contrasts, and their interaction: SUBJECT.NUMBER compared the subject types that ostensibly take singular agreement, namely disjunction and singular (coded as -0.5) to those that take plural agreement, namely conjunction and plural (coded as 0.5); and SUBJECT.COORD comparing the coordinated subjects (disjunction and conjunction; coded as -0.5) to the non-coordinated subjects (singular and plural; coded as 0.5). Verb number was coded as follows: VERB.GRAM compared the putatively ungrammatical verb number (singular for conjunctive and plural subjects, plural for disjunctive and singular subjects; coded as -2/3) to the other two verb number conditions (coded as 1/3); and VERB.MARKING compared the two grammatical conditions to each other, with the marked verb number coded as -0.5 and the unmarked verb number coded as 0.5. All interactions between the subject type factors and the verb number factors were also included. Centered region length, in characters, was also included as a fixed effect for the reading time measures. We report models with only random intercepts for subjects and items, as more complex models would not consistently converge, across measures; when we were able to assess more complex models, there was never a difference, in terms of patterns of significance, between the results of those models and the simpler models that we report here. All p-values for the reading time models are based on the Satterthwaite approximation to the denominator degrees of freedom, as implemented in the *lmerTest* package (Kuznetsova,

Brockhoff, & Christensen, 2017; Luke, 2017). For all experiments, tables presented here report the model's fixed effect estimates; full model output is included in our publicly available OSF files.

In first pass time, the only effect that reached significance (other than the expected effect of region length) was of VERB.GRAM, with slightly longer reading times for ungrammatical verbs, compared to unmarked and grammatical verbs. Interactions involving this variable did not reach significance in first pass time. In go-past time, on the other hand, interaction effects emerged. The most theoretically significant are the two-way SUBJECT.COORD:VERB.GRAM interaction, and the three-way SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM interaction. The first of these effects indicates that the effect of ungrammaticality on go-past times was much greater (by about 166 ms) for non-coordinated subjects, while the second indicates that this interaction was more pronounced for singular subjects than for plural subjects. Fig. 1 shows why this three-way interaction holds: There was an increase in go-past time on an ungrammatical singular verb following a *singular-and-singular* subject, compared to either an unmarked or a plural verb (which a post hoc analysis shows to be significant,  $p < .001$ ), but there was no evident increase on a plural verb following a *singular-or-singular* subject. The model of regressions out shows the same patterns, with the same significant two-way and three-way interactions.

Because differences between the disjunction conditions were of particular interest, we also evaluated models of only these conditions, using the same coding of verb number. In these models no effects

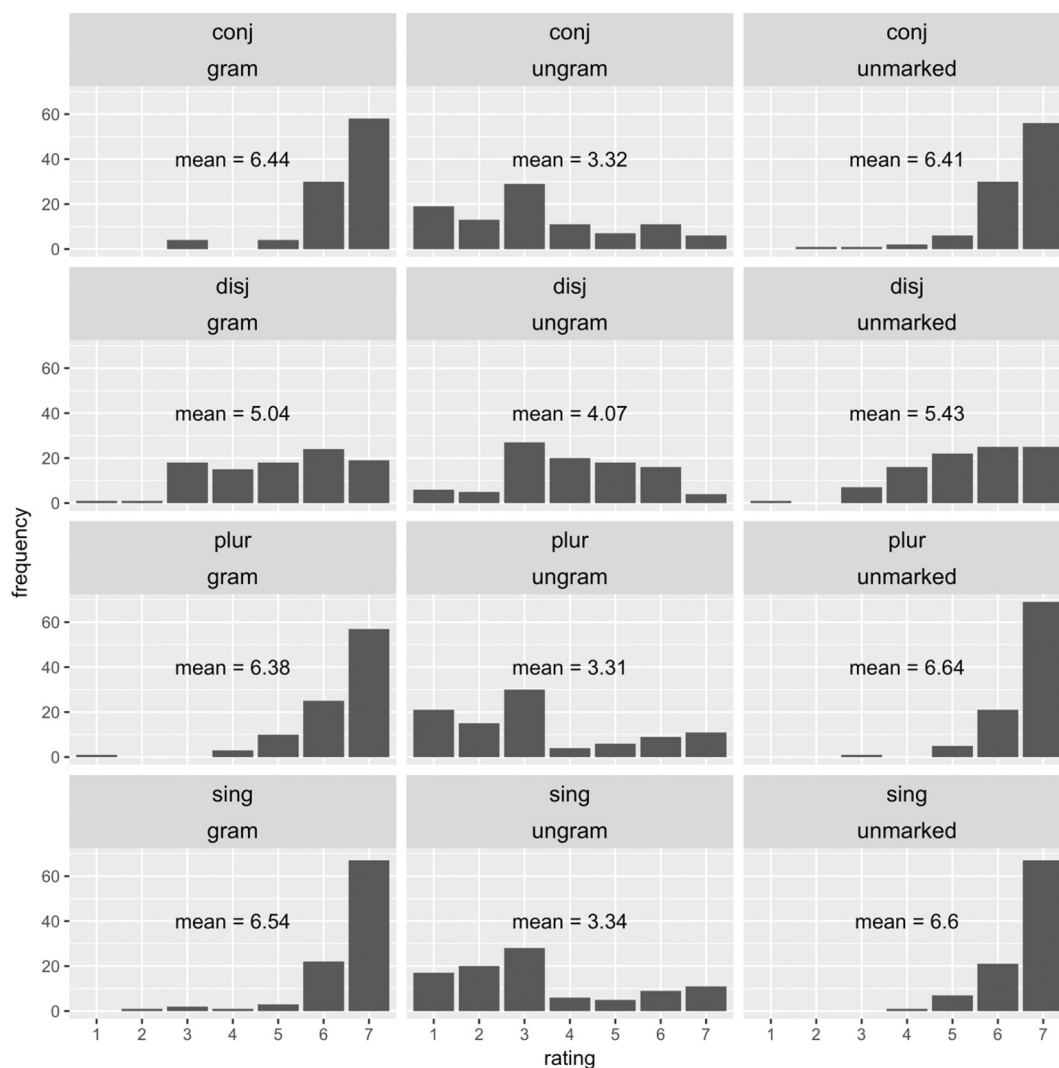


Fig. 2. Ratings in Experiment 2, by subject type (rows) and verb number (columns); *gram* corresponds to singular for the disjunctive and singular subjects, and to plural for the conjunctive and plural subjects; *ungram* corresponds to plural for the disjunctive and singular subjects, and to singular for the conjunctive and plural subjects; *unmarked* denotes the non-number-marked condition.

approached significance, for any measure, with all  $ps > 0.14$ . Finally, we assessed whether there were differences between the disjunction conditions in go-past times on the remainder of the sentence, following the critical region. On this region, sentences with a plural verb did induce longer mean go-past times (1665 ms) than the singular (1529 ms) or unmarked (1493 ms) conditions ( $p = .02$ ). The latter two conditions did not significantly differ ( $p = .55$ ). Thus, there is evidence that a plural verb following a disjunction of singulars did ultimately result in processing difficulty, but substantially downstream from the number-marked verb itself.

In sum, this experiment confirms that when a reader encounters a verb with the incorrect number after a non-coordinated subject, there are rapid and pronounced effects on eye movement behavior, with an ungrammatical verb inducing many regressive eye movements and a very large increase in go-past reading time on the critical region. The experiment also replicates the finding from Keung and Staub (2018) that a singular verb after a conjoined subject in which the second noun is singular - or in this case, in which both nouns are singular - elicits a more modest effect in the eye movement record. The new finding from the present experiment is that readers appear to be entirely insensitive, at first, to verb number after a disjunction of singulars. Eye movements upon encountering singular, plural, or unmarked verbs after a disjunction were not found to differ from each other on the critical region

where agreement violation effects appeared with other subject types, but only downstream of this region.

### 3. Experiment 2

Experiment 2 used the same materials as Experiment 1, but in a rating study, to assess whether off-line judgments show a sensitivity to agreement with disjunction.

#### 3.1. Methods

##### 3.1.1. Participants

Twenty-four self-reported monolingual English speakers living in the U.S. were recruited on Amazon Mechanical Turk, and received payment for participating. One additional subject was excluded, as described below.

##### 3.1.2. Procedure

The experiment was conducted online using the Ibx Farm platform (Drummond, 2013). Participants were asked for acceptability judgments of sentences on a 7 point Likert scale, with 1 representing fully unacceptable (labeled 'bad' on the screen) and 7 representing fully acceptable (labeled 'good'). Sentences remained visible on the screen

until participants selected their response. Full instructions were as follows:

"For each sentence, please give your rating of whether it seems like an acceptable sentence. If you think it sounds fine, give a high rating like 6 or 7; if you think it does not sound like a possible sentence of English, then you should give it a low rating like a 1 or a 2. Note that in this experiment you are NOT being asked to judge the plausibility of the meaning of the sentence; you are simply being asked to judge whether the sentence sounds like possible English or not. You are also not being asked to judge whether the sentence is acceptable according to 'school grammar.' You're just being asked to judge whether it sounds like natural English that somebody speaking or writing English might be able to use, given the proper context."

In addition to the experimental items, participants rated filler sentences that were designed to be clearly grammatical or ungrammatical. Participants rated four sentences involving sequence-of-tense violations and four corresponding grammatical controls, four sentences involving unlicensed negative polarity items and four grammatical controls, and four *whether*-island violations and four grammatical controls. Participants who showed reversed patterns of judgments for any of the filler types (i.e., a higher mean in the ungrammatical condition than in the corresponding grammatical condition) were assumed not to be attending to the task and/or not to be native English speakers, and were excluded. On this basis only one participant was excluded. Fillers and experimental materials were presented in an individually randomized order to each participant, after three practice items.

### 3.2. Results and discussion

The distributions of responses and condition means are shown in Fig. 2. The conjunctive, singular, and plural subject conditions all behaved similarly, showing a difference of over three points between the mean ratings of grammatical and ungrammatical sentences. The difference between the mean ratings for grammatical and ungrammatical fillers was also over three points (5.66 vs. 2.42). For all three of these subject types, the unmarked verb condition behaved very similarly to the grammatical, number marked condition.

The disjunctive subject conditions behaved differently. The difference in mean rating between the grammatical (singular) and ungrammatical (plural) conditions was just under one point (0.97). While this reduced penalty was partially due to higher ratings in the putatively ungrammatical (plural) condition, there was also a substantial reduction in the rating of the putatively grammatical (singular) condition, and the unmarked condition. In short, there appears to be both a smaller penalty for the putatively ungrammatical verb number with disjunctive subjects, and a general dispreference for the sentences with disjunctive subjects.

Fig. 3 directly illustrates the size of the grammaticality effect for each of the four subject types, enabling comparison to the subsequent rating experiments (Experiments 4, 5, and 7). The plot shows the mean difference between the ratings of the grammatical verb number and the ungrammatical verb number (with singular coded as grammatical for disjunctive subjects; unmarked verb conditions are not included on this plot) for each of the four subject types, as well as 95% confidence intervals on these differences (computed based on by-subject differences).

To evaluate these patterns statistically, we implemented a mixed-effects ordinal regression model with a logit link function, using the *clmm()* function in the *ordinal* package (Christensen, 2018). This is an appropriate statistical model for ratings that cannot be assumed to represent an interval scale, i.e., the values may not represent equally spaced points in subjects' subjective acceptability space. Results are shown in Table 2. Fixed effects in this model are exactly as in Experiment 1, except that region length is not included. Random intercepts for subjects and items were included, as well as random slopes for both SUBJECT.NUMBER and SUBJECT.COORD, for both subjects and items,

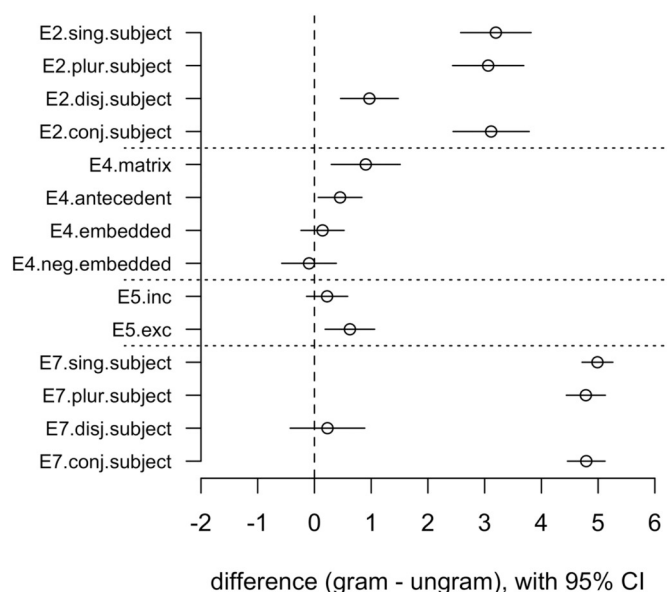


Fig. 3. Mean difference between grammatical and ungrammatical verb number, for each pair of conditions in each rating experiment, and 95% CI (based on by-subject difference scores). For disjunctive subject conditions, singular verb was coded as grammatical.

and random slopes for both VERB.GRAM and VERB.MARKING for subjects only; models with larger random effect structures would not converge.

Almost all factors (and their interactions) resulted in significant effects on ratings; unsurprisingly, the largest effect was of verb grammaticality. We focus on tests of the theoretically important patterns described above. First, the SUBJECT.NUMBER:SUBJECT.COORD interaction is significant; this reflects the fact that ratings were, overall, lower in the disjunction condition than for the other three subject types. Second, the three-way interaction of SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM is significant; this reflects the fact that the difference between the (putatively) ungrammatical condition and the two other verb number conditions is smaller for disjunctive subjects than for the other types. Third, the three-way interaction of SUBJECT.NUMBER:SUBJECT.COORD:VERB.MARKING is also significant, reflecting the fact that when the subject is a disjunction there is a difference between the non-number marked condition and the singular condition that is larger than for the other subject types.

As in Experiment 1, we also directly test the differences among the three disjunctive subject conditions, using the same coding of verb number. Ratings of sentences with plural verbs were indeed lower than the other conditions ( $p < .001$ ), and the singular and unmarked conditions also differed from each other ( $p = .02$ ), with unmarked verbs rated higher than singular verbs.

One possibility is that the very small overall rating penalty for plural agreement with disjunctive subjects (0.97 points) is due to some speakers finding plural agreement perfectly acceptable, or even preferring it, while others find it substantially degraded. To assess this possibility, we illustrate in the left panel of Fig. 4 the distribution of by-subject difference scores, calculated as a subject's mean rating of singular agreement with disjunction minus that subject's mean rating for plural agreement. For the majority of subjects, there is little if any penalty for plural agreement. Only a very few subjects show a more substantial difference score, indicative of substantially higher ratings for singular agreement. We also computed the same difference scores by item, shown in the right panel of Fig. 4. In principle, this plot could reveal that the semantics of certain items resulted in a preference for plural agreement, while others elicited a strong singular preference. There is no evidence for such bimodality; most items show a small singular preference.



**Table 2**  
Experiment 2 results of mixed-effects ordinal regression model. Significant effects ( $p < .05$ ) are in bold.

Effect	Estimate	SE	t/z-value	p value
SUBJECT.NUMBER	0.533	0.140	<b>3.78</b>	< <b>0.001</b>
SUBJECT.COORD	0.861	0.174	<b>4.95</b>	< <b>0.001</b>
VERB.GRAM	4.871	0.450	<b>10.85</b>	< <b>0.001</b>
VERB.MARKING	0.414	0.192	<b>2.15</b>	<b>0.03</b>
SUBJECT.NUMBER:SUBJECT.COORD	-1.349	0.255	<b>-5.29</b>	< <b>0.001</b>
SUBJECT.NUMBER:VERB.GRAM	1.714	0.260	<b>6.60</b>	< <b>0.001</b>
SUBJECT.NUMBER:VERB.MARKING	0.095	0.319	0.30	0.765
SUBJECT.COORD:VERB.GRAM	2.412	0.268	<b>9.02</b>	< <b>0.001</b>
SUBJECT.COORD:VERB.MARKING	0.257	0.322	0.80	0.424
SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM	-3.852	0.517	<b>-7.45</b>	< <b>0.001</b>
SUBJECT.NUMBER:SUBJECT.COORD:VERB.MARKING	1.414	0.640	<b>2.21</b>	<b>0.027</b>

Together, the results of Experiments 1 and 2 indicate that a plural verb following a disjunction of singulars behaves differently from a typical agreement violation in two ways. Experiment 1 showed that the disruption induced by a plural verb is very late compared to the effect of other agreement violations, with no effect showing up until after the eyes had left a critical region that consisted of a number-marked auxiliary and a participle or non-finite verb form. Experiment 2 showed that the effect of a plural verb on rated acceptability is very small compared to the effect of other agreement violations.

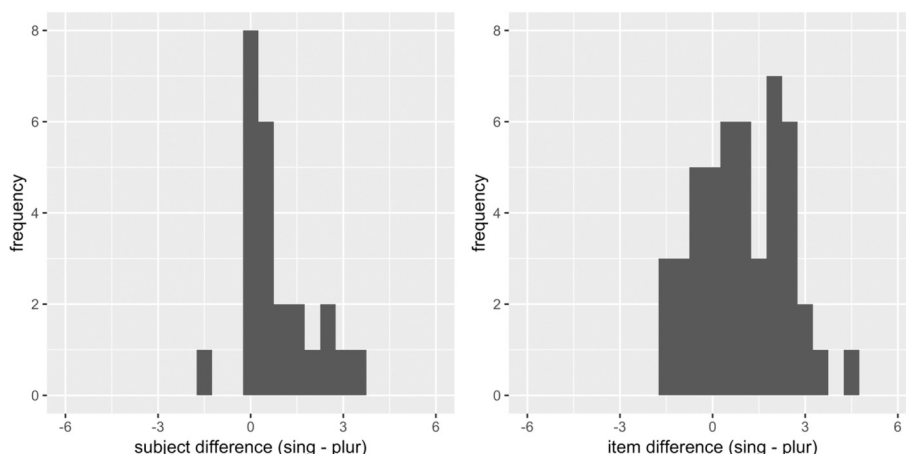
Before moving on, we suggest a possible source of the generally lower ratings in the disjunctive conditions in Experiment 2, namely, the potential difficulty of accommodating the speaker's state of uncertainty that is communicated by disjunction (Clifton Jr & Frazier, 2016, 2017; Staub & Clifton Jr, 2011). This is likely to be especially difficult when a disjunctive subject is used with a past tense predicate. Clifton Jr and Frazier (2016) have shown that ratings of sentences containing disjunctions are higher in the future tense than in the past, which they attribute to the fact that it is typical for speakers to lack complete knowledge of events in the future. In the present experiment, for half of the items the condition with an unmarked verb was in the future tense, and the conditions with number marked verbs were in the present progressive, which can be interpreted as future oriented. Singular verbs with disjunctive subjects did receive numerically higher mean ratings in the progressive items than in the imperfect items (5.23 vs. 4.85; due to the post hoc nature of this comparison, we do not report statistical tests), and unmarked verbs received higher mean ratings in the future than in the simple past (5.67 vs. 5.19). However, there was no corresponding difference for plural verbs (4.04 vs. 4.10). In short, the current experiment does contain a suggestion that difficulty in accommodating the speaker's epistemic state may have played a role in the reduced ratings of the sentences with disjunctive subjects in the past tense. In light of this, no past tense items were used in Experiments 3 and 4.

#### 4. Experiment 3

In Experiment 1, readers' eye movements showed only delayed sensitivity to verb number following a subject that is a disjunction of singulars. Experiment 3 provides an opportunity to replicate this finding, and also explores the potential role of the subject's syntactic position and its interaction with semantic-pragmatic factors. The processing of agreement with disjunction may be modulated when the disjunction occurs in the antecedent of a conditional, or when it is embedded under an attitude verb, with or without negation (e.g., *I think that; I don't think that*). These contexts might render a disjunctive subject more felicitous in general, because they are used to express uncertainty and/or the speaker's ignorance. In addition, plural agreement in particular may be made more acceptable when disjunction appears in the scope of negation or in the antecedent of a conditional, as noted above. These are downward-entailing contexts that are thought to cancel (or suspend) the exclusive reading of disjunction (Chierchia, 2013), allowing for an inclusive reading that might allow for plural agreement, if not favor it (Ivlieva, 2012).

In all experimental items, the subject was a disjunction of singulars. This subject was either in the matrix clause (10a), in the antecedent of a conditional (10b), the subject of a clause embedded under *I think that* (10c), or the subject of a clause embedded under *I don't think that* (10d). Verbs were in the present tense, and were either singular or plural. In 16 of the 24 items, the verb was in a progressive form as in (10); in the remaining 8 items, the verb was a copula.

- (10) a. The lawyer or the accountant is/are coming to the meeting.
- b. If the lawyer or the accountant is/are coming to the meeting, I won't go.
- c. I think that the lawyer or the accountant is/are coming to the meeting.



**Fig. 4.** Experiment 2 by-subject (left) and by-item (right) difference in mean ratings for singular and plural agreement with disjunctive subjects.

d. I don't think that the lawyer or the accountant is/are coming to the meeting.

In the (b) and (d) conditions, the disjunction was in a downward-entailing context, where it would be expected to receive an inclusive reading. Condition (c) provides a minimal pair with condition (d), differing only in the presence of negation. It is the presence of negation that triggers the inclusive reading; while the speaker of (d) would be interpreted as believing that *neither* the lawyer nor the accountant will be at the meeting (i.e., using *or* inclusively), the speaker of (c) would be interpreted as believing that only one of them, not both, will be at the meeting (i.e., using *or* exclusively).

#### 4.1. Methods

##### 4.1.1. Participants

Sixty participants from the same pool as Experiment 1 were run in Experiment 3, of whom seven were excluded based on the same criteria, leaving final  $N = 53$ .

##### 4.1.2. Procedure

The procedure was identical to Experiment 1. One subject was excluded due to poor performance on comprehension questions (53%); all others achieved at least 80% correct. Six subjects were excluded due to deletion of > 20% of trials because of blink or track loss on the critical region; for the remaining subjects, 4.4% of trials were excluded based on these criteria. An additional 85 trials were removed due to skipping of the critical region, and 12 trials due to an error, leaving 1119 for analysis.

##### 4.1.3. Materials

Twenty-four items similar to (10) were created, so that each subject read three sentences in each of the eight experimental conditions. These 24 items were intermixed with 68 items examining syntactic ambiguity resolution (Staub et al., 2018, Experiment 1), of which 17 were followed by comprehension questions, and the same 50 filler items used in Experiment 1, all of which had comprehension questions. The 142 items were intermixed in an individually randomized order and presented after eight practice trials. The critical region for analysis was the same as in Experiment 1, i.e., the auxiliary and participle. In the 8 items that used the copula rather than the present progressive, the word following the copula, which ranged from 2 to 6 characters, was included in the critical region (e.g., The bar or the restaurant *is open* on Sunday).

#### 4.2. Results and discussion

Condition means for each measure are shown in Fig. 5, and statistical results in Table 3. The manipulation of the subject's structural position was coded as follows: SUBJECT.MATRIX compared matrix position ( $-0.75$ ) to the three other positions (0.25); SUBJECT.ANT compared the antecedent of a conditional ( $-2/3$ ) to the two embedded positions (1/3); and SUBJECT.EMBED compared embedding without negation ( $-0.5$ ) to embedding under negation (0.5). Verb number was coded (VERB.NUM), with plural =  $-0.5$  and singular = 0.5. As in Experiment 1, models included random intercepts for subjects and items, except in the regressions model, which would converge only if random subject intercepts were removed.

In both of the reading time measures there was an effect of region length, and in go-past time there was an effect of the SUBJECT.MATRIX contrast, corresponding to longer go-past times when the subject was in matrix position. There were also more regressions from the critical region when the subject was in matrix position. No other effects reached significance, on any measure. Notably, while the main effect of VERB.NUM was marginal in first pass time ( $p = .08$ ), there was no hint of an effect of this variable on the other measures. An additional analysis that assessed the effect of verb number in only the matrix subject

conditions (i.e., those that were comparable to Experiment 1) also did not find any effects; the hint of an effect on go-past time evident in Fig. 5 did not reach significance ( $p = .11$ ).

In contrast to Experiment 1, an additional analysis of go-past time on the final region of each sentence (with effects coded as for the critical region) did not reveal any effect of verb number. It also did not reveal significant interactions with subject position. For all four subject positions, the go-past mean on the final region was quite similar for singular and plural agreement, and in only two of the four conditions was the mean numerically greater for plural agreement (matrix 1182 ms for plural vs. 1147 for singular; antecedent 1938 vs. 2008 ms; embedded 1137 vs. 1081 ms; embedded with negation 1078 vs. 1134 ms; note that these times are much longer in the antecedent condition due to the additional clause at the end of these sentences).

In sum, readers' eye movements appear to be quite insensitive to verb number when the subject is a disjunction of singulars. Indeed, while Experiment 3 replicated the lack of effect of verb number on the critical region that was observed in Experiment 1, this experiment failed to replicate the downstream effect that we observed in that experiment. We speculate that in Experiment 1, the presence of clear agreement violations in other conditions may have made subject-verb agreement more salient in general, resulting in increased attention to verb number in the disjunction conditions.

In considering the evidentiary value of these null effects, it is important to note that Experiment 3 had substantially greater power to detect a main effect of verb number when the subject was a disjunction than did Experiment 1, as each subject read 12 singular and 12 plural trials with a disjunctive subject, compared to only 4 with each verb number in Experiment 1. We cannot rule out entirely the hypothesis that there is some small effect of verb number downstream from the verb itself, or even on the verb region, where agreement violation effects appear with other subject types. But given that in neither experiment was there even a notable numerical trend in the direction of difficulty on a plural verb following a disjunction of singulars, we think such an effect must be very small indeed. The 95% confidence interval for the go-past effect of a plural verb on the critical region in Experiment 3 (computed using the *confint.Mermod()* function) extends from  $-36.27$  ms to 25.19 ms. Thus, we can be fairly confident that a true effect, if one does exist, would be  $< 36$  ms.

#### 5. Experiment 4

Experiment 4 was a rating experiment using the same manipulations as in Experiment 3. Because disjunctive subjects appeared in all of the critical items, we were concerned that in the absence of an unusually large number of fillers these would be highly salient in a rating experiment. Thus, we used only eight of the 24 items from Experiment 3, with each participant rating only a single item in each of the eight conditions.

##### 5.1. Methods

###### 5.1.1. Participants

Participants were 42 individuals recruited as in Experiment 2. An additional six were excluded based on performance on the filler trials, using the same criterion as in Experiment 2.

###### 5.1.2. Procedure

The procedure was identical to Experiment 2, except that the *whether*-island violations and the corresponding controls were not included among the fillers. The experiment as a whole was substantially shorter, as it included only eight critical trials and 16 fillers.

##### 5.2. Results and discussion

The distributions of responses and the means in each condition are

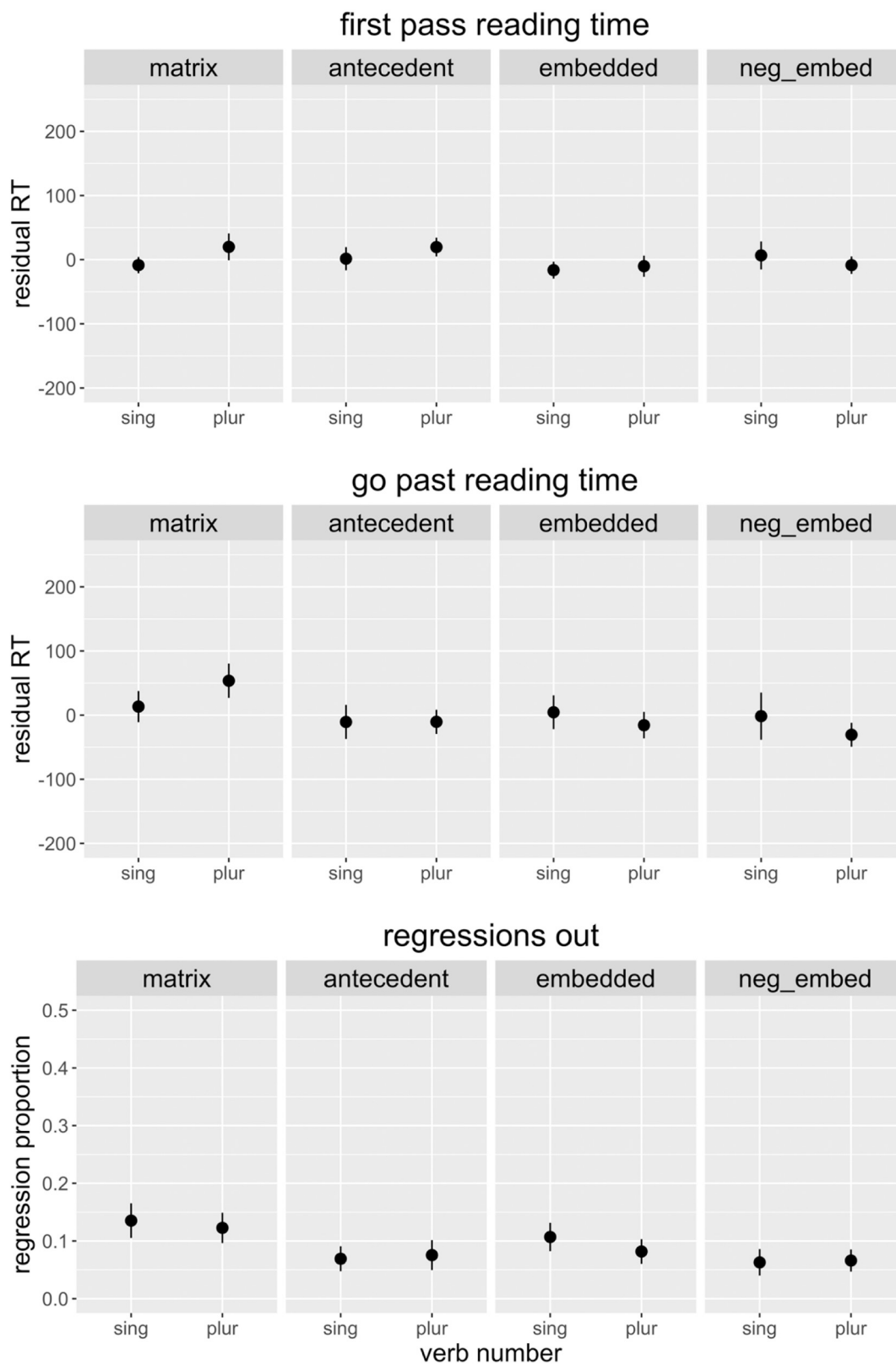


Fig. 5. Experiment 3 condition means and standard errors, by subject, for each eye movement measure.

shown in Fig. 6. For comparison, the grammatical fillers received a mean rating of 5.85 and the ungrammatical fillers a mean rating of 2.93. In the matrix subject conditions, the plural verb penalty was very similar to the corresponding effect in Experiment 2, with a decrement of 0.91 points when the verb was plural. The decrement for plural

agreement when the subject was in the antecedent of a conditional was about half this size, 0.45 points. When the subject was embedded under *I think that* or *I don't think that*, there was almost no difference at all between singular and plural agreement; with negation, the numerical difference actually favors plural agreement. Notably, the ratings for

**Table 3**  
Experiment 3 mixed-effects model results. Significant effects ( $p < .05$ ) are in bold.

Effect	Estimate	SE	df	t/z-value	p value
First pass reading time					
INTERCEPT	337.49	12.90	73.69	<b>26.15</b>	< <b>0.001</b>
REGION.LENGTH	12.19	2.81	23.69	<b>4.34</b>	< <b>0.001</b>
SUBJECT.MATRIX	-20.14	13.16	1042.27	-1.53	0.13
SUBJECT.ANT	-27.51	14.09	1042.49	-1.95	0.051
SUBJECT.EMBED	-1.63	16.49	1045.60	-0.10	0.92
VERB.NUM	-15.22	8.73	801.68	-1.74	0.08
SUBJECT.MATRIX:VERB.NUM	13.26	18.99	1043.12	0.70	0.49
SUBJECT.ANT:VERB.NUM	18.72	20.50	1045.39	0.91	0.36
SUBJECT.EMBED:VERB.NUM	14.71	23.52	1044.98	0.63	0.53
Go past reading time					
INTERCEPT	395.54	19.04	60.80	<b>20.77</b>	< <b>0.001</b>
REGION.LENGTH	13.19	5.67	23.29	<b>2.33</b>	<b>0.03</b>
SUBJECT.MATRIX	-74.24	23.44	1043.27	<b>-3.17</b>	< <b>0.01</b>
SUBJECT.ANT	-4.36	25.08	1044.08	-0.17	0.86
SUBJECT.EMBED	-18.51	29.37	1046.53	-0.63	0.53
VERB.NUM	-5.53	15.77	683.44	-0.35	0.73
SUBJECT.MATRIX:VERB.NUM	40.92	33.82	1044.71	1.21	0.23
SUBJECT.ANT:VERB.NUM	10.28	36.50	1047.35	0.28	0.78
SUBJECT.EMBED:VERB.NUM	-3.95	41.89	1046.41	-0.09	0.92
Regressions out					
INTERCEPT	-2.47	0.18		<b>-13.86</b>	< <b>0.001</b>
SUBJECT.MATRIX	-0.64	0.31		<b>-2.05</b>	<b>0.04</b>
SUBJECT.ANT	0.24	0.41		0.59	0.55
SUBJECT.EMBED	-0.21	0.45		-0.47	0.64
VERB.NUM	0.10	0.22		0.45	0.65
SUBJECT.MATRIX:VERB.NUM	-0.02	0.44		-0.04	0.97
SUBJECT.ANT:VERB.NUM	-0.08	0.58		-0.13	0.90
SUBJECT.EMBED:VERB.NUM	-0.46	0.64		-0.73	0.47

singular agreement with disjunction are higher in all of these conditions than in Experiment 2. In part this may be due to the absence of past tense predicates. But in addition, it appears that putting the disjunction in the antecedent of a conditional or embedding it under *I don't think that* further increases ratings. This might also be attributable to the epistemic status of the speaker (Sauerland, 2004), as the speaker's ignorance or uncertainty is more clearly evident in these contexts, possibly rendering the use of disjunction more appropriate. In these conditions the mean rating is at or approaching 6 points, near the ratings for grammatical agreement with other subject types in Experiment 2.

To analyze these results statistically, we again computed an ordinal regression model, with fixed effects coded as in Experiment 3. The model included random intercepts for subjects and items, and random slopes for the verb number predictor; larger models would not converge. Results are shown in Table 4.

The effect of VERB.NUM was significant overall, and this effect was more pronounced when the subject was in the matrix clause, as indicated by the SUBJECT.MATRIX:VERB.NUM interaction. No other interactions were significant. Overall ratings were also lower when the subject was in the matrix clause (i.e., the main effect of SUBJECT.MATRIX), and there is also evidence that negation increased the ratings of sentences with embedding (i.e., the main effect of SUBJECT.EMBED).

We may summarize as follows. It appears that the decrement of about 1 point for plural agreement with a disjunctive subject obtained in Experiment 2 may actually correspond to the maximal size of the effect. In Experiment 4, the decrement was made even smaller when the disjunction was in the antecedent of a conditional, and essentially disappeared altogether when the disjunctive subject was embedded under a (negated or non-negated) attitude verb. Thus, the results of Experiment 4 do offer some support for the notion that plural agreement with a disjunctive subject is especially acceptable in downward entailing contexts in which the inclusive interpretation of *or* should be more readily available. However, plural agreement was also about as acceptable as singular agreement when the critical disjunction was embedded under *I think that*, which does not, in a strict sense, introduce

a downward entailing context, and where the subject is likely to be interpreted exclusively.

In addition, another aspect of the data from Experiment 4 is not easily reconciled with the view that an inclusive interpretation of a disjunctive subject increases the acceptability of plural agreement by rendering the subject notionally plural. While the acceptability of plural agreement with a disjunction of singulars was increased when the disjunction appeared in a downward entailing context, which encourages an inclusive reading, there was no evidence whatsoever that the acceptability of singular agreement *decreased* in this circumstance. Indeed, the conditions that elicited the highest ratings for plural agreement also elicited the highest ratings for singular agreement. Singular and plural agreement are maximally acceptable in the same conditions; they do not trade off in acceptability.

A remaining possibility is as follows. Judgments in these experiments may be dependent, at least in part, on the *possibility* of an exclusive or inclusive reading of the disjunction, rather than on whether such a reading is initially adopted. The comprehender may adjust her reading of the disjunction as exclusive or inclusive based on whether she encounters a singular or plural verb. This would explain why both singular and plural agreement can receive quite high ratings in the same conditions; as long as both readings are possible, both forms of agreement will ultimately be acceptable. If this is correct, then it may be possible to reduce the acceptability of plural agreement by making use of predicates that rule out an inclusive reading, based on the comprehender's world knowledge. This is the strategy of Experiment 5.

## 6. Experiment 5

Experiment 5 tested the acceptability of plural agreement when the predicate is designed to rule out an inclusive reading of *or*, because it can be predicated of only one entity, such as *is/are going to become the next CEO of the company*. To the extent that plural agreement enforces an inclusive reading, it should be incompatible with such predicates, leading to reduced acceptability. We created items such as (11), in which the predicate either did (11a) or did not (11b) allow an

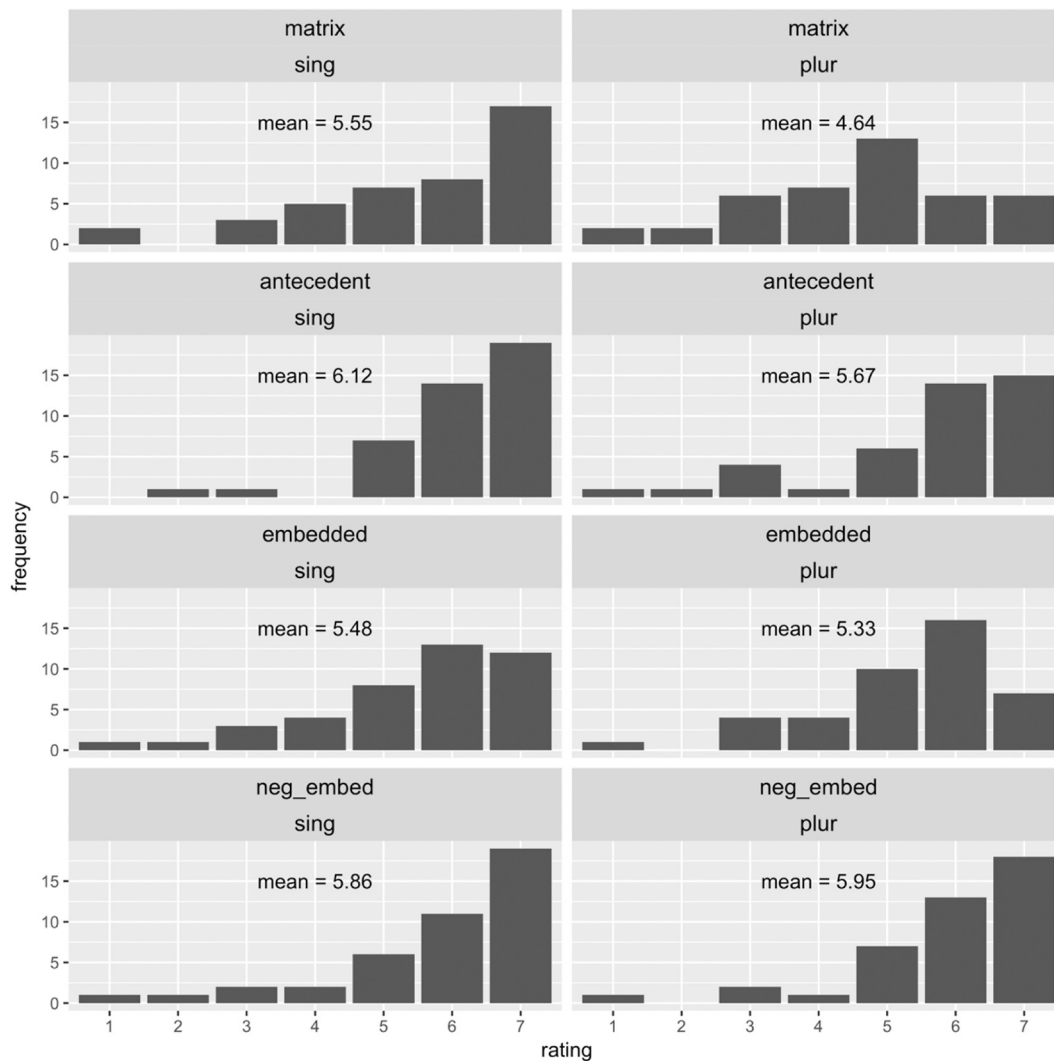


Fig. 6. Ratings in Experiment 4, by subject position (rows) and verb number (columns).

**Table 4**  
Experiment 4 results of mixed-effects ordinal regression model. Significant effects ( $p < .05$ ) are in bold.

Effect	Estimate	SE	t/z-value	p value
SUBJECT.MATRIX	1.047	0.255	<b>4.11</b>	<b>&lt; 0.001</b>
SUBJECT.ANT	-0.401	0.262	-1.53	0.12
SUBJECT.EMBED	1.173	0.307	<b>3.82</b>	<b>&lt; 0.001</b>
VERB.NUM	0.725	0.255	<b>2.84</b>	<b>0.004</b>
SUBJECT.MATRIX:VERB.NUM	-1.282	0.499	-2.57	<b>0.01</b>
SUBJECT.ANT:VERB.NUM	-0.611	0.523	-1.17	0.24
SUBJECT.EMBED:VERB.NUM	-0.369	0.599	-0.62	0.54

interpretation on which it was true of both disjuncts; while it is possible for both a lawyer and an accountant to come to a meeting, it is not possible for both to be the next CEO. The verb was again presented in either singular or plural form.

- (11) 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.

### 6.1. Methods

#### 6.1.1. Participants

Participants were 28 individuals recruited as in Experiments 2 and 4. An additional two participants were excluded based on the same criterion used in those experiments.

#### 6.1.2. Procedure

The procedure was identical to Experiments 2 and 4.

#### 6.1.3. Materials

Sixteen items as in (11) were created, so that each subject read four in each of the four experimental conditions. The experiment used the same filler items as in Experiment 2.

### 6.2. Results and discussion

The distributions of ratings are shown in Fig. 7; for comparison, the means for grammatical and ungrammatical fillers were 5.83 and 2.83, respectively. Two patterns are notable. First, the decrement for plural agreement in the conditions that mirrored the matrix subject conditions from the previous experiments was now extremely small (0.22 points)

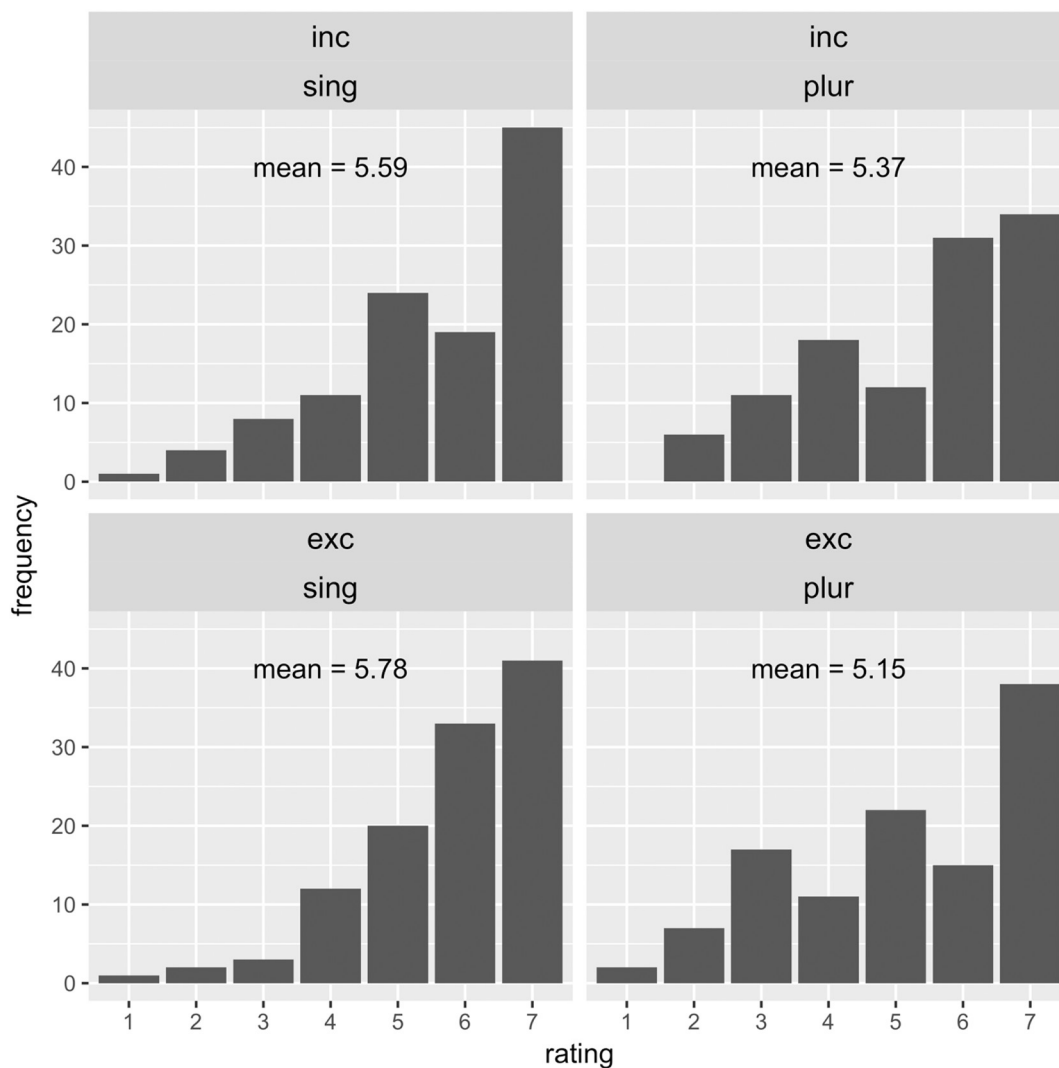


Fig. 7. Distribution of ratings in Experiment 5 by predicate type (rows) and verb number (columns).

compared to those experiments (0.97 and 0.91 points). We do not have a clear explanation for this difference, especially given that ratings for the fillers were so extremely similar across experiments. We assume the most parsimonious explanation, namely that the difference is due simply to sampling variability. Second, when both disjuncts could not simultaneously satisfy the predicate (e.g., *...is/are going to become the next CEO of the company*), the difference between singular and plural ratings did increase somewhat, to 0.63 points. This decrement is still smaller than the plural agreement penalty expected based on previous experiments. Moreover, the increase is due about equally to reduced ratings in the plural condition and increased ratings in the singular condition.

An ordinal regression model with effect coding of verb number (VERB.NUM) and predicate type (PRED.TYPE) was used to evaluate these patterns. Random effects included intercepts for both subjects and

**Table 5**  
Experiment 5 results of mixed-effects ordinal regression model. Significant effects ( $p < .05$ ) are in bold.

Effect	Estimate	SE	t/z-value	p value
PRED:TYPE	0.013	0.185	0.07	0.94
VERB.NUM	0.689	0.286	<b>2.41</b>	<b>0.02</b>
SUBJECT.MATRIX:VERB.NUM	-0.447	0.369	-1.21	0.23

items, and random slopes for both factors, by both subject and item. The only significant effect was of VERB.NUM; the interaction did not reach significance (Table 5).

In sum, it appears that an ‘exclusive’ predicate – one that cannot be satisfied by both entities in the disjunction, but only by one or the other – has only a very small effect on the acceptability of plural agreement with a disjunction. Indeed, the relevant interaction effect did not reach significance in the present experiment. When the inclusive reading is ruled out by the meaning of the predicate, plural agreement still received a mean rating above five points.

We summarize the results of the five English experiments as follows. One central conclusion is that on-line processing, as revealed by eye movements in reading (Experiments 1 and 3), is largely insensitive to number agreement with a subject that is a disjunction of singulars. In these experiments neither singular nor plural agreement elicited disruption on a critical verbal region, while agreement violations when the subject was singular, plural, or a conjunction of singulars did elicit disruption on this region. In Experiment 1, a plural verb following a disjunction of singulars resulted in some disruption on a later region, but this was not replicated in Experiment 3. In untimed rating experiments, on the other hand (Experiments 2, 4, and 5) English speakers do show a preference for singular agreement. But the penalty for plural agreement is quite small compared to the penalty for agreement violations with other subject types – less than one-third the size – and is essentially eliminated in certain structural configurations (see Fig. 3).

This modulation of the effect does not precisely track the predictions of the hypothesis that an inclusive reading of *or* encourages plural agreement, and in some configurations, both singular and plural agreement receive a mean rating of near six points on a 7-point scale. Even when the predicate is one that would appear to rule out an inclusive reading entirely, plural agreement receives a mean rating of above five points.

## 7. Experiment 6

In the English rating studies reported above, we found only a weak preference for a singular verb when the subject is a disjunction of singulars, which was eliminated altogether in some structural configurations. In eyetracking-during-reading experiments, neither verb number resulted in notable disruption in the course of incremental processing. The most general conclusion from these experiments is that English speakers are highly tolerant of both singular and plural agreement with a disjunction of singulars. The data do not confirm the hypothesis that the interpretation of the disjunction as exclusive or inclusive plays an important role.

In the remaining experiments, we explore whether the situation is different in Italian. Unlike in English, there is not a clear prescriptive rule for agreement with disjunction in Italian; to our knowledge, Italian grammarians are silent on this issue. Moreover, a preliminary corpus search reveals a very high degree of variability in usage. In the first 110 cases in the itWaC corpus (<http://wacky.sslmit.unibo.it/>; Baroni, Bernardini, Ferraresi, & Zanchetta, 2009) of a disjunction of singular nouns in subject position, there are 76 cases of a singular verb (69%) and 34 cases of a plural verb (31%).

This state of affairs may be regarded as particularly surprising in light of the role of verbal number marking in Italian. Italian has a much richer system of verbal inflectional morphology than does English, which may be related to the fact that it is a *pro*-drop language (e.g., Jaeggli & Safir, 1989). Because an overt subject is not obligatory and thus is absent in many Italian sentences, the verb's inflection for person and number becomes highly informative as to the identity of the subject, while in English the subject's person and number are marked on the subject itself, which is obligatorily expressed. The fact that there are no verb forms in Italian that are not marked for number may be seen as related to its *pro*-drop feature. Thus, one might expect that in general, Italian speakers would be more sensitive to the verb's number, and might have more definitive agreement preferences.

In Experiment 6, we asked Italian speakers to provide a typed continuation of a sentence beginning with a disjunction of definite singular noun phrases. English speakers tend to use a singular verb following a disjunction in which the second noun is singular (Haskell & MacDonald, 2005; Keung & Staub, 2018) or in which both nouns are singular (Keung & Staub, 2018), but there are no comparable experimental data from Italian.

### 7.1. Methods

#### 7.1.1. Participants

Participants were 74 monolingual Italian speakers, living in Italy, recruited via the participant recruitment system of the University of Milano-Bicocca, who received course credit for participating. All were students enrolled in a BA course in social-psychological sciences with no formal training in linguistics.

#### 7.1.2. Materials and procedure

Participants' task was to provide a full grammatical sentence completion for a single sentence fragment: *Il legale o il contabile...* (*The lawyer or the accountant...*). The task was implemented in the Moodle course management system. The fragment appeared on the screen together with a blank space in which participant could type up to 600 characters. No restrictions were given with respect to possible

continuations, except that a full grammatical sentence in Italian should be provided.

### 7.2. Results and discussion

Three participants did not provide a full sentence completion. Of the remaining 71 completions, 12 (17%) used a singular verb, and 59 (83%) used a plural verb; by binomial test, plurals were more likely than chance ( $p < .001$ ). Examples of each type are provided in (12):

- (12) a. legge la carte. (*reads the cards*).  
b. controllano il contratto. (*check the contract*)

However, some of the plural responses suggested that participants actually (mis)interpreted the disjunction as a conjunction, as they involve predicates that cannot apply to a single entity, as in (13):

- (13) a. sono due professioni. (*are two professions*).  
b. sono amici. (*are friends*)

Liberally excluding such responses reduced the number of plurals from 59 to 35. In the remaining set of 47 responses, singular verbs (26%) were still less likely than plurals (74%;  $p = .0011$ ).

The small corpus search reported above found a singular preference, and we briefly consider a possible source of the discrepancy between the corpus data and the experimental results. Consider the example in (14), taken from Chierchia (2013, p. 19): While the disjunction in (14a) is likely to receive an exclusive reading, the disjunction in (14b) is likely to receive an inclusive reading. Chierchia relates this to the fact that in the latter case, the disjuncts are interpreted as generics, rather than as denoting specific individuals.

- (14) a. An Italian or a Frenchman ordered white wine.  
b. An Italian or a Frenchman always orders white wine.

If it is also true that an inclusive interpretation of the disjunction might promote the use of the plural, then participants in the present study may have used a plural verb because they adopted a generic reading of the definite singular noun phrases in the prompt.

In the present data set it was not always possible to determine whether the noun phrases in the prompt were being interpreted generically. We adopted a conservative coding scheme that excluded any of the remaining 47 completions that was consistent with a generic interpretation of the noun phrases, leaving only 19. Of these, 5 were singular and 14 were plural, leaving the proportions unchanged. This analysis, then, does not support the notion that the use of the plural is due to participants interpreting the definites in the prompt as generics. Moreover, we note that the hypothesis relating the use of plural agreement to the generic reading is not consistent with the grammatical intuitions of a few native informants. In the Italian translation of (14b), given in (15), the verb can be singular or plural, but the disjunction always receives an inclusive interpretation, as in the English example:

- (15) a. Un italiano o un francese *ordina*<sub>[+sing]</sub> sempre del vino bianco.  
b. Un italiano o un francese *ordinano*<sub>[+plu]</sub> sempre del vino bianco.

This observation again suggests a lack of transparent mapping between the verb's number marking and interpretation of the disjunction as inclusive or exclusive.

In sum, the results of this completion study confirm that number agreement with a disjunction of singulars is highly variable in Italian. In contrast to English, this study suggests a preference for plural agreement.

## 8. Experiment 7

In Experiment 7 Italian speakers provided ratings of singular and plural agreement with disjunction, as well as with conjoined, singular, and plural subjects, in a design mirroring that of Experiment 2 conducted in English. Unmarked verb conditions were not included, as these forms are absent in Italian.

### 8.1. Methods

#### 8.1.1. Participants

Participants were 49 monolingual Italian speakers living in Italy recruited on Facebook or via the subject recruitment system of the University of Milano-Bicocca. They either volunteered or received course credit for participating.

#### 8.1.2. Materials and procedure

The 48 items developed for Experiment 2 were adapted to Italian. Only the singular and plural verb conditions were tested for each of the four subject types, resulting in eight conditions overall. Each participant rated six sentences in each condition, intermixed with 20 filler sentences. Unlike in the English experiments, the fillers were designed to range from marginally to fully ungrammatical, and were not used for purposes of subject exclusion. The overall mean rating of the fillers was 2.94, ranging from 1.82 for a subset of four items with a tense violation to 3.85 for four items with an incorrect use of an apostrophe. As in Experiment 1, the study was conducted on-line using Ibx farm and participants were asked for acceptability judgments of sentences on a 7 point Likert scale.

### 8.2. Results and discussion

Responses to one of the 48 items were removed, due to an error in the script. The distribution of responses and the condition means are shown in Fig. 8. The conjunctive, singular, and plural subject conditions all behaved similarly: There was a difference of almost 5 points between the mean ratings in the grammatical and the ungrammatical sentences in each condition. This difference is substantially larger than in Experiment 2, which contained the corresponding English conditions, confirming that Italian speakers are highly sensitive to subject-verb agreement violations. The pattern is different for the disjunctive conditions, for which the mean rating was very near the middle of the scale for both singular and plural verbs.

We fit a mixed-effects ordinal regression model to these data, with subject type coded as in Experiment 1, and with verb coded as grammatical (0.5) or ungrammatical (-0.5). Given that, as we have noted, there is no apparent prescriptive rule for agreement with disjunction in Italian, in Fig. 8 we represent verb number as simply singular or plural; for statistical analysis, however, we coded singular as the 'grammatical' verb number for the disjunction conditions. The model included random intercepts for subjects and items, and random slopes, by subject and by item, for verb grammaticality. Results are shown in Table 6. The critical finding is a significant three-way interaction, corresponding to the reduced effect of verb grammaticality in the disjunctive subject conditions. A model of only the disjunctive subject conditions revealed that ratings in these two conditions did not significantly differ ( $p = .43$ ).

The distributions of ratings in the disjunction conditions are unusually uniform across the 1–7 scale, and there may even be slight peaks near the ends of the scale. This raises the possibility that the mean ratings of around 4 – at the center of the scale – might be due to some subjects showing a strong preference for singular, and others for plural. This would result in relatively neutral ratings on average, though individual subjects would have strong preferences. To assess this possibility, we again computed a difference score for each subject, as in Experiment 2, calculated as the subject's mean rating of singular

agreement with disjunction minus that subject's mean rating for plural agreement. The distribution of these scores is shown in the left panel of Fig. 9. There is no hint of bimodality at the level of subject means, and most subjects showed only a small preference toward one verb number or the other. In other words, the equivocal ratings of both singular and plural agreement are not due to averaging across subjects.

Item variability might also help to explain the wide dispersion of ratings in the disjunction conditions; perhaps, due to unintended differences between items, singular agreement received high ratings in some specific items, and plural agreement received high ratings in others. To address this, we computed the same type of difference scores by item. These are shown in the right panel of Fig. 9. In fact, most items were rated as about equally acceptable with singular and plural agreement; there is even less variability across items than across subjects.

In sum, we have ruled out two possible sources of the variability in ratings of agreement with disjunctive subjects: It is not the case that some subjects strongly prefer singular agreement and other subjects prefer plural, and it is not the case that singular agreement is preferred with some items and plural agreement is preferred with others. Rather, singular and plural agreement do not differ much in acceptability, for most subjects, and singular and plural agreement are regarded as about equally acceptable in most items. It appears, then, that the observed variability should be characterized as true noise arising at the trial level. Ratings of sentences with disjunctive subjects are highly variable not because of variability at the participant or item level, but because ratings are simply unstable from trial to trial.

We repeat a point we made from the discussion of Experiment 2: It is possible that some part of the acceptability decrement for both singular and plural agreement with disjunction is due to the fact that sentences with a disjunctive subject in matrix position may not be perfectly felicitous. However, in English this resulted in a small decrement, at most, and we assume that this could only have played a small role here as well. Instead, it appears that neither singular nor plural agreement is consistently regarded as acceptable by Italian speakers.

Summarizing the two Italian studies, the clearest conclusion is that agreement with disjunction is highly uncertain in Italian as well as English. But it is worth noting both the similarities to English and the apparent differences. First, Experiment 6 found that Italian speakers' elicited continuations of the disjunctive subject *Il legale o il contabile* were highly variable, but that, unlike in English, plural agreement was more common than singular. We did not directly compare English and Italian speakers' completions of the same prompt, but previous completion studies (e.g., Haskell & MacDonald, 2005; Keung & Staub, 2018) show that singular, not plural, is dominant for English speakers.

Second, Experiment 7 found a difference of only 0.23 points in Italian speakers' mean ratings of singular and plural agreement (in favor of singular), which did not reach significance; this contrasts with the numerically small but statistically significant plural penalty in English when the subject was in matrix position, in Experiments 2, 4, and 5 (see Fig. 3). The fact that the difference is statistically significant in the English experiments and not in the Italian experiment does not license the inference that there are real differences between English and Italian speakers in the degree to which they penalize plural agreement; indeed, we do not claim that there are, on the basis of these data. However, a lack of singular preference in Italian speakers' ratings would certainly be consistent with the completion data in Experiment 6, where plural was dominant.

Another possible contrast with English is in the degree to which Italian speakers find both singular and plural agreement to be degraded. In Italian, both forms received mean ratings of about 4 points on a 7-point scale, compared to mean ratings of about 6.5 for grammatical agreement with other subject types. In Experiment 2, English speakers' mean rating of singular agreement with disjunction was higher (5.04 points), but it is worth noting that this was significantly lower than the ratings they gave to an unmarked verb (5.43 points).



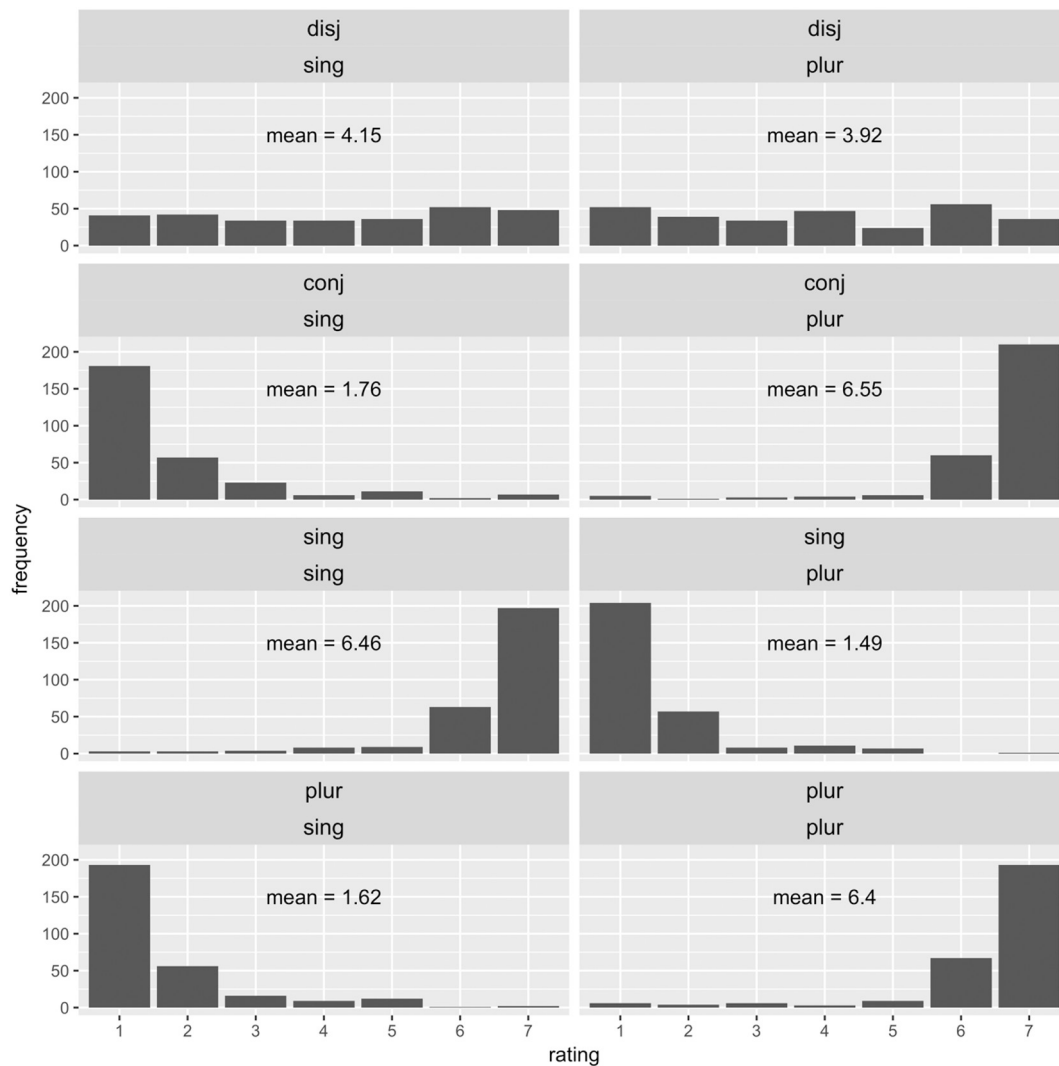


Fig. 8. Distribution of ratings in Experiment 7 by subject type (rows) and verb number (columns).

Thus, it is possible that both English and Italian speakers find a number-marked verb after a disjunction of singulars to be somewhat degraded. Again, we could not directly test this in Italian by comparing these verbs to an unmarked verb, as there are no unmarked forms in this language.

A clearer difference between English and Italian, however, is in the extreme trial-level variability of the Italian ratings. For both singular and plural agreement, the Italian ratings are essentially uniformly distributed across the 1–7 scale, with both singular and plural eliciting extremely low ratings of 1 or 2 as often as they elicited high ratings of 6 or 7. English subjects in Experiments 2, 4, and 5 very rarely gave ratings of 1 or 2 to either singular or plural agreement with disjunction. It is

notable, however, that Italian speakers were quite generally willing to use the lowest ratings when they perceived an agreement violation, while English speakers were not. In Italian, a rating of 1 was the modal response to unequivocal agreement violations (i.e., singular agreement with a plural subject or with a conjoined subject, and plural agreement with a singular subject), while for English speakers in Experiment 1, a rating of 3 was the modal response in these conditions. This difference is consistent with the hypothesis, discussed above, that agreement violations are simply more salient for Italian speakers due to the fact that it is a *pro*-drop language with a richer system of inflectional morphology.

Table 6

Experiment 7 results of mixed-effects ordinal regression model. Significant effects ( $p < .05$ ) are in bold.

Effect	Estimate	SE	t/z-value	p value
SUBJECT.NUMBER	0.162	0.094	1.73	0.08
SUBJECT.COORD	-0.207	0.094	-2.20	<b>0.03</b>
VERB.GRAM	5.580	0.366	<b>15.23</b>	<b>&lt; 0.001</b>
SUBJECT.NUMBER:SUBJECT.COORD	-0.219	0.188	-1.16	0.24
SUBJECT.NUMBER:VERB.GRAM	3.183	0.197	<b>16.18</b>	<b>&lt; 0.001</b>
SUBJECT.COORD:VERB.GRAM	3.456	0.198	<b>17.46</b>	<b>&lt; 0.001</b>
SUBJECT.NUMBER:SUBJECT.COORD:VERB.GRAM	-7.165	0.399	<b>-17.96</b>	<b>&lt; 0.001</b>

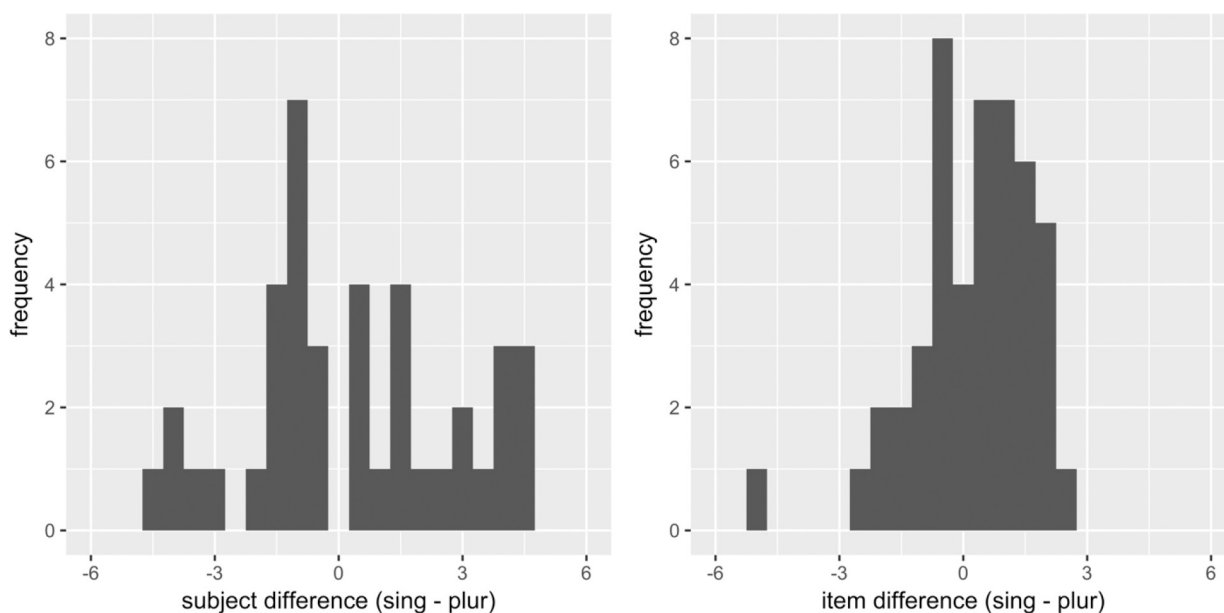


Fig. 9. Experiment 7 by-subject (left) and by-item (right) difference in mean ratings for singular and plural agreement with disjunctive subjects.

## 9. General discussion

In this paper we presented two eyetracking-during-reading studies in English, four judgment studies in English and Italian, and one completion study in Italian to assess the processing and acceptability of singular and plural agreement following a subject that is a disjunction of singular definite noun phrases. In the eyetracking studies we found that plural agreement with a disjunction of singulars did not disrupt readers' eye movements, with the exception of a downstream effect that appeared in one experiment but not the other. In contrast, there was a relatively immediate effect of other types of agreement violation. In three off-line rating studies in English we found that plural agreement resulted in only a small decrement in acceptability, compared to other agreement violations, and that in some structural configurations (the embedded subject conditions of Experiment 4) there was no decrement at all. The pattern of ratings across the experiments did not support the hypothesis that the availability of an inclusive reading of *or* plays a critical role in determining the acceptability of plural agreement. We found that Italian speakers also show variability in their use of singular vs. plural agreement following a matrix subject that is a disjunction of singulars, with plural actually being more frequent, and that they rate both forms about equally, with both showing some penalty compared to grammatical agreement with other subject types.

As noted in the Introduction, linear order plays an important role in determining what verb number speakers use when the subject is a disjunction (Haskell & MacDonald, 2005); when two disjuncts differ in number, speakers tend to use a verb that matches the number of the nearer noun, especially when this nearer noun is plural. While a less pronounced version of a linear order effect appears with conjunctive subjects (Keung & Staub, 2018), the linear proximity of a potential agreement controller to the verb appears to play no role with non-conjoined subjects. The present study has shown that this is not the only respect in which agreement with disjunction is anomalous, as speakers of English and Italian do not have clear agreement preferences when the subject is a disjunction of singulars. Though English speakers do tend to produce singular agreement more than plural, when asked to rate plural agreement they find it to be quite acceptable, and it does not result in any reliable disruption in the course of incremental, on-line comprehension, as revealed by their eye movements. Italian speakers

show an apparent *plural* preference in production, and are essentially indifferent between the two verb forms in a rating task.

The data provide no reason to invoke processing errors or limitations in an explanation of these phenomena. The lack of on-line effect of plural agreement with disjunction in Experiments 1 and 3 essentially mirrors the results from untimed rating studies, where plural agreement received ratings that are nearly as high as, or fully as high as, singular. Thus, it appears that the reason that readers do not, in the course of incremental comprehension, respond to a plural verb following a disjunction of singulars as if it were an agreement violation is that it is not one. A useful contrast is evident in the conjunction data. In Experiment 1, singular agreement with a conjunction elicited substantially less disruption in the eye movement record than did singular agreement with a non-conjoined plural subject, as expected based on Keung and Staub (2018). But in Experiments 2 and 7, English and Italian off-line ratings of singular agreement with conjunction were just as low as the ratings for singular agreement with non-conjoined plural subjects. Thus, the attenuation of difficulty in the eye movement record when a singular verb follows a conjoined subject is best attributed to the demands of rapid, incremental processing, rather than to the grammar itself.

We propose that agreement with disjunction is a grammatical lacuna, by which we mean that the grammar provides no means of valuing the verb's number feature when the subject is a disjunction of singulars. As a result, either verb form may be acceptable, or neither may be fully acceptable; below we discuss why the latter result might obtain. There may be no other subject type or configuration in which speakers display such a lack of number agreement preference, at least in English. There are certainly other constructions, such as expletive subject and locative inversion constructions, where agreement preferences are not perfectly categorical (see Schütze, 1999, for a review of rating data). However, in none of these cases are speakers as indifferent as they are in the case of agreement with a disjunction of singulars. In certain cases (the embedded conditions of Experiment 4, and in Experiment 7) the data suggest essentially complete indifference between singular and plural agreement.

A principle of parsimony would attribute both of the anomalous aspects of agreement with disjunction, i.e., the tendency for the verb to agree with the nearer disjunct and the lack of clear preference when

both disjuncts are singular, to the same source. Peterson (2004), following Reis (1974), suggests such an account. He proposes that a disjunctive subject simply lacks grammatical number, and that as a result, the speaker is left to rely on idiosyncratic and inconsistently applied ‘strategies,’ one of which is to agree with the nearer noun. (Peterson claims that a conjunctive subject also lacks grammatical number, but that speakers usually deploy a specific semantic strategy of using a plural verb because the conjunction usually denotes a plurality. The fact that a conjunction can take singular agreement when it is interpreted as denoting a single entity, e.g., Lorimor, 2007; Lorimor, Jackson, Spalek, & van Hell, 2016, is regarded by Peterson as evidence that a conjunction, too, does not have grammatical number. For present purposes, we leave this issue aside. Peterson (2004) invokes Reis’ (1974) description of ‘patch up devices,’ which must be deployed when:

“the standard rules do not tell the speaker what to do; unless he escapes into an innocuous paraphrase, he will have to patch up the holes left by his core grammar. He may do so in various ways: He may either admit all options as grammatical, or rule them all out, or establish ad hoc priorities by specifying one of the usually correlative features as more essential for agreement than the others, by devising or invoking subsidiary principles such as the ‘closest conjunct’ principle, etc. (Reis, 1974, p. 166”).

Reis also observes that the use of ‘patch up devices’ can be characterized by the hesitation with which they are used and by inconsistent behavior.

The position that agreement with disjunction is dealt with by means of extra-grammatical ‘patch up devices’ or ‘strategies’ has the virtue that it would not seem to mandate a correspondence between the verb’s number and the interpretation of the disjunction as inclusive or exclusive, either for speakers or comprehenders. Several authors (e.g., Ivlieva, 2012; Peterson, 1986) have suggested that disjunctions take plural agreement when they have an inclusive, and therefore notionally plural, reading. But the present data do not provide much support for this hypothesis, as the ratings of singular and plural agreement did not consistently track the inclusive reading of *or* (Experiment 4), and plural agreement received a mean rating of above five points even when the predicate was one that required an exclusive reading of the disjunctive subject (Experiment 5). In the eyetracking experiments, there was no apparent disruption associated with either singular or plural agreement, regardless of whether *or* was likely to receive an inclusive reading. The notion of ‘patch up devices’ suggests that speakers’ decisions about verb number are ad hoc and probabilistic, as opposed to well-justified and deterministic, and that comprehenders may tolerate either singular or plural agreement because neither contradicts any established grammatical principle. On this view, it is unsurprising that there is little interpretive consequence of the verb’s number. At the same time, this view is not inconsistent with there being *some* interpretive consequence (which, e.g., Experiment 5 suggests that there may be), given that some of the time comprehenders may be influenced by a ‘semantic’ strategy.

Though we think that the present data are consistent with the notion that agreement with disjunction is a unique grammatical lacuna, it is important to acknowledge an alternate perspective. Haskell, Thornton, and MacDonald (2010; see also Haskell & MacDonald, 2003) argue that complex patterns of agreement attraction data can be attributed to the details of speakers’ experience with related constructions. Variability in agreement behavior is self-reinforcing: To the extent that speakers have not converged on a consistent agreement pattern (e.g., a singular verb after a phrase such as *the key to the cabinets*), the input that any speaker receives will be variable, which will in turn result in variable productions from that speaker. Though Haskell et al. do not explicitly address comprehension and rating data, presumably these, too, will reflect variability in a speaker’s experience.

This ‘experience-based’ view of agreement might be deployed in the context of agreement with disjunction. It seems clear, based on the available corpus and production data, that a speaker of either English or

Italian will encounter examples of both singular and plural agreement with a disjunction of singulars. Moreover, while disjoined subjects are not rare, they are almost certainly rarer than, e.g., conjoined subjects, in part due to the fact that, as we have discussed above, a disjunctive subject is likely to be used by a speaker only under specific epistemic circumstances (e.g., Clifton Jr & Frazier, 2016).<sup>6</sup> Thus, the agreement data with respect to disjunctive subjects is likely to be relatively sparse, and therefore more variable than a larger sample would be.

We suspect that equivocal patterns in a speaker’s experience do play a role in the lack of definitive agreement preferences with disjunctive subjects. However, we think that on its own, an experience-based account of this phenomenon risks circularity. Why does highly consistent agreement behavior emerge for most subject types, but not for disjunction? We suspect that the answer to this question will ultimately make reference to theoretical notions such as the lack of number-marking on the head of a coordinate phrase.

Finally, we turn to the question of why both forms may be somewhat degraded, if the grammar does not rule out either one, and if either one can be justified by some strategy. We note, first of all, that in the eyetracking experiments there was little indication that either singular or plural agreement with a disjunction of singulars resulted in any difficulty on-line. But in the rating studies, there was evidence that both forms were perceived as somewhat degraded. In Experiment 2, ratings for both singular and plural agreement with a matrix disjunction were slightly but significantly lower than for an unmarked verb form. In Experiment 7, we could not directly compare Italian singular and plural agreement with disjunction to an unmarked form, but ratings in both conditions were a full 2.5 points lower than ratings of grammatical agreement with other subject types. Thus, there may indeed be some penalty for both forms, and this penalty may be especially large in Italian. We offer only speculation here, but we think it is possible that speakers do have some meta-linguistic awareness of their use of extra-grammatical strategies to resolve agreement with disjunction, and that this awareness itself results in a small decrease in acceptability. Reis (1974) points out that when a speaker uses a ‘patch up’ rule, the speaker is often aware that “a linguistic decision is forced on him that for the sake of grammaticality he would prefer to avoid” (p. 167). This awareness may be more salient in Italian, due to the ubiquity and interpretive importance of number agreement in that language. The hypothesis that there is a meta-linguistic source of the acceptability decrement for both verb forms is consistent with the lack of difficulty in on-line processing.

## 10. Conclusion

The present eyetracking, rating, and completion studies may be regarded as providing psycholinguistic validation of a claim about agreement with disjunction that is not new, going back to Peterson (2004) and Reis (1974), but which lacked empirical support. This is the claim that agreement with disjunction is an unusual, perhaps unique, grammatical lacuna: Neither singular nor plural agreement is ungrammatical, and the choice of verb number does not have clear interpretive consequences.

## Authors’ contribution

The two authors contributed equally to this work.

<sup>6</sup> In this paper we have not explicitly addressed the question of how common, in relative or absolute terms, disjunctive subjects are, and we know of no other work that has addressed this. This is clearly an important topic for future investigation.

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