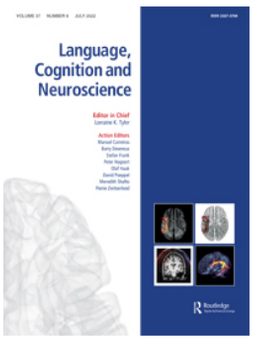

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The scalar meaning prediction in the processing of Spanish focus operators *hasta* and *nada más*

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ABSTRACT

Connectives have been shown to confirm or reverse the prediction of upcoming discourse content. Whether the non-conceptual meaning of other types of discourse markers can further constraint the upcoming discourse remains mostly unexplored. This study evaluates the predicting effect of two scalar focus operators, Spanish *hasta* (even) and *nada más* (only). In a visual-world paradigm experiment, participants heard sentences that included either one of the scalar focus operators that guided the prediction of one of four simultaneously displayed images. Results showed that the utterance of the focus operators triggered anticipation of the corresponding visual element according to a higher or lower position of the scale. Also, looking times suggest different processing demands for each of the focus operators. These results shed light on the way non-conceptual meaning contributes to building expectations about upcoming discourse, and provide evidence of the scalar organisation of elements in the shared discourse knowledge.

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KEYWORDS
Focus operator; prediction; discourse markers processing; scalar meaning; linguistic preactivation

Introduction

This article addresses the question of whether the conventional meaning of scalar focus operators such as Spanish *nada más* (only) and *hasta* (even) affects the prediction of subsequent discourse. In other words, this article focuses on whether, while processing (1) and (2) as opposed to (3), the incremental integration of *nada más* and *hasta*, both carrying scalar meanings, results in the preactivation of the scalar characteristic of the upcoming focus element.

(1) Julia nada más lleva suéter ("Julia is only wearing a sweater")
(2) Julia hasta lleva suéter ("Julia is even wearing a sweater")
(3) Julia lleva suéter ("Julia is wearing a sweater")

Focus operators belong to the broad category of discourse markers, a heterogeneous set of linguistic items whose meaning is not conceptual or descriptive, but contributes to the utterance. This contribution has been described in the literature as guiding its inferential processing (Blakemore, 2000), imposing certain conditions on the discourse context for the felicitous use of the utterance (Gutzmann, 2013) or marking coherence relations between discourse segments (Sanders, 1997).

Recent studies have shown that discourse markers, and specifically the subset of causal and concessive connectives, constrain the preactivation of upcoming discourse content, thus contributing to linguistic prediction. Nevertheless, the subset of discourse markers analyzed so far in light of their predicting effect, namely causal and negative causal connectives, could be defined as elements whose meaning guides the interlocutor to confirm (causal markers) or reverse (negative causal, or concessive, markers) the prediction *obtained from the conceptual meaning* of previous discourse, together with event representation or schema (Altmann & Mirković, 2010; Kuperberg & Jaeger, 2016): causal and concessive connectives lead the interpreter to confirm or reverse the content preactivated based on previous discourse (Xiang & Kuperberg, 2015, p. 25), but they do not contribute with a piece of semantic information to more specifically shape or narrow the preactivated upcoming content. For example, in (4a), it is the conceptual content conveyed with "cold" and "wear" -together with our knowledge of the world- what guides the prediction of the upcoming discourse (something along the lines of sweater, coat, etc.). This prediction is confirmed in (4b) with therefore, and reversed in (4c)

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with nevertheless (e.g. tee-shirt, short, or other clothing not appropriate for cold weather).

(4) a. It is cold today. Julia is wearing a _____.
b. It is cold today. Therefore, Julia is wearing a _____.
c. It is cold today. Nevertheless, Julia is wearing a _____.

The key issue of interest for this study is the fact that connectives such as therefore and nevertheless do not contribute further information to the preactivation of the upcoming content: the upcoming element here could be any lexical item congruent with the expectation created by "cold weather" and "wear" (or the opposite of that expectation for nevertheless), and *therefore* or *nevertheless* do not further constrain the possibilities of the upcoming discourse.

Whether the predicting effect found in causal and negative causal connectives is shared by other subsets of discourse markers and, specifically, whether discourse markers can further constrain the preactivation of upcoming discourse by virtue of other semantic meanings is an open question in the literature. The study of scalar focus operators contributes to answering this question.

Focus operators such as *nada más* and *hasta* carry, as other discourse markers, non-conceptual meaning. However, unlike causal and negative causal connectives, they carry a more complex semantic meaning, involving, among other meaning components, information regarding the position of the focus element in a discourse scale. In example (5), on top of the constraining effect of "cold" and "wear" on the content of upcoming discourse, even should be playing a role in preactivating an element that occupies a certain position in the discourse relevant scale of "clothing for cold weather", where, for example, a coat occupies a position that is higher than a sweater. While both sweater and coat were plausible in (4a) and (4b), one of them is expected to be preferred in (5) due to the scalar meaning of even.

(5) It is cold today. Julia is even wearing a _____.

The idea that languages encode scalar meanings is present in semantics and pragmatics literature (Sawada, 2017; Schwenter, 1999). However, the cognitive status of these scales and whether they are activated upon encountering scalar particles remain mostly unexplored. The current study addresses the question of whether the specific scalar semantic component of scalar focus operators translates into predicting effects and, consequently, into the activation of a context relevant scale and the preactivation of a position in that scale for the upcoming discourse element.

The prediction effect of discourse markers

Discourse marker (a.k.a. discourse particles, pragmatic markers) is the umbrella term to refer to a heterogeneous category of linguistic units characterised by the lack of conceptual meaning and the fact that they contribute non-propositional meanings to the utterance (Andersen, 2001; Blakemore, 2000; Portolés, 1998; Schiffrin, 1987; Asr & Demberg, 2020). The limits of this broad category, as well as the inventory of elements in it, vary among scholars, yet there is consensus in the recognition of a set of lexical units, typically with high form fixation, that do not, or do not only, contribute to the truth-value of the proposition and whose meaning interacts with the discourse structure or with information pertaining the participants' (speaker or hearer) knowledge and inference-obtaining processes. Although discussing the different theoretical conceptions of these units is beyond the scope of this paper, it is useful to review previous literature focusing on the processing and, crucially, the predicting effect of discourse markers, which further motivates the research question in the current study. Several studies have addressed the processing cost of pairs of sentences with and without discourse markers, mainly connectives signalling causal and concessive relations (*therefore, nevertheless*). When the reading times of pairs of sentences with and without a connective are compared, studies consistently find that the presence of a connective, which makes the discourse relation explicit, facilitates the processing of the second sentence (de Vega, 2005; Millis & Just, 1994; Nadal et al., 2016). The presence of a connective was also found to improve accuracy and speed in answering comprehension questions (Millis & Just, 1994). Other studies tested the effect of connectives in the utterance by comparing the processing cost of congruent vs. incongruent discourse markers (de Vega, 2005; Xu et al., 2018). These experiments confirm that processing a discourse with an incongruent connective (i.e. one whose procedural meaning clashes with the hosting discourse), is costlier than processing a discourse where the connective is congruent, as predicted by the discourse marker theoretical description. As for the cognitive cost of processing connectives themselves, Nadal et al. (2016) found that connectives (Spanish *sin embargo* "nevertheless", *además* "moreover" and *incluso* "even" in their studies) take longer time to process (measured by reading time) than conceptual words.

More relevant for the current investigation are the studies testing the time course of processing discourse markers (Koehne et al., 2013; Millis & Just, 1994; Traxler et al., 1997; Zhan et al., 2015) and the conclusions regarding the effect of discourse markers in the process of predicting upcoming discourse. After Millis and Just (1994) proposed the delay integration hypothesis, suggesting that discourse markers would be integrated after the propositional meaning, Traxler et al. (1997) found evidence that pairs of sentences connected with *because* are interpreted incrementally: readers incrementally construct the semantic interpretation of the second sentence as a cause for the first one, thus arguing against the delayed integration hypothesis. The incremental interpretation of discourse markers, nowadays broadly accepted, is empirically confirmed by Koehne et al. (2013), and Köhne-Fuetterer et al. (2021), as well as van Bergen and Bosker (2018) and Zhan et al. (2015), who more specifically test whether interpreters integrate the connective meaning to generate predictions while processing an utterance.

Koehne et al. (2013) performed an eye-tracking experiment with the visual world paradigm in which participants listened to items consisting of three sentences in German, such as (6), while they observed a visual scene.

(6) Marc fancies a snack. He feels like having something sweet.
Therefore/nevertheless, he gets from the kitchen the delicious waffle/pretzel.

In the second sentence, all items included a category word (*sweet*, in the example). Two elements in the visual scene were congruent with this category (waffle and cake in the example), and two elements were incongruent (cheese and pretzel). The third sentence started with the causal discourse connective *therefore* (*Daher/Dennoch*) or the concessive *nevertheless* (*Deswegen/Trotzdem*), and ended with the target element. As predicted, participants were able to decide what the target element would be, and looked more often towards it, upon hearing the discourse marker. Their experiment not only proves that connectives are integrated in an incremental fashion, but also that participants in their task used previous discourse to make predictions regarding the content of ulterior discourse and, crucially, that the online integration of the connectives *therefore* and *nevertheless* resulted in the confirmation or the reverse, respectively, of this prediction: upon hearing *therefore*, participants kept looking at the elements congruent with the description of the second sentence (in our example, "sweet"); upon hearing *nevertheless*, as expected because of its negative meaning, participants changed their fixation preference and looked more to the elements not matching the category in the second sentence, in agreement with the connective meaning ("not sweet", in this example). Crucially, this decision took place slightly after the connective, and clearly before the target noun was pronounced.

The predicting effect of integrating discourse markers was also the focus of van Bergen and Bosker (2018), who studied the processing of Dutch *inderdaad* (indeed) and *eigenlijk* (actually). Their question was whether the prediction made by hearers based on the previous short interaction was confirmed with *inderdaad* and reverted with *eigenlijk*. In their stimuli, a first context sentence and a question constrained the content of the answer sentence, hence leading to preactivating a certain discourse content. The answer contained either the Dutch *inderdaad* or *eigenlijk* (or an adverb in the control condition), as illustrated in (7).

(7) - Despite her fear of animals, Mary went to the circus.
- You must have been terrified by the animal act?
- I was very/ indeed/actually scared by the running [beep] at the end.

The answer sentence contained a "beep" corresponding to the critical element, and the participant's task was to choose, from the four images displayed on the screen while they listened to the dialogue, the one that better fitted in the blank. Their results showed that upon processing *indeed*, the expectation created based on previous discourse was confirmed, whereas the results for *eigenlijk* (*actually*) were less clear and more dependent on the different specific experimental items.

Koehne et al. (2013) and van Bergen and Bosker (2018) provided convincing evidence that the integration of positive and negative causal connectives, together with the content of the hosting discourse, affect the prediction of upcoming information. Evidence of the comprehender's anticipation of upcoming discourse in the presence of a discourse marker also comes from event-related potential (ERP) studies. Drenhaus et al. (2014) find that, upon encountering the causal connective *therefore* and the concessive *however*, participants update their expectations regarding the upcoming discourse. In the same line, Xiang and Kuperberg (2015) conducted an event-related potential study on the processing of pairs of sentences with and without *even so* and found that comprehenders use the connective to make predictions about the upcoming discourse: in agreement with previous

studies on concessive markers, *even so* was used to reverse the predictions made from previous discourse and real-world knowledge, and to enhance predictive processing.

In summary, literature studying the processing of discourse markers and, specifically, the effect of these markers on the prediction of upcoming discourse, has mostly focused on causal and negative causal (concessive) markers (but see Staub & Clifton, 2006; and Scholman et al., 2017 for paired markers). As these studies have shown, causal and concessive markers contribute to the prediction of upcoming discourse. Specifically, causal and concessive discourse markers have been shown to confirm or reverse the expectation created from previous discourse and word knowledge (see examples in 4); in other words, these causal connectives guide the interpreter to expect what was predicted based on previous discourse, whereas concessive connectives guide them to preactivate the reverse expectation (Köhne-Fuetterer et al., 2021; Xiang & Kuperberg, 2015). In a sense, it could be argued that the prediction in these cases is, in fact, built from the conceptual content of previous discourse together with event structure knowledge, and that the connective guides the hearer to keep, or reverse, this prediction but does not contribute a specific semantic feature to the preactivated content. In other words, in an utterance like (6) from Koehne et al. (2013), the meaning of the connective does not contribute to the specific activation of "waffle", which is preactivated by virtue of "sweet"; likewise, in van Bergen and Bosker's (2018) item in (7), the target element "lion" is preactivated by the processing of the conceptual lexical item "animal" (together with other conceptual elements such as circus, running, and so on in previous discourse), but the meanings of *indeed* or *actually* do not specifically contribute any semantic or pragmatic feature of the activated content "lion", although clearly confirm or reverse the online prediction.

Whether discourse markers can not only confirm or reverse discourse predictions but also contribute, by virtue of their semantic meaning, to the specification of the preactivated content is a question that has not, to our knowledge, been addressed in previous literature. The current article addresses this question by analyzing the processing of another type of discourse markers, scalar focus operators *nada más* and *hasta*, thus seeking to test whether the predicting effect found in connectives is also found in this other kind of discourse marker and, more particularly, whether the specific scalar meaning coded in scalar focus operators shapes the prediction of upcoming discourse.

Focus operators and the scalar meaning of hasta *and* nada más

Focus particles (a.k.a. focus markers, focus adverbs or focus operators) are lexical items that associate with a focus element in the utterance, over which they have syntactic scope, and evoke a set of discourse-determined alternatives to the focus element while conveying a specific relation between the focus and its alternatives. The syntactic position of the focus operator and the utterance prosody combine to determine the scope of the focus operator and, hence, the element whose alternatives are evoked, as illustrated in (8).

(8) a. Julia nada más lleva suéter ("Julia is only wearing a sweater")
b. Julia nada más LLEVA suéter ("Julia is only WEARING a sweater")
c. Nada más Julia lleva suéter ("Only Julia is wearing a sweater")

In (8a), the focus element is *suéter* and the presence of the focus particle *nada más* is guiding the interpreter to access a set of discourse determined alternatives (coat, jacket, etc.); in (8b), pronounced with a pitch accent in *lleva*, the verb is the focus associated with *nada más* and, consequently, the alternatives instantiated by the focus particle are other possible verbs in the utterance (*buying, asking for* …); in (8c), the focus particle has scope over *Julia*, hence evoking a set of alternatives like *María, Luis, me*, etc.

Different types of focus operators convey different types of relations between the focus element and its alternatives. We will be interested here in one exclusive focus operator, Spanish *nada más*, and one scalar additive, Spanish *hasta*, and specifically on the scalar meaning that they convey. We will not test the exclusive and the additive meanings of hasta and nada más.

Much has been written about exclusive focus operators in the semantics and pragmatics literature, and specifically on the English exclusive adverb *only* (Beaver & Clark, 2008; Horn, 2016; Roberts, 2006). These studies characterise *only* as coding several meaning components: a positive one, the prejacent (in 8c, Julia is wearing a shirt); a negative or exclusive one, "nobody else but Julia is wearing a shirt", which denies the alternatives to the focus element (no *María*, no *Luis*, and so on); and a scalar meaning component, which captures the idea that the focus element (*Julia*, in 8c) and its alternatives (*María, Luis, me*) are organised in a scale, either semantic or pragmatic (Schwenter, 1999). In Beaver and Clark (2008, pp. 252–254), the meaning conveyed by the exclusive operator, as

compared to the corresponding proposition without it, is not really exclusivity, but rather the scalar meaning conveying that nothing higher in the scale applies. Regarding scalar additives, English *even* has been thoroughly discussed in the literature (Giannakidou, 2007; Wilkinson, 1996) and Spanish *hasta* and *incluso* have also received great attention (Portolés, 2007; Schwenter, 1999). Scalar additives indicate a scalar relation between the focus element and the alternatives evoked: the focus operator conveys that, relative to the expectation that the addressee (or speaker) has, the focus element occupies a higher position in the scale (Kay, 1990).

Our specific interest for scalar exclusive *nada más* and scalar additive *hasta* relies here in the fact that both focus particles convey a scalar meaning: they code, and therefore guide the interlocutor to interpret, that the focus element and its alternatives are to be conceived as ordered in a scale. Crucially, *nada más* and *hasta* can be considered "pragmatic antonyms", following Beaver and Clark (2008, p. 71): *nada más* indicates that the focus element occupies a lower position in a discourse scale than the expected alternatives, whereas *hasta* indicates that the focus element occupies a higher (informatively stronger) position in the scale than the alternatives expected in the discourse situation. This is illustrated in Figure 1.

Following a question such as *Is it cold outside?*, the presence of *nada más* in *Julia nada más lleva suéter* evokes, by means of its scalar meaning, a set of alternatives potentially answering the question under discussion (*¿qué lleva Julia*?, "What is Julia wearing?"), such as *sweater, jacket, coat;* crucially, it also evokes an ordering of the elements in the scale such that *sweater* is placed in a lower position relative to the alternatives, whereas the presence of *hasta* evokes a scale in which the focus *sweater* is in a higher position than the alternatives (see Figure 1). The scalar meaning component that hasta and nada más convey is the meaning component

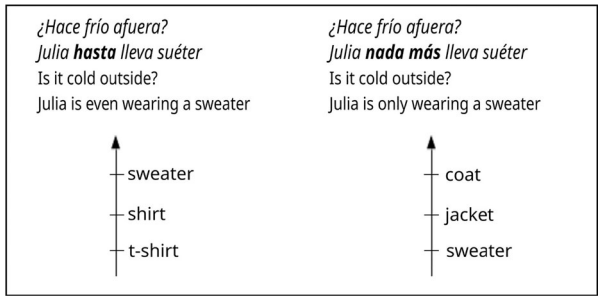

Figure 1. Examples of scales and position of the focus element (sweater) evoked by focus operators *hasta* (even) and *nada más* (only).

that will be put to the test as contributing to the preactivation of the upcoming discourse in this experimental study. Notice that, as previously mentioned, nada más and hasta also carry an exclusive and an additive meaning, respectively. However, these meaning components refer to whether the alternatives to the focus should be excluded or not or, in Beaver and Clark's (2008) terms, whether the alternatives apply. The exclusive vs. additive meaning component of nada más and hasta will not be directly put to the test in our experiment, where participants are expected to use scalar information to choose the upcoming focus element, but where the resulting status of the alternative (included or excluded) is not evaluated.

Focus particles (*only, also*) have recently received attention from experimental studies (Gotzner et al., 2016; Kim et al., 2015; Romoli et al., 2014; Spalek et al., 2014) testing the effect of focus particles on the retrieval of the alternatives and the alternatives recall (Gotzner et al., 2016), as well as the comparison and interplay of focus operators with intonational focus (Gotzner et al., 2014; 2017). These studies have shown that the presence of a focus particle in the utterance triggers an active search for alternatives, mentioned or unmentioned in previous discourse (Gotzner et al., 2016) and that the alternatives to the focus are better recalled by participants when the linguistic stimuli contained a focus particle than when it did not (Spalek et al., 2014). Although these studies suggest that the meaning of different focus operators constrain different expectations regarding the new or old status of the focus element (Kim et al., 2015; Romoli et al., 2014), none has taken into account other meaning components of the focus operators, such as the scalar meaning. Recent experimental studies, therefore, have put to the test the theoretical predictions regarding the activation of alternatives when processing a focus operator.

The current study complements previous findings by focussing on a different aspect of the meaning of the focus operator: the scalar relation between the focus and the alternatives. Moreover, taking into consideration the differences found in the processing of positive and negative causal connectives (Köhne-Fuetterer et al., 2021; Xiang & Kuperberg, 2015), this study also seeks to explore possible differences in the processing of the additive (*hasta*) and the exclusive (*nada más*) focus operators. This investigation seeks to test the incremental interpretation of focus operators in discourse and, crucially, to determine whether this incremental integration of the scalar semantic meaning has an anticipating effect in the processing of utterances. At the same time, testing the expected preactivation of upcoming discourse based on the scalar meaning of the operator should

shed light on the cognitive reality of semantic and pragmatic scales activated during language processing.

Method

A visual world paradigm experiment with an alternative forced choice task was conducted. Four images were presented on the screen while participants listened to a short dialogue consisting of a context sentence, a question, and an answer, in this order. The context and the question sentence were designed to include enough descriptive material for the interpreter to choose two of the shown images as possible discourse continuations before hearing the answer. These two images differed from each other in their relative position on a semantic or pragmatic scale: one of the two items occupied a higher position in the scale than the other one.

The incremental integration of focus operators should be reflected in different looking behaviours between the control condition (without focus operator) and the *hasta* and *nada más* conditions, in which the focus operators are expected to guide the interpreter towards the most likely focus element in the discourse by virtue of their semantic meaning. Since *hasta* and *nada más* are scalar antonyms, they are expected to guide the interpreter towards the focus element in a higher or lower position in the scale, respectively.

Participants

Thirty-five university students volunteered in the experiment. Participants were native Spanish speakers whose ages ranged from 18 to 25 years. None of the participants reported any hearing or visual impairments. Two participants were excluded due to extremely poor performance (i.e. results showed they were looking out of the set visual workspace in more than three trials according to the software calibration), which suggested low commitment and a failure in the selection task described later in this article. Data from 33 participants was included in the final sample (25 women and 8 men).

Materials

Twenty trials consisting of two media components (i.e. visual and auditory) were created for each of the three conditions. Thus a total of 60 items were used.

Visual arrays

Each of the 60 visual arrays consisted of four greyscale pictures (300ppi) of objects displayed simultaneously on each of the corners of the screen (Figure 2):

(a) The *target* (T): the object that complied with the scalar instruction of the focus operator.
(b) The *competitor* (C): an element consistent with the context in the first utterance (i.e. lexically predictable), but which does not represent a felicitous continuation once the focus operator appears.
(c) Two *distractors* (D1 and D2) that are not related to the context in the first utterance. These objects were expected to be discarded upon listening to the first utterance (context/request).

Pictures were extracted from the free access databases: *Pexels*, *Freepik*, *Stockvault*, and *Pixabay*. Images were edited with the free access software GIMP 2.10.10 to remove the background as well as any other object that could result in distraction and, therefore, hinder the task. As a consequence, each image exclusively depicted the object of interest for T, C, D1, and D2, with no other elements around. These visual objects corresponded to the short noun phrases tested in the validation pre-test for the linguistic stimuli (see below). In order to validate our visual stimuli, a recognition task was conducted previous to the main experiment. The pictures were presented to twenty volunteers who participated in this validation. We asked them to look at the pictures on a 15,6 in. screen and to name the depicted object. Those that resulted unrecognisable, difficult to distinguish or that took longer to be named by at least three people were discarded. Position and size adjustments were also made in order to make the pictures clearer according to participants' feedback. Once the pictures were modified or exchanged for new ones, the validation was repeated until the set of pictures fulfilled the requirements.

Auditory stimuli

The 60 auditory stimuli were divided into three conditions, each of them containing 20 stimuli: (a) *hasta* condition: stimuli contained the focus operator *hasta*; (b) *nada más* condition: stimuli contained the focus operator *nada más*; and (c) No focus operator condition: stimuli with no focus operator.

Each auditory stimulus was constructed of two utterances. In the first one, a male voice uttered a declarative sentence (e.g. *Hace mucho frío* "It is very cold") followed by a request (e.g. *¿me prestarías algo para taparme?* "Could you lend me something to cover up?"). Subsequently a second utterance recorded by a female voice replied to the previous turn (e.g. *Sí, hasta te podría prestar un abrigo* "Yes, I could even lend you a coat"). The purpose of using a male voice followed by a female one was to facilitate the recognition of the

Figure 2. Example of visual stimuli used in the experiment. The accompanying auditory stimuli was "-*Hace mucho frío* ("It is very cold") – *¿me prestarías algo para taparme?* ("Could you lend me something to cover up?") – *Sí, hasta te podría prestar un abrigo* ("Yes, I could even lend you a coat")". The pumpkin and the shell were the two distractors. The images with the coat and the scarf were congruent with previous discourse and occupy different positions in a scale. The presence of *hasta* in the auditory stimuli makes the coat the Target and the scarf the Competitor.

two different turns. This pattern was used for each item in the three conditions (see Table 1).

Validation of stimuli

Auditory items were validated to ensure that the elements selected as targets and competitors in the experimental stimuli were in fact perceived as members of a scale in the intended order. Thirty individuals (18–35 years old) participated in the validation pretest through Google Forms. In order to run the survey, 60 items were created: 30 for *hasta* and 30 for *nada más*. These consisted of inconclusive dialogues that were presented to the participants in a written form. For each item, three possible endings were included: a critical element that corresponded to T, a competitor that corresponded to C, and only one possible distractor that corresponded to D. These were displayed in a pseudo-randomised order and participants had to select the element that most naturally completed the dialogue, for example:

– Necesito las impresiones para hoy, ¿me las podrías dar? ("I need the prints by today, could you give them to me?")
– Nada más te podría dar ("I could only give you"):
  (a) dos impresiones ("two prints"),
  (b) algunos sillones ("some armchairs"),
  (c) cinco impresiones ("five prints").

In all cases, the possible answers were short noun phrases with a determiner and a noun. From the original set of 60, the forty items that received the highest agreement rates in the choice of the scalar focus element were selected (i.e. 20 for *hasta* and 20 for *nada más*). In all of them, at least 80% of the participants agreed on the focus element choice. Crucially, since this linguistic pre-test tested for the scalar relation between T and C, and the images chosen for the visual component of the experiment exclusively depicted the object mentioned with these noun phrases, we consider it safe to assume that the same scalar relation holds between the image representations of these noun phrases.

Experiment

The experiment consisted of three conditions regarding the focus operator presence: (1) *hasta*, (2) *nada más* and (3) *no focus operator*. All participants were presented to 20 trials per condition in a pseudo-randomised order, for a total of 60 trials.

Configuration of trials

Prior to the test trials, an exploring window of 1500ms was presented. This time allowed the participants to explore and identify the objects without any auditory stimuli. The testing phase started immediately after the exploring window with an auditory stimuli of 9500ms

Table 1. Examples of the division of auditory stimuli in five time windows for each condition. Word-by-word correspondences are given in square brackets.

	Context/request (0–3500ms)	Yes (3500–400ms)	Focus operator (4000–4650ms)	Reply to request (4650–6700ms)	Target named (6700–8600ms)
Hasta	Hace mucho frío, [make much cold] ¿me prestarías algo [me-AC lend something] para taparme? [to cover]	Sí [yes]	Hasta [even]	te podría prestar [you-AC could lend]	un abrigo [a coat.]
	It is very cold, could you lend me something to cover up?	Yes, I could even lend you a coat.			
Nada más	Necesito las [need the] impresiones para hoy, [prints for today] ¿me las podrías dar? [me-AC them could give]	–	Nada más [No more]	te podría dar [you-AC could give]	dos impresiones [two prints.]
	I need the prints by today, could you give them to me?	I could only give you two prints.			
No focus operator	Hoy se me antoja pan [today me crave bread]				
dulce, ¿podríamos [sweet could] comprar? [buy]	–	Sí [yes]	podríamos comprar [could buy]	cuatro donas [four doughnuts]	
	I'm craving sweet bread today, could we buy some?	Yes, we could buy four doughnuts			

on average. Also, at the end of the trial two more seconds were added, so that the participants were able to select the target object.

Trials were divided into five time windows, corresponding to the information in the auditory stimuli. These windows were used for the analysis of looking time (see Table 1 for examples of each window):

1. *Context/request* (0 ms–3500 ms): The auditory stimulus started with the first utterance recorded by the masculine voice and finished at the end of the interrogative sentence.
2. *Yes* (3500 ms–4000 ms): The confirmation adverb *yes* was uttered only for the condition *hasta*. For the rest of the conditions this window was empty. The inclusion of *yes* for this condition was related to the naturalness with which it is used in daily life language.
3. *Focus operator* (4000 ms–4650 ms): The focus operator was mentioned for the two critical conditions. For the control condition, the confirmation adverb *yes* appeared in this window.
4. *Reply to request* (4650 ms–6700 s): The response to the first utterance started right after the focus operator (or *yes*) was mentioned. We call this window an *extended region*, where the effects of the presence or absence of the focus operator could be displayed.
5. *Target named* (6700 ms–9500 ms): The target was mentioned and the visual stimuli remained until the end of the trial.

Procedure

Participants were presented four pictures that remained visible on the screen while they listened to the audio stimulus. The specific task was to select, with a mouse click – and once the conversation was finished – the image that corresponded to the object mentioned at the end of the recording. Participants' looking behaviour while listening to the audio recording was registered by means of an eye tracker (Tobii X2-30).

The beginning of each trial was cued by a fixation cross that appeared in the middle of the screen for 500ms. Then, the visual stimulus was depicted on the screen with the four objects corresponding to T, C, D1 and D2 (one in each corner) that remained on the screen for 11000ms in average. The testing trial started with the pre-recorded conversation, which was played simultaneously with the visual component for a mean length of 9500ms. Objects (T, C, D1 and D2) were arranged in a randomised order in the four corners of the screen for each visual stimulus. Participants went through 3 training trials prior to the main experimental items.

Results

Response accuracy (i.e. selection of the object that matched the *Reply to request* sentence*)* and looking behaviour was used to assess and control the participant's commitment to the task. Two of the participants were excluded from the sample due to a significantly poor performance (i.e. looking out of the set visual workspace in more than three complete trials), which suggested a lack of commitment to the task.

Four equal-sized AOIs (Objects) were defined: the Target (T), the Competitor (C) and two Distractors (D1 and D2). Participants' visual attention to the Objects was registered in each of the trials to obtain *Looking time* in milliseconds (ms). This measure reflects total

looking duration in which a participant's gaze was registered by the eye tracker and was fixated on a given AOI.

Main analyses were performed based on the *looking time* to each of the objects (T, C, D1, D2), along the three conditions (i.e. *hasta*, *nada más* or *no focus operator*) and for each of the 5 time windows: *Context/request, Yes, Focus operator, Reply to request* and *Target named*. Looking time (i.e. duration of fixations) was sampled at a constant data rate of 30 Hz (i.e. one fixation every 33ms). We averaged looking time to each AOI across all visual arrays for each of the five time windows. Descriptive statistics are shown in Table 2.

Data analyses for all five windows were performed by means of linear mixed effects regression models using the lme4 and lmerTest package (Bates et al., 2015) in R (R core team, 2020). The models for all the time windows included both Object and Focus operator as fixed factors, except for the Context/request window which included only Object as the fixed intercept. As random effects, we added intercepts for participants and items, as well as by-participant and by-item random slopes for the effect of Object and Focus operator, accordingly. We compared Akaike Information Criteria (AIC) to select among models, starting from a maximal model and updating the null model by excluding or adding random effects (i.e. *participants* and *items*). Predictors that did not improve fit were dropped.

Context/request: 0 ms–3500 ms

The objective for this window was to evaluate the effect of the context (i.e. mention of the relevant semantic category) on the preference to the objects. Another purpose was to discard any previous preference to T (compared to C). The prediction was that participants would start discarding the two distractors and, in this way, they would show longer looking duration to the two elements that were congruent with previous context (T and C), independently of the conditions. Distractor 1 and Distractor 2 were grouped as a single averaged measure (D1/D2) given that their labelling (i.e. D1 or D2) was arbitrary along the trials. Thus, the effect of the utterance of context on the looking time to T-and-C (T/C), compared to D1-and-D2 (D1/D2) was evaluated.

Table 2. Average performance (and SE) of looking time (in milliseconds) to the objects during each *time window* by *condition*.

	Context				
	Yes	Focus operator	Reply to request	Target naming	
Hasta					
Target	717 (36)	94 (10)	156 (13)	725 (24)	1706 (31)
Competitor	671 (35)	114 (10)	88 (13)	457 (24)	227 (31)
D1/D2	363 (63)	39 (7)	39 (9)	98 (17)	64 (22)
Nada más					
Target	672 (26)	108 (10)	144 (13)	693 (24)	1522 (31)
Competitor	903 (43)	129 (10)	165 (13)	530 (24)	269 (22)
D1/D2	348 (72)	34 (7)	40 (9)	83 (17)	78 (22)
No focus operator					
Target	740 (26)	105 (10)	138 (13)	535 (24)	1690 (31)
Competitor	702 (43)	116 (10)	160 (13)	556 (24)	301 (31)
D1/D2	354 (72)	36 (7)	48 (9)	115 (17)	63 (22)

The mixed model for this window included *Object* (2 levels; reference category D1/D2) as the fixed predictor and *participant* and *item* as random effects, showed that participants looked longer to T/C ($\beta = 359$, SE = 47, $p < .001$, $t = 7.50$) than to D1/D2 (see Figure 3). This model resulted in a better fit than the null models with only *participant* or only item as random factors (AIC for model with *participant* and *item:* −457, AIC for model with only *participant*: −339, AIC for model with only item: −330).

Also, in order to validate any subsequent effect of the auditory stimuli in the next windows, it was important to discard any prior preference to T in the current window. Accordingly, a linear mixed analysis including three levels of *Object* (T vs. C vs. D1/D2; reference category T) as fixed predictor and two random factors (*participant* and *item*) was selected. As shown in Figure 3, participants looked shorter to D1/D2 ($\beta = -345$, SE = 40, $p < .001$, $t = -8.48$). No significant difference in looking time between T and C was observed ($\beta = 55$, SE = 61, $p = .40$, $t = .90$). Accordingly, prior preference to T over C was discarded (Figure 4). This model resulted in a better fit than the null model with only *participant* or only *item* as random factors (AIC for model with *participant* and *item:* −451, AIC for model with only *participant*: −337 AIC for model with only *item*: −321).

Yes: 3500 ms–4000 ms

The objective of this window was to discard that the confirmation adverb *sí* (yes) presented in the *hasta* condition – and that was included to improve the naturalness of these utterances – was generating a looking preference to T. Despite the differences among conditions, the prediction for this window was that the adverb would not generate any bias, because the focus operator was still not mentioned until this moment and the reply *yes* was compatible with both T and C.

A linear mixed effect model with *Object* (T vs. C vs. D1/D2) and *Focus Operator* (*hasta* vs. *nada más* vs. *no focus operator*) as fixed factors and *participant* as random factor was selected As Figure 5 shows, participants looked longer to T and to C (compared to D1/D2), in

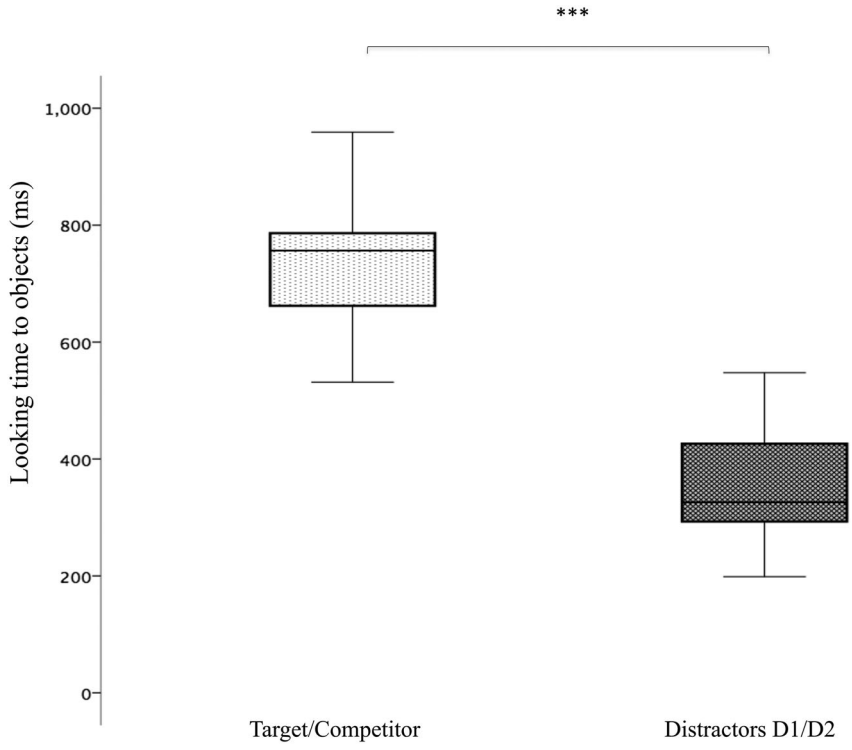

Figure 3. Mean looking time to Target/Competitor (T/C) vs. Distractors (D1/D2) across conditions, during the *Context/request* time window. *** $p < .001$.

each of the three conditions: *hasta* (T: β = 54, SE = 7, $p < .001$, $t = 9.77$; C: β = 75, SE = 7, $p < .001$, $t = 6.9$), *nada más* (T: β = 73, SE = 7, $p < .001$, $t = 9.42$; C: β = 95, SE = 7, $p < .001$, $t = 12.43$) and *no focus operator* (T: β = 68, SE = 7, $p < .05$, $t = 9.38$; C: β = 79, SE = 7, $p < .01$, $t = 11.07$). The mixed model showed a statistically significant

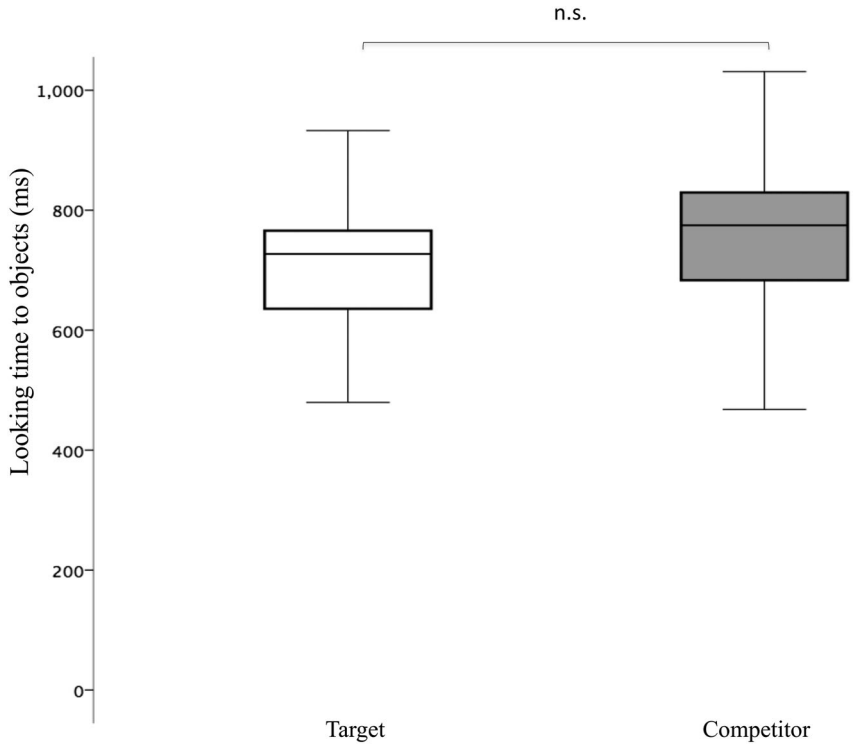

Figure 4. Mean looking time to Target vs. Competitor averaged across all three conditions during the *Context/request* time window.

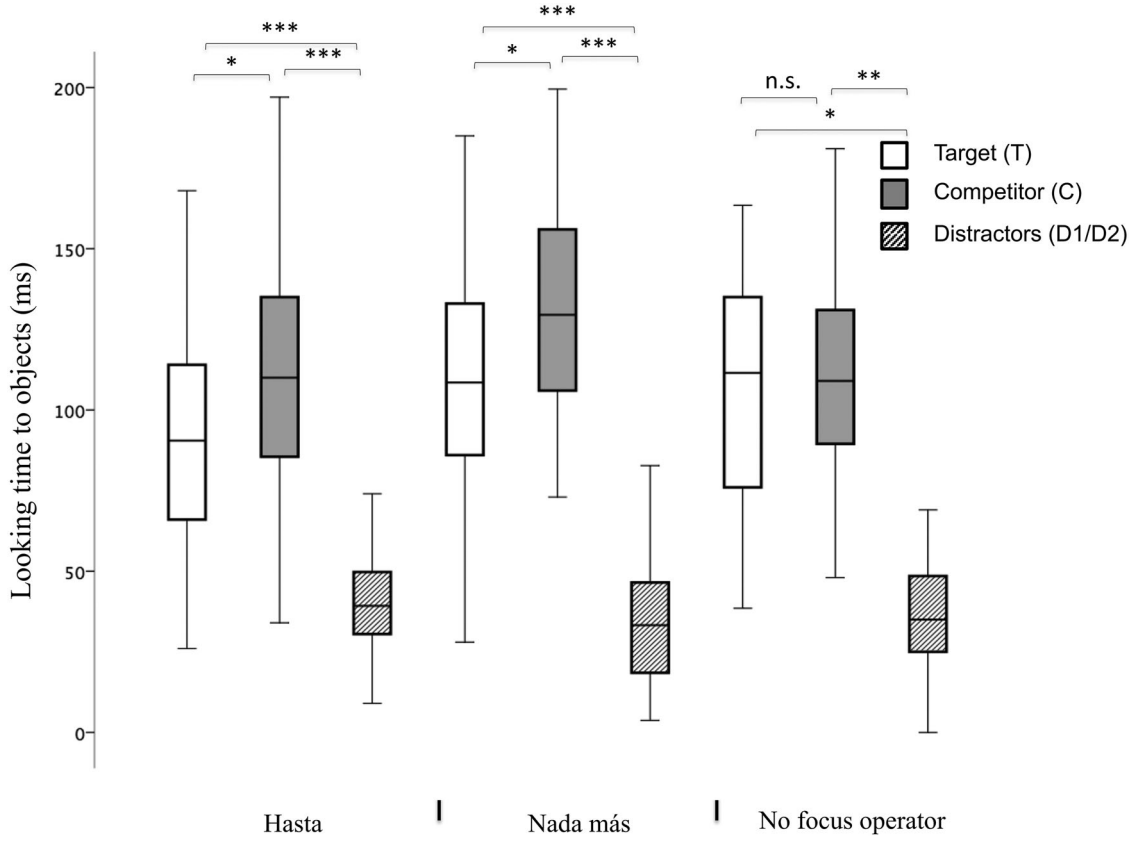

Figure 5. Mean looking time to Target vs. Competitor vs. D1/D2 by condition during the *Yes* time window. $^{**}p < .01$, $^{*}p < .05$

difference between T and C in *hasta* (β = 20, SE = 8, $p < .05$, $t = 2.53$) and in *nada más* (β = 21, SE = 8, $p < .01$, $t = 2.6$). No significant difference was observed in the *no focus operator condition* (β = 11, SE = 8, $p > .05$, $t = 1.36$). This model resulted in a better fit than the null model with *participant* and *item* or only item as random effects (AIC for model with *participant* and *item*: −1495.2, AIC for model with *participant*: −1517, AIC for model with *item*: −1470). In sum, as in the previous time window, any prior preference to T (compared to C) was discarded. However a non expected preference to C over T in *hasta* and *nada más* was observed. Finally, as expected, participants showed a significant and obvious preference to T and C compared to D1/D2.

Focus operator: 4000 ms–4650 ms

The aim of this window was to evaluate the effect of *hasta* and *nada más* in the two corresponding conditions and in contrast with the *no focus operator* condition. The prediction for this window was that participants would start guiding their look to T, and, thus, start discarding C. Looking time to distractors was consistently short through the experiment in all conditions. Accordingly data analyses from those objects are not reported for subsequent time windows in order to more clearly present the most relevant results.

As well as in the previous time window, looking duration was analyzed using a linear mixed effect model with *Object* (T vs. C) and *Focus Operator* (*hasta* vs. *nada más* vs. *no focus operator*) as fixed factors. The best fitting model included *participant* as random factor (AIC for model with participant and item: −1273, AIC for model with participant: −1301, AIC for model with item: −1240). As shown in Figure 6, a comparison of looking time between C and T in each condition revealed that participants look longer to T in the *hasta* condition (β = 67, SE = 10, $p < 0.001$, $t = 6.73$). A small, but significant preference to C in the *nada más* condition (β = −21, SE = 10, $p = .03$, $t = -2.12$) was observed. There was no significant effect in the *no focus operator* condition (β = −15, SE = 10, $p = .13$, $t = -2.23$).

Reply to request: 4650 ms–6700 ms

The objective of this window was to evaluate a possible late effect of the focus operators that favoured looking

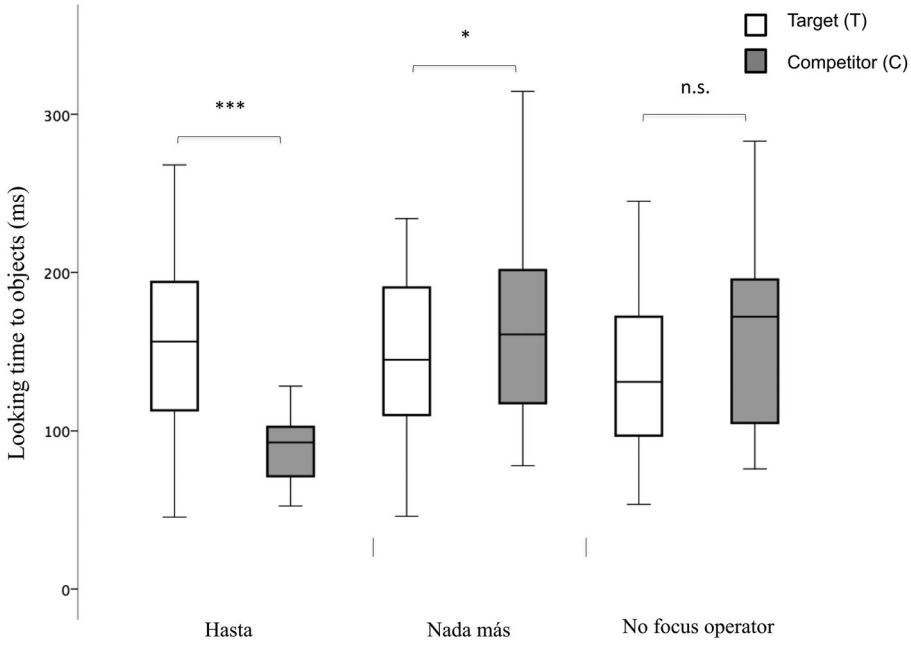

Figure 6. Mean looking time to Target vs. Competitor by condition during the *Focus operator* time window. *$p < .05$

duration to T before the name of the Target was actually pronounced. From it, the prediction for this window was that participants would continue looking at T or, eventually, that the effect of the focus operator in the previous window would be observed here with a slightly late effect.

Once more, a linear mixed analysis was performed to compare looking time between C and T in each condition. The model included Object (T vs. C) and Focus Operator (hasta vs. nada más vs. no focus operator) as fixed factors and participant as random factor, as well as the interaction between Object and Focus Operator. As Figure 7 shows, results reveal that looking time to T (compared to looking time to C) was statistically longer in the *hasta* condition ($\beta = 268$, $SE = 38$, $p < .001$, $t = 7.00$) and in the *nada más* condition ($\beta =$

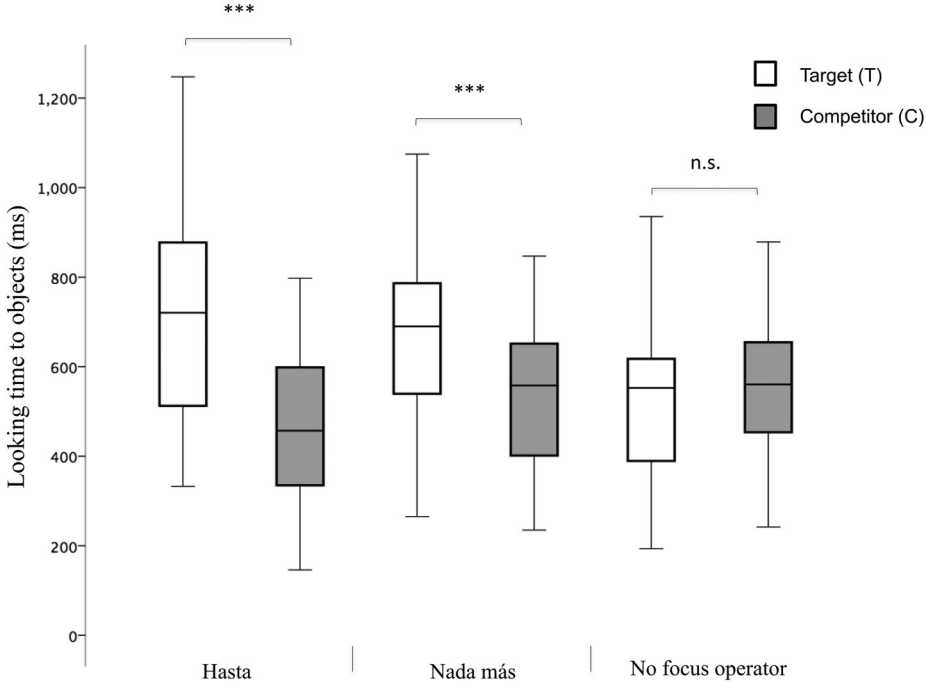

Figure 7. Mean looking time to Target vs. Competitor by condition during the *Reply to request* time window. ***$p < .001$, **$p < .01$

162, SE = 38, $p < .001$, $t = 4.24$). No statistically significant difference between T and C was observed in the control *(no focus operator)* condition (β = −20, SE = 38, $p = .58$, $t = -.58$). This model fitted the data better than the model with participant and item as random factors (AIC for model with participant and item: −431, AIC for model with only participant: −455, AIC for model with item: −330).

Target named: 6700 ms–9500 ms

The objective of this window was to ascertain that, when T was mentioned in the audio, participants would look longer at this object rather than the rest of the elements in the three conditions. Because T is directly named, no differences between conditions should be expected.

A linear mixed effect model with *Object* (T vs. C) and *Focus Operator* (*hasta* vs. *nada más* vs. no focus operator) as fixed factors and *participant* as random factor, showed that preference to the Target (compared to C) was longer in each of the experimental conditions (see Figure 8): *hasta* (β = 1479, SE = 57, $p < .001$, $t = 25.90$), *nada más* (β = 1252, SE = 57, $p < .001$, $t = 21.91$) and *no focus operator* condition (β = 1389, SE = 43, $p < .001$, $t = 24.32$). This model fitted the data better than the model with *participant* and *item* or only *item* as random factors (AIC for model with *participant* and *item*: −394, AIC for model with *participant*: −371 AIC for model with *item*: −148).

Taken together, these results represent an integrated time course where visual processing and looking behaviour are clearly mediated by the processing of linguistic information, including information conveyed by the focus operators. In order to obtain a more continuous image of the participants' looking behaviour that shows a more detailed online processing, Figure 9 shows Proportion of looking time to T, C and D1/D2 in a data rate of 250 milliseconds intervals. As the timeline of Figure 9 shows, focus operators change looking behaviour, guiding participants to predict the object to be named. Description of Figure 9 also shows faster looking anticipation when hearing *hasta* compared with *nada más*.

Discussion

The present study asked whether, upon encountering the scalar focus operators *hasta* and *nada más*, interpreters would generate expectations regarding the content of the upcoming focus element by virtue of the scalar meaning of the focus operator. Our results confirm the hypothesis regarding the predicting effect of scalar focus operators.

In the first two windows, in agreement with previous findings on linguistic prediction, the conceptual content

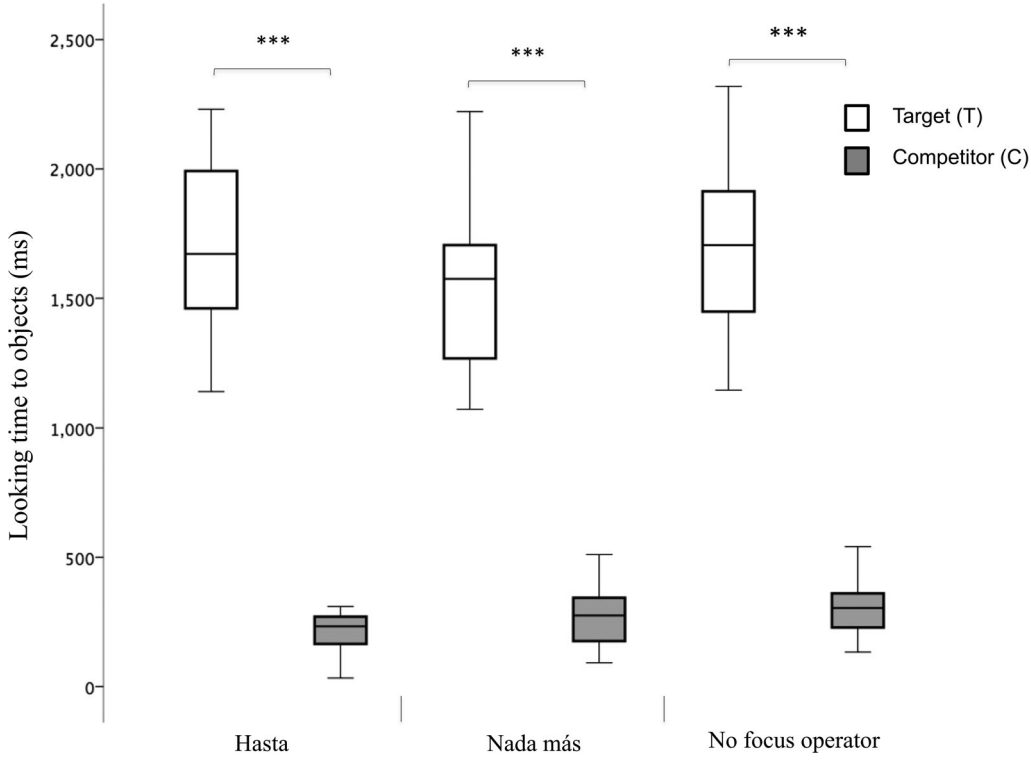

Figure 8. Mean looking time to Target vs. Competitor by condition during the *Target named* time window. ***$p < .001$

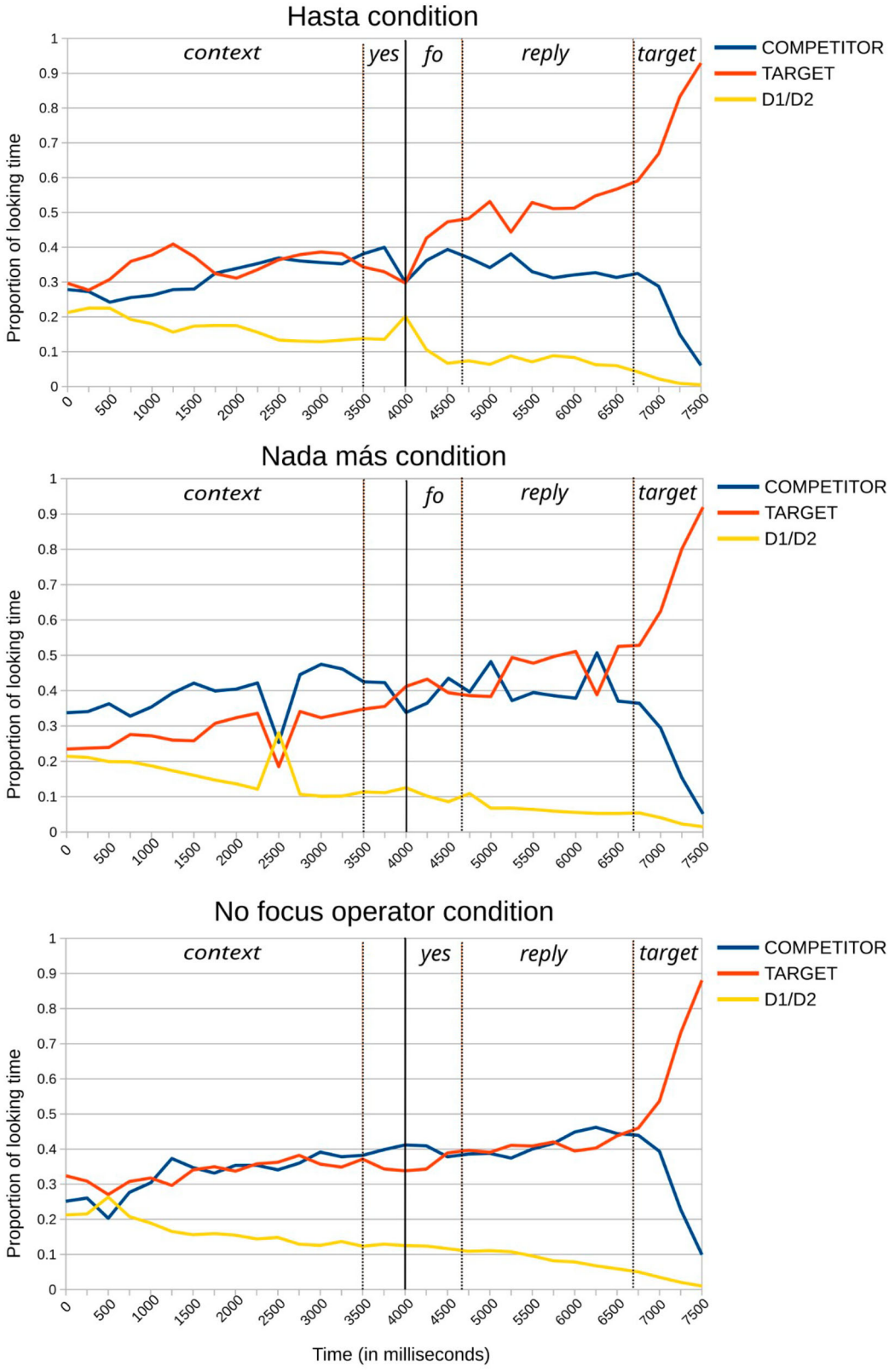

Figure 9. Timeline of looking proportion to the objects during the overall trial by condition (graphed every 250ms).

in the utterance resulted in the preferential look to the two contextually likely elements (T and C) over the two distractors (with an unexplained preference for C over T). On the margin of our main results, the time course also shows an unexpected change from mostly looking at the competitor and the target to looking at

the distractors during the context time window (around 2500 ms) in the *nada más* condition. However the fact that this alternation is only observed in one of the conditions seems more just a random behaviour of our data. More importantly, the top-down preference for target and competitor over the two distractors was maintained, in the no focus operator condition, until the target word was mentioned. In the *hasta* and the *nada más* condition, on the other hand, the interpreter's prediction was narrowed based on bottom-up information (the meaning of the focus operator), causing one of the previously activated elements (the competitor, which was preferred in the first part of the stimuli) to be discarded (see Figure 9). As expected, in the *hasta* condition, the gaze patterns show a preactivation of the element in a higher position of the semantic or pragmatic scale, relative to the other context congruent visual element, whereas integrating *nada más* guided the interpreter to anticipate the element in a lower position of the scale. The effect of *nada más* is, in our data, slightly slower than the effect of *hasta*: while the *hasta* effect was perceived in the focus operator window, the *nada más* effect was registered in the following window. In the *Reply to request* window, where the target was not yet mentioned, both conditions with a focus operator showed a preference towards the target; longer looking times to the competitor were found in the *nada más* than in the *hasta* condition in this pre-target window.

There are two possible explanations for the earlier effect of *hasta* in our data. The first one, which we argue against, is methodological: in our experimental design, *hasta* utterances included an affirmative adverb, *sí* (yes), preceding the focus operator. *Yes* was included before *hasta* in order to assure naturalness of the utterance. It could be argued that the inclusion of *yes* in the *hasta* condition is guiding the interpreter towards looking to the target element and that the *hasta* effect in the focus operator window is in fact capturing a late *yes* effect. This, however, is unlikely: first, both the target and the competitor are equally plausible as continuations in affirmative responses to the preceding question in each stimulus. It is unclear why the affirmative adverb would favour the higher element on the scale as opposed to a contextually congruent element in a lower scale position. But more importantly, the *no focus operator* condition also includes an affirmative adverb *yes* in the response first position (see Table 1). If the *hasta* effect were due to the initial *yes*, the same effect (a favouring effect towards the higher element on the scale) should be found in the *control* condition, but this is not the case, thus ruling out the possibility of the *hasta* earlier predictive effect being due to *yes*. Instead, we argue that the earlier versus later predicting effect of *hasta* and *nada más* has to do with one crucially different meaning component: the negative meaning conveyed by the exclusive focus operator (*nada más*), and absent in the scalar additive (*hasta*) operator. The negative (also called exclusive) component negates that the alternatives to the focus apply (Beaver & Clark, 2008) and although the exclusive or additive component of hasta and nada más were not tested in the experiment, the processing of the utterances with these focus operators involves integrating the whole meaning of their parts, including the exclusive or additive meaning of the operator.

There is consistent evidence that negation is, in general, costly to process (Kaup et al., 2006; Larrivée & Chungmin, 2016), and previous research has shown that positive causal connectives involve less processing cost than negative causal connectives (Koehne et al., 2013; Köhne-Fuetterer et al., 2021; Knoepke et al., 2017; Xu et al., 2018). The earlier predictive effect of *hasta*, as compared to *nada más*, is most likely due to the negative element in the latter but not the former, in line with previous findings on other discourse particles and on negation processing in general.

Alternatively, the delayed integration of *nada más* compared to *hasta* might have to do with the following observation: *nada más* (only) may allow the interpreter to evoke an alternative scale in which the originally visual competitor (the element higher in the scale) could function as the focus element and other contextually evoked elements occupy higher positions in this alternative scale. For example, in the dialogue " – I'm moving tomorrow, could you help me move some things? – I could only help you with two boxes", in which the visual competitor was a group of around 10 pieces, it is not impossible to evoke a scale in which "10 boxes" follows *nada más*, if one pragmatically evokes new alternatives such as "20 boxes", "some furniture", and so on. This possibility of evoking an alternative scale in which the originally intended competitor could be, in fact, the target, is apparently less plausible for *hasta*, in which the competitor already occupies, in our items, a fairly low position in the evoked scale, making it difficult or contextually impossible to easily activate elements in lower positions. This difference between *hasta* and *nada más*, and the lower vs. upper-scale alternatives, could also be affecting the less straightforward preference for the target element in the *nada más* condition relative to the *hasta* condition.

Our experimental results shed light on the time-course of processing focus operators and, more generally, discourse markers. On a broader perspective, our data contribute to the general theoretical discussion

on prediction in language processing and, more importantly, add new evidence on the psychological reality of scales and their activation during linguistic processing. We tackle these points in the following discussion.

Our study specifically contributes to the emerging picture about the processing of focus operators. Focus operators have been the subject of experimental studies investigating processing, truth judgments, and accommodation of their presuppositions as well as their effect on the retrieval and recall of alternatives to the focus element (Gotzner & Spalek, 2017; Gotzner et al., 2016; Kim et al., 2015; Spalek et al., 2014). Different focus operators differ in their conventional, non-conceptual individual meaning and, consequently, code different meaning relations between the focus element and its alternatives. Although it has been pointed out that this makes focus operators a useful locus to examine the expectations associated with both explicit descriptive and contextually determined content (Kim et al., 2015), little is known about the processing of these items and the effect of their individual differences on discourse processing, and previous literature pointed out the need of further analyzing them (Gotzner & Spalek, 2017). In this line, Kim et al. (2015) (exp.4) analyzes how the different meanings of *only* and *also* constraint different expectations regarding the set of entities in the focus element relative to their alternatives: a superset, including a novel target, for *also*; a subset of the previously mentioned referents for *only*. In a similar study, Romoli et al. (2014) found an effect of *also* (expectation of a focus element that is discourse old in their experimental paradigm), but failed to observe the expected effect of *only* constraining the expectation of a new focus element. Whereas Kim et al. (2015) and Romoli et al. (2014) focussed on the presuppositional component of *only* and *also* as the key element in predicting the old vs. new status of the focus element, in our study, the conventional scalar meaning of the two focus operators *hasta* and *nada más* determined the scale position of the focus element relative to its context-relevant alternatives, thus generating expectations about the upcoming element. Taken together, these studies suggest a picture in which the multiple components of the meaning of focus operators are integrated online and processed in parallel to incrementally construct the discourse representation, constraining the expectations about upcoming discourse regarding their different meaning components (discourse status of the focus, scale position of the focus, etc.).

More broadly, the current study demonstrates that the predicting effect of discourse markers is not limited to confirming or reversing the prediction set out by virtue of the conceptual discourse content. Previous studies had convincingly shown that causal and concessive connectives lead the interpreter to confirm or, more interestingly, reverse the preactivation of the upcoming utterance (Drenhaus et al., 2014; Koehne et al., 2013; Köhne-Fuetterer et al., 2021; van Bergen & Bosker, 2018; Xiang & Kuperberg, 2015). In the case of these connectives, however, the preactivated content was based on the descriptive or conceptual content in previous discourse together with common ground knowledge (Köhne-Fuetterer et al., 2021; Xiang & Kuperberg, 2015). Besides causal and concessive connectives, Zhan et al. (2015) found that processing the Mandarin Chinese sentential connectives *only if* and *even if* resulted in anticipatory looks towards contents that could be felicitously merged using each connective and previous context information. Discourse markers, nevertheless, convey a variety of non-conceptual meanings, but the integration of these meaning components and, specifically, whether they have predictive effects in utterance processing has received little attention in the psycholinguistic literature. The current results provide evidence that one of such non-conceptual meaning components, the scalar meaning that characterises scalar additive and exclusive particles such as *hasta* and *nada más* (Beaver & Clark, 2008), does constraint the expectation of the upcoming discourse: discourse prediction is constructed taking into account not only conceptual, descriptive meaning and event knowledge, by which both the target and the competitor in our task would be preactivated, but also, and crucially, the non-conceptual meaning of the scalar discourse particle: the indication of the scale position of the focus relative to its alternatives.

Previous literature has shown that various kinds of linguistic elements play a role in the interpreters' predictions about upcoming discourse: prosody (Weber et al., 2006), verb subcategorization (Trueswell et al., 1993), case marking (Kamide et al., 2003), the thematic structure of the verb (Tanenhaus et al., 1989), the discourse context (van Berkum et al., 2005), among various other factors (see Altmann & Mirković, 2010; Huettig & Mani, 2016; Kuperberg & Jaeger, 2016, for a review). This article adds evidence that interpreters make use of lexical non-conceptual meaning (procedural or use-conditional meaning) in building discourse predictions. The interest of showing the predictive effect of non-conceptual meaning to the discussion on linguistic prediction is twofold.

First, previous accounts on predicting processing held the theoretical discussion on whether the preactivation of certain elements could or should be accounted for with the notion of semantic priming, in such a way

that the preactivation of certain lexical items would be the effect of the activation spread in the lexical network (Otten & Van Berkum, 2008; Kuperberg & Jaeger, 2016, for a concise review). In our opinion, the addition of non-conceptual meaning to the equation of predicting processing plays a key role in this discussion: although it can be discussed whether the activation of certain nodes on the lexicon network (based on contextual knowledge and functional relations between words) could explain the activation of both the target and the competitor items in our experiment (for example, the activation of "bedroom" could spread to *bed* and *lamp*) (but see Otten & Van Berkum, 2008), the interpreter's choice between them as soon as the focus operator is integrated (in this case, the preference for *lamp* after *nada más*) cannot be explained by virtue of semantic priming, but only by a mechanism of decoding the conventional, non-conceptual meaning of the discourse marker and rapidly integrating it and, consequently, constraining the discourse representation being created online.

Second, the fact that the lexical linguistic component includes both conceptual and non-conceptual meaning is commonly accepted in theoretical semantics and pragmatics, and non-conceptual meaning is the locus of intense theoretical discussions pertaining to the existing types of non-conceptual meanings, their characteristics and the frontier between semantics and pragmatics (Turner & Horn, 2018). The cost and time course of processing the different types of non-conceptual meanings is a growing research line in psycholinguistic studies, in which presuppositions and scalar implicatures have been privileged (see Schwarz, 2016; and Chemla & Singh, 2014, respectively, for reviews). The conventional, non-conceptual meaning of discourse particles has been characterised as rigid and non-flexible content that instructs the hearer in the inferencing process (Blakemore, 2000; Carston, 2016; Gutzmann, 2013; Recanati, 2004. But see Asr & Demberg, 2020 for a different perspective). With these characteristics, the expectation that this kind of meaning would be key in the predictive language processing is straightforward, yet very little is known so far about the predictive effect of integrating non-conceptual meaning. Our findings, showing that the scalar meaning triggers immediate expectations about the upcoming discourse element, are compatible with these theoretical descriptions of a rigid, conventional meaning guiding the interpretation process.

Finally, the present study contributes to our understanding of semantic and pragmatic scales in discourse processing. The visual world paradigm allowed us to show that the processing of the scalar particle was not only congruent with the target visual element (making it less costly to process), but resulted in its immediate preactivation. These anticipatory eye movements, we argue, reflect that, as the discourse unfolds, scale relations among entities are also accessed. In other words, the anticipatory sight towards the target element indicates the online activation of the discourse relevant scale already shared by speakers and hearers in a discourse exchange. The fact that integrating *hasta*, or *nada más*, translates into choosing one of the available contextually predicted elements not only proves that *hasta* rises expectations regarding the focus element being high in a discourse scale, but also that the two visually available elements (and, arguably, other contextually congruent elements) are in fact cognitively organised in a scale, which in turn depends on the discourse context; the appearance of the scalar focus operator only triggers the activation of the scale. The interpreter does not wait for the target element to occur in order to generate the scale: if the discourse relevant scale is at all available in the common ground, it is merely activated upon encountering the scalar focus particle. In our experimental setting, the visual target and the competitor were not only activated as elements congruent with the previous discourse, but also conceived as elements in a relative order in a discourse relevant scale. Contextually possible alternatives are conceived as members of scales relative to a discourse question under discussion; these alternatives are more or less expected, or occupy higher or lower positions relative to the contextually expected element. This pragmatic organisation of concepts is available during discourse processes and relevant scales are, in light of our findings, rapidly activated when the integration of the focus operator requires it.

The fact that scalar meanings are linguistically coded and that evoked alternatives are cognitively conceived as ordered scales is broadly accepted in linguistic theory and language descriptions (Beaver & Clark, 2008; Sawada, 2017; Schwenter, 1999), but empirical evidence of whether discourse alternatives are actually cognitively organised in scales and how or whether these scales are in fact activated by means of discourse particles was, to our knowledge, lacking from the literature. The theoretical concept of scale and the theoretical supposition that speakers and hearers build their discourse model including information about the question under discussion, expectations and alternatives that are more or less – in a given scale – than expected, is not only a theoretical supposition but finds a psychological correlation in our study. In this sense, our findings contribute to our understanding of the processes involved in the building of a discourse representation in discourse processing, which has been pointed out as a "persistent

gap in psycholinguistic research" (Scholman et al., 2017, p. 57).

Conclusion

This study provides evidence that the incremental processing of scalar focus operators has predicting effects: the presence of *hasta* (even) makes the interpreter expect an element in a higher position in the scale, whereas the presence of *nada más* (only) activates a lower position in the scale. Both focus operators show a slightly different processing time course: *nada más* shows a slower effect relative to *hasta*, a difference that can be attributed to the negative component present in the exclusive *nada más*. These findings contribute to our understanding of how individual differences among focus operators translate to processing differences.

Our results add to our knowledge on the predicting effect of discourse markers by showing that these can not only confirm or reverse previous discourse expectations, but they can also contribute, by means of their non-conceptual meaning – in this case, scalar meaning – to building expectations about upcoming discourse. These results also indicate that speakers share the scalar organisation of elements in the discourse context and are able to use this shared knowledge to construct discourse predictions as guided by the lexical, non-conceptual meaning of the focus operators coding scalar values.

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References

Altmann, G. T. M., & Mirković, J. (2010). Incrementality and prediction in human sentence processing. *Cognitive Science*, *33* (4), 538–609. https://doi.org/10.1111/j.1551-6709.2009.01022.x.Incrementality

Andersen, G. (2001). *Pragmatic markers and sociolinguistics variation*. John Benjamins Publishing Company.

Asr, F. T., & Demberg, V. (2020). Interpretation of discourse connectives is probabilistic: Evidence from the study of but and although. *Discourse Processes*, *57*(4), 376–399. https://doi.org/10.1080/0163853X.2019.1700760

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Beaver, D. I., & Clark, B. Z. (2008). *Sense and sensitivity. How focus determines meaning*. Blackwell.

Blakemore, D. (2000). Indicators and procedures: Nevertheless and but. *Journal of Linguistics*, *36*(3), 463–486. https://doi.org/10.1017/S0022226700008355

Carston, R. (2016). The heterogeneity of procedural meaning. *Lingua. International Review of General Linguistics. Revue internationale De Linguistique Generale*, *175–176*, 154–166. https://doi.org/10.1016/j.lingua.2015.12.010

Chemla, E., & Singh, R. (2014). Remarks on the experimental turn in the study of scalar implicature. *Language and Linguistics Compass*, *8*(9), 373–386. https://doi.org/10.1111/lnc3.12080

de Vega, M. (2005). El procesamiento de oraciones con conectores adversativos y causales. *Cognitiva*, *17*(1), 85–108. https://doi.org/10.1174/0214355053114745

Drenhaus, H., Demberg, V., Köhne, J., & Delogu, F. (2014). Incremental and predictive discourse processing based on causal and concessive. *Proceedings of the Annual Meeting of the Cognitive Science Society*, *36*, 403–408.

Giannakidou, A. (2007). The landscape of EVEN. *Natural Language and Linguistic Theory*, *25*(1), 39–81. https://doi.org/10.1007/s11049-006-9006-5

Gotzner, N., & Spalek, K. (2017). The connection between focus and implicatures: Investigating alternative activation under working memory load. In S. Pistoia-Reda, & F. Domaneschi (Eds.), *Linguistic and psycholinguistic approaches on implicatures and presuppositions* (pp. 175–198). Palgrave Macmillan.

Gotzner, N., Spalek, K., Degen, N. G. J., & Franke, M. (2014). Exhaustive inferences and additive presuppositions: The interplay of focus operators and contrastive intonation. In Judith Degen, Michael Franke, & Noah Goodman (Eds.), *Proceedings of the formal and experimental pragmatics workshop (ESSLII 2014)* (pp. 7–13). Tübingen University.

Gotzner, N., Wartenburger, I., & Spalek, K. (2016). The impact of focus particles on the recognition and rejection of contrastive alternatives. *Language and Cognition*, *8*(1), 59–95. https://doi.org/10.1017/langcog.2015.25

Gutzmann, D. (2013). Expressives and beyond: An introduction to varieties of use-conditional meaning. In Daniel Gutzmann & Hans-Martin Gärtner (Eds.), *Beyond Expressives: Explorations in Use-Conditional Meaning* (pp. 1–58). Brill.

Horn, L. R. (2016). A presuppositional analysis of only and even. *Papers from the Fifth Regional Meeting of the Chicago Linguistics Society*, *5*(1969), 98–107.

Huettig, F., & Mani, N. (2016). Is prediction necessary to understand language? Probably not. *Language, Cognition and Neuroscience*, *31*(1), 19–31. https://doi.org/10.1080/23273798.2015.1072223

Kamide, Y., Altmann, G. T. M., & Haywood, S. L. (2003). The time-course of prediction in incremental sentence processing: Evidence from anticipatory eye movements. *Journal of Memory and Language*, *49*(1), 133–156. https://doi.org/10.1016/S0749-596X(03)00023-8

Kaup, B., Lüdtke, J., & Zwaan, R. A. (2006). Processing negated sentences with contradictory predicates: Is a door that is not open mentally closed? *Journal of Pragmatics*, *38*(7), 1033–1050. https://doi.org/10.1016/j.pragma.2005.09.012

Kay, P. (1990). Even. *Linguistics and Philosophy*, *13*(1), 59–111. https://doi.org/10.1007/BF00630517

Kim, C. S., Gunlogson, C., Tanenhaus, M. K., & Runner, J. T. (2015). Context-driven expectations about focus alternatives. *Cognition*, *139*, 28–49. https://doi.org/10.1016/j.cognition.2015.02.009

Knoepke, J., Richter, T., Isberner, M.-B. B., Naumann, J., Neeb, Y., & Weinert, S. (2017). Processing of positive-causal and negative-causal coherence relations in primary school children and adults: A test of the cumulative cognitive complexity approach in German. *Journal of Child Language*, *44*(2), 297–328. https://doi.org/10.1017/S0305000915000872

Koehne, J., Demberg, V., Köhne, J., & Demberg, V. (2013). The time-course of processing discourse connectives. *35th Annual Meeting of the Cognitive Science Society*, 2760–2765.

Köhne-Fuetterer, J., Drenhaus, H., Delogu, F., & Demberg, V. (2021). The online processing of causal and concessive discourse connectives. *Linguistics*, *59*(2), 417–448. https://doi.org/10.1515/ling-2021-0011

Kuperberg, G. R., & Jaeger, T. F. (2016). What do we mean by prediction in language comprehension? *Language Cognition & Neuroscience*, *31*(1), 32–59. https://doi.org/10.1080/23273798.2015.1102299

Larrivée, P., & Chungmin, L. (2016). *Negation and polarity: Experimental perspectives*. Springer.

Millis, K. K. A., & Just, M. A. (1994). The influence of connectives on sentence comprehension. *Journal of Memory and Language*, *33*(1), 128–147. https://doi.org/10.1006/jmla.1994.1007

Nadal, L., Cruz, A., Recio, I., & Loureda, Ó. (2016). El significado procedimental y las partículas discursivas del español: Una aproximación experimental. *Revista Signos*, *49*, 52–77. https://doi.org/10.4067/s0718-09342016000400004

Otten, M., & Van Berkum, J. J. A. (2008). Discourse-based word anticipation during language processing: Prediction or priming? *Discourse Processes*, *45*(6), 464–496. https://doi.org/10.1080/01638530802356463

Portolés, J. (1998). *Marcadores del discurso*. Ariel.

Portolés, J. (2007). Escalas informativas aditivas: Pruebas del español. *Spanish in Context*, *4*(2), 135–157. https://doi.org/10.1075/sic.4.2.02por

RC Team. (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna. Austria. https://www.R-project.org/

Recanati, F. (2004). Pragmatics and semantics. In L.-R. Horn, & G. Ward (Eds.), *The handbook of pragmatics* (pp. 442–462). Blackwell.

Roberts, C. (2006). Only, presupposition and implicature. *Journal of Semantics*. Advance online publication. https://www.asc.ohio-state.edu/roberts.21/only.pdf

Romoli, J., Khan, M., Sudo, Y., & Snedeker, J. (2014). Resolving temporary referential ambiguity using presupposed content. In F. Schwarz (Ed.), *Experimental perspectives on presuppositions. Studies in theoretical psycholinguistics* (pp. 67–87). Springer. https://doi.org/10.1007/978-3-319-07980-6_3

Sanders, T. (1997). Semantic and pragmatic sources of coherence: On the categorization of coherence relations in context. *Discourse Processes*, *24*(1), 119–147. https://doi.org/10.1080/01638539709545009

Sawada, O. (2017). *Pragmatic aspects of scalar modifiers: The semantics-pragmatics interface*. Oxford University Press.

Schiffrin, D. (1987). *Discourse markers*. Cambridge University Press.

Scholman, M. C. J., Rohde, H., & Demberg, V. (2017). "On the one hand" as a cue to anticipate upcoming discourse structure. *Journal of Memory and Language*, *97*, 47–60. https://doi.org/10.1016/j.jml.2017.07.010

Schwarz, F. (2016). Experimental work in presupposition and presupposition projection. *Annual Review of Linguistics*, *2*(1), 273–292. https://doi.org/10.1146/annurev-linguistics-011415-040809

Schwenter, S. A. (1999). *The pragmatics of conditional marking: Implicature, scalarity, and exclusivity*. Routledge.

Spalek, K., Gotzner, N., & Wartenburger, I. (2014). Not only the apples: Focus sensitive particles improve memory for information-structural alternatives. *Journal of Memory and Language*, *70*, 68–84. https://doi.org/10.1016/j.jml.2013.09.001

Staub, A., & Clifton, C. J. (2006). Syntactic prediction in language comprehension: Evidence from either … or. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *32*(2), 425–436. https://doi.org/10.1037/0278-7393.32.2.425

Tanenhaus, M. K., Carlson, G., & Trueswell, J. C. (1989). The role of thematic structures in interpretation and parsing. *Language and Cognitive Processes*, *4*(3–4), SI211–SI234. https://doi.org/10.1080/01690968908406368

Traxler, M. J., Bybee, M. D., & Pickering, M. J. (1997). Influence of connectives on language comprehension: Eye-tracking evidence for incremental interpretation. *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *50*(3), 481–497. https://doi.org/10.1080/027249897391982

Trueswell, J. C., Tanenhaus, M. K., & Kello, C. (1993). Verb-specific constraints in sentence processing: Separating effects of lexical preference from garden-paths. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *19*(3), 528–553. https://doi.org/10.1037/0278-7393.19.3.528

Turner, K. P., & Horn, L. (2018). *Pragmatics, truth and underspecification. Towards an atlas of meaning*. Brill.

van Bergen, G., & Bosker, H. R. (2018). Linguistic expectation management in online discourse processing: An investigation of Dutch inderdaad 'indeed' and eigenlijk 'actually'. *Journal of Memory and Language*, *103*(August), 191–209. https://doi.org/10.1016/j.jml.2018.08.004

van Berkum, J. J. A., Brown, C. M., Zwitserlood, P., Kooijman, V., & Hagoort, P. (2005). Anticipating upcoming words in discourse: Evidence from ERPs and reading times. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*(3), 443–467. https://doi.org/10.1037/0278-7393.31.3.443

Weber, A., Grice, M., & Crocker, M. W. (2006). The role of prosody in the interpretation of structural ambiguities: A study of anticipatory eye movements. *Cognition*, *99*(2), B63–B72. https://doi.org/10.1016/j.cognition.2005.07.001

Wilkinson, K. (1996). The scope of even. *Natural Language Semantics*, *4*(3), 193–215. https://doi.org/10.1007/BF00372819

Xiang, M., & Kuperberg, G. R. (2015). Reversing expectations during discourse comprehension. *In Language Cognition & Neuroscience*, *30*(6), 648–672. https://doi.org/10.1080/23273798.2014.995679

Xu, X., Chen, Q., Panther, K. U., & Wu, Y. (2018). Influence of concessive and causal conjunctions on pragmatic processing: Online measures from eye movements and self-paced reading. *Discourse Processes*, *55*(4), 387–409. https://doi.org/10.1080/0163853X.2016.1272088

Zhan, L., Crain, S., & Zhou, P. (2015). The online processing of only if- and even if- conditional statements: Implications for mental models. *Journal of Cognitive Psychology*, *26*(7), 367–379. https://doi.org/10.1080/20445911.2015.1016527