

Disjunction in negative contexts: a cross-linguistic experimental study

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We discuss experimental findings from a study investigating the interpretation of simple disjunction in negative contexts in 4 languages: Italian, French, English, Romanian. We provide evidence that the narrow scope reading for disjunction with anti-additive operators is available in all 4 languages, a result that can be shown to (i) contradict the claim that disjunction in Italian or French exhibits positive polarity item (PPI) behavior (Szabolcsi 2002, Spector 2014, Nicolae 2017) and, more generally, (ii) cast doubt on the robustness of the distinction between PPI and non-PPI disjunction cross-linguistically, which is therefore not as sharp as assumed in the theoretical (e.g., Szabolcsi 2004) or experimental literature (e.g., Crain 2012, Guasti *et al.* 2017).

1. Introduction

Sentences like (1), with the simple disjunction *or* in the immediate scope of negation, are typically ambiguous between a *narrow scope* interpretation of disjunction (1a), where none of the disjuncts¹ is true, and a *wide scope* interpretation (1b), where one of the disjuncts may be true:

- (1) Mary didn't invite John **or** Suzi to the party.
- It is not the case that Mary invited John and it is not the case that Mary invited Suzi to the party. NEG > OR
 - It is either John or Suzi that Mary didn't invite to the party. OR > NEG

Languages have been claimed to differ with respect to the availability of these two readings (e.g., Szabolcsi 2002, 2004). Certain languages (Type A), e.g., English, Greek, Korean, allow both readings. Other languages (Type B), e.g., Hungarian, Japanese, Russian, only allow the wide scope reading.² This has led to the claim that simple disjunction in Type B languages is a Positive Polarity Item (PPI). I.e., just like *someone/something* in English, certain connectives are 'anti-licensed' by negation. PPIs do not form a uniform class cross-linguistically (see van der Wouden 1997, Israel 2011, a.o) and there is no consensus in the literature on how to properly describe and capture positive polarity phenomena (for a recent overview, see Liu and Iordăchioaia 2018). However, a standard characterization holds that an item such as *some* exhibits PPI-behavior if it cannot take immediate scope below a clausemate anti-additive operator (Szabolcsi 2002, 2004), e.g., sentential negation, *without*, neg-words like *nobody*.³ PPIs can, however, scope below extra-clausal negation or clausemate merely downward entailing (DE) operators like *few NP*, *fewer than 3 NP*, *at most 4 NP*.⁴

¹ By disjuncts in these examples we mean the affirmative propositions: *Mary invited John to the party* and *Mary invited Suzi to the party*.

² Szabolcsi (2002) suggested that "Type B" languages might include both Type A and Type B speakers.

³ Though see e.g., Spector (2014) or Homer (2012) for possible issues with this characterization.

⁴ A function f is downward entailing (DE) iff for all A, B in the domain of f such that A entails B ($A \Rightarrow B$), $f(B) \Rightarrow f(A)$. A function f is anti-additive (AA) iff for any A and any B , $f(A \vee B) \Leftrightarrow f(A) \wedge f(B)$. All AA functions

The extent and the source of the PPI-hood (of disjunction) across languages is not well understood. This is partly because the status of PPIs differs from other polarity sensitive items: whereas unlicensed negative polarity items lead to ungrammaticality, sentences containing anti-licensed PPIs are reported to be degraded, without however being entirely ruled out. As such, judgments are harder to elicit and the extent of cross-linguistic and cross-speaker variation harder to determine (see Szabolcsi 2002 for discussion). This makes PPI-connectives particularly well suited for experimental studies. Indeed, various language acquisition studies have provided experimental evidence that seems to substantiate the existence of a PPI-disjunction parameter (e.g., Crain 2012, Jing 2008, Guasti *et al* 2017). However, as far as adult language data is concerned, to date, the only experimental evidence for the PPI-behavior of simple disjunction in Type B languages comes from data from the adult control groups used in these acquisition studies. Not only is this kind of data insufficient, but it is also controversial, as there is also evidence clearly indicating the existence of the narrow scope reading of disjunction in languages with alleged PPI disjunctions, e.g., French (see the French corpus example in (2a)) or Italian (see the Italian Wikipedia example in (2b)):

- (2) a. La crise de croissance de la science n'est **pas** une maladie **ou** une mort. (FRANTEXT)
 the crisis of growth of the science is not an illness or a death
 'The growing pains that science has do not constitute illness or death.'
- b. Questa montagna non è molto frequentata dagli appassionati di trekking anche
 this mountain not is much frequented from enthusiasts of trekking also
 perché su di essa **non** ci sono rifugi **o** malghe.
 because on of it not there are refuges or lodges
 (source: https://it.wikipedia.org/wiki/Monte_Ozol)
 'This mountain isn't much frequented by trekking enthusiasts because there aren't
 mountain refuges **or** lodges on it.'

Examples such as (2) cast doubt on the robustness of the distinction Type A vs. Type B languages and call for a more thorough examination of the PPI-behavior of disjunction across adult grammars. The present experimental study seeks to contribute to this goal through a cross-linguistic investigation of disjunction in downward-entailing contexts.

The remainder of the paper is organized as follows. Section 2 presents an experiment testing the interpretation of simple disjunction in DE contexts in four languages (French, Italian, English and Romanian). We bring evidence for the existence of narrow scope readings in Italian and French, a result that goes against the PPI-characterization of simple disjunction in these languages. Section 3 raises the question of whether the diagnostic we used to test the existence of narrow scope readings of disjunction is correct. A follow-up experiment is set up to address this question. Taken together, the results of the two experiments confirm the existence of narrow scope readings in Italian and French and raise questions about the existence of the PPI parameter. Section 4 brings up some methodological issues and concludes.

are DE, but not vice versa. This is due to the fact that the left-to-right part of the definition of anti-additivity ($f(AVB) \Rightarrow f(A) \wedge f(B)$) is equivalent to being DE; the right-to-left part ($f(A) \wedge f(B) \Rightarrow f(AVB)$) imposes a stronger requirement, which only AA functions can meet. The inferences in (ii) and (iii) below illustrate this difference:

- (i) *At most 4/No students smoke or drink* \Rightarrow *At most 4/No students smoke and at most 4/no students drink.* (DE)
 (ii) *No students smoke and no students drink.* \Rightarrow *No students smoke or drink.* (Anti-Additive)
 (iii) *At most 4 students smoke and at most 4 students drink.* $\not\Rightarrow$ *At most 4 students smoke or drink.* (DE)

2. Experimental study

Once we adopt Szabolcsi’s definition of PPI-behavior, the difference between Type A and Type B languages lies in the availability of the *narrow scope* interpretation of disjunction in anti-additive contexts, which in Type B languages, which have a PPI-disjunction, should be ruled out. In order to check the validity of this claim and the robustness of the distinction between disjunction in Type A vs. Type B languages, we set up an experiment testing the interpretation of disjunction in negative contexts in four languages: two allegedly Type A languages—English, Romanian (Szabolcsi 2002, 2004)—and two allegedly Type B languages—Italian, French (Spector 2014, Nicolae 2017, Guasti *et al* 2017).

2.1 Procedure, materials and design

A total of 123 adults participated in the experiment: 25 French native speakers, 25 Romanian native speakers, 42 Italian native speakers and 31 English speakers. Participants were instructed to perform a Likert-scale acceptability judgment task hosted on the IbexFarm platform (Drummond 2013). The trials consisted in potentially ambiguous sentences involving simple disjunction and various DE operators. Each sentence was followed by a continuation compatible with either the narrow scope or the wide scope reading of disjunction. Participants had to judge the continuations based on their naturalness using a scale from 1 (very unnatural) to 7 (very natural). There were four versions of the experiment (a French, an Italian, a Romanian and an English version, respectively). Below, we illustrate our experimental stimuli with an English example involving simple disjunction and negation.⁵

- (3) If I remember correctly, Mary didn’t invite John or Suzi to her birthday party.
- a. **narrow scope** continuation: She’s upset with both of them and doesn’t want to see them.
 - b. **wide scope** continuation: I don’t know which of them.

Previous experimental studies (Crain 2012, a.o) typically use one anti-additive operator—negation—to test the PPI-behavior of disjunction. In our study, we included two anti-additive operators—negation and *without*, anti-additivity being the key factor in the anti-licensing behavior of PPIs. In addition, we included three merely DE operators (*few, doubt, rarely*). The experiment used scope (*wide, narrow*) and DE operator (*negation, without, otherDE*) as factors, which gave rise to 6 experimental conditions:

DE-operator \ Scope	Negation	Without	OtherDE (rarely, few, doubt)
Narrow	Negation-Narrow	Without-Narrow	OtherDE-Narrow
Wide	Negation-Wide	Without-Wide	OtherDE-Wide

Table 1. Experimental conditions

Each participant saw 6 items per condition, for a total of 18 experimental items distributed over two lists so that a participant would not see both the narrow scope continuation and the wide scope continuation for the same sentence. The order of presentation of the stimuli and of the two continuations were randomized within each list. There were two practice items preceding the experimental items and 34 additional fillers randomly interspersed among the experimental

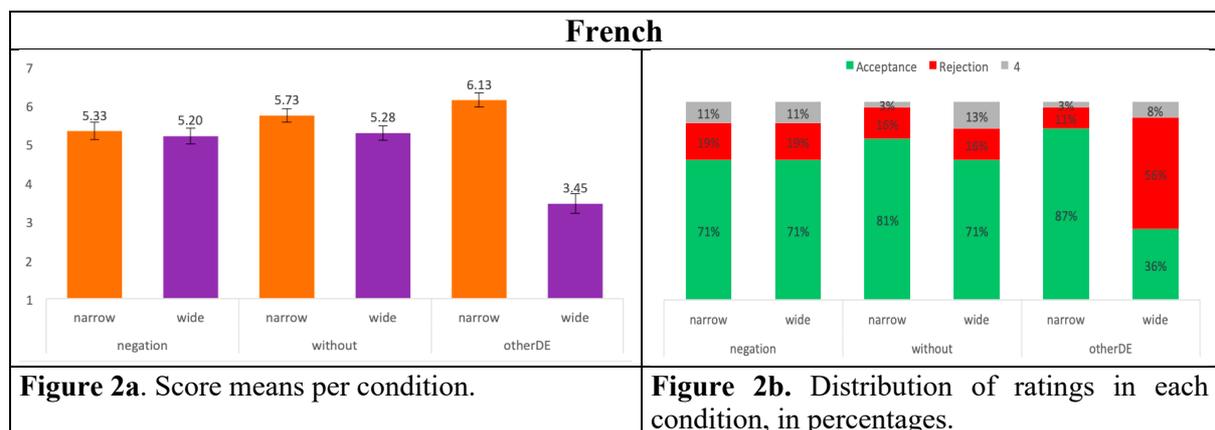
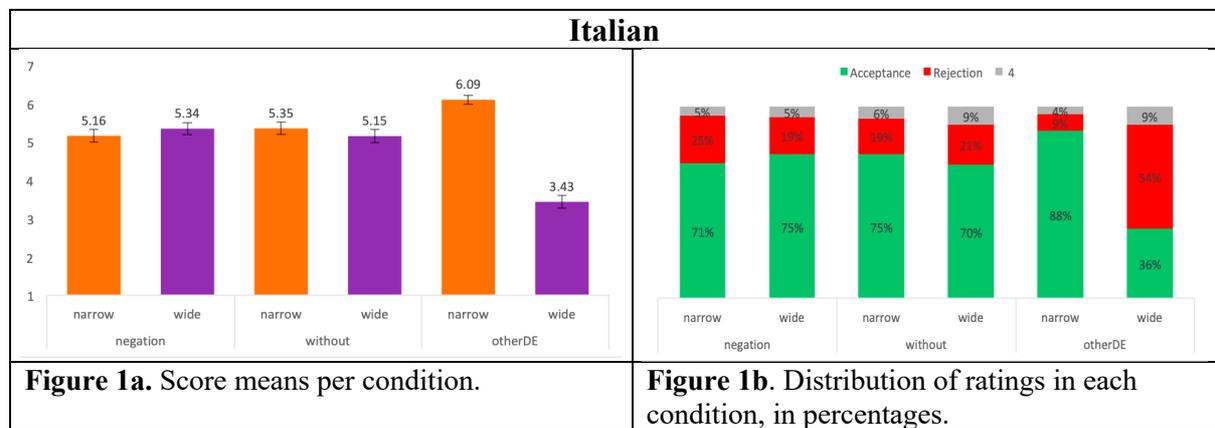
⁵ The complete set of stimuli is available upon request.

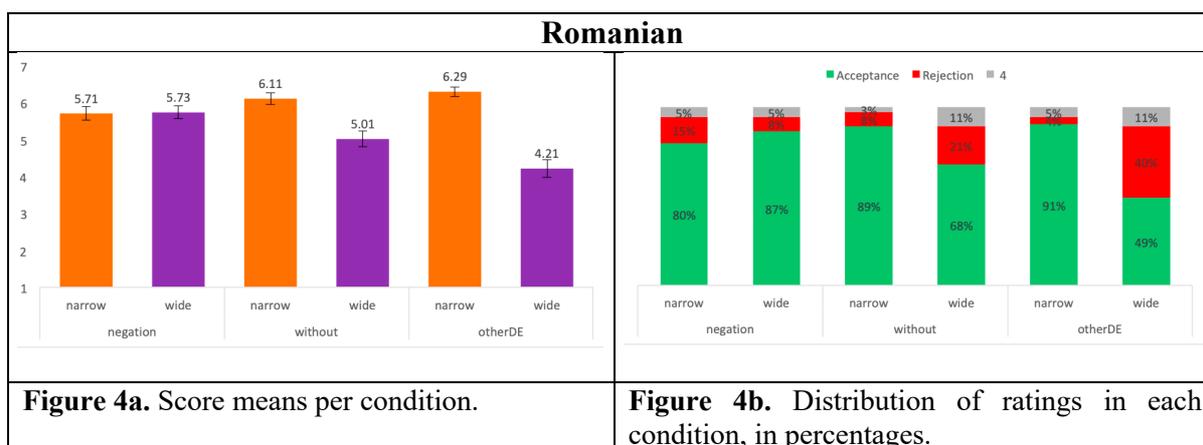
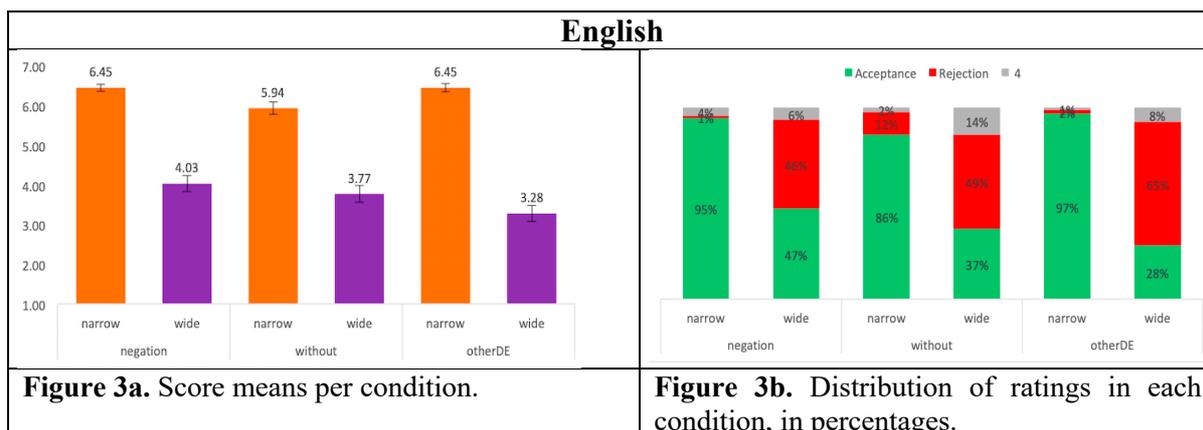
items. The total number of trials was 54. The experimental session lasted for approximately 25 minutes.

Our aim was to test the claim that disjunction is a PPI-item in Type B languages. Assuming this, we expect Italian and French participants (i) to accept only wide scope continuations below anti-additive operators (negation and *without*); and (ii) to access both interpretations below merely DE operators (otherDE). In contrast, in Type A languages (i.e., English and Romanian), both continuations are predicted to be natural with both anti-additive and merely DE operators.

2.2 Results and discussion

For every language, we report the score means for the narrow scope (orange bars) and the wide scope (purple bars) continuations (Figures 1a, 2a, 3a, and 4a), and also, for each condition, the percentage of **acceptances** (ratings of 5 or more), **rejections** (ratings of 3 or less, red) and **ratings of 4** (grey) (Figures 1b, 2b, 3b and 4b). In all the graphs in (a) below, the error bars correspond to standard error of the mean.





The results for Italian and French (Figure 1 and Figure 2) show that in both languages the wide and the narrow scope readings are accepted and receive similar scores with both negation and *without*.⁶ Likewise, with these two anti-additive operators, the percentages of sentences that are accepted or rejected are approximately the same in both languages. With merely DE operators, the narrow scope continuations are preferred over the wide scope ones.⁷ These findings seem to invalidate the claim that simple disjunction in French and Italian has a PPI-behavior.

Moving now to English and Romanian (Figure 3 and Figure 4), we notice that in both languages the narrow scope continuations with anti-additive operators receive very high scores. This result is expected given the claims in the literature that English and Romanian have a non-PPI simple disjunction. Interestingly however, English and Romanian do not pattern together. In English, unlike in Romanian, we notice a clear advantage of the narrow scope continuation

⁶ One might wonder whether similar scores in the narrow and the wide scope conditions means that French and Italian speakers do not make a difference between these two readings. We don't think this is the case, since with otherDE operators, speakers do make a difference between the two readings: in each language, narrow scope is rated significantly higher than wide scope in this condition (Wilcoxon signed-rank tests performed on pairs of conditions revealed a p-value <0.001, in both languages). This means that French and Italian speakers *are* sensitive to scope, and arguably, if they had considered the wide scope reading with anti-additive operators to be more natural than the narrow scope one, they would have signaled that.

⁷ The observed preference for the narrow scope reading of disjunction in otherDE contexts is not surprising, given that the narrow scope interpretation entails the wide scope one (Section 3) and there is a general preference for stronger readings, in virtue of the 'Maximize Strength' principle (see Chierchia 2013 for recent discussion).

over the wide scope continuation with all DE operators.⁸ In Romanian, on the other hand, just like in French and Italian, we notice similar acceptance rates for narrow and wide scope continuations with anti-additive operators, and a preference for narrow scope with other DE operators.

Summarizing, our main results show that in both Italian and French the narrow scope continuation (which we take to be a diagnostic of the narrow scope reading of disjunction) is judged just as natural as the wide scope continuation (which we take to be a diagnostic of the wide scope reading of disjunction), a fact that invalidates the claim that disjunction behaves like a PPI in these languages.

3. Further evidence for narrow scope readings: follow-up experiment

In our experiment, we took the narrow scope continuations to be a diagnostic of the narrow scope readings. This is potentially controversial, as, strictly speaking, any proposition consistent with the truth of the narrow scope reading is also consistent with the truth of the wide scope reading. The reason for this is that the narrow scope reading entails the wide scope one. Consider again the two readings of the simple disjunction with negation in (1) *Mary didn't invite John or Suzi to the party* and the situations in which they are true:

- (4) a. Narrow scope NEG>OR ($\neg(p \vee q)$, i.e., $\neg p \wedge \neg q$)
 S1 Mary didn't invite either John or Suzi to the party.
 b. Wide scope OR>NEG ($\neg p \vee \neg q$)
 S1 Mary didn't invite either John or Suzi to the party.
 S2 Mary didn't invite John (but invited Suzi)
 S3 Mary didn't invite Suzi (but invited John)

The narrow scope reading results from a structure where disjunction has narrow scope with respect to negation ($\neg(p \vee q)$), which is equivalent to the conjunction of two negative propositions (4a). This reading is true in a context where Mary invited neither John nor Suzi at the party (S1). The wide scope reading results from a structure where disjunction takes wide scope with respect to negation, i.e., a disjunction of two negative propositions, the proposition *Mary didn't invite John* and the proposition *Mary didn't invite Suzi* (4b). This reading is true in situations in which either John or Suzi didn't get invited (S2-S3), but also in a “narrow scope” situation where Mary invited neither John nor Suzi (S1). Given this entailment relation, it seems difficult to show that a sentence such as (4) admits a genuine narrow scope reading: any context that makes the narrow scope reading true will make the wide scope reading true as well.⁹ Incompatibility with a “narrow scope” scenario arises via an additional step, namely an implicature: since in the wide scope configuration the structure is a matrix disjunction, just like in positive contexts it typically gives rise to an implicature that the speaker does not believe

⁸ A closer look at the percentages of acceptance in English (Figure 4b) reveals a bimodal distribution with anti-additive operators: roughly, half of the English participants (48% for negation, 65% for *without*) accept only the narrow scope continuation, while the others (48% for negation, 35% for *without*) accept both. We take this to indicate interlanguage variation, a result that corroborates previous findings (see, for instance, Jing 2008, who also reports bimodal distribution in English, for disjunction under clausemate negation).

⁹ See Bhatt and Homer (2019) for recent discussion of a similar problem for structures involving an existential and a universal operator (where the inverse scope *some*>*always* entails the surface scope reading, *always*>*some*). They argue that one way to circumvent this problem is by resorting to tasks in which speakers are not asked to assess the truth or falsity of a given sentence, but rather to judge whether a response to a certain assertion is natural. Our study, which tests the naturalness of continuations (rather than responses), is based on a similar premise: if speakers find a given continuation natural, it means they can access the corresponding reading.

both disjuncts to be true. I.e., an implicature that the speaker does not believe it to be true for both John and Suzi that Mary didn't invite them. In other words, the speaker believes that Mary invited one of them. Once this implicature is there, one can argue that the sentence *has a genuine narrow scope reading*. If speakers who believe Mary to have invited neither John nor Suzi can naturally use these sentences, we can conclude that this is because they assign a genuine narrow scope structure to the sentence. If they assigned a wide scope structure to the sentence, the implicature would prevent this from happening.

Going back to the results of our experimental study, one might therefore object that the acceptability of the narrow scope continuation does not diagnose a genuine narrow scope reading, and that it rather reflects a situation where speakers of Italian and French assign the sentence a wide scope interpretation that amounts to *not A or not B and maybe not A and not B*. To show that this objection is not warranted, and provide evidence for the existence of the above-mentioned implicature responsible for the incompatibility with the narrow scope continuation, we conducted a follow-up experiment. The goal of this experiment is to show that speakers compute the implicature that allows us to distinguish the wide scope and the narrow scope readings of sentences involving disjunction in the scope of DE operators. If we find evidence for this implicature, we have an (admittedly indirect) argument that the acceptance of the narrow scope continuation in the previous study reflects a true narrow scope reading (rather than a truth-conditionally weaker wide scope reading). Since the existence of an actual narrow scope reading is less expected in Italian and French, in view of the claims in the literature, we chose to limit our follow-up study to these two languages.

3.1 Procedure, materials and design

20 Italian native speakers and 17 French native speakers participated in this second study. We used the same procedure and design as for the first experiment. However, unlike the first experiment, which included potentially ambiguous sentences with disjunction and different DE operators (see (3) above), this experiment used sentences which, given their syntax, necessarily gave rise to a wide scope reading of disjunction with respect to the downward entailing operator. Below, we illustrate the stimuli with an English example.

(5) If I remember correctly, Mary didn't invite John or *she didn't invite Suzi* to her birthday party.

- a. **wide scope** continuation: I don't know which of them.
- b. **narrow scope** continuation: She's upset with both of them and doesn't want to see them.

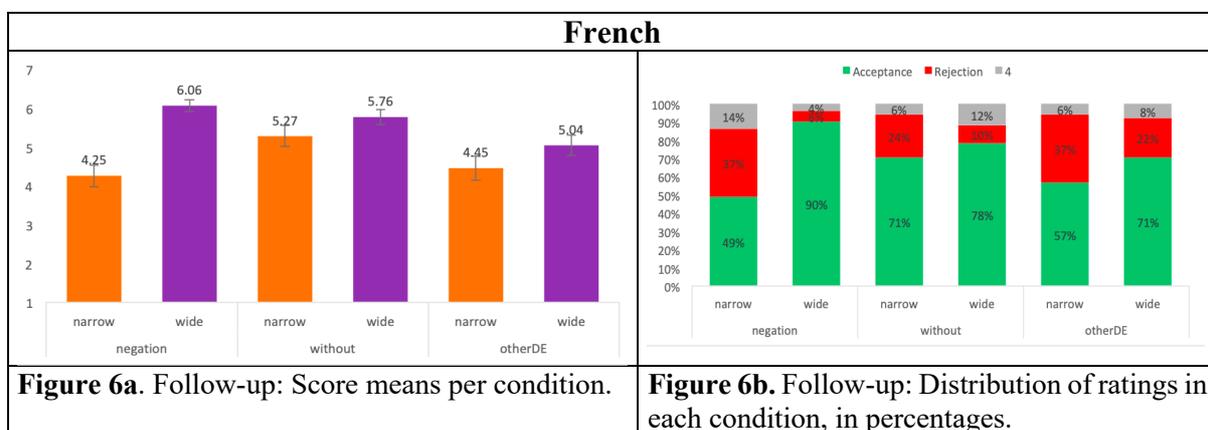
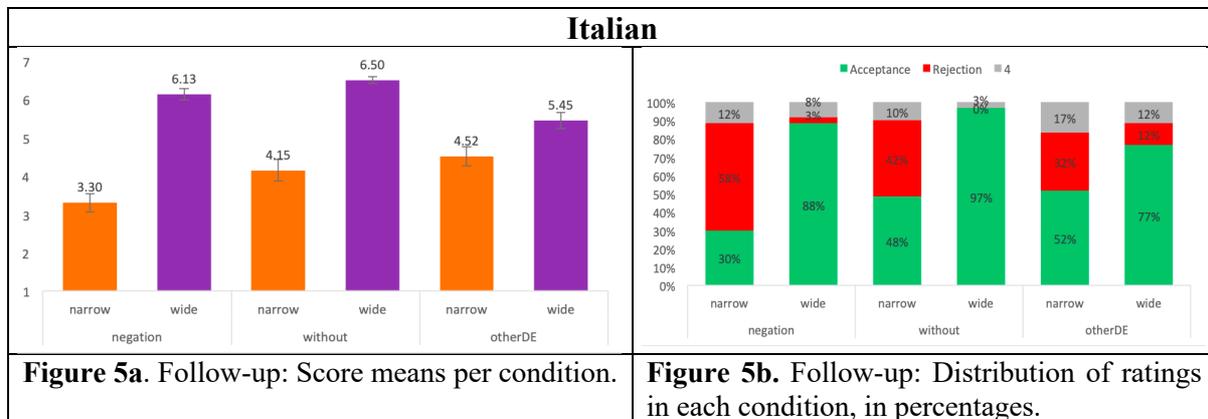
The predictions are as follows:

- 1) If speakers compute the implicature associated with the sentence in (5), we expect the wide scope continuation to be rated high and the narrow scope continuation to be rated low.
- 2) If speakers do not (always) compute the implicature, we expect both continuations to be rated high, as both should be compatible with what the first sentence expresses in this case.

3.2 Results and discussion

Figures 5 and Figure 6 summarize the results. In both languages, there is a general tendency to rate the narrow scope continuation lower than the wide scope continuation. Statistical analyses performed on the results showed that, in Italian, there is a significant difference between the wide scope continuations and the narrow scope continuations in the case of all DE operators (p-values <.01): the wide scope continuations were rated significantly higher than the narrow

scope continuations. For French, the analyses revealed a significant difference in the case of negation (p -value < 0.001), a marginally significant difference in the case of otherDE operators (p -value = 0.06), but no significant difference in the case of *sans* ‘without’ (p -value = 0.15).¹⁰



Taken together, the results for negation in both Italian and French show that speakers rate the narrow scope continuation significantly lower than the wide scope continuation. The low ratings for the narrow scope continuation with negation in both French and Italian (as well as with *senza* ‘without’ in Italian) confirm our prediction (1) above and stand as evidence that speakers compute the implicature associated with the wide scope reading. We take this as indicating that speakers always compute the implicature when they assign a wide scope structure to sentences involving disjunction and DE operators and conclude that the high ratings of the narrow scope continuations in the first experiment are due to the existence of a genuine narrow scope reading.

4. General discussion and conclusion

Languages have been claimed to differ with respect to the availability of the narrow scope reading of disjunction in negative contexts, a difference captured in terms of a PPI parameter. This view has inspired work on cross-linguistic variation in the semantics of connectives and moreover, language acquisition studies have used the PPI parameter to address learnability

¹⁰ As we can notice, the results for the French *sans* are not as sharp as those for the Italian *senza*, although the tendency is the same in the two languages (narrow scope is rated lower than wide scope). We leave this difference between French and Italian as an open issue for future work.

issues across languages. However, the results reported here show that languages like French and Italian, where the PPI parameter was assumed to have a positive value, allow genuine narrow scope readings of disjunction in negative contexts. These findings call into question the robustness of this parameter across languages (as well as within a single language, as also acknowledged in Szabolcsi 2002) and have implications for language acquisition. There is a body of acquisition literature that relies on the assumption that there is a PPI parameter for disjunction (see Crain 2012 for an overview). If there is no such parameter, then the results reported in the literature should receive another interpretation.

Our study also raises important methodological issues. Previous work on language acquisition (Goro & Akiba 2004, Goro 2007, Guasti *et al* 2017) used a truth value judgment (TVJ) Task: participants were presented with a scenario in which either (a) only one disjunct was false or (b) both disjuncts were false, and were asked to evaluate the appropriateness of a sentence containing a disjunction under negation. Guasti *et al* (2017) found that Italian and French adults consistently rejected it in the narrow scope scenario (b). We believe that the difference between our findings and Guasti *et al*'s findings is task-induced.

Assume that both narrow and wide scope interpretation of disjunction are available, with languages differing in terms of the *preference* for one reading over the other one. The acceptability judgment task used in our study asked participants to evaluate a sentence (the continuation that disambiguates the readings) in the context of another sentence (i.e., a sentence containing disjunction and a DE operator). The hypothesis is that, when we read or hear two sentences together in a discourse, we try to make them coherent with each other. If the continuation is compatible with the preferred interpretation, it will be rated as natural. And if it corresponds to the dispreferred interpretation, the search for coherence would make (at least some of) the speakers revise their initial hypothesis, and access the other interpretation. With a TVJ task, on the other hand, there is arguably no such pressure to look for coherence. The TVJ task asks speakers to judge whether a potentially ambiguous sentence is true or false in a context that makes only one reading true. If speakers have a preference for one reading over another, nothing would force them to change their initial hypothesis. They would thus answer *no* in a context that is incompatible with their initial hypothesis. Coming back to disjunction in anti-additive contexts, we conclude that our experiment showed that in Italian and French both the narrow and the wide scope readings of disjunction are available, whereas Guasti *et al*'s study showed that speakers merely have a *preference* for wide scope readings. This preference is similar to other language-dependent preferences for ambiguous constructions, such as those involving high or low attachment of relative clauses, e.g., *Someone shot the maid₁ of the actress₂ [that was standing on the balcony]_{1/2}* (Grillo and Costa 2014, among many others). The psycholinguistic literature attributes this kind of variation to language-specific or processing factors, but the debate is still open.

Further empirical investigation is needed to settle the existence of PPI-disjunction, assess the extent of cross-speaker and cross-linguistic variation, and develop a comprehensive explanation. In future work, we plan to extend the study to disjunction in other languages and to test more complex patterns involving PPIs and additional operators (e.g., shielding or rescuing configurations, see Szabolcsi 2004, Spector 2014, Nicolae 2017).

Acknowledgments

To be added

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