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HUNGARIAN PRE-VERBAL FOCUS: REPRESENTATION AND INTERPRETATION

THESIS BOOKLET

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1 Introduction and goals

The function of linguistic focus is to mark certain pieces of information in our message as especially relevant, important, or new. Consider the example in (1a) (linguistically focused elements will be set in small capitals henceforth).

(1) a. It is his WALLET that John lost at the party.
b. John lost his wallet at the party.

In example (1a), the element *wallet* is focused, while the same linguistic element is not in (1b). The focus containing sentence in (1a) may be used to convey the message that it is his wallet that John lost, as opposed to some other object, such as a key or a cellphone. The phenomenon of focus is ubiquitous in languages, and it has attracted substantial attention in the fields of both theoretical linguistics and psycholinguistics.

In Germanic languages, the information structural role of focus (and topic) may either be expressed through prosody, or through particular syntactic structures, such as the cleft construction in (1a), or passivization, while word order is primarily maintained for the expression of grammatical roles, like subject and object. In other words, grammatical roles are marked via the configuration of constituents. Hence, these languages are categorized as configurational languages. On the other hand, in Hungarian, the configuration of constituents expresses information structural roles as opposed to grammatical roles (É. Kiss 1995). This is illustrated in example (2).

(2) a. A kutya A KECSKÉT keltette fel.
the dog.NOM the goat.ACC wake.PST.3SG up
The dog woke up the GOAT.
b. A kutya a kecskét fel-keltette.
the dog.NOM the goat.ACC up-wake.PST.3SG
The dog woke up the goat.

The sentence in (2a) is an example of a pre-verbal focus (preVf), also referred to as identificational focus (É. Kiss 1998). In this construction, the focused element sits immediately pre-verbally and the verbal modifier occupies a post-verbal position (É. Kiss 2002). Also, the focused element bears a so-called eradicating stress, i.e., it is assigned a prominent sentential stress which "eradicates" all subsequent stresses in the remaining part of the focus containing clause (Kornai & Kálmán 1988). In the sentence in (2b) the verbal modifier sits in the immediately pre-verbal position, while the element *a kecskét* (i.e. *the goat*) occupies a so called topic position. Since it is discourse that determines what information is coded by elements of different information structural roles, and Hungarian expresses these roles via syntactic configurations (as exemplified above), the category of languages to which Hungarian belongs is called discourse configurational languages. We contend that a general focus theory has to accommodate findings on languages belonging to different typological categories. Since evidence informing such theories comes mainly from configurational languages (such as English and German), we consider it important to extend the investigation also to discourse configurational languages, such as Hungarian.

The Thesis sets out to investigate two central questions regarding focus. The first question pertains to the mental representation of the linguistically focused information. The question of representation becomes especially intriguing considering the functional definition of focus above: if linguistic focus serves to indicate that a certain piece of information is new or especially important, can we show that focused information is represented differently in the mind than non-focused information? For example, is *a kecskét* (i.e. *the goat*) represented differently in the addressee if she hears (2a) as opposed to (2b)? We will address this question by examining three processes related to the representation of focused information: i) the encoding of the linguistically focused information (i.e. the process of forming the representation of the focused element in the mind), ii) the retention of the representation associated with the focused element in memory, and iii) the

accessibility to this representation in memory, i.e. the ease with which such a representation is retrieved. To investigate these questions, we set out to test the hypothesis that focus modulates the attention of the addressee during the processes of encoding and retention. Additionally, we also hypothesized that representations associated with linguistically focused elements are more easily accessed in memory. According to some theories in the literature on primarily configurational languages, focus evokes the alternatives of the focused element (e.g. 2a should activate the representation of other animals potentially chased by the dog). Hence, we hypothesized that preVf also evokes alternatives. We also propose that the observed attention capturing properties of focus can be accounted for by relying on the extra-linguistic factor of prominence: since focus is the most prominent part of the sentence by virtue of its phonologically, syntactically, or morphologically marked nature, it captures the attention of the addressee. Thus, prominence is a factor which accounts for our observations pertaining to the representation of focused elements.

The second question relates to the interpretation of focus containing sentences. It has long been observed that sentences with focus are interpreted exhaustively, i.e. in a way that the assertion in the focus containing predicate is considered to be true only for the piece of information marked for focus. For example, hearers of (1a) will most probably infer that John did not lose anything else apart from his wallet at the party. The source of this interpretational component has also long intrigued researchers: the central question is whether exhaustivity is an immanent syntactic-semantic feature of focus constructions, or whether it is calculated via the involvement of more general pragmatic principles. We address this question by testing the hypothesis that the exhaustive interpretation of focus constructions is generated as a scalar type pragmatic implicature.

Finally, we make an attempt to offer an explanation for the exhaustive interpretation of focus based on results pertaining to its attention controlling properties by claiming that exhaustivity can be derived from the interplay of linguistic focus marking and the mechanisms of attention. More specifically, we conjecture that exhaustivity is the consequence of the selective nature of attention which is guided by linguistic focus.

2 Thesis points

2.1 Theses related to the representation of the focused expression

In what follows, findings pertaining to the representation of the focused expression in preVf will be outlined as addressed in **Study 1** and **Study 2**.

Study 1:
Káldi, T., & Babarczy, A. (2021). Linguistic focus guides attention during the encoding and refreshing of working memory content. *Journal of Memory and Language,* 24.

Study 2:
Káldi, T., Szőllősi, Á. & Babarczy, A. (to appear in *Frontiers in Psychology*). Hungarian structural focus: accessibility to focused elements and their alternatives in Working Memory and delayed recognition memory

2.1.1 Thesis 1. Encoding: Focused elements are allocated more attention during Working Memory encoding

One objective of **Study 1** was to investigate attention allocation during the encoding of focused elements using pupillometry. As pupil size is a reliable reporter variable of attention allocation (Hoeks & Levelt, 1993; Aston-Jones & Cohen, 2005), it may be used to measure whether linguistic focus modulates attentional load during the processing of focus containing sentences. Experiments 1 and 3 measured pupil size while focus containing sentences such as (2a) were presented and participants memorized them for later use in the experimental tasks. Analogous control sentences were also presented in which critical sentential elements occupied the same relative position as the focused element in the experimental condition (2b). Pupil sizes from the focus and control sentences were compared.

Results from the two experiments consistently revealed that pupil dilates more while focus containing sentences are processed. We take these data to clearly indicate that focus indeed modulates attention allocation, and that the processing of focus incurs greater attentional load. Thus, these findings corroborate the conjecture that linguistically focused elements are allocated more attention during encoding, i.e. during the formation of the memory representation corresponding to the focused elements.

2.1.2 Thesis 2. Retention: Focus modulates the refreshing of the representation associated with the focused element in Working Memory

Another objective of **Study 1** was to test the conjecture that the representation of focused elements receives a more intense refreshing in Working Memory (WM). In order to achieve this, we used a blank screen eye-tracking experiment (for the blank screen paradigm and the looks to nothing effect see Johansson & Johansson 2014, Scholz et al. 2016) in which we measured and compared the amount of looks to the location of the object corresponding to the second Noun Phrase (NP) (cf. 2a and 2b) in both Experiment 1 and 3. The two experiments differed in terms of the experimental task. Experiment 1 employed a decision task: after the blank screen, participants were presented one visual probe and had to decide if the given object was presented in the given location earlier during encoding or not. Experiment 3 employed a selection task: participants were presented the same set of visual stimuli as during the visual encoding phase and had to select all the objects mentioned in the test sentence (e.g. to select the images depicting the goat and the dog). The two different task types were used to study potential task effects observed earlier on linguistic processing (see e.g. Knoeferle 2019).

The results of Experiment 1 showed that the location of the object corresponding to the second NP received more looks if this NP was focused than if it was not. In other words, in the decision task experiment, the representation of the focused element was refreshed at a higher rate than its non-focused counterpart. These results confirm the conjecture that focus directs the attention to the focused element not only during encoding, but also during retention.

However, the measurements in Experiment 3 yielded an exact reverse pattern: less looks were detected to the location of the image corresponding to the focused element than to its non-focused counterpart. We offered an explanation to account for the reversed trend using the findings of Lemaire et al. (2018). The authors of this study found that in the case of complex span tasks, in which memoranda are to be recalled in a serial fashion (just as in Experiment 3), a so-called Least Activated First refreshing schedule is selected and used. According to this schedule, refreshing occurs in a cyclic fashion and in each cycle the least active memory representation is selected for refreshing. This is a reasonable assumption, since the least active representation needs refreshing if it is also to be retrieved later. Thus, we reasoned that in the case of the selection task of Experiment 3, the Least Activated First schedule was used: the focused element may have had a higher activation as a consequence of its stronger encoding (cf. pupil data on encoding), or, in other words, the activation of elements to be held in WM were unequal. However, the non-focused and consequently least active element was also task-relevant. For this reason, this latter element received priority for refreshing.

Taken together, our findings support the idea that focus *modulates* attention allocation during the retention of the focused element: if the focused element is foregrounded and primarily task-relevant, its representation receives more attention, however, if a non-focused element of equal task relevance is also present, the Least Activated First refreshing schedule is selected, and the non-focused element is refreshed at a higher rate.

2.1.3 Thesis 3. Alternatives: Focus activates the representation of a set of alternatives in Working Memory

One of the goals of **Study 2** was to investigate the activation of focus alternatives (for results in German see Gotzner 2017, Jördens 2020) using two change detection experiments. Participants were presented preVf and neutral sentences embedded in short texts, and were later given a sentence probe about which they had to decide if it was the same as any of the sentences in the story or it contained a change. When the sentence

contained a change, the critical word (i.e. the focused element or its non-focused counterpart in the original sentence) was either replaced by a semantically related or a semantically unrelated but contextually suitable alternative. This manipulation was included to test the predictions of the restrictive versus permissive views on focus alternatives (Gotzner 2017). Experiment 1 tested WM performance, while Experiment 2 tested Long Term Memory (LTM) performance. The experimental variable was correct rejection rate: a higher rate of correct rejections was interpreted as higher activation in WM.

First of all, no reliable difference between the rejection rates of probe types containing a semantically related and semantically unrelated but contextually suitable alternative was found in neither experiments. Therefore, our results are inconclusive regarding the restrictive versus permissive views on focus alternatives. For this reason, the distinction between the semantically and contextually related elements in the two probe types are collapsed and we refer to these commonly as alternatives.

The conjecture that preVf activates a set of alternatives is jointly supported by the results of Experiment 1 and 2. In Experiment 1, the results of the statistical analysis of the difference in rejection rates between preVf and neutral sentences just missed the level of significance ($p = .061$). A reliable difference was found, however, in Experiment 2: the rate of correct rejections was lower for preVf sentences than for neutral sentences. We contend that this overall effect is a consequence of semantic interference (Baddeley 1966) and is in line with our conjecture: Since the function of focus is to mark the presence of alternatives, not only the focused element, but also its alternatives are activated. In the long term, these activated elements interfere with each other, which is reflected in the deterioration of memory performance for these items (for similar results see Spalek et al. 2014). The almost significant difference in WM may have also reflected this higher activation.

To conclude, the experiments testing the WM and LTM performance on the correct rejection of focus alternatives jointly support the conjecture that preVf activates the representation of a set of alternatives in the mind.

2.1.4 Thesis 4. Retrieval: Focus enhances the accessibility of the focused element in Working Memory

Apart from the activation of alternatives, **Study 2** also investigated the access to the representation of the focused element in memory (for results in other languages see e.g. Sanford et al. 2006, Sanford et al. 2009, Ward & Sturt 2007, Almor & Eimas 2008). Access was measured using recognition rates and related RTs of unchanged (i.e. same) probes in both WM (Experiment 1) and LTM (Experiment 2). Since recognition data did not show reliable differences, we will concentrate on RTs.

RTs in Experiment 1 were lower for preVf sentences than for neutral sentences, i.e. preVf had a facilitative effect on recognition. Since RT has been shown to be a correlate of the durations of processes (or stages) that take place when the correct recognition of an item occurs (Sternberg, 1969), we conclude that these results support our conjecture that the representation of the focused element is more accessible in WM. RTs, however, in Experiment 2 showed no reliable difference between the two sentence types.

Based on these findings, we suggest that the facilitative effect of preVf in WM and the lack of this effect in LTM shows that focus has primarily a local function in organizing discourse and in contributing to efficient communication (Spalel & Oganian 2019).

2.2 Thesis 5. Focus is a grammaticalized means to express prominence

Focus has been characterized as the most prominent part of the sentence (see e.g. Rochemont 1986, Büring 2008). Stevens & Roberts (2019) propose that focus amounts to conventionalized or grammaticalized prominence marking across languages. This universal characteristic is claimed to be responsible for the attention controlling function of focus (see e.g. Birch & Rayner 1997, Sanford 2006). **Study 1** also set out to investigate this claim based on the following rationale: if non-grammatical ways of prominence marking trigger the same refreshing schedules as focus, the formulation that focus is the linguistic equivalent of prominence marking

gains further empirical support. In order to test this conjecture, Experiments 2 and 4 measured attention allocation to unimodally and multimodally presented items during the retention phase using the same experimental setup as Experiment 1 and 3. Based on findings in the literature (Goolkasian & Foos 2005; Delogu et al. 2009; Heikkilä et al. 2014), we assumed that multimodally presented items are more prominent. Thus, we expected to see similar patterns of attention allocation in the case of multimodally presented items as in the case of preVf. Experiment 2 used the decision task of Experiment 1, while Experiment 4 used the selection task of Experiment 3.

Results were in line with our predictions. In the case of the decision task, the multimodally presented item received more refreshing during the retention phase. On the other hand, when the task was to select all items presented earlier, the unimodally, i.e. the less prominent element received more attention. Thus, we concluded that our results support the conjecture that focus is a grammaticalized means of marking prominence.

Considering the above findings, we propose that it is prominence that has an attention capturing effect, and that in verbal communication linguistic focus serves the attention capturing function by being prominent.

2.3 Theses related to the interpretation of the pre-verbal focus

In what follows, the Thesis points and experimental findings related to the interpretation of preVf will be outlined. In order to test the hypothesis that the exhaustive interpretation associated with preVf is derived as a pragmatic implicature, and more precisely, a scalar type implicature (Thesis point 9), we formulated and tested three main predictions (cf. Thesis point 6, 7, 8). The first prediction is related to the contextual availability of sets and the use of preVf (**Study 3**), the second one concerns the rate of exhaustive interpretation (i.e. the probability with which preVf is interpreted exhaustively) (**Study 4** and **Study 5**), while the third one concerns mental processes associated with the generation of exhaustive interpretation (**Study 4** and **Study 5**). What is common in the predictions tested here is that they all take context into account as a critical factor. To our knowledge, no study before the ones included in the present thesis had investigated the effect of context on preVf production and interpretation before. Also, the studies concerning interpretation presented here (**Study 4** and **Study 5**) are the first to investigate the process of preVf interpretation using the online method of eye-tracking and the visual world paradigm.

Study 3:
Káldi, T., Madarász, L., & Babarczy, A. (2020). Contextual triggers of the Hungarian pre-verbal focus structure – A guided production study. In V. Hegedűs & I. Vogel (Eds.), *Approaches to Hungarian,* (pp. 73–96).

Study 4:
Káldi, T., Babarczy, A., & Bende-Farkas, Á. (2016). Hungarian Focus: Presuppositional Content and Exhaustivity Revisited. In J. Emonds & M. Janebová (Eds.), *Language Use and Linguistic Structure, Proceedings of the Olomouc Linguistics Colloquium 2016,*(p. 18). Palacký University Press.

Study 5:
Káldi, Tamás, and Anna Babarczy. 2018. "Linguistic Exhaustivity Inference Is Context Dependent: A Visual-World Eye-Tracking Study on Hungarian Focus." *Acta Linguistica Academica,* 65(4):547–95.

2.3.1 Thesis 6. Contextually available sets motivate the use of the pre-verbal focus

The theoretical basis for Thesis 6 is the focus theory of Rooth (1985 1992, but also see Kenesei 1989, 2006) according to which focus operates on contextually given sets. Based on this consideration, we predicted that the presence of a relevant set in the context plays a crucial role in licensing preVf constructions: if such a set is available, the preVf construction is used. This prediction was tested in **Study 3**, in which we investigated the effect of a contextually available and relevant set on the production of preVf constructions using a guided production task in the form of an online survey. Two experiments were conducted. In both of these participants

were presented a short text describing a context and a cloud of randomly arranged words. The experimental task was to create sentences that naturally fit the context by clicking the words in the cloud. Contexts either contained a set or they did not. In contexts with sets the set was either introduced explicitly (by enumeration) or implicitly (by a question, or via a reference to a category). The dependent variable in the experiments was the proportion of preVf and postVf constructions produced in the different context conditions.

Results revealed that the presence of a set in the contexts motivates the use of a preVf construction. The effect is observable even when this set is implicitly present in the context. On the other hand, if no set is present, the preVf construction is not reliably produced.

2.3.2 Thesis 7. Context modulates the rate of exhaustive interpretation associated with the pre-verbal focus

We predicted that the presence of a contextual restriction on the number of referents to which the proposition of a preVf sentence can potentially hold has an effect on the rate of exhaustive interpretation of that sentence. Our primary interest is the source of exhaustivity (semantic vs. pragmatic), and not its status (at issue vs. not at issue). Since this question hinges on whether exhaustivity is truth conditional or not (in the vein of the two assumptions by Onea and Beaver 2009), we formulate all our following predictions in a way that only-f serves as a basis for comparison. Since the source of exhaustivity is indeed truth conditional in only-f, this construction is suitable for a baseline measurement.

Study 4 and **Study 5** used the visual world eye-tracking paradigm to test Thesis points 7 and 8. Participants were presented test sentences, and were instructed to choose an image or images that best corresponded to the sentence. Target images depicted exhaustive scenarios, while alternative images depicted non-exhaustive scenarios. In **Study 4**, task type was used as an independent variable to manipulate the presence of contextual restriction. In one experiment, participants performed a forced choice task, i.e. they were instructed to choose only one image they considered to be compatible with the test sentence, while in another experiment, they could choose any number of images. The forced choice task corresponded to a restrictive context, while the multiple choice task corresponded to a non-restrictive context.

The results of the experiment employing the forced choice task showed that there was no difference in the rate of exhaustive interpretation between preVf and only-f (100% in both sentence types). This is not a surprising result, and it is predicted by all focus accounts. More interestingly, the results of the other experiment revealed a difference: while the rate of exhaustivity was still at ceiling in the case of only-f sentences (93%), preVf sentences were interpreted exhaustively at a significantly lower rate (65%). As outlined earlier, such high variability is not expected if exhaustivity is triggered by an operator or if it is part of the conventional meaning of the construction. The results thus strongly suggest that the exhaustive interpretation of preVf is computed as an implicature: since preVf is underspecified for exhaustivity, participants occasionally generated a non-exhaustive interpretation in the non-restrictive context, however, when the context of the task restricted the number of choices, exhaustivity was consistently generated.

Study 5 investigated the same question using textual contexts in which the restriction on the possible interpretational alternatives (or the lack of it) was made explicit in the descriptions of situations. For example in one of the trials this situation was a reception, at which an agent was permitted to have *one* drink in the restrictive context, while in the non-restrictive context the amount of drinks was not limited. The description of such scenarios were followed by sentences, such as those in example (3).

(3) a) only-f: Aliz csak egy SÖRT ivott meg a fogadáson.
'Alice only drank a BEER at the reception.'
b) preVf: Aliz egy SÖRT ivott meg a fogadáson.
'Alice drank a BEER at the reception.'

The scalar implicature account predicts that while the rate of exhaustive interpretation should be uniformly high in only-f sentences in both contexts, this rate in the case of preVf should be comparable to only-f sentences exclusively in the restrictive contexts, while it should be lower in the non-restrictive contexts. The lower rate of exhaustive interpretation of preVf in non-restrictive contexts is expected if we assume that the construction at hand is underspecified for exhaustivity and accept that it is non-at-issue content.

The results of experiments were in line with the prediction of the scalar implicature view: while the rate of exhaustivity in only-f sentences was not affected by context, in non-restrictive contexts, the rate of exhaustivity dropped in the case of preVf sentences significantly. In order to further investigate the interaction of context and rate of exhaustivity in preVf, **Study 5** included an additional experiment in which preVf and postVf sentences were presented in restrictive and non-restrictive contexts. The rationale for including the postVf sentence was that there is a consensus regarding its status of exhaustive interpretation: both theory (e.g. Surányi 2011) and experimental results (Gerőcs et al. 2014; Tóth & Csatár 2017) support the claim that whenever a postVf sentence is interpreted exhaustively, this interpretation is computed as a conversational implicature. Thus, **Study 5** predicted that if the conversational implicature view is tenable, a comparison of the rates of exhaustive interpretation of preVf and postVf in restrictive and non-restrictive contexts should reveal no difference: in restrictive contexts both sentence types should be consistently interpreted exhaustively, while in non-exhaustive contexts the rate of exhaustive interpretation should drop for both sentence types. The results were in line with the predictions. While the rate of exhaustive interpretation was at ceiling in the restrictive contexts for both sentence types, these rates dropped uniformly in the non-restrictive contexts. Given i) that there is consensus regarding that exhaustivity of postVf should be analyzed as an implicature, and ii) that a uniform pattern was found in the rate of exhaustivity in preVf and postVf in the two context types, we contend that the view that exhaustivity in preVf should be analyzed as scalar implicature is further corroborated.

2.3.3 Thesis 8. Context modulates the mental processes associated with the computation of exhaustivity

We predicted that the presence of a contextual restriction on the number of referents to which the proposition of a preVf sentence can potentially hold has an effect on how the exhaustive interpretation of that sentence is calculated in the mind. More specifically, we predict that the presence of such a contextual restriction has an effect on whether non-exhaustive interpretational alternatives are entertained. The specific theory-based predictions we formulate here assume the interactive model of implicature generation. Regarding the four context-target sentence combinations exemplified bove, the operator based view of exhaustive interpretation predicts no difference in the calculation of exhaustive inference in the case of the two sentence types in the two contexts. On the other hand, the scalar implicature account, along with the interactive view on implicature generation, predicts that while in restrictive contexts non-exhaustive alternatives should not be considered, and therefore the exhaustive interpretation associated with only-f and preVf should be computed similarly, in non-restrictive contexts, the non-exhaustive alternatives should also be considered in the case of preVf as opposed to only-f. This is expected, since conversational implicatures are predicted to be computed based on context, task-related goals etc. In the case of preVf, this computation involves the exclusion of non-exhaustive interpretational alternatives when context does not directly support the exhaustive reading. The most important findings of these studies are presented below.

In **Study 4** and **Study 5**, the rate with which the non-exhaustive interpretational alternative is considered during processing was estimated based on the ratio of looks to the exhaustive and non-exhaustive images as a function of time while the linguistic stimulus unfolded. As mentioned earlier, these measures were evaluated through a comparison with data from only-f sentences.

The results of the two experiments in **Study 4** support the scalar implicature view. Looking patterns obtained in the experiment employing the forced choice task showed that looks to the target image converged at an equal rate in the case of the two sentence types. This result is predicted by all focus interpretation accounts. The

results of the multiple choice experiment, however, showed a divergence as predicted by the scalar implicature view. While participants increasingly looked at the target image at the same rate during the sentences, the rate of looks only increased in the case of only-f sentences during the critical, post-sentence period, while the rate of looks to the target image remained at chance level during the same period in the case of preVf sentences, despite the fact that at the end of the trial the exhaustive image was chosen. In other words, in the case of preVf participants constantly switched between the target and the alternative images before selecting the target image clearly indicates that the non-exhaustive alternative was considered to a greater extent than in the case of only-f sentences. This is exactly what the scalar implicature view predicts.

Study 5 manipulated the presence of contextual restriction through textual descriptions of scenarios as exemplified in above. Analysis of eye tracking data, just as in **Study 4**, included exclusively those trials in which participants gave an exhaustive response.

Study 5 used a different design: while in **Study 4** we compared two different sentence types within separate experiments using different contexts (i.e. task types), in **Study 5** we presented both sentence types in both context types (i.e. restrictive and non-restrictive) within each experiment. Thus, the difference within the sentence types between the two context types could be analyzed: preVf in the restrictive versus non-restrictive contexts, and likewise, only-f in these two contexts. This method of comparison was used to circumvent potential confounds resulting from the comparison of two different sentence types whose interpretation may involve different steps during processing. Thus, in this respect, **Study 5** is a methodological refinement to **Study 4** also in terms of design and in terms of how eye-tracking data is used to test our predictions.

Results revealed that context had an effect on the processing of preVf sentences, as predicted by the scalar implicature view: in the restrictive context, looks converged quickly on the target image, whereas in the non-restrictive context this convergence was much slower reflecting a tendency that participants were considering the non-exhaustive interpretational alternative to a greater extent.

Also, **Study 5** compared the processing of preVf and postVf sentences in the two contexts. With regard to this comparison, it was predicted that the mental processes associated with the interpretation of preVf and postVf will be affected similarly by the contextual manipulation. Namely, the looks to the target image should be superseded in the restrictive context in both sentence types. This prediction is borne out of theoretical considerations (Surányi 2011), empirical findings (Gerőcs et al. 2014; Tóth & Csatár 2017) together with the results of Experiment 3 of **Study 5** on the rates of interpretation in restrictive and non-restrictive contexts outlined in the above (Section 4.2.3).

The results of the experiment investigating the processing of preVf and postVf sentences (Experiment 3), were also in line with the predictions of the scalar implicature view. The comparison of looking patterns during the preVf sentences in the restrictive and non-restrictive contexts were replicated: the percentage of looks to the target in the restrictive context was higher than in the non-restrictive contexts suggesting that participants considered the non-exhaustive interpretational alternative in the latter context to a greater extent during the processing of the sentence. Gaze measurements during the processing of postVf sentences showed a similar pattern: looks to the target converged faster in the restrictive context than in the non-restrictive context. Since exhaustivity in the case of postVf is computed as a pragmatic inference (Surányi 2011, Gerőcs et al. 2014, Tóth & Csatár 2017), and looking patterns reflecting the interpretational processes of preVf and postVf patterned similarly as a function of our contextual manipulations, the conjecture that exhaustivity in the case of preVf is also associated with a pragmatic inference is further corroborated.

2.3.4 Thesis 9. The exhaustive interpretation of the pre-verbal focus is best seen as a scalar type implicature

One of the major issues addressed in the Thesis concerns the source of exhaustive interpretation associated with preVf. We claim that it arises as a conversational implicature. More specifically, we propose that within

the taxonomic category of conversational implicature, preVf exhaustivity should be seen as a scalar type inference.

As a starting point, we argue that the exhaustive interpretation of preVf should be seen as a conversational implicature, since the following defining characteristics apply. First, exhaustivity is cancellable: a wide array of studies used experimental tasks in which participants had to make a judgement about the acceptability of preVf sentences in depicted non-exhaustive scenarios. Results (see e.g. Gerőcs és mtsai. 2014, and **Study 4 and 5**) unanimously show that people have a tendency to accept such sentence-picture pairs. Second, exhaustivity is calculable: if a speaker uses a preVf sentence, such as the one in (3b), one can calculate the inference that apart from a beer, Alice did not have any other drink assuming that the speaker is obeying the Cooperative Principle and thus observes the Maxim of Quantity. Had the speaker known that Alice drank also wine, (s)he would have also made reference to this beverage. Third, exhaustivity is reinforceable: in **Study 4**, in a sentence completion task, participants were instructed to complete preVf sentences with expressions of the type *Mást nem* or *Nem mást* (~(*and*) *exactly that*). Results showed that participants used the *Mást nem* type of expressions to complete preVf sentences in 54.5% of the cases suggesting that the reinforcement of the exhaustivity inference is acceptable, and that it does not create a sense of redundancy. Fourth, exhaustivity is non-detachable: with regards to the interpretation of clefts, both Kenesei (1989, 2006) and Dékány (2010) propose that exhaustivity emerges as the identification part in the two sentence types creates a complementary set, and excludes elements by necessity. Thus, in this respect, the semantic makeup if preVf and clefts is identical. Gerőcs et al. (2014) found that the rate of exhaustive interpretation for cleft was around chance level (54%). In other words, clefts give rise to the same implicature as preVf. Fifth, exhaustivity is universal: it has been observed that the exhaustive interpretation is associated with focus in a vast array of languages (Destruel et al. 2015; van Rooji & Schulz 2017).

As a next point, let us argue why exhaustivity in preVf should be seen as scalar type implicature. The construction types only-f and preVf can also be ordered on a scale of informativity (where only-f corresponds to the lexicall marked focus): <only-f, preVf>, in which preVf constitutes the weaker term by virtue of being underspecified for exhaustivity. Consider sentences in example (4) and suppose there is a set of three individuals {Alíz, Benedek, Cili} in the universe of discourse to whom the proposition [x travelled to Hague] potentially holds.

(4) a. Alíz utazott el Hágába.
Alice travelled to Hague.
b. Alíz és Benedek utazott el Hágába.
Alice and Benedek travelled to Hague.
c. Alíz, Benedek és Cili utazott el Hágába.
Alice, Cili and Benedek travelled to Hague.

If exhaustivity is a conversational implicature, it should be calculable. We propose that this is indeed the case: upon hearing (4a), the hearer will calculate an upper-bounded interpretation and infer that unlike Aliz, Benedek and Cili did not go to Hague. Else, the speaker, obeying the Cooperative Principle (Grice 1975) or the Principle of Relevance (Sperber & Wilson 1995), would have uttered (4b) or (4c) depending on who exactly travelled to Hague. As experimental results also suggest (see **Study 4 & 5**), only-f is a stronger alternative for preVf since it codes exhaustivity lexically. Hence, we propose that only-f and preVf form a scale of informativity with respect to exhaustive interpretation in which only-f is the more informative, stronger term.

Note, that an entailment relationship between preVf and only-f does not hold, as in the case of classical Horn scales (Horn 1972). However, preVf exhaustivity can and should be analyzed *a type of* scalar inferences: not only scales of strict ordering licensed by logical operators have been identified, but also scales of partial ordering, most of which are determined by world knowledge or current contextual factors Hirschberg (1985). In order

to imply that we do not consider the exhaustivity inference in preVf a scalar inference strictly in the classical, Hornian sense, we will refer to it as 'scalar type implicature'.

2.4 Thesis 10. Exhaustivity associated with focus is derivable from its attention capturing properties

As a final point, we formulate the tentative proposal that the exhaustive interpretation associated with preVf is derivable from its attention capturing properties. To introduce the idea, let consider the Birch & Rayner's (1997), according to which during linguistic processing, those elements are given priority by a selective mechanism which are most likely crucial in understanding the forthcoming information. One factor that affects such prioritization is linguistic focus. Although Birch & Rayner (1997) do not make any reference to exhaustivity, their consideration is directly applicable to it. A central notion in their formulation is selectivity. The selective nature of attention is observable when salient linguistic elements (such as linguistically focused elements) are processed: salient information is attended, while the non-focal information remains unattended. This claim is in line with our findings that focus modulates attention-based WM processes. The role of attention in tasks that WM is involved in is crucial: "the focus of attention allows a coherent organization and interpretation of the information it contains, but that information is limited to a few, separate known items at a time" (Adams et al. 2018 pp 345). In the case of focus interpretation, one task of the processing system is to integrate the focused element and the rest of the predicate to generate the interpretation of the whole focus containing expression. During this process, the representation of the focused element is allocated extra attention, and as a consequence of the selective nature of attention others are excluded. Thus, it follows that the predicate will be considered to hold for this element and not some other, less attended items. Hence, the whole focus containing expression will be assigned exhaustive interpretation. Hence, focus functions as a linguistic spotlight.

3 Discussion

The Thesis addressed questions regarding the representation and interpretation of the Hungarian pre-verbal focus construction.

In the first part, we proposed that the function of focus is to guide the attention of the addressee. To test this claim, attention allocation during the encoding, and refreshing of focused elements was examined. The results showed that during encoding, more attention is allocated to the focused element than to its non-focused counterpart, while during refreshing attention is allocated to the focused element depending on task demands: if, in sentences with a topic and a focus constituent, the foreground-background distinction is relevant, the focused element is refreshed at a higher rate than its non-focused counterpart. If, however both the topic and the focus are equally relevant for the given task, the topic receives more refreshing than its focused counterpart. In line with the international literature on different languages, we also claimed that the focused element is more accessible in Working Memory, and that focus alternatives are generated. Evidence for this claim was provided via the results of a probe recognition experiment. Additionally, we tested the claim formulated by Stevens & Roberts (2019) that focus should be seen as a grammaticalized means of applying prominence selectively within utterances. We provided evidence for this claim in an experiment in which the redundancy of verbal stimuli was manipulated and their refreshing rate was measured. Results showed that redundantly presented verbal stimuli gave rise to the same refreshing patterns as focus suggesting that the above claim is tenable. Finally, considering the above findings we propose that it is prominence that has an attention capturing effect, and that in verbal communication focus serves the attention capturing function by being prominent.

In the second part we investigated the exhaustive interpretation of the pre-verbal focus construction, and conjectured that it should be analyzed as a scalar type pragmatic inference. We aimed to support our claim by theoretical considerations and empirical results. Regarding theory, we showed that exhaustivity can be seen as a conversational implicature (as opposed to a conventional implicature), and demonstrated that the pre-verbal focus and the lexically marked focus construction form a scale of informativity, or explicitness in terms of

exhaustivity. Regarding experimental findings, we showed that the use of the focus construction is motivated by contexts that contain a set of relevant alternatives, and that the rate of exhaustive interpretation and the mental processes associated with the calculation of exhaustivity are affected by contextual factors: in the absence of contextual support on exhaustivity, non-exhaustive interpretational alternatives are also considered. Taken together, we concluded that our conjecture regarding the scalar nature of the exhaustive inference in the pre-verbal focus is tenable.

Finally, we made the tentative proposal that the exhaustive interpretation of focus is derivable from its attention guiding properties. We suggested that there is a strong analogue between the selective nature of attention and exhaustivity: relevant items are attended, while others are excluded. Nevertheless, we admit that this account is more of a hypothesis than an explanation, and that further experimental investigation is needed to test it.

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