

Necessity, intention, and causation: from force interaction to eliminating the causative entailments

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Abstract

In this paper, I argue that the interpretation of the necessity modal *prepi* in Greek and the individuation of the modalities (epistemic vs. deontic reading) depends on causation rather than the argument structure (raising vs. control) of the modal verb. The necessity verb behaves like volitional and directive verbs, and triggers the *force individuation criterion* as defined in Copley et al. (2015), distinguishing between CAUSE and ENABLE causal frames. The individuation between epistemic necessity and deontic necessity depends on the conceptualization of agency and the different configurations of force. I show, first, that the phenomenon is not just syntactical (*pace* Hofmann 1966; Perlmutter 1970b; Ross 1969; Jackendoff 1972; Butler 2003; Hacquard 2006, 2009; among many others): the variation in the interpretation (epistemic vs. deontic) is the result of differences in the argument structure (*raising vs. control*) of the modal auxiliary verbs. The key, I argue is *causation*, which triggers a shift from pure necessity, to intention as *force* (in the sense of Copley et al. (2015), i.e., as a field generating force. In Greek, the epistemic and deontic reading of the necessity modal comes about in a conceptual causal frame, where the two clauses are connected with the subjunctive particle *na* ‘to/that’— a pattern that we find also in other languages, including English, at least with some performative verbs such as *agree*, *insist* where the different modal reading are visible through complement choice. The current analysis implies a meaning of modality richer than mere argument structure (raising vs. control); and, by capitalizing on the causal frame and the presence of force in modal structures, the analysis enables a principled explanation of the shift to intention-necessity without positing ambiguity for the necessity verb *prepi*.

Keywords • necessity • intention • modality • force • causal • tense • agency • mental state • defeasible • nonveridicality

1 Background: necessity, force and the individuation of modalities

Necessity in English is expressed through verbs such as *must*, *have to*, *should*, etc.:

(1) a. She *must* be the new French teacher

- b. He *has* to be home
- c. You *should* learn French

Necessity can be subdivided into deontic and epistemic necessity. Deontic (or *priority*, in Portner 2009) necessity expresses what is compulsory, required or what someone is obligated to do. In other words, deontic necessity has to do with right and wrong according to a system or rules (Portner 2009:2) where the subject of a sentence is obliged to do something. Epistemic necessity concerns what is known (Portner 2009:2), but without guaranteeing that the contained proposition is true in fact — namely, epistemic necessity expresses a speaker’s opinion about the truth about a proposition. Necessity modal verbs tell us that there is an agent that intends an anticipated outcome, i.e., there is an *implied agent* who controls or causes *intentionally* what the complement sentence says, *without entailing its actualization*. The agent of the necessity modal verbs is thus intentional (see also Ilić 2013 for Serbian dative anticausatives) — in contrast to the subjects of possibility modality. As Bybee et al. (1994) put it: “Necessity reports the existence of physical conditions compelling an agent to complete the predicate action.” Thus, necessity itself is a disposition or precondition for intention, though a mere disposition since in the sentences in (00), necessity, epistemic or deontic, does not entail an actual state of affairs.

The individuation of deontic and epistemic modality has not been an easy task. One dimension of complication has to do with the role of the subject. On the one hand, it is argued that the variation in the interpretation — epistemic vs. deontic — is the result of differences in the argument structure — raising vs. control — of the modal auxiliary verbs (e.g., Hofmann 1966; Perlmutter 1970b; among others). According to that view, modals come into two varieties: TP-level (control) and VP-level (raising) modals (e.g., Ross 1969; Jackendoff 1972; Kratzer 1981, 1991b; Zubizarreta 1982; Picallo 1990; Brennan 1993; Butler 2003; Hacquard 2006, 2009; among many others). On the other hand, it is suggested that modal auxiliary verbs are raising predicates (e.g., Bhatt (1998) for English and Hindi; Wurmbrand (1999) for English; Eide (2006) for Norwegian; Staraki 2013, 2017 for Greek). In other words, no modals take their subject as an argument. The data that I discuss in this paper support the second thesis, as we shall see.

Another fact about modality is that it can be understood very broadly in terms of force dynamics. As Talmy (1988:49) puts it: “Force dynamics is a generalization over the traditional linguistic notion of “causative” ... Force dynamics, moreover, appears to be the semantic category that uniquely characterizes the grammatical category of modals, in both their basic and epistemic usages.” What Talmy (1988) means is that deontic modality can be analyzed as opposing forces — where forces should be understood as relations of dynamical concepts like “desire” and “power” — between an “agonist” and an “antagonist”. Extending Talmy’s analysis into the domain of epistemic modality, Sweetser (1984, 1990) argues that epistemic modality is the force-dynamically parallel case in the realm of reasoning. Thus, forces interact, causing to an entity to act on a result/effect. Commenting on examples like *You must comply* and *You must be Ann* Sweetser (1984:502) says: “If causal forces and barriers are viewed as generalized from the content (real-world) domain to the domain of propositions as epistemic objects or as speech acts, then it is scarcely surprising that modality (composed, like causality, of intentional forces)

manifests a similar extension from its real-world application to application in an epistemic world.” Copley (2010) further shows that teleological modality in English (anankastic/eparkastic conditionals) — a subdivision of deontic modality (see Portner 2009) that describes the goal of an individual — can be analyzed in the frame of acting on under the influence of physical or psychological forces.

Thus, necessity may be epistemic or deontic, differing only in the kind of forces influencing a situation; but neither epistemic, nor deontic modality implies bringing about an effect/result; they are nonveridical. As Giannakidou (1997, 1998, 1999, 2011, 2017), building on an argument about perception verbs offered by Montague (1969), argues, nonveridicality is a property of expressions — like modality and modal verbs — that do not entail the truth or the falsity of their complement sentence. Giannakidou (2017), in particular, distinguishes between two kinds of nonveridicality — objective and subjective — objective, when appealing to what is the case in the actual world, and subjective when appealing to commitment that individuals have to the truth of the sentence. It is worth pointing out, that Giannakidou’s (2017) distinction is identified with respect to an individual anchor’s epistemic state — a set of worlds. As she puts it: “A nonveridical state, on the other hand, is defined as one that contains at least one $\neg p$ world, it therefore conveys weaker commitment to the proposition than a veridical state, i.e. only partial commitment at best.” Thus, we can assume that necessity pertaining to intentions of an individual is subjective-nonveridical, in terms of Giannakidou (2017).

This *defeasibility*, as one may think of it, has been argued in a number of works (e.g., Moens & Steedman 1988; Dowe 2000; Kistler 2006, Mumford & Anjum 2011; Copley & Wolff 2014; among others) with regard to a causal relationship between two eventualities under the label “defeasible causation” (Copley & Harley 2014). This *non-result-entailing* causation has been assumed, since (Copley 2010), to be due to the intentions of a volitional/intentional agent. As Copley & Harley (2010, 2015) contend: “... the existence of a force does not entail any necessary effect, because forces are naïvely understood to be inherently defeasible and to interact with each other in deterministic ways ...” I provide two examples from Greek, which, like English, and other languages (for detailed discussion on *defeasibility*, Copley & Martin 2014) correlate the intentions of an agent to defeasibility:

(2) I diametros tu kiklu prepi na pernai apo to kendro tu
 the diameter the circle must SBJV passes through the center it
 “It must be the case that the diameter of the circle passes through the center of the circle.”
but it does not

(3) O Janis prepi na pernai apo to kendro tis polis
 The John must SBJV passes.PFV.3SG.NPST from the center the city
 “It must be the case that John passes through the center of the city.”
but it does not

In Greek, the necessity modal *prepi*, like all modals and other nonveridical verbs selects a subjunctive complement, introduced by the subjunctive mood marker *na* (Giannakidou 1998,

2009). The sentence (2), since it depends on what is the case in the actual world, and does not pertain to an intentional agent, is not imbued with uncertainty. (2) is a statement of logical/alethic necessity, and the contained proposition is indeed necessarily true — there is no possibility to be false, in any circumstances. Thus, (2) is a statement of objective necessity. By contrast, the sentence (3) pertains to an intentional agent, is characterized by defeasibility. The truth of the contained proposition is not entailed. Thus, (3) is a statement of subjective necessity.

In this paper, I argue that the interpretation of the necessity modal *prepi* in Greek and the individuation of the modalities (epistemic vs. deontic reading) depends on causation rather than the argument structure (raising vs. control) of the modal verb. In particular, I show that *prepi* is the grammatical indication of force and appears in a causal frame in which necessity is a field generating intentions, triggering the nonveridical inference, thus, not entailing any necessary effect/result (for non-culminating predicates see Copley & Harley 2015). This causal frame characterized by defeasibility is found not only Greek, but also in English with some performative verbs like *agree*, *insist*, and with verbs that imply the application of force — like verbs meaning want, order, allow, intent — all of which imply causal dependence and defeasible effect/result. More generally, necessity offers an input of energy into an initial situation that results in a situation as long as nothing external to the initial situation intervenes (*ceteris paribus* Copley 2010; Copley & Harley 2014; Copley et al. 2015). This conceptualization of necessity, and because a causal frame implies an interaction between forces, imposes a dynamic interpretation of *prepi p*, i.e. an input of energy, triggering the initial situation $init(f)$ but since a volitional/intentional agent is involved the net force is non-deterministic, meaning that all intermediate phases leading to the final situation-result $fin(f)$ are not entailed (Copley 2010; Copley & Harley 2014; Copley et al. 2015).

The discussion proceeds as follows. In section 2, I discuss the syntactic approach to the distinction between the deontic and epistemic reading of necessity. In section 3, I show them to be challenged in Greek, since the two readings arises in the unambiguous causal frame. I also present data that show that the interpretational variation (epistemic vs. deontic reading) of modality is best analyzed as depending on causation rather than the argument structure (raising vs. control). In section 4, I discuss necessity in the causal frame, and offer an analysis of the distinct readings of *prepi*, arguing that agency and different configurations of force is the factor individuating the two readings of the necessity modal. The analysis of deontic and epistemic necessity as relying on causation and force carries over to verbs that imply the application of force which also appear in the conceptual causal frame. This way, I explain why the defeasible effect/result is found with both modal verb and verbs of intention and volition, without suggesting that the necessity modal verb *prepi* is ambiguous contrary to the long generative syntactic approach, though I certainly appreciate and value the connection between necessity and verbs of intention and volition: verbs of intention and volition and necessity-initiated intentions are not the same; but they are both causal frames at the conceptual level.

2 Syntactic analyses of modality and problems with them

A number of generative linguists (Hofmann 1966; Perlmutter 1970b; among many others) suggest that the variation in the interpretation (epistemic vs. deontic) is the result of differences in the argument structure (*raising* vs. *control*) of the modal auxiliary verbs. According to that view, modals come into two varieties: TP-level (control) and VP-level (raising) modals (e.g., Ross 1969; Jackendoff 1972; Kratzer 1981, 1991b; Zubizarreta 1982; Picallo 1990; Brennan 1993; Butler 2003; Hacquard 2006, 2009; among many others). Thus, modals are epistemic when they function as raising (4b), and deontic (priority) when they function as control predicates (4a), as follows:

- (4) a. CONTROL: [ModP **DP** [ModP' VP [INF PRO [INF ...]]]]
 b. RAISING: [ModP [INF DP [INF ...]]]

The motivation behind this analysis comes from the syntactic relation between the subject and the rest of the clause. Contrary to control predicates, raising verbs do not impose any selectional restrictions on the matrix subject which does not constitute the semantic agent of the main verb. Ross (1969), for instance, argues that deontic modal verbs are transitive (two-place predicates) and that they assign two theta-roles (dyadic modals): one in the subordinate clause and one in the main clause. Epistemic modals, on the contrary, are intransitive (one-place predicates) and assign only one theta-role (monadic modals) to the subject of the infinitive. Jackendoff (1972), in the same line, argues that deontic modals are like control verbs, denoting a semantic relation between the clause and the subject, while epistemic modals have only one argument, the embedded clause. Zubizarreta (1982) argues that while epistemic modals do not assign theta-roles, deontic modals do. Ross (1969) and Zubizarreta (1982) rightly focus on the issue of the theta-role assignment, emphasizing on the type of modality. Also, a semantic relation between a clause and a subject is rightly pointed out by Jackendoff (1972). However, they inaccurately attribute the interpretational to the syntactic predication of the modal verbs:

- (5) Ο Pavlos prepi na epistrepsi to vivlio pu dhanistike
 The Paul must SBJV return the book that borrowed
 “Paul must/should return the book he borrowed”
Deontic: “Paul is under an obligation to return the book he borrowed.”
Epistemic: “I suppose that Paul will return the book he borrowed.”

In this syntactic-semantic approach, the conversational background (accessibility relation) is derived from the referent of the subject, i.e., since the modal in the deontic interpretation behaves like a control predicate, the modal takes its subject *Paul* as argument. By contrast, the modal in the epistemic interpretation behaves like a raising verb, thus, the modal does not take the referent of the subject as argument.

However, several authors (e.g., Bhatt 1998; Wurmbrand (1999); Eide 2006; Staraki 2013, 2017; among others) make a couple of empirical points of criticism that are very important (see Portner 2009:187, for an opposing view). Providing crosslinguistic evidence from languages like

English (Bhatt 1998; Wurmbrand 1999), Hindi (Bhatt 1998), Norwegian (Eide 2006) and Greek (Staraki 2013, 2017), they argue that modal auxiliary verbs are raising predicates. That is, that modals do not take their subject as an argument, but they have similar syntactic behavior to raising predicates. In particular, Staraki (2013, 2017, working paper) argues, that in Greek modal verbs like *prepi* ‘must’ and *bori* ‘might/may’ similarly to raising verbs: (a) allow to elements of the *na*-clause to be raised in a higher position in the structure (6), (b) their complement *na*-clause does not constitute an agreement domain (7), (c) do not project external arguments, thus, they do not assign thematic roles (8)-(9), and (d) allow the subject of the embedded *na*-clause to be interpreted either as taking wide or narrow scope.

- (6) O eaftos tu_i prepi na tu_i ares-i
 The self his-3SG.GEN must SBJV CL-GEN appeal-3SG.PFV.NPST
 “He must like/accept himself.”

Deontic: “Someone is compelled to like himself.”

Epistemic: “I suppose someone likes himself.”

- (7) *Ta agoria prepi na figun ta koritsia
 The boys.NOM.PL must SBJV leave.3PL.PFV.NPST the girls.NOM.PL
 Intended: “The boys must leave.”

- (8) Ta ghramata prepi na paradhothun to mesimeri
 The letters.NOM.PL must SBJV delivered.3PL.PFV.NPST the noon
 “The letters should be delivered at noon.”

Deontic: “Someone is under the obligation to deliver the letters at noon.”

Epistemic: “I suppose someone delivers the letters at noon.”

[_{TP DP Ta ghramata_j [_T prepi [_{CP C [_{MoodP na} [_{TP [_{VP paradhothun t_i]]]]]]]]}}}}

- (9) The old man must fall down the stairs and it must look like an accident. (Wurmbrand 1999)

A second fact which is common to Greek and English — and a pervasive characteristic of most of the languages — is that modal auxiliary like other (causative) verbs, i.e., *make*, *cause*, *melt* etc., exhibit argument structure variation. For instance, even though the Greek modal verb *prepi* only needs to combine with a *na*-clause conveying an entity undergoing what is described by the embedded predicate, as in (10a), Greek language also allows the sentence in (10b), where the entity that must be returned is now the object of the embedded predicate and the subject referent is filled with a noun phrase expressing the entity of the returning event. Moreover, it is quite common to add yet another argument to this structure, as in (10c), where the new argument is the indirect object and is interpreted as some type of a beneficiary of the returning event. The same is true in English. Despite the rule of thumb that the subject referent constitutes a core argument of deontic modal verbs, the following examples are “ambiguous” between an epistemic and deontic reading (see also Portner 2009 for English):

- (10) a. To vivlio prepri na epistrepsi sti thesi tu
 The book.NOM.SG must SBJV return.3SG to-the place its
 “The book must return to its place”
 b. I Maria prepri na epistrepsi to vivlio
 The Mary.NOM.SG must SBJV return.3SG the.ACC.SG book.ACC.SG
 “Mary must return the book”
 c. I Maria prepri na mu epistrepsi to vivlio
 The Mary.NOM.SG must SBJV me.GEN.SG return.3SG the.ACC.SG book.ACC.SG
 “Mary must return the book to me”

These data suggest that the correlation of the subject's referent and kind of modality (epistemic vs. deontic) is not perfect: there is a conceptual overlap between an agent and a causee. What appears to be the subject referent is in fact the causee who is affected — in the typical “proto-Patient” sense (for an extensive discussion, see Dowty 1991) — by an intentional agent which is absent from the sentence. The subject's referent is not intentional, agentive or deliberate, even when the subject's referent is an animate entity (compare (10a) to (10b-c)). In fact, the causee is semantically distinct from and under the direction of the agent. This observation is in line with Bhatt (1998) and Wurmbrand (1999) who argue that the agent is not expressed syntactically in the subject position. Instead, *prepi* expresses a causal meaning involving two interacting forces or tendencies (see Talmy 2000; Wolff 2007) where one of the forces is associated with the agent and another with the patient (see Copley et al. 2015). Moreover, the *prepi* causative meaning is similar to the causative meaning of causal verbs, i.e., cause or make in that it is realized with a *na*-goal-clause even though it does not have an obviously causative meaning. In the current syntactic analyses of modal auxiliary verbs, it is unclear how to individuate between those two semantic entities, unless, we consider causation as an essential feature of modality.

A parallel between subjective necessity and volitional and directive verbs seems to be supported — apart from the fact that they both allow the nonveridical inference to the truth of *p*, also by an additional inference of volition/intention: in our earlier example *John must pass through the center of the city*, there is a certain volition/intention that John passes through the center of the city, and the same is true of volitional, permissives and directive verbs:

- (11) I Maria {theli/prepi} na taksidhepsi stin Afriki
 The Mary wants/must SBJV travel.3SG to-the Africa
 “There is a certain *intention* that Maria travels through Africa”

This inference of intention in the sense of a broader causal notion is systematically present with the implicative class: verbs like *want*, *hope*, *order*, *advise*, *allow* etc. have it. Intention seems to be a presupposition, as it preserved under negation:

- (12) a. Mary {didn't want to/must not} go tonight Still allows the inference that:
 b. Mary intended to leave tonight
 c. There is an intention that Mary leaves tonight

At the same time, however, we see that the inference that *p* is true does not hold under negation:

- (13) a. Mary {didn't want to/must not} go tonight Do not entail:
 b. Mary left tonight

Hence, volitional, permissives and directives (see Giannakidou 1998, 1999) — mostly translatable as *to*-infinitivals — and necessity modality intend the result (that *p*), while both presuppose a certain noteworthy degree of volition/intention to get to that result.

As we see, volition/intention is observed also with the modal. Notice that even if we don't have a verb meaning like e.g. *want* or *permit*, which admittedly implies intention on the part of the referent of the subject, intention will be still accommodated:

- (14) I Maria/to aftokinito prepī na apomakrinthi
 The Maria/car must SBJV be.taken.away.3SG.pass
 “There is a certain *intention* that Maria/the car should/must be taken away.”

To be taken away is the intended and anticipated effect or result — and recall that with *prepī* there is a distinction between an intentional agent and a causee (the patient). Then, observe in the example (14) that the kind of interaction between an agent and a causee may vary. When the agent is causing — in the sense of affecting, intending a *change-of-state* — (not oriented toward the same direction as) the patient, then the meaning is deontic. However, when the agent is causing — in the sense of believing or perceiving (Dowty 1991), then the meaning is epistemic.

Before we proceed with the Greek data, it is important to note a few more points of concern for the syntactic analysis. Crucially, a syntactic approach fails to derive the intention inference. The meaning of PREPI is that of a regular universal modal, so it is difficult to see how to built in the presupposition of intent in syntactic terms. Recall also what we said at the beginning, namely that in subjective necessity, a component of action is needed, and an intentional — defined in a world with respect to an intention, not just abstractly in a world — modal force than mere universal seems more appropriate. With these in mind, let's move on now to examine in more detail the Greek data.

3 The syntax of necessity in Greek: the causal frame

In this section, I present data that show that the interpretational variation of necessity is best analyzed as depending on causation rather than the argument structure (raising vs. control). I show first that both readings arise in a particular conceptual causal frame in Greek, one that appears to involve intention and defeasibility. We have seen already in (14) that in this frame, the truth of the embedded predicate is not entailed, and we present more data to this effect in the present section. The *na*-frame can be causative, and is observed also with volitional and directive verbs, and verbs of permission both in Greek and English. I also present data from English to show that the frame exists in that language too, with properties very similar to Greek. In the

causal frame, necessity is forced into an intention, and an analysis follows in section 4. First, some background on Greek modals.

3.1 Background on Greek modals

Greek has three modal verbs¹: *prepi*, *bori* and *boro*; for earlier detailed descriptions of uses of Greek modals see Staraki (2013, 2017), Tsangalidis (2004, 2009) Iatridou (1986). All three modals are nonveridical and select subjunctive complements introduced by *na* (Giannakidou 1998, 1999, 2009); indicative complements, introduced by *oti*, *pu* are unacceptable². *Bori* and *boro* are impersonal (3rd person singular) and personal variants of the same verb. As we see below, the impersonal *bori* is an epistemic possibility modal, whereas the personal is abilitative or deontic, never epistemic. The modal verb *prepi* is a necessity modal, epistemic or deontic, and is always impersonal:

- (15) a. * Ta pedhia prepun na ine sto spiti.
 The children must.IPFV.3SG SBJV be.IPFV.3PL at-the home
 Children must be at home.

- b. Ta pedhia prepi na ine sto spiti.
 The children must.IPFV.3SG SBJV be.IPFV.3PL at-the home
Epistemic necessity: As far as I know, the children must be at home
Deontic necessity: The rules dictate that it is necessary that children be at home

- (16) a. Ta pedia bori na ine sto spiti
 The children might.IPFV.3SG SBJV be.IPFV.3PL to-the home
Epistemic possibility: As far as I know, it is possible that children are at home.

- b. Ta pedia borun na pane sto spiti mona tus.
 The children can.IPFV.3PL SBJV go.IPFV.3PL to-the home alone them
Ability: Children are able to go home on their own.
Deontic possibility: The children are allowed to go home by themselves.

Notice that in none of these cases do we get the entailment that the *na*-complement is true, since the modal verbs are nonveridical, as we said, including the necessity modal (see Giannakidou 1997,1998, and more recently 2011). At the same time, it is important to note the flexibility of the necessity modal *prepi* with respect to the modality (epistemic or deontic reading), and the rigidity of the impersonal *bori* as an exclusive epistemic modal.

¹ This is not an exhaustive list or presentation of Greek modal verbs.

² Greek realizes the subjunctive vs. indicative difference in what appears to be the *that* element, the particle introducing the clause.

At first glance, the necessity modal *prepi* is not a causative verb either in its syntax or its morphology. *Prepi* does not form causative either by means of an affix or of a structure. For example, *prepi* does not permit transitive/causative (18) or intransitive/anticausative (19) construals:

(18) *O Janis *prepi* to parathiro
 The John must.**active** the window
 “Intended: John causes something to the window”

(19) *To parathiro *prepithike* apo to Jani
 The window must.**passive** by the John
 “Intended: “The window was affected by John”

Although lexically and syntactically, the thematic roles of the agent and the patient are not part of the argument structure of *prepi*, as I have showed in section (see section 2, but see also Staraki 2013, 2017, manuscript), the necessity modal, nevertheless, induces a causal frame. In the example (20), the causal frame is bi-clausal: the predicate of cause and the predicate of effect occur in different clauses. Observe the example below. This example has the necessity reading, and the complement *na*-clause, the syntactic argument of *prepi*, conveys the pursuit of a particular result/effect, as indicated in the translation:

(20) Ta pedhia *prepi* na ine sto school
 The children must.IPFV.3SG SBJV be.IPFV.3PL at-the sholio

Paraphrase: The intended result/effect that *children be at school* is to become true, if the conditions pertaining to the relevant situation are efficiently carried out.

We have seen a couple of examples in (17a-b) where the application of the force has the potential to cause a result/effect. The bi-clausal causative frame is not rare. In Greek, the subjunctive particle *na* (21)-(23) and the conjunctive *ke* (24) (Giannakidou & Staraki 2013), and in English the particle *to* are employed to construct a bi-clausal causal frame, expressing causing and caused events:

(21) Episa ti Maria *na* fighi
 Persuaded.1SG.active the Maria.ACC SBJV leave.3SG
 “I persuaded Mary *to* leave.”

(22) Katafera *na* skondapso sto podhi mu
 Managed.1SG.active SBJV trip-over.1SG to-the foot my
 “I managed *to* trip over my own feet.”

(23) Ton ekana *na* mu dhosi afksisi
 Him made.1SG.active SBJV me give.3SG pay rise
 “I got him *to* give me a pay rise”

(24) Boresa *ke* tu milisa
 Could.1SG.active and him spoke.1SG
 “I could, and did, talk to him.”

The bi-clausal structure with *na* allows the nonveridical inference (that the result *p* is not entailed true), and is essential in conveying the necessity of an intended result which presupposes force, but without entailing its actualization. Signaling the sense of purpose or goal with the subjunctive particle *na* (Joseph & Philippaki 1987) is also observed with volitional and directive verbs, and verbs of permission both in Greek and English:

(25) O Janis theli *na* aghorasi ena aftokinito
 The John wants SBJV buy.3SG a car
 “John wants to buy a car” does not entail “John bought a car”

(26) O Janis dhiatazi *na* fighete apo eki
 The John orders SBJV leave.3PL from there
 “John orders you to leave the premises” does not entail “You left the premises”

(27) O Janis epitrepi *na* erthese sto spiti
 The John allows SBJV come.2SG in-the house
 “John permits you to come into the house” does not entail “You came into the house”

The potential-result entailment we get with the *na*-clause might seem problematic in conceptualizing the necessity modal *prepi* as inducing a causal frame, since, as a causal frame crucially depends on the link: *cause-realized effect* (Dowty 1979; Talmy 2000; Giannakidou & Staraki 2013; among others). In this approach, the existence of a result is absolutely necessary. The *na*-clause, strictly speaking, does not express an actualized effect, but an *effect-to-be*, an expected, anticipated effect. In other words, *na*-clause does not assert the occurrence of, although it refers to, a result. Notice, however, that the existence of a force not entailing a result is not an *ad hoc* argument of the proposed analysis. In fact, a causal link of the form *cause-effect* can be envisioned in terms of the causal chain: *cause-non-efficacy conditions-effect* (Copley 2010; Copley & Harley 2014). Against this background, then, a series of situations precedes the effect, but the effect may never become the actual state of affairs. In other words, a result/effect has the potentials to be actualized, if the series of situations proceeds normally. Compare the English translational counterparts with the Greek examples in (21) - (24). English also derives the causal frame employing *to*-clause and *that*-clause, and likewise Greek, the bi-clausal structure is also employed with verbs that imply the application of force — like verbs meaning want, order, allow, intent — all of which imply causal dependence and defeasible effect/result. On this basis,

then, the *na*-clause represents an anticipated result dependant on relevant and sufficient conditions (Hall 2004) pertaining to the situation overall, and we have reasons to believe that the same applies in English as well as crosslinguistically.

3.3.2 Causal frame: necessity and meaning shifts

We have seen, then, that an implied force is part of the conception of the modal *prepi*. So, a force can be thought as the cause that produces a change through necessity, by physical, moral or intellectual means. Here, I want to show that force is directly involved in determining the interpretation of *prepi*, based on what causal frame underlies necessity. Specifically, the causal frames, I argue, that underlie each necessity reading differ in terms of the conceptualized event structure (Jackendoff 1991, for a conceptual approach of meaning):

- (28) Ta pedhia prepi na ine sto spiti
 The children must.IPFV.3SG SBJV be.IPFV.3PL at-the home
Deontic necessity: “The rules dictate that children have to be at home.”
Epistemic necessity: “As far as I know, the children must be at home.”

In particular, on the deontic reading, the rules, the laws or anything pertaining to duty and obligation generates a force that influences the addressee — we can consider the addressee as the patient —, and the speaker is considered as enforcing or directing the necessity of an action — we can consider the speaker as the agent —, deciding upon what an entity is prescribed/assigned to do. By contrast, on the epistemic reading, the premises, the information or any intellectual means produce a force that is directed toward the individual — usually the speaker — making an evaluation/estimation, and reaching a conclusion. In both causal frames, the effect, action or conclusion, is dependent on the forces. However, the direction of the force varies between the two conceptualization patterns (causal frames), depending on the kind of the event structure being assessed and the kind of force being implied. Notice, also, that in both causative frames, sometimes, the true agent (speaker) or the true patient (addressee) are not always syntactically present. Namely, the individual that is considered as responsible for bringing about an action or reaching a conclusion might not surface into the syntax. For instance, the requirement to be at home might as well rest with *the mother* or *the guardian* of the children, and not necessarily with *the children* in the main clause. The same applies to the epistemic necessity reading: the speaker does not always express his/her judgment or degree of confidence. The claim that *children must be home* might as well belong to an individual other than the speaker. This pattern, of course, is expected as both the agent and patient are external to *prepi* arguments (see section 2). Moreover, the force (i.e., laws, rules, knowledge, etcetera) that is exerted by the agent can also go unmentioned. Thus, semantics provides a causal frame, mapping out the argument structure of the modal *prepi*.

It is not unusual to find an implication of force and individuated readings, depending on the conceptualization of event structure. Such is the case of the following performative verbs in

Greek and English where the epistemic vs. deontic reading is visible through complement choice. In particular, the following examples in (29)-(32) marked with (a) illustrate cases where the main verb embeds a *na*-clause, expressing deontic necessity, and the examples marked with (b) show cases where the main verb embeds an *oti*-clause, expressing epistemic necessity:

- (29) a. Simfono na apoklisti i eteria
 Agree.IPFV.1SG.NPST SBJV exclude.PFV.3SG.NPST the company
 “I agree to exclude the company”
 Implied: “Based on the laws/rules, the company has to be excluded”
- b. Simfono oti hrizi peretero eksetasis
 Agree.IPFV.1SG.NPST IND need.IPFV.3SG.NPST care
 “I agree that this issue deserves further examination”
 Implied: “Based on what I know/believe the issue deserves further examination”
- (30) a. Epimeno na kanume ena meghalitero vima
 insist.IPFV.1SG.NPST IND make.IPFV.3SG.NPST one greater step
 “I insist on taking a further step”
 Implied: “Based on my goals, we should take a further step”
- b. Epimeno oti appetite politiki vulisi
 insist.IPFV.1SG.NPST IND require.IPFV.3SG.NPST political will
 “I insist that it requires political will”
 Implied: “Based on my view/opinion, political will is required”
- (31) a. Protino na ghini dhekti i ekthesi
 suggest.IPFV.1SG.NPST SBJV become.PFV.3SG.NPST accepted the report
 “I suggest that the report be accepted ”
 Implied: “Based on my goals, this report should be accepted”
- b. Protino oti prepri na fighume
 suggest.IPFV.1SG.NPST IND have-to.IPFV.3SG.NPST SBJV leave.3PL
 “I suggest that we should leave”
 Implied: “According to my opinion, we should leave”
- (32) a. Perimeno na erthis simera
 expect.IPFV.1SG.NPST SBJV come.PVF.2SG.NPST today
 “I expect you to show up today”
 Implied: “According to my expectations/desires, you have to show up today”

component as we saw: a non-culminating, defeasible causal frame (see Copley & Harley 2010; Copley & Harley 2014, for the defeasibility and elimination of causative entailments). The problem, then, with mere universality is that it conceptualizes the necessity modal *prepi p* as a static situation, non-susceptible to change, i.e., it makes the contained proposition of the structure *prepi p* necessarily true in all possible worlds — it is not possible for the contained proposition to be false, in any circumstances. Intuitively, however, the structure *prepi p* has to do with what is intended (belief, goal, etc.), when necessity applies — the anticipated result, although intended and necessary, might never be reached. Thus, the basis of our discussion is that necessity is a field generating intentions, but without entailing any necessary effect (for non-culminating predicates see Copley & Harley 2015).

Here, I propose an analysis of the necessity modal *prepi* as a universal modal of a dynamic mental state. A proposition is identified with the set of possible worlds where it is true; a modal base $f(w)$ is the set of worlds accessible from w — by some accessibility relation (Kratzer 1977, 1981, 1991b). For instance, in the example (00), for every world we consider, it is necessarily the case that the diameter of the circle passes through the center of the circle. Though a universal analysis represents cases where p is necessarily true in all worlds, due to facts and principles of our actual world, in cases like the example (00), i.e., where compliance with the European directives is defeasible, p might not be necessarily true in all worlds — p might not be the necessary effect/result:

- (33) I diametros tu kiklu prepi na pernai apo to kendro tu
 the diameter the.GEN circle.GEN must SBJV passes through the center it.GEN
 “It must be the case that the diameter of the circle passes through the center of the circle.”
- (34) Prepi na simorfothite me tis evropaikes odighies
 must SBJV comply.past.2PL.NPST to the.PL.ACC european directives
 “You must comply with the European directives.”
- (35) I Maria prepi na ine treli
 The Maria must SBJV be.IPFV.2SG.NPST crazy
 “Mary must be crazy”

Observe that intentionality is a systematic characteristic of the causal frame of *prepi*: the modal base is defined in a world with respect to an intention, although the intention can be assumed by different syntactic and/or semantic agents. In both examples (34) and (35), the modal base is defined in a world with respect to intentions involving the speaker's beliefs, goals and thoughts. By contrast, notice that in the example (33) where we are based on facts and principles of our actual world, there is no intention. As Copley (2010) also argues, affirming our observation, when a volitional agent is involved — meaning the existence of a deliberate intention — the result is non-deterministic, i.e., the case (35). I propose, therefore, that what is essential to do is distinguish the notion of the necessity modal *prepi* with the intention of achieving a goal, or more generally, with the expectation/anticipation of a result/effect. In Greek, the relevance of an

anticipated result is clearly suggested by the fact that the necessity modal *prepi* embeds a *na*-clause denoting purpose (Holton, Mackridge & Philippaki-Warburton 2004) that can be formally represented as:

$$(36) \quad N(i)(w) = \{w' : \forall p [i \text{ is the intend to } p(w) \rightarrow \Box p(w')]\}$$

In effect, the definition (36) tells us that the necessity worlds of *prepi* are worlds in which there is an intention to reach *p*. In particular, the modal base is defined in a world with respect to an intention, not just abstractly in a world. Thus, necessity is defined via an intention component, since only worlds where the necessity has been intended upon will be included in the modal base. *Prepi*, then, is defined, as follows:

$$(37) \quad \textit{Prepi} p \text{ is true in a world } w \text{ with regard to an intention modal base } N_{\textit{intention}}(i)(w) \text{ and an ordering source } <_w \text{ iff:}$$

For all worlds w' in $N_{\textit{intention}}$ there is a world w'' in $N_{\textit{intention}}$ such that $w'' <_w w'$, and for every other world $w''' <_w w''$ in N , p is true in w''' .

To reinforce this, Copley (2010) also mentions that: “... any time there is a volitional agent, there is the agent's intention, which is a psychological force”. Then, an agent with deliberate intention can be the source of intention, either physical or psychological (mental). The modal *prepi* then, is all causal in the sense that it is about the intentions that bring about effects from intentions; broadly speaking, an input produces an output. Moreover, the agency pertains to how we represent intervention (Sloman 2005) — the intervention (or lack thereof) of an agent will have an effect upon interpretation, as we will see. Thus, the necessity modal *prepi* should be formalized in a way that could be carried out in formalisms for reasoning about dynamic mental states like intention and change.

Parra et al. (2005) propose an extension of action to intention in the framework of situation calculus (for situation calculus: Barwise & Perry 1981; Cohen & Levesque 1990; Reiter 1991; among many others), introducing the notion of fluent for dynamic mental states like belief, goals, and intention along with their successor state axioms. In this framework, an agent interacts with the world having an intention (either a goal or a belief), and there is a function *I* from intended results/effects *T* to situations *s* represented by the intention fluent $I_{ip}(T, s)$. In particular, the intention fluent $I_{ip}(T, s)$ states that an agent *i* has the intention to perform *T* (a sequence of actions) in a situation *s* to satisfy a goal *p* (*I* implies a non-deterministic sort of change, at least as far as indent-induced change goes), as follows:

$$(38) \quad I_{ip}(T, \text{do}(\alpha, s)) \leftrightarrow G_{ip}(\text{do}(\alpha, s))$$

Thomason's (2005) revision of situation calculus also provides the basis for a blueprint of causal axioms, linking conventional effects and preconditions with actions. In consideration of these

previous treatments of dynamic mental states, I propose that a necessary goal should be indexed to intentions, in the form of a causal axiom which associates anticipated results and preconditions with intentions. The causal axiom for an intention denoted by I is the following:

$$(39) \quad \forall x_s [\text{Pre}(I, x) \rightarrow \text{Post}(\text{Result}(I, x))]$$

In (39), I represents the intention fluent $I_{ip}(T, s)$ and Result the goal G_{ip} , Pre is the precondition for intention I and Post is the postcondition (effect/result) of I . However, the way the causal axiom is constructed makes too strong predictions. It predicts that the result will be a necessary true outcome, thus turning the agent to an omniscient individual. In real life situations, however, agents may have wrong beliefs about the evolution of world or initial state (Parra et al. 2005), i.e., about cases where the evolution of a necessary goal or mental state is affected by intervening factors. Thus, it is necessary to introduce “defeasible”, invoking the common sense reasoning that the anticipated result/effect — in our case the *na*-clause — is not necessarily the actual state of affairs, i.e. we need to incorporate a non-result-entailing meaning (Copley & Martin 2014 for discussion on defeasibility):

$$(40) \quad \forall x_s [\text{Prepi}(I, x) \rightarrow \text{Fin}(\text{Result}(\text{defeasible}(I, s), x))]$$

(40) means that provided the immediate causal antecedents of the intention denoted with *prepi*, the occurrence of the effect/result in *na*-clause is not-result-entailed. In this approach, to say that an agent has the intention in anticipating a result does not entail the successful culmination of the anticipated result. The introduced fluents from Parra et al. (2005) provided a method of representing these kinds of dynamic mental states.

Thus, intention in anticipating a result (PREPI) is a precondition for inducing a causal frame. However, it is not the sufficient condition to bring about the result. In the following section, I show that the *na*-clause in Greek offers the result/effect in a causal frame, and yields the reading of a necessary and indented effect/result which, nevertheless, is the expression of a defeasible, non-culminating causal frame.

4.2 Necessity as *force* and the role of causation

Let us take stock of what we observed thus far: first, the necessity reading can be agentic. Agency, here, should be understood in terms of causal intervention. As Sloman (2005:5-6) puts it: “Agency can be treated as nothing more than the ability to intervene on the world and change it... But even more important, agency is about how we represent intervention, how we think about changes in the world. Because by being able to represent it, we are able to imagine changes in the world without actually changing it.” Recall that in the cases of the necessity modal *prepi* we examined, there is always a volitional entity — the agent — that intends

something (see also Copley 2010), having the ability to intervene (Sloman 2005). Something inanimate like *water* is seemingly compatible with the causal frame, because the true agent is implied (and conceptualized) as that intervening entity having an intent to direct in a situation and toward an anticipated result:

(41) To nero prepi na proerhete apo tin pighi
 The water must SBJV come.3SG from the spring
 “The water has to be from the spring”

(42) Prepi na pethane
 Must SBJV died.3SG
 “S/he must be dead”

Evidence: no pulse, coolness, dilated pupils

Even in the case of epistemic necessity (42) which is all about inanimate things — information and evidence — an agent, an intentional entity, is involved in representing how the choice of inputs (information, evidence, etcetera) determines the outputs (the intended conclusion of an agent).

Second, the *na*-clause creates a bi-clausal causal frame in the sense of theories (e.g., Lewis 1973; Dowty 1979; Pearl 2000) that define causation in terms of dependencies between propositions. In this approach, the causal frame seems to correspond to the logical form $[\phi \text{ CAUSE } [\text{BECOME } \psi]]$: an agent *x* initiates a series of actions that cause the result in the second conjunct. However, this logical form does not correspond to our observations with regard to *prepi*. First and foremost, the necessity modal structure *prepi p* does not entail an actual result, thus a theory requiring the causal factor in some way entail the result conflicts with the empirical observations. Secondly, we could alter the logical form to $[\phi \text{ CAUSE } [\text{BECOME}_{\text{potential}} \psi]]$. This change, seems to set the approach in its right dimension. However, it is a partial treatment, because this accommodation in the logical form does not prove efficient in individuating between the two kinds of necessity: epistemic and deontic. Recall the empirical observation: the two distinct readings depend on different kinds of conceptual representations of causation forces. We should enrich, thus, the meaning of PREPI with a component that will produce this intent initiating necessity. Dowty’s inertia worlds won’t be efficient for various reasons (see Copley & Harley 2010, Grinsell 2010 for an overview). However, Copley & Harley (2010) provide the notion of *force*, which is in accordance with the empirical observations, as we will see:

(43) “A force is an input of energy into some initial situation. This energy is either generated by an animate entity, or it comes from the motion or properties of an inanimate object. The application of this energy changes the initial situation into a different situation, as long as no stronger force keeps it from doing so.... A force’s observed final situation is thus contingent on the existence and strength of other forces opposing it.” Copley & Harley (2010: section 3)

Copley et al. (2015) also argue that force interaction is relevant to expressions throughout syntactic structure, and propose that a causing entity is conceptually represented. On this forces-everywhere hypothesis, Copley et al. (2015) point, a field is an abstract object that, if an entity of the correct kind is placed in it, generates a force on that entity. This abstract notion of field can be extended to fields that generate other physical forces or tendencies, as well as to fields that psychosocially generate forces such as intentions. In this framework, I propose that *necessity* is to be understood as a field generating forces such as intentions, and *prepi* as the grammatical indication of that field of force: an input of energy into an initial situation that results in a result situation as long as nothing external to the initial situation intervenes (*ceteris paribus* Copley 2010; Copley & Harley 2014; Copley et al. 2015). A first approximation of the meaning of *prepi* a force-dynamic perspective, inspired by Copley & Harley (2014), and Copley et al. (2015), can thus be as follows:

(44) Force-PREPI (first approximation):

$$PREPI_{CAUSAL}(s_0) = s_1$$

On this view of the causal frame (44), *prepi* initiates a situation which leads to a final situation. But what, then, is taking us from the initial to the final situation? *Prepi* expresses an intention, and as Copley (2010:7) argues "... Intentions are to be understood as net desires ...". In order to bridge the gap between action initiation force and psychological force like intentions, Copley (2010) propose the following *Law of Rational Action*:

(45) *Law of Rational Action* (Copley 2010: (16))

If a volitional entity intends something in a situation *s*, and is not prevented by anything from acting in such a way (according to his/her beliefs) as to achieve it, the being acts (exerts a force on *s*) in such a way (according to his/her beliefs) to achieve it.

According to Copley (2010:7), this law is itself "... a tendency of volitional entities, so when it is saturated with an entity and a situation, it is a force. This is why we say it is included in the normal field... any time there is a volitional agent, there is the agent's intention, which is a psychological force." In other words, this law says that whenever there is a volitional agent and the agent has an intention to act, this intention, *if nothing else prevents it*, will become force. In this general sense, the law is admittedly too strong, because as shown, it just doesn't follow from *x* wanting or intending something that *x* will act upon her desire. Desires are, in other words, nonveridical (Giannakidou 1998, 1999; see also Heim 1992, Laca 2010, Yoon 2010) as we saw, and we have good reasons to keep this characterization (i.e., it accounts for presupposition

projection, mood choice, negative polarity items, and triggering of expletive negation, among other things). Also, conceptually, it is simply true that one may never act on a intention or desire, even if there are no forces preventing action. Intention in the necessity modal *prepi*, as shown, is also nonveridical, since just having the intention doesn't imply an actual result either. So, it can't be the case that the law of rational action holds as a general law. The law of rational action can be triggered in certain structures because of properties of the structure, thus producing an actual result (see the case of the causative *ke*-frame in Greek, Giannakidou & Staraki 2013). However, in the case of necessity modal *prepi*, the causal frame is nonveridical: it does not entail that a result (the second conjunct) holds. This, naturally, affects significantly how necessity is going to be interpreted, and based on (Copley 2010:6), I argue that the net force of the causal frame is non-deterministic because volitional agents are involved, thereby triggering a transition of necessity from intention (a psychological force) to a non-deterministic net force (see Copley 2010; Copley & Harley 2014). *Prepi* then, in the causal frame, generates in an agent an intention to a tendency, but without entailing an actual result.

The case of interpretation of *prepi*, then, seems to pertain to verbs that, conceptually, their causal meanings involve interacting forces or tendencies, as described by Talmy (2000), Wolff (2007), and recently, by Copley et al. (2015): one of the forces is associated with the agent and another with the patient. But, in the case of the necessity modal *prepi* in Greek, it is the same verb that features two causal alternations (Levin 1993, for a discussion of causative alternations of English verbs).

I will now implement the analysis of necessity modal *prepi* as force building on Copley (2010) and Copley & Harley (2014). First, a summary of the ontology and basic types:

(46) Copley (2010) and Copley & Harley (2014) ontology:

- a. Eventive ν Ps are predicates of forces (type $\langle f, t \rangle$, that is, type $\langle \langle s, s \rangle, t \rangle$, since type f is shorthand for type $\langle s, s \rangle$); they will be represented by lowercase Greek letters π, ρ .
- b. Predicates of situations, also called propositions, are type $\langle s, t \rangle$ and are represented by lower case Roman letters p, q, \dots
- c. Stative predicates are also type $\langle s, t \rangle$
- d. Situations are given by the variables s, s', s'', \dots
- e. We refer to situations in a causal chain both with respect to the forces in that chain (i.e., a situation can be referred to as **init(f)** or **fin(f)**), as well as with respect to other situations in the causal chain; i.e., if s is a situation, s_1 is the (ceteris paribus) successor, and $s-1$ is its predecessor.
- f. The net force of a situation is **net(s)**, and all situations are assumed to have a net force.
- g. The net force is deterministic except when volitional entities are involved.

The proposal is that necessity is the field that generates the force of intention, triggering the initial situation $\text{init}(f)$ but since a volitional agent is involved the net force is non-deterministic, meaning that all intermediate phases leading to the final situation-result $\text{fin}(f)$ are not entailed. This captures the fact that necessity and the generated force intention do not presuppose that s is efficacious. Therefore, the result situation $\text{fin}(f)$ of the net force of s is not entailed to occur. A definition of *force-prepi* p follows:

(47) *force-PREPI* ψ is instantiated at time t in w iff:

- a. *PREPI* ψ ; (*PREPI* as defined in section 4.1)
- b. The Law of Rational Action holds;
- c. Necessity generates a force on the agent, i.e., an intention;
- d. Intention initiates a path, i.e., a sequence of eventualities S ($\langle \text{init}(f), \dots, (\text{fin}(f)) \rangle$);
- e. The net force of *PREPI* is **net(s)**;
- f. The **net(s)** is non-deterministic;
- g. ψ is the non-entailed $\text{fin}(f)$ of S .

I now turn to the mapping of thematic relations within that framework of force-dynamic causation (Copley & Harley 2014; Copley et al. 2015), arguing that agency and different configurations of force (Barbey & Wolff 2007, for causal relationships) is the factor individuating the two readings of the necessity modal *prepi*. First, as shown earlier, volitional individuals are subject to a field tendency: the Law of Rational Action (Copley & Harley 2014), thus, agents are the source of intention or desire. Second, it is neither rare to have fragmentation of a verb's semantic roles (e.g. Dowty 1991:553-55) nor uncommon to have agents with distinct roles — volitional, effective, initiative, and agentive — displaying distinctive behavior (Cruse 1973; Levin & Rappaport Hovav 2005). In the case of *prepi* — an impersonal verb — there is a split of roles between an agent and a patient (in the sense of Dowty 1991), depending on the force interaction in the causal frame (Copley et al. 2015). Consider the following example:

- (48) Ta pedhia prepi na ine sto spiti
 The children must.IPFV.3SG SBJV be.IPFV.3PL at-the home
Deontic necessity: “The rules dictate that children have to be at home.”
Epistemic necessity: “As far as I know, the children must be at home.”

In the causal frame of deontic necessity, a necessity force is generated by the agent: this is the agent force. In the same causal frame, a patient undergoes change of state or is causally affected by the agent: this is the patient force. Now, the agent has a certain intention, and because of the agent's control, the agent's intention, i.e., a mother's intention, has a greater magnitude than the patient's intention, i.e., the children. Thus, in this causal frame of deontic necessity, an agent controls or causes intentionally one's participation in a situation or change of state, even in

situations where no action at all is reported or the agent is syntactically absent (see Pylkkänen 2002) — agents can be the external arguments of change-of-state predicates (Folli & Harley 2004; Folli & Harley 2008; Copley & Harley 2014). For instance, this reminds us similar cases of phrases like *What you must do is be here by noon* or *I persuaded her to be here by noon*, where a stative verb like *to be* can be agentive, because it contains the essential agent property of volition/intention, and directs someone's participation in a situation (Jackendoff 1990). The intentional involvement in a situation or, in other words, the exertion of a force is the characteristic feature of this causal frame. Most times than not, the force associated with the agent is not in concordance with the force associated with the patient. In this frame, then, there is an interaction of two forces: the agent's and the patient's.

By contrast, in the causal frame of epistemic necessity, the background knowledge, information and evidence do not have an intention. Nevertheless, there is still a way for a body of information (premises, henceforth) to influence the agent, through the significance of premises in his/her reasoning (Lyons 1977; Sweetser 1982; Copley & Harley 2010; among others). This significance of premises in reasoning is a mental field (Goldman 1967, for a causal theory of knowledge; Dretske 1988:4.1, 1989, 1993; Barbey & Wolff 2007, for causal structures from reasoning; Copley 2010; among many others). That is, when a person knows or evaluates the significance of certain information, that creates a certain kind of intention in the person, involving the agent's beliefs, knowledge and thoughts, creating underlying and connective series of causal chains (Goldman 1967; Copley 2011, 2014, for extensive discussion). In this causal frame of epistemic necessity, an agent is able to reason with respect to a situation. This reminds us, for example, phrases like *What made me think so is that ...* where is clearly indicated the effect of information on the reasoning process. Even though the premises may essentially function similarly as in the deontic necessity, there is a difference: there is no imparting of an external force upon the agent. Rather, the premises internally invoke a field that results in the creation of a force on the agent. As a result, there are not two entities with intentions, but only one, the agent. The origin of the force associated with the premises is in the agent's mind, not in the premises themselves. So is the origin of her pre-existing intention to reason and think.

It seems, therefore, that the necessity modal *prepi* triggers the *force individuation criterion* as defined in Copley et al. (2015), distinguishing between CAUSE and ENABLE causal frames:

(49) Force individuation criterion:

Two forces that have their origin in the same entity must be summed at the conceptual level together into a single force.

According to Copley et al. (2015): “The criterion in (00) is a conceptual, not a grammatical criterion. We hypothesize that such force individuation is a factor in determining whether there is force interaction, and thus whether there is a CAUSE/ENABLE distinction.” Thus, in the causal frame of *prepi* two factors are essential in distinguishing the two readings, epistemic vs. deontic: (a) the direction of the force (CAUSE vs. ENABLE), and (b) the manner in which the force was

created by the conceptual cause (force-generating entity vs. non-force generating entity). More specifically, in the deontic reading (a) the force associated with the agent is not oriented toward the same direction as the force associated with the patient, and (b) the force is generated by the agent's power. In the epistemic reading, (a) the force associated with the agent is oriented toward the same direction as the force associated with the patient, and (b) a field is invoked, resulting in the creation of a force on the agent.

Application of the force can cause change, and change depends on forces, as stated in (49). We understand, then, instantly that necessity as a field of force captures not just application of energy in generating intention, but also the non-deterministic component of intention. If necessity *prepi* in the causal frame represents a force, as I argue, and if force's final result partly depends also a volitional/intentional agent, then a non-entailed result simply follows.

4.3 Possible counterarguments

I dedicate this section to address two possible counterarguments to the analysis I promote in this paper. The first objection pertains to an analysis of the argument structure of *prepi* in the framework of focusing and topicalization. This thesis concerns the fact that in Greek — a highly inflected language — word order is far less crucial for the meaning of a sentence due to the case form of the noun phrases: nominative for the subject and accusative for the direct object. Moreover, in Greek the most neutral word order is either (a) verb-subject-object, or (b) subject-verb-object (Holton, Mackridge & Philippaki-Warbuton 2004). It follows, then, that the fronted noun phrase(s) can be considered a case of focus or topicalization, conveying new information, and the individual readings of necessity as an issue to be resolved in terms of pragmatics by contextual information.

This would be a sensible analysis of *prepi* grounded on syntactic facts about Greek language in general, and here I am not arguing that there is no chance of focusing or topicalization. The semantic analysis I argue for in this paper, does not underestimate the significance of the syntactic facts, but it provides an additional semantic mapping of the argument structure of *prepi* via a force-dynamic perspective in order to explain the conceptualization of necessity and the individuation of its readings. However, since syntax is not the focus of this paper, I leave the contribution of structure for a future analysis where syntax and semantics would combine. Moreover, even in the case where we would investigate *prepi* as a case of focusing or topicalization exclusively, we would not avoid missing an important observation of the semantic analysis offered here: the meaning of necessity is richer than mere deontic or epistemic in containing an intention for result/effect component.

A second objection concerns the fact that *prepi* receives only epistemic reading when the embedded *na*-clause is in past tense — irrespective of lexical or grammatical aspect:

- (50) a. I Maria *prepi* *na* *djavaze*
 The Mary must SBJV read.PST.3SG.IPFV
 Epistemic necessity: “Mary must have been studying.”

- b. I Maria prepi na djavase
 The Mary must SBJV read.PST.3SG.PFV
Epistemic necessity: “Mary must have studied.”
- c. I Maria prepi na ihe djavasi
 The Mary must SBJV had.3SG.PST read.NPST.3SG.PFV
Epistemic necessity: “Mary must have studied”

The problem is that, while the theory of causal frames helps in individuating the readings of necessity modal *prepi* with nonpast tense in the embedded clause, the predictions of the current account seem to fall short when the embedded tense is past. Then, as one might argue, tense seems to play a crucial role in distinguishing the reading of necessity: nonpast tense for deontic and epistemic, and past tense for epistemic reading. That this indeed seems to be an issue needs to be argued, of course. However, I believe that an embedded past tense does not pose a problem to the analysis offered here since the tense's import is modal rather than temporal. In particular, many authors argue that past tense morphology, for example, in Greek (Iatridou 2000), English (e.g., Langacker 1978, 1991; Condoravdi 2002) and French (De Mulder 2004; De Mulder & Brisard 2006; Brisard 2010; Patard 2011), can also indicate — besides denoting past reference — that the described situation is epistemically distant from the speaker's present actual state of affairs. In this sense, then, a past tense is motivated by intentionality and is used to express information about the epistemic status of what is considered as a settled³ situation. This can be revealed by means of substitution test. If the nonpast tense can be replaced by past in a given context, and if this substitution entails a different modal interpretation, i.e., a different epistemic status of the situation, then the use of the tense can be considered modal:

- (51) a. O Petros prepi na djavazi ta mathimata tu
 The Peter must SBJV read.NPST.3SG.IPFV the courses his
Epistemic necessity: “As far as I know, Peter must be doing his homework.”
 “Peter must be doing his homework” *does not entail* “Peter is doing his homework”
- b. O Petros prepi na djavase ta mathimata tu
 The Peter must SBJV read.past.3SG.PFV the courses his
Epistemic necessity: “As far as I know, Peter must have done his homework.”
 “Peter must have done his homework” *does not entail* “Peter has done his homework”

In the example (51), the speaker's intention is not concerned with the temporal grounding of the situation in time, but with a modal attitude conveyed by the tense employed: the situation (Peter's doing his homework), it is not considered settled yet. Thus, in the example (51a), the speaker does not wish to communicate the temporal viewpoint on the situation, but the modal attitude, i.e., the situation is considered as very likely (Iatridou 2000, Ogihara 2000, Dancygier & Sweetser 2005: chap. 3; among others). By contrast, in the example (51b) the speaker's intention

³ *Settled* in the sense of a predetermined situation at the speech time. *Actual* in the sense of a veridical inference to the truth of *p*. *Settled* then does not imply *actual* and vice versa.

is to communicate that the situation is considered as settled, thus, the situation is viewed as less probable.

Crucially, (51a-b) do not entail a resultant state, meaning that the event in the complement clause is not an actual result/effect. Instead, in both examples (51a-b) the actual status of affairs is suspended. In other words, the embedded nonpast conveys a non-settled situation, and an embedded past a settled situation, but this does not entail the actual state of affairs. The modal structure *prepi* with either nonpast or past allows the nonveridical inference to the truth of *p*. Thus, even in the case where *prepi* embeds a past tense, the nonveridicality of the modal verb — the defeasibility of the causal frame — is retained, as we predicted it all along.

I think, then, the exclusion of the deontic necessity reading with embedded past tense falls out nicely. The modal construction with *prepi* and embedded past tense conveys that a situation is viewed as settled (predetermined at the speech time and unknown to the speaker), meaning that a change-of-state is not possible. However, deontic modality — like other directive expression like imperatives — have nonpast orientation and are considered as non-settled by default. In this respect, then, deontic necessity reading conflicts with a situation viewed as settled. In contrast, deontic necessity is concordant with nonpast because a situation is not predetermined at speech time. If a situation was to hold, it would already be doing so at the time of utterance. Therefore, the choice of tense in the embedded clause is insufficient in individuating the readings of the necessity modal *prepi*, but reaffirms the observations made here: *prepi* underlies a causal frame characterized by intentionality. If we are on the right track, then, there is nothing surprising about the past: it is simply another way to create a modal reading. However, the *na*-clause causal frame is important because it allows us to see what is really doing the work: the dynamic interaction of forces at the semantic level, and not syntax.

5 Conclusions

The aim of this paper was to investigate the application of the force-interaction analysis to the individuation of readings of the necessity modal verb *prepi*. The major advantage of the account proposed here is the fact that it associates epistemic necessity and deontic necessity with a causal frame and different configurations of force and agency. In particular, I argued that the meaning of modality is richer than argument structure (raising vs. control) in containing an intention component. This by itself challenges the syntactic analyses of modality, where the distinction between epistemic and deontic reading of necessity comes from the argument structure of a modal verb: raising vs. control, *not* causal frame and agency. Moreover, I showed that, in Greek and English at least, argument structure is not the decisive factor for the individuation of modal readings — a finding in line with Bhatt (1998), Wurmbrand (1999), Eide (2006), and Staraki (2013, 2017, manuscript) observations that modal verbs in English, Hindi, Norwegian and Greek are raising predicates. In other words, no modals take their subject as an argument, as shown. The important factors, I argued, are (a) the direction of the force (CAUSE vs. ENABLE), and (b) the manner in which the force was created by the conceptual cause (force-generating entity vs.

non-force generating entity). The current analysis, crucially, does not posit ambiguity in the meaning of the necessity verb. Rather, it builds on the semantic conceptualization of the defeasible causality and the existence of an intention component in necessity, as argued for by Copley et al. (2015) and more indirectly in Staraki (2013, 2017), postulating a force interaction between structure (causal frame), agency and configurations of force that affects the modal readings individuation. Such force interactions are common crosslinguistically (Barbey & Wolff 2007; Copley & Martin 2014) when it comes to the conceptualization of the argument structure, areas that are affected in the necessity case as well.

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