Revisiting the secrets of BEFORE: lessons from Modern Greek*

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Abstract. I consider two analyses of the semantics of BEFORE-clauses (**BC**s) in light of two phenomena in Modern Greek (**MG**): licensing of strong Negative Polarity Items (NPIs) and an anti-PAST restriction on the verb in the **BC**. I show that [2] and [11] cannot be extended to **MG** (at least without significant modifications) and that a new approach is necessary. This paper proposes a disjunctive semantics for BEFORE that makes **BC**s non-committal by default (that is, there is no commitment about the instantiation of the event described by the **BC**) and makes the factual and non-factual inferences contextual entailments. The disjunctive semantics makes BEFORE a NONVERIDICAL environment which explains the licensing of weak NPIs in **BC**s and the emergence of the PERFECTIVE NON-PAST (PNP) as the tense-aspect combination of the verb of **BC**s. The licensing of strong NPIs is achieved through a rescuing mechanism similar to that of [6].

1 Introduction

It is a well-attested fact of English that BEFORE-clauses (**BC**s) can yield a factual [1], a non-factual [2] and a non-committal [3] inference about the instantiation of the eventuality they describe.

1. Dreyfus ate the salad BEFORE he had dessert.
   $\Longrightarrow$ Dreyfus had desert. (**factual**)
2. The MI6 defused the bomb BEFORE it exploded.
   $\Longrightarrow$ The bomb did **not** explode. (**non-factual**)
3. Dreyfus left the country BEFORE anything **ever** happened.
   $\not\Longrightarrow$ Something did (not) happen. (**non-committal**)

A natural question is whether, crosslinguistically, words whose meaning is akin to that of English BEFORE, namely words which (at least in an intuitive sense) are used to talk about temporal precedence, exhibit similar semantic behavior. It turns out that these patterns are crosslinguistically robust and can

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be observed in a number of languages, including Italian [3], German [12,15], Catalan [13], Russian [15] and Japanese [10,9, *inter alia*]. The following examples, which are direct translations of [1] - [3] in Modern Greek (**MG**), show that the English inference pattern is observed in this language, too:

4. O Dreyfus éfaɣe ti saláta PRIN fái to ɣlikó.
   $\Longrightarrow$ O Dreyfus éfaɣe to ɣlikó. (**factual**)
5. I MI6 apeneryopíise ti vómva PRIN ekraɣí.
   $\Longrightarrow$ I vómva **ðen** ekseráɣi. (**non-factual**)
6. O Dreyfus éfiɣe apó ti χóra PRIN simví **poté** típota.
   $\not\Longrightarrow$ Káti (ðen) sinévi. (**non-committal**)

A second robust crosslinguistic fact is that BEFORE licenses weak Negative Polarity Items (NPIs) in the **BC**, as the presence of *ever* in the **BC** of [3] and of *poté* 'ever' in the **BC** of [6] exemplify. In this paper, I want to consider two phenomena from **MG BC**s that, to the best of my knowledge, have not been addressed in the literature and their study might shed light to some intricacies in the meaning of **BC**s.

- **MG BC**s sporadically allow strong NPIs à la [18], that is NPIs that need to be in the scope of an at least ANTIADDITIVE operator, as exemplified by the presence of focused *kanéna* in the **BC** of [7]; and
- they forbid PAST tense marking on their verb and only allow it to surface in the PERFECTIVE NON-PAST (PNP) form [8], a tense-aspect combination that is only sanctioned in NONVERIDICAL contexts[1] in **MG**, as argued in [7]. This does not hold true for other **MG** temporal connectives as can be seen in[2] [8], where AFTER- and WHEN-clauses do not forbid PAST tense marking on the verb.

7. O Iorðánis péθane PRIN ði / *íðe **kanéna**$_{\text{F}}$ egóni tu.
   the Jordan died BEFORE see.PNP / saw **nobody** grandchild his
   'Jordan died before seeing **any at all** of his grandchildren.'
8. I Féðra éfiɣe ÓTAN/AFÚ *ftási / éftase i Natasa.
   the Phaedra left WHEN/AFTER arrive.PNP / arrived the Natasha
   'Phaedra left when/after Natasha arrived.'

This paper aims to address three questions: (a) How do the inferences in [1] – [3] arise and what is their truth-conditional status? (b) How is the PNP verbal form in **MG** related to the potential (non)veridicality of BEFORE? and (c) How does the licensing of (strong) NPIs take place in **MG BC**s?

[1] An operator $\mathscr{F}$ is NONVERIDICAL if for all propositions p, $\mathscr{F}(p) \not\Longrightarrow p$.
[2] Some **MG** temporal connectives are followed by certain particles that impose their own selectional restrictions on the verb. I do not address this class of temporal connectives in this paper.

2 Previous work

The most successful analyses of the meaning of **BC**s are by [2], who develops an intensional account for temporal clauses (and **BC**s in particular), and [11], who provides a Gricean account of the relevant phenomena. It can be shown that these accounts cannot be extended to model the **MG** data we presented. The intentional account of [2] relies on STRAWSON DOWNWARD ENTAILMENT (SDE) to account for NPI-licensing in **BC**s, which has been shown to face challenges with **MG** NPIs [6] across the board, not only in temporal clauses. To illustrate one shortcoming of the SDE approach to NPI-licensing in **MG BC**s, consider the following sentences:

9. Páre **kanéna** milo.
   take.IMP.2SG any.NPI apple.
   'Take some apple or other.' (non-SDE; NPI licensed)

We note that SDE is not even a necessary condition for NPI-licensing, since imperatives are not SDE environments but still license NPIs in **MG** as illustrated in [9]. Imperatives are not the only non-SDE environments that license NPIs in **MG**. Future tense, modals and exclusive disjunction are some other non-SDE operators that license NPIs (see [5] for a thorough distribution of **MG** NPIs). [4]'s SDE approach is not able to handle the distribution of **MG** NPIs. In [2]'s approach, **BC**s support strengthening inferences in terms of STRAWSON ENTAILMENT and therefore create SDE contexts but this approach will not do the trick for the NPIs we consider.

Turning to the Gricean account, one observes that it employs a denotation of BEFORE that renders it ANTIADDITIVE[3], and according to [17] predicts licensing of strong NPIs in all **BC**s, a prediction that does not hold for many languages as exemplified by [10] and [11].

10. *I Avɣeriní éfaɣe mesimerjanó PRIN meletísi **kanéna**$_F$ máθima.
    the Avgerini ate lunch BEFORE study.PNP none lesson
    (MG)

11. *Lira iku PARA se të shikonte **asnjërin**.
    Lira left BEFORE than SUBJ see.SUBJ.3SG nobody
    (Albanian)

A more detailed discussion of these (and other) shortcomings of these accounts has to be postponed due to space limitations but I hope to have convinced the reader that an immediate application (that is, without significant modifications) of either of these two accounts to **MG** would be unsuccessful.

[3] A proof of the ANTIADDITIVITY of [11]'s before is in Appendix [A].

3 Proposal

I restrict my attention to BEFORE when it conjoins two untensed clauses; I ignore BEFORE with a nominal complement. I take it, following [14, among others], that verbs require a time-interval argument of the form $[a, b]$, $a \prec b$. The type of time intervals will be i and therefore the type of temporal properties will be $\langle i, t\rangle$. I do not take any position regarding the properties of the denotation of verbs depending on their *Aktionsart* class, but the reader can consult [2] for a possible set of assumptions. We assume, with [2], that the untensed clause $[\mathscr{A}$ BEFORE $\mathscr{B}]$ composes intersectively, i.e. $[\![\mathscr{A}$ BEFORE $\mathscr{B}]\!] = [\![\mathscr{A}]\!] \wedge [\![\text{BEFORE } \mathscr{B}]\!]$. Finally, we denote by "$\prec$" the relation of temporal precedence and by "inf" the greatest lower bound of a non-empty set of $\mathbb{R}$, with the additional premise that there exists an isomorphism between $\mathbb{R}$ and the set of moments of time $\mathscr{T}$. With this background, we propose the denotation for BEFORE in [B0], where $\veebar$ is exclusive disjunction:

$$[\![\text{BEFORE}]\!] =$$
$$\lambda\mathscr{X}_{\langle i,t\rangle}\lambda t_i\left[\Big((\exists t'' \neq \emptyset)\big[(\inf(t) \prec \inf(t'')) \wedge \mathscr{X}(t'')\big]\Big) \veebar \Big(\forall t'\big[\neg\mathscr{X}(t')\big]\Big)\right] \quad \text{(B0)}$$
$$[\![\text{BEFORE } \mathscr{B}]\!] =$$
$$\lambda t_i\left[\Big((\exists t'' \neq \emptyset)\big[(\inf(t) \prec \inf(t'')) \wedge \mathscr{B}(t'')\big]\Big) \veebar \Big(\forall t'\big[\neg\mathscr{B}(t')\big]\Big)\right] \quad \text{(B1)}$$

As a temporal property, [B1] can intersectively combine with $\mathscr{A}$ to yield the truth conditions in [B2]:

$$[\![\mathscr{A} \text{ BEFORE } \mathscr{B}]\!] =$$
$$\lambda t_i\left[\mathscr{A}(t) \wedge \Big(\Big((\exists t'' \neq \emptyset)\big[(\inf(t) \prec \inf(t'')) \wedge \mathscr{B}(t'')\big]\Big) \veebar \Big(\forall t'\big[\neg\mathscr{B}(t')\big]\Big)\Big)\right] \quad \text{(B2)}$$

Under the simplifying assumption that there is one PAST tense operator scoping above both clauses and denoting the underlined portion of [B2] by $\mathscr{E}$, the utterance time by t_{UT}, the contextually restricted relevant time interval by $\mathscr{T}_c$ and the least upper bound of a set of $\mathbb{R}$ by "sup" we obtain the truth conditions in [B3]:

$$[\![\text{PAST}]\!]\Big([\![\mathscr{A} \text{ BEFORE } \mathscr{B}]\!]\Big) = \exists t \subset \mathscr{T}_c\Big(\big(t \neq \emptyset \wedge \sup(t) \preceq t_{\text{UT}}\big) \wedge \mathscr{E}\Big) \quad \text{(B3)}$$

Informally, this approach, similar in spirit to [11], claims that a sentence $[\mathscr{A}$ BEFORE $\mathscr{B}]$ is true either if event $\mathscr{B}$ occurs at a time after $\mathscr{A}$ or if it is not instantiated at all in the contextually relevant interval.

4 The nature of the inferences

The default inference is the non-committal. More specifically, in out-of-the-blue contexts, i.e. in situations in which there is no discourse-specific information added to the CONTEXT, the exclusive disjunction does not allow resolution in favour of any of the two disjuncts. The factual and non-factual inferences arise as contextual entailments from the disjunction elimination rule [DE] below:

$$\frac{\mathscr{X} \veebar \mathscr{Y} \quad \neg\mathscr{X}}{\mathscr{Y}} \vee E \tag{DE}$$

The motivation for this is apparent. **BC**s are disjunctive propositions, so if the CONTEXT contains the negation to one of the disjuncts of a **BC**, the remaining disjunct will be the contextually entailed one. In particular, if the meaning of the **BC** is $\mathscr{A} \veebar \mathscr{B}$ and we can deduce $\neg\mathscr{B}$ (respectively $\neg\mathscr{A}$) from the set of premises containing the common ground and the main clause with its presuppositions and entailments, then by [DE], $\mathscr{A}$ (respectively $\mathscr{B}$) can be concluded. In [7], Jordan dying has an entailment that he cannot be the agent of any action occuring after the time of death. This entailment together with disjunction elimination contextually entails the negative disjunct in the denotation of [$\mathscr{A}$ BEFORE $\mathscr{B}$], namely that Jordan did not see his grandchildren.

In an analogous fashion, one derives the positive disjunct from contexts that favour it. Consider [12] below:

12. **Q:** When did John wash his car?
    A: BEFORE he mowed his lawn.

If we assume that *wh*-adjunct questions carry an existential presupposition (following work such as [8] and [1] *inter multa alia*), then the expected answer to the question will be a time specification for the car-washing event. This presupposition of existence is the negation of the disjunct stating that "$\forall t' \left[\neg[\![\mathscr{B}(t')]\!]\right]$". Consequently, using $\vee$E we can conclude that the other disjunct is true.

There is one additional, typological observation that seems to favor an account in which BEFORE is by default non-committal. In **MG**, the verb of the **BC** is in a dependent form, as mentioned in the introduction. More precisely, it is in PERFECTIVE NON-PAST, a form that as [7] argues, "contains a dependent time variable, i.e. a referentially deficient variable that cannot be identified with the utterance time of the context". This restriction is only present for **BC**s, and does not surface with other temporal connectives. This referential deficiency of the PNP might serve as additional evidence for an ignorance-based account, such as the one I am advocating here.

5 The PNP verbal form

The PNP form of the verb is a weak NPI, per [5], as its presence is parasitic to that of a NONVERIDICAL environment. In particular, it is dependent on the

presence of a subclass of NONVERIDICAL environments: the future, the subjunctive, the conditional and the optative. NONVERIDICALITY, however, is merely a necessary condition for the licensing of the PNP. For example, NEGATION, a prototypical NONVERDICAL operator does not license the PNP. This is because of selectional restrictions and additional semantic requirements of the PNP, thoroughly discussed in [7].

6 NPI-licensing

The denotation of BEFORE contains (exclusive) DISJUNCTION, a NONVERIDICAL operator, so adopting the theory of NPI-licensing of [5], which states that weak NPIs need to appear in NONVERIDICAL environments, we can see how examples like [3] are accounted for. Interestingly, exclusive disjunction does sanction weak NPIs in **MG** [13]:

13. I bíke **kanénas** sto spíti i afísame ta fota aniχtá.
    or entered.3SG **anyone** at.the house or left.1PL the lights switched-on.PL
    'Either **someone or other** entered the house or we left the lights on.'

For the licensing of the strong NPI in [7], we posit a rescuing mechanism in the spirit of [6]'s rescuing mechanism for explaining the occurrence of *any* under ONLY. We posit that strong NPIs are sanctioned in the presence of strictly nonveridical operators (that is, nonveridical but not antiveridical) if a negative inference is contextually entailed.

I want to conclude the discussion about strong NPI-licensing in **BC**s by briefly mentioning the results of [16]. [16] investigate the time course of processing negation by studying how the NPI *ever* is processed in different types of negative environments. Their results show that negative information from both asserted and non-asserted content, i.e. explicit and implicit negation, is accessed equally rapidly in online processing. However, they find that explicit negation, namely negation that is present in the syntactic-semantic representation is applied immediately to license NPIs while implicit or pragmatically inferred negation is adopted at a later processing stage as a last-resort NPI-licensing mechanism, leading to additional pragmatic processing cost. This is a potentially welcome result for the STRONG RESCUING hypothesis as it might be the case that an analogous mechanism is at play for the licensing of strong NPIs in **BC**s. Further experimental work is necessary to validate this hypothesis and will be the focus of future work.

7 Conclusion

This paper has reconsidered two analyses of the semantics of **BC**s in light of two phenomena in **MG BC**s : licensing of strong NPIs and the anti-PAST restriction on the verb. I showed that [2] and [11] cannot be extended to **MG**

(at least without modifications) and that a new approach is necessary. The proposal in this paper proposes a disjunctive semantics for BEFORE that makes **BC**s non-committal by default and renders the factual and non-factual inferences contextual entailments The disjunctive semantics makes BEFORE a NONVERIDICAL environment and explains the licensing of weak NPIs in **BC**s and the emergence of the PNP as the tense-aspect combination of the verb of **BC**s. The licensing of strong NPIs is achieved through a rescuing mechanism similar to that of [6].

This paper is a small addition to the important literature about temporal clauses in particular, and adjunct clauses more generally. It enriches the verbal typology as far as verbal forms appearing in adjunct clauses are concerned and it adds to the long-standing problem of the semantics of BEFORE by taking crosslinguistic perspective. Finally, it adds to the vast literature on NPI-licensing byby calling attention to another potential mode of NPI-licensing, a licensing of last resort similar to that introduced in [6]

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A [11]'s BEFORE is ANTIADDITIVE

Theorem 1. *Let* BEFORE *be defined as in [11]. Then* BEFORE *is* ANTIADDITIVE.

Proof. Let $\mathscr{B}, \mathscr{C}$ be arguments of BEFORE and denote by $[\![\mathscr{X}(t')]\!]^{t' \leq t}$ the expression $\left[t' \leq t \wedge [\![\mathscr{X}(t')]\!]\right]$. Recall, also, the following statements from propositional logic and set theory, where α denotes an arbitrary type:

1. $\neg(\exists x)[\mathscr{P}(x)] \equiv (\forall x)\neg[\mathscr{P}(x)]$	(NE)
2. $\lambda x_\alpha.\left(\mathscr{X} \vee \mathscr{Y}\right) \equiv \lambda x_\alpha.\mathscr{X} \vee \lambda x_\alpha.\mathscr{Y}$	(PD)
3. $\lambda x_\alpha.\left(\mathscr{X} \wedge \mathscr{Y}\right) \equiv \lambda x_\alpha.\mathscr{X} \wedge \lambda x_\alpha.\mathscr{Y}$	(PC)
4. $\mathscr{A} \wedge (\mathscr{B} \vee \mathscr{C}) \equiv (\mathscr{A} \wedge \mathscr{B}) \vee (\mathscr{A} \wedge \mathscr{C})$	(STA)
5. $(\forall x)[\mathscr{P}(x) \wedge \mathscr{R}(x)] \equiv (\forall x)[\mathscr{P}(x)] \wedge (\forall x)[\mathscr{R}(x)]$	(QD)

Then:

$$
\begin{aligned}
&[\![\text{BEFORE}(\mathscr{B} \vee \mathscr{C})]\!] \\
&\equiv \lambda t.\Big(\neg(\exists t')[\![(\mathscr{B} \vee \mathscr{C})(t')]\!]^{t' \leq t}\Big) && (??)\\
&\equiv \lambda t.\Big((\forall t')\neg[\![(\mathscr{B} \vee \mathscr{C})(t')]\!]^{t' \leq t}\Big) && (\text{NE})\\
&\equiv \lambda t.\Big((\forall t')\neg\Big[(t' \leq t) \wedge \big([\![\mathscr{B}(t')]\!] \vee [\![\mathscr{C}(t')]\!]\big)\Big]\Big) && (\text{PD})\\
&\equiv \lambda t.\Big((\forall t')\neg\Big[[\![\mathscr{B}(t')]\!]^{t' \leq t} \vee [\![\mathscr{C}(t')]\!]^{t' \leq t}\Big]\Big) && (\text{STA})\\
&\equiv \lambda t.\Big((\forall t')\Big[\big(\neg[\![\mathscr{B}(t')]\!]^{t' \leq t}\big) \wedge \big(\neg[\![\mathscr{C}(t')]\!]^{t' \leq t}\big)\Big]\Big) && (\text{de Morgan})\\
&\equiv \lambda t.\Big[\Big((\forall t')\neg[\![\mathscr{B}(t')]\!]^{t' \leq t}\Big) \wedge \Big((\forall t')\neg([\![\mathscr{C}(t')]\!]^{t' \leq t}\Big)\Big] && (\text{QD})\\
&\equiv \lambda t.\Big[(\forall t')\neg\Big([\![\mathscr{B}(t')]\!]^{t' \leq t}\Big)\Big] \wedge \lambda t.\Big[(\forall t')\neg\Big([\![\mathscr{C}(t')]\!]^{t' \leq t}\Big)\Big] && (\text{PC})\\
&\equiv \lambda t.\Big[\neg(\exists t')\Big([\![\mathscr{B}(t')]\!]^{t' \leq t}\Big)\Big] \wedge \lambda t.\Big[\neg(\exists t')\Big([\![\mathscr{C}(t')]\!]^{t' \leq t}\Big)\Big] && (\text{NE})\\
&\equiv [\![\text{BEFORE}(\mathscr{B}) \wedge \text{BEFORE}(\mathscr{C})]\!] && (??)
\end{aligned}
$$

$\therefore$ BEFORE is anti-additive.