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Quantifier scope and the role of intonation in Greek

A dissertation submitted in partial satisfaction of the
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by

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To the memory of my dear father.

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ABSTRACT OF THE DISSERTATION

Quantifier scope and the role of intonation in Greek

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In this thesis I give a pragmatic account of the relation between intonation and meaning in Greek. I argue that the main function of intonation is to anchor an utterance to its context: different prosodic realizations of the same sentence signal different partitions of that sentence into old and new parts—i.e., different information structures—which make it appropriate for different contexts. In the first part of the thesis, I establish how information structure categories are prosodically realized in different sentence types in Greek (statements, negatives, questions) and show that different rules apply for encoding focus and background across sentence types. In the second part of the thesis, I

show through experimental evidence that even when the intonation/information structure organization of an utterance makes a truth conditional difference, the effect is still pragmatic and not semantic. I present results from three experiments which tested the hypothesis that distinct prosody reflects distinct underlying scope relations in scope-ambiguous sentences. These experiments examined how sentences containing two quantificational elements are produced and interpreted. Each experimental sentence was embedded in two different contexts and the expectation that each of the contexts would induce a distinct prosodic realization of that sentence was confirmed. In the perception part of the three experiments, though, results are not consistent. In the first two experiments, the interpretation listeners gave to the utterances they heard depended on the intonation: the focused quantifier was interpreted with wide scope. However, in the third experiment listeners gave subjects a wide scope interpretation, regardless the intonation. In other words, focused and backgrounded material did not receive an invariant truth-conditional interpretation, which I take as an argument against dealing with focus in the semantics proper. On the other hand, I found that the disambiguating effect of intonation is a function of context. Intonation encodes information about the context of an utterance: if this context is unambiguous (in experiments 1, 2), the utterance is unambiguous too; if the context is ambiguous (in experiment 3), intonation cannot disambiguate. This result suggests that intonation is consistently linked with pragmatics and occasional truth conditional effects of intonation are epiphenomenal.

CHAPTER 1

Introduction: the role of Intonation in grammar and its link with Information Structure

1.1 Introduction

In this thesis I discuss the role of intonation in grammar. I argue that the main function of intonation is to anchor utterances within their context, and that it does so by giving different melodic realization to the elements of an utterance that were part of the context and to the elements that are new. Examples of two different melodic realizations of a sentence are shown in (1) and (2), where the constituent in focus is in square brackets. Suppose that I tune in a talk show mid-program and I hear (1). In addition to the compositional meaning of the utterance (brought about from the combination of the meanings of the words in it), I will be able to deduce that the topic of the discussion is something like 'people of high intellectual ability in positions of power'. On the other hand, if the utterance I hear is (2), which has the same compositional meaning as (1), the topic of discussion I reconstruct will be 'the quality of top executives in the White House' (capitals on a word indicate that it is accented—i.e., prosodically prominent).

(1)   *We have a genius in the* [*WHITE House*]$_F$ *now*

(2)   *We have a* [*GEnius*]$_F$ *in the White House now*

Although the two utterances have the same propositional content, they are not interchangeable in context. Their intonation (i.e., their melody) makes them felicitous only in certain contexts and infelicitous in others. By extension, in the absence of context, the implicit knowledge of the function of intonation helps listeners decode the different melodic realizations of the utterances to recover their context. We perceive the two utterances as having 'different meaning'. This meaning difference, however, is not one of truth conditions. That is, we cannot find situations that would make the propositional content of (1) true and that of (2) false. Instead, this 'meaning difference' has to do with the context each of the utterances can be appropriately used in. In other words, changing the intonation of an utterance has an effect on what contexts it is appropriate in and in that sense we attribute different meanings to it.

The idea that different contexts require different melodies of a particular sentence is of course very old and uncontroversial in linguistics (Bolinger (1965), Halliday (1967), Jackendoff (1972), Ladd (1980, 1996), Gussenhoven (1984), Selkirk (1984, 1995), Erteschik-Shir (1986), Prince (1986), Rochemont (1986), Ward (1988), Pierrehumbert and Hirschberg (1990), Steedman (1991), Vallduví (1990), Roberts (1996), Vallduví and Engdahl (1996), Büring (1999, 1997b), Schwarzschild (1999) among countless others). However, it is still controversial that this is the core function of intonation. It is sometimes assumed for example that focus makes its own truth-conditional-interpretation contribution, i.e. it contributes a meaning apart from that of the lexical material it is realized on. This assumption is based on the fact that there are occasions when an intonation change can make a truth-conditional difference. Consider

the two melodic realizations of the sentence in (3) and (4). Each of these has a different truth-conditional interpretation (the most frequently cited early reference for such examples is Jackendoff 1972), shown in (3) and (4).

(3)   *ALL the men didn't go*
          |
       H*   L⁻ L%   Contour A

       'No man went'   (ALL > NOT)

(4)   *ALL the men didn't go*
          |
       L+H*   L⁻ H%   Contour B

       'Some men went'   (NOT > ALL)

Each of these interpretations is realized with a different intonation of the sentence, what Jackendoff (1972), adopting Bolinger (1958) called contour A for (3) and contour B for (4). The meaning difference in (3) and (4) is attributed to different scope relations between *all* and *not*. The questions asked in this thesis are: Do these effects arise from a special interpretation attached to A contours and B contours? Does an A contour always receive wide scope and a B contour narrow scope interpretation? The answer I give is 'No'. I show through experimental evidence that the role of intonation in grammar is constant: it links the utterance with an appropriate context. Different intonational realizations of the same sentence make it appropriate for different contexts and these different contexts bring about the disambiguating effect of quantificational sentences. In other words, the disambiguating effect of intonation is not due to the semantic

contribution of focus but to pragmatic principles. For a similar argument on the role of context as the source of the disambiguating effect of intonation in quantificational sentences in English, see Kadmon and Roberts (1986) and Büring (1997a).

There are of course other types of sentences that get disambiguated by prosody. For example, Lehiste (1973) found that speakers and listeners were best able to disambiguate sentences with syntactic bracketing ambiguities ((A+B) + C) versus (A + (B+C)) among all the different kinds of syntactic ambiguities she tested for. More recently, several studies (Cooper & Paccia-Cooper (1980), Warren (1985), Price et al (1991), and Wightman et al (1992), Schafer (1996), Schafer and Jun (2000) , Schafer and Jun (2002), Jun (in press)), examined differences in the prosodic contours of several types of structural ambiguity, such as Prepositional Phrase attachment or Relative Clause attachment ambiguities (attachment of a Prepositional Phrase to a noun occurring in a higher or lower position in a sentence) and found that listeners disambiguated them using cues such as pre-boundary lengthening, pitch accents, and boundary tones. It is not clear whether such disambiguating effects can be attributed to pragmatic principles.

The experiments undertaken for this thesis involve quantificational, scopally ambiguous sentences in Greek. They were conducted to establish the relation between intonation structure and scopal interpretation of utterances. I found that whereas intonation disambiguated the sentences for two of the three experiments by giving a wide scope interpretation to focus, it did not do so in the third one, a fact that I take to be counter-evidence to the claim that focus carries a truth conditional interpretation.

Furthermore I take the experimental results as evidence that the constant role of intonation is to link the utterances with their context.

In subsequent chapters, I present and analyze the Greek facts. In this chapter I briefly present background notions necessary to appreciate the following chapters. In section 2, I present some definitions for quantifier, scope and the accounts given for scope effects (c-command etc). Furthermore, in section 3 I present the notion of information structure (the new/old or focus/ground division of sentences), which will be central to the account given in this thesis and present some of the models that have been proposed to account for the relation between information structure and the rest of grammar, for a number of Germanic and Romance languages.

1.2 Quantifiers and scope: Some background notions

Since the experiments presented in chapters 3 and 4 investigate utterances that contain quantifiers and examine their scope interpretation, clarification of some background notions is necessary. In section 2.1 I define the notion of *quantifier/operator*, and in section 2.2 I present the syntactic theories of scope which will be useful in the discussion of the experimental results. Although the accounts of quantifiers and scope presented in this section cover mainly the English facts, I will assume that they can be extended to cover Greek, as well.

1.2.1 Quantifiers

Quantified NPs (QNPs) like *every* N, *some* N, *few* N are treated differently from NPs like *the tree* and names like *Mary* because they do not refer to a specific entity, but denote sets of properties (i.e., sets of sets of individuals).

(5)   Mary saw everyone

The meaning of (5) can be represented as shown in (6), where the interpretation of the variable *x* depends on the quantifier, in this case $\forall$ (*everyone*)[1]. According to standard logic terminology, the quantifier binds the variable.

(6) $\forall x$, (Saw mx): for all x, Mary saw x.

QNPs are also sometimes referred to as operators. It is assumed that each variable must be bound by an operator and that each operator must bind a variable. In cases where two operators are found in a sentence (and thus two variables as well), the order the operators are written in a formula like (6) is important because the order denotes their relative *scope*, and when scope relations change, the meaning changes as well. For example, (7) can be represented in logic either as (8) or (9). The logical scope of the quantifier is everything to its right, so in (8) *everyone* ($\forall$) scopes over *someone* ($\exists$),

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[1] I use $\forall x$ and $\exists x$ etc. as shorthand for the determiner meanings.

whereas in (9) the reverse relation holds. (8) means that everyone saw a possibly different person, whereas (9) means that there was one person that everyone saw.

(7)   *Everyone saw someone.*

(8) $\forall x \, \exists y \, (Sxy)$: 'For all x there is a y such that x saw y'.

(9) $\exists y \, \forall x \, (Sxy)$: 'There is a y such that every x saw y'.

In (8), *everyone* is said to have *wide* scope over *someone* and *someone* is said to have *narrow* scope. Furthermore, in (8) *everyone* is said to have *linear* wide scope because the order of the quantifiers in the logical formula matches their linear order in the sentence in (7). On the other hand, in (9) *someone* has *inverse* wide scope because the order of the quantifiers in the formula is the reverse of their linear order in the sentence in (7).

1.2.2 The syntax of scope

The relative scope of operators is also represented in syntax. Operators/quantifiers have to move to positions which determine their scope in a phrase structure tree. For English, this is achieved by movement called quantifier raising (QR), which is assumed to occur at a level of representation referred to as the 'invisible' syntax, also known as Logical Form (LF). Most models assume that QR occurs at LF mainly because, for

English, in many cases the linear surface order of the constituents in a sentence is different from the order of constituents that establishes their scope relation.

With QR, the quantifier moves out of its argument position to a position where it takes scope, leaving a trace x (the bound variable in the logical representation), co-indexed with the quantifier. The scope of the quantifier is assumed to be its c-command domain. The relation of c-command (as first discussed and defined by Reinhart (1976)) is schematically represented in (10) and the definition is given in (11):

(10)

(11)　C-command:

　　　Node A c-commands node B iff

　　　(i)　　A does not dominate B and B does not dominate A; and

　　　(ii)　　The first branching node dominating A also dominates B.

In (10), A c-commands B: A does not dominate B and Z, the branching node that dominates A, also dominates B.

This is the base of the syntactic theory on quantifier scope and it is widely assumed even among competing theories of scope (May (1977, 1985), Aoun & Hornstein (1985),

Aoun & Li (1989, 1993), Hornstein (1995), Beghelli & Stowell (1997) among others). Sentences containing two operators usually give rise to scope ambiguities, represented in syntax by different c-command relations between the two quantifiers: the c-commanding QP takes wide scope.

According to some authors QR is a uniform rule, in the sense that it is blind to the type of quantifier it applies to. QPs can adjoin either to the S node (in contemporary terminology, this translates to IP), or to VP at LF, thus deriving ambiguity. For example, the sentence in (12) will have either derivation (12a) where *somebody* has wide scope because it c-commands the lower QP, *everyone*, or (12b) where *everyone* has wide scope because it has raised higher than *somebody*.

(12)   *Somebody loves everyone.*

        a. [$_S$ Somebody$_j$ [$_S$ x$_j$ [$_{VP}$ everyone$_k$ [$_{VP}$ loves x$_k$]]]]

        b. [$_S$ everyone$_k$ [$_S$ Somebody$_j$ [$_S$ x$_j$ [$_{VP}$[loves x$_k$]]]]]

The theory proposed in Beghelli & Stowell (B&S) (1997), however, postulates that QR is not a uniform rule. Quantifiers are classified according to their semantic properties. The syntactic behavior of each quantifier class is determined by its semantic type, so it is implicitly assumed that lexical semantics are also important in the determination of scope. Properties or features of QPs determine their membership in one of the QP categories proposed in the model. The mechanism of Feature Checking is seen as the basis for scope interactions: QPs have some feature which forces them to

move to the specifier of a functional projection that also has this feature, so that the QP in the specifier will agree in features with the head of the projection (by the mechanism called spec-head agreement). This is LF movement of QPs to functional projections at the top of the hierarchical structure. B&S propose that the functional hierarchy of the clause encodes the structural order in which semantic information is processed, and scope is simply the by-product of the spec-head agreement processes.

Among the QP-types are distinguished in this theory, are:

- Distributive QPs (DQPs), headed by *every* and *each,* moving to a functional projection called DistP which occupies a high position in the hierarchical structure and therefore gives DQPs the ability to take wide scope;

- Counting QPs (CQPs), with determiners like *few, at most six,* or *more than five,* etc, taking scope in their case positions, AgrSP and AgrOP—this position for scope taking accounts for the fact that these quantifiers can't take inverse wide scope: that is, they cannot take wide scope as objects, because there is no functional projection they can move to above their case positions (AgrOP), so when they are found together with any other QP, which can move to one of the functional projections above the object case position, they are 'trapped';

- Group QPs (GQPs), including indefinite QPs headed by *a, some,* bare numeral QPs like *three students,* and definite QPs like *the students.* GQPs can take scope in several positions. Depending on the position they land they have different scoping abilities and receive a different interpretation. In a functional projection called RefP these quantifiers can take widest scope and receive a referential specific

interpretation and in a different functional projection called ShareP they take narrow scope under DQPs and other GQPs and receive an indefinite, existential interpretation.

Notice that these theories do not discuss the prosodic realization of the sentences they examine so it is unclear how the disambiguating effect of intonation in examples like (3) and (4) '*All the men didn't go*' would be accounted for. In many syntactic accounts, focused and topicalized constituents occupy special structural positions (called FocusP and TopicP sometimes). It is not clear how the positions assumed for the scope facts and the positions assumed for the focus-topic facts could be combined to yield the right empirical results. The actual implementation of extending this proposal to Greek falls outside the scope of this thesis so I leave it open for future research. The pragmatic account of disambiguation I give does not preclude a syntactic account from also being applicable. Here I am concerned with the disambiguation of (structurally) scope-ambiguous sentences, however these are actually represented or derived.

With that said, we now turn to pragmatics and the proposals made in the literature for the information structure of utterances in English and other languages.

1.3 Information Structure

This thesis deals exclusively with spoken language and distinguishes between a *sentence* (written) and an *utterance* (oral). The exchange of utterances among any number of people is a *discourse*. The contribution of utterances that the participants make as well as any beliefs and knowledge agreed upon by the participants are called

the *common ground.* At the outset of any discourse the common ground probably contains notions like *I, you, here, now,* and knowledge of the world. Utterances that are added to the common ground are, in the general case, assumed to conform to Gricean maxims of conversation, like be relevant[2], be informative, be perspicuous, be truthful (Grice 1975), which are though of as general implicit rules that govern conversation and which participants adhere to (without of course excluding the possibility that these maxims may be flouted).

One way conversation can proceed is by questions and answers. Questions direct the conversation and are seen as the *context* of the answers. The construction of 'appropriate' answers is governed by specific information structure, prosodic structure, and in some cases syntactic structure conditions: a rule of thumb very commonly used is that what is usually called the *new information* in the answers corresponds to the wh-constituent in questions and the remainder is the *old information.* New and old information are encoded in different ways across languages and may be distinguished from each other through differences in their prosodic prominence, in their morphological marking, or in their syntactic position in a sentence, as will be discussed below.

The structuring of a sentence into categories such as old/new information, focus, background, theme, rheme, topic, comment, and a host of other terms, is referred to as its *information structure* or *information packaging* (Halliday (1967), Chafe (1974), Steedman (1991), (2000), Buring (1994), (1997b), Roberts (1996), Vallduví (1990),

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[2] This is evident also by the fact that when people want to change the topic of conversation they often

(1993), Vallduví and Engdahl (1996)). All these informational notions fall within the realm of Pragmatics, which—very informally—is the part of grammar that deals with interpretation of sentences that is not truth conditional (i.e. not involving the truth or falsity of their propositional content). In other words, pragmatics is the realm of 'extrapropositional' meaning (a term borrowed from Vallduví and Engdahl (1996)) and involves the appropriateness of an utterance in a particular context. The domain of pragmatics is closely bound up with intonation, syntax, and semantics as will become evident in this thesis. In fact, as I will show in subsequent chapters, in Greek, the language I experimentally investigated, information structure is the source of some truth conditional effects of intonation, specifically the disambiguating effects of scopally ambiguous sentences.

New information is very often encoded in languages through focus. The term *focus* is multiply ambiguous in the literature: it has been used to refer to the pragmatic notion of new information and the division of a sentence into a focus part and a ground part (see Erteschik-Shir (1986), Prince (1986), Rochemont (1986), Ward (1988), Vallduví (1990), Büring (1999), Roberts (1996), among others), the prosodic notion of a prominent pitch accent (Pierrehumbert (1980), Pierrehumbert and Hirschberg (1990), Ladd (1983), (1986) among others), the syntactic notion of F-marking of constituents as they become part of a phrase marker (in the sense of Selkirk (1984), (1995), Rochemont (1986)), or the semantic interpretation of F-marked constituents (as a set of alternatives in the sense of Rooth (1985), (1992), among others). Such ambiguity is unsurprising

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need to use special 'topic changing' opening phrases like 'by the way…' or 'speaking of …' etc.

given the fact that very often these notions are just different facets of the same phenomenon as it is realized in the different components of grammar. For example it is often the case that new information is encoded in prosody by the most prominent pitch accent.

Old, or *given*, information on the other hand does not have such uniform realization. In prosody it might be realized as de-accented material or with a special 'topic intonation'. In syntax it might be elided, or moved to a peripheral position. The semantic contribution of topics has been formalized in different ways (for a discussion of these formalizations see Buring (1997b)).

Algorithms predicting the information structural realization of utterances were until very recently lopsided, paying far more attention to the focus part than the ground part. Although the field was aware that both de-accented and topicalized material belongs to the given part of an utterance there was no model to account for the distribution of the given material until very recently, in the 1990's, when several proposals emerged almost simultaneously. All these new models make finer distinctions among different occurrences of given material (de-accented or topicalized) and are better able to predict what contexts trigger different interpretation of information structure realizations and interpretation of the same sentence.

The three models I discuss here, Steedman (1991, 2000), Vallduví (1992, 1993; Vallduví and Engdahl 1996), and Büring (1999, 1997b, to appear), arose out of the realization that a simple two-dimensional focus-ground articulation of information structure is not enough. These models examine mostly Germanic and Romance

languages but also extend to languages like Hungarian and Turkish. As I will show in chapter 2, Greek shares information structural properties with many of these languages. The presentation here serves as the backdrop against which the description of the relation between information structure, intonation, and word order in Greek will be presented.

In section 3.1 I present the background that information structure theories assume, Selkirk's theory of F-marking (1984, 1995); in sections 3.2.1, 3.2.2, and 3.2.3, I present the three models of information structure, Büring, Steedman, and Vallduví respectively. Section 3.3 presents a summary and a comparison of the three models.

1.3.1 Givenness, F-marking, and accenting

Since all three authors whose information structure models I discuss build on previous theories of F-marking to derive the distribution of accents within the Focus and Topic parts, I will briefly discuss Selkirk's theory (1995) of F-marking, which is an amalgam of Selkirk (1984) and Rochemont (1986). Note that this theory as well as competing theories like Schwarzschild (1999) and Rochemont (1986) for example, address predominantly the focus part of utterances. The ground part does not figure in the analysis except for being the complementary category to focus: it is what is left when focus is taken out of the utterance and its realization is not only unexamined, but it is also assumed to be invariable, that is all ground material is assumed to be unaccented—which as we will see in 3.2.1, 3.2.2, is inaccurate.

The goal of any theory of focus is, given a context question, to predict where focus will be located in the answer. Furthermore, given a context question, the focused constituents that will carry accents need to be determined. In Selkirk, non-given information must be F-marked. F-marking (locating the new information in an utterance) is the primary process and it obeys information structure and syntactic principles. The alternative model proposed in Schwarzschild (1999) argues that Givenness is the basic notion, which is given a semantic definition and focus is a derivative notion. Givenness in pragmatic accounts doesn't require literal previous mention, but can be satisfied by coreference, hyponymy, inference, etc.

A pitch accent, say H*, aligned with a stressed syllable is the phonetic realization of focus in Selkirk's model. The word carrying the pitch accent is called the *focus exponent*. The focus, however, is thought to be bigger than the pitch-accent-carrying syllable and quite often bigger than the focus exponent; it is rather an entire phrase containing the focus exponent. In Selkirk the pitch accent is a realization of an abstract focus feature F, assigned in the syntax, and there are laws that allow F to 'project' to the entire constituent. The rules underlying this process, shown in (13), are termed the rules of *focus projection* and the highest syntactic node having the F-feature is called FOC. This is how FOC is interpreted in Selkirk: 'A wh-question expression focuses a constituent, and an appropriate answer to a wh-question must focus the same constituent.' (Selkirk 1995:553). Example (14) shows how F-marking works.

(13)   F-projection rules

1. An accented word is F-marked

2. F-marking the head of a phrase licenses the F-marking of the phrase

3. F-marking the internal argument of a head licences the F-marking of the head

(14)   Q: *What did Mary do*?

A: *She* [[*praised*]$_F$ [*her* [BROTHER]$_F$]$_F$]$_{FOC}$

In (14), accent on *brother* entails that it is F-marked, by rule 1. The NP *her brother* is also F-marked by rule 2. The NP is the internal argument of the verb and thus the verb can be F-marked, by rule 3, and in turn the whole VP is F-marked by rule 2.

In a quite famous example shown in (15) (Chomsky (1971)), each of the F labeled constituents may count as the FOC of the focus feature that is realized phonetically on *shirt*. As it is labeled now the example is an answer to the question 'What happened to him?' However smaller and smaller constituents can be the FOC, without a change of the focus exponent, each FOC can be the answer to a different question. The immediately smaller constituent as FOC, *to look out for an ex-convict with a red SHIRT,* would be the answer to 'What was he warned about?' The constituent *an ex-convict with a red SHIRT,* would be the answer to 'Who was he warned to look out for?' and so on.

(15)   *He was* [*warned* [*to look out for* [*an ex-convict* [*with* [*a red SHIRT*]$_F$]$_F$] $_F$] $_F$] $_F$]$_{FOC}$

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F can be projected up to the highest VP node as shown in (15), according to the rules of focus projection in (13). So the pitch accenting of words can be used to indicate their information status as well as the information status of the phrases containing them. When more than one of the constituents dominated by FOC is F-marked, then the main prominence goes to the last Pitch Accent in the domain (compare this to the Nuclear Stress Rule (Chomsky (1972), Jackendoff (1972), Cinque (1993)), according to which the main prominence goes to the most deeply embedded constituent, which in simple sentences is the rightmost one).

However there are restrictions for focus projection which can be illustrated by changing the location of the final pitch accent and placing it on *red*. In this case, as shown in (16), no F-projection is possible. Only *red* can be a focus because there is no way for focus to project above the focus exponent according to the rules in (13).

(16)   *He was warned to look out for an ex-convict with a* [*RED*]_F *shirt*

The definition of the focus of an utterance (FOC) as 'an F-marked constituent not dominated by any other F-marked constituent' (Selkirk (1995):555) makes a distinction between plain F-marked constituents and FOC, which results in a three-way distinction among constituents: non-F marked constituents, which must be given, plain F-marked constituents, which must be new, and FOC constituents, which can be either new or given.

Although F-marked material is in general accented, some F-marked constituents can remain unaccented through a process called *integration* (the term is not Selkirk's but appears in Jacobs (1991,1992, 1999); notice though, that the effect of integration is build into the focus projection algorithm in her framework, namely 13.3): the head of a syntactic phrase can remain unaccented if its complement is accented, as shown in (17) where both the verb and the object in the VP are F-marked but only the complement of the verb, *a watch* is accented:

(17)   Q: *What did Ethel do*?

        A: *She* [[*bought*]F [*a WATCH*]F]FOC

In chapter 2 I will show cases in Greek where F-marking does not trigger pitch accents (especially in negative and interrogative utterances) and also cases where pitch accents occur on F-less/non-F-marked material (every content word in Greek, given or new, needs to carry pre-nuclear pitch accents in non-negative declarative sentences).

Summarizing Selkirk's F-marking proposal[3], the algorithm for the distribution of accents in a sentence (ignoring fine details) is: Find the F-marked material by looking at the context wh-question, and accent F-marked XPs. The last accent within a prosodic phrase is the (Nuclear Pitch Accent, or) focus exponent. Leave given XPs unaccented. Non-given verbs can be left unaccented as long as their complement is accented. This is in broad terms the theory presupposed in the models presented in the remaining

sections. These models build on Selkirk's theory and give fuller pictures of the structure of utterances by providing theories for the realization of the background part which was neglected in Selkirk.

1.3.2 Three models of information structure

The order of presentation of these models does not follow chronological order. Instead I present them according to the number of information structural categories they assume—from those who assume more categories to those that assume fewer—for expository reasons, that is to avoid unnecessary repetitions.

1.3.2.1 Büring's *Contrastive Topic*

Büring's Contrastive Topic theory has developed over several stages (1994, 1997b, to appear); I will describe the latest version of it here. In this model, utterances are divided into three primary information units: *Contrastive Topic (CT), Background,* and *Focus,* as shown in (18). The B-accent of Bolinger (1958) (L+H* L⁻ H%) signals a contrastive topic. The A-accent (H* L⁻ L%) signals focus. Background is the given material, i.e., material that was in the context, and Focus in the answer must match the wh-expression in the question, according to the widely used Question-Answer condition. The main contribution of Büring's theory is the formalization of the conditions for the use and interpretation of contrastive topics: this model predicts when the presence of a contrastive topic is obligatory, optional, or impossible. Contrastive

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[3] For criticisms of Selkirk's theory see Gussenhoven (1999), Schwarzschild (1999) and references in there.

Topics mark deviance from the question, in the sense that they answer a sub-question to the question asked. For example, a complete answer to (18) would give a list of the people-clothes pairs. In that sense (18A) is not a complete answer because it gives information about only one of the people going to the concert. The CT marking in (18A) indicates the deviance from a complete answer and also the fact that questions about what other people are wearing are left open.

(18)   Q: *What are people wearing to the concert*?

      A: [ANN]   [*is*   *wearing*]   [*a TUTU*]

       L+H* L⁻H%   H* L⁻L%

         CT   Background   Focus

Simplifying considerably, here is how this information structure is interpreted:

- The focus gives rise to an alternative set interpretation (Rooth 1985, 1992). It creates a 'focus alternative set', a set of propositions of the form 'Ann is wearing x' by abstracting over the focused element, that is,

    F: {'Ann is wearing overalls', 'Ann is wearing a Tutu', 'Ann is wearing a clown costume', …}.

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- Büring defines a formal semantic object, the CT value of sentences that contain contrastive topics. The CT-value is a set of question meanings of the form 'What is X wearing?' derived from the sentence (*Ann is wearing a tutu*) by abstracting over the CT-marked element, that is,

  T: {'What is Ann wearing?', 'What is Bianca wearing?', 'What is Olivia wearing?', …}.

- Assuming that each question in set T has an interpretation like set F (a set of propositions which are its possible answers cf. Hamblin (1973) and Karttunen (1977), theories of question interpretation), T is a set of sets of propositions, which is formed by substituting each question with the set of propositions it defines:

  T: {{'Ann is wearing overalls', 'Ann is wearing a Tutu', 'Ann is wearing a clown costume', …}, {'Bianca is wearing overalls', 'Bianca is wearing a Tutu', 'Bianca is wearing a clown costume', …}, {'Olivia is wearing overalls', 'Olivia is wearing a Tutu', 'Olivia is wearing a clown costume', …}, …}.

So, stated informally, CT marking and F marking provide different kinds of variables to substitute for the constituents they mark. In the case of (18) this would result in an open proposition of the form 'X is wearing x' with X ranging over different individuals and x ranging over different clothes.

Question (18Q) is called Question Under Discussion, a term adopted from Roberts (1996), and questions like those in set T are called sub-questions. Two conditions on the use of CT marking are that (i) it implies that one of the sub-questions is answered and (ii) other sub-questions to the same QUD are part of the discourse.

A further division is made in this model, within the Focus and Contrastive Topic constituents: both can have a *focus* part and a *background* part, shown in (19). Selkirk's F-marking theory can account for the accent patterns in both Focus and Contrastive Topic constituents. According to rule 1 in Selkirk's Focus Projection rules in (13), non-F-marked constituents, that is, given ones, are not accented. At first glance this rule cannot account for the pitch accents found in topics (which count as part of the background); however since both topic phrases and focus phrases are further divided into a focus part and a ground part, rule 1 can be made to apply even for topics. So, the focus part and the background part within the Focus and the CT constituent correspond to accented and unaccented material respectively, as in (19).

(19)   Q: *What are people wearing to the concert?*

A: [*The YOUNG people*]   [*are   wearing*]   [*INFORMAL clothes*]

L+H*   LH%   H*   LL%

+F   -F   +F   -F

CT   Background   Focus

Note that this analysis is purely pragmatic. It interprets 'Focus/Topic as pertaining to the discourse structure (question under discussion, …, givenness. . .), but never as changing the truth conditions' (Büring (1997b)). The application of this model is extended in Büring (1997a) to cases where focus has been argued to have a truth conditional interpretation. Büring shows that the truth conditional effects arising through the different prosodic realizations of quantificational sentences are due to different contexts: focus can be used to reconstruct, or guess at, a context, in context-less utterances, and that reconstructed context yields the semantic effect.   A similar proposal will be made to account for the disambiguating effect of intonation in Greek in this thesis.

1.3.2.2 Steedman's *Theme and Rheme*

In Steedman (1991), (2000) prosodic, syntactic, and information structure are isomorphic. Utterances are divided into two primary information units called *theme*—what the utterance is about, which in (20) is 'Mary prefers x (i.e. something)'—and *rheme*—what the speaker says about the theme, which in (20) is 'corduroy'. Theme and rheme are co-extensive with both prosodic and syntactic phrases. The notions of theme and rheme can apply to non-standard syntactic constituents like *Mary prefers* ---which in his model are possible constituents--- as well as standard ones.

(20)   Q: *I know that Alice likes velvet. But what does MARY prefer*?

A: [*MARY prefers*]$_{Theme}$ [*CORDUROY*]$_{Rheme}$.

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Intonational constituents must have coherent translations at information structure. The rheme receives an interpretation similar to the 'focus meaning' of Rooth (1992, 1996): this is a set of propositions of the form 'Mary prefers x', which Steedman calls the 'Rheme Alternative Set'. The theme interpretation is not fully developed in Steedman's work. He assumes that the pitch accent in the theme marks it as contrasted with other 'contextually available themes.' However, there is no precise prediction about when they can be used or how their interpretation is calculated. In later work Steedman more or less adopts the theory of Contrastive Topic Alternative Set developed in Büring (1997b), which he terms the interpretation of themes 'Theme Alternative Set'. This is a set of Rheme Alternative Sets arrived at in the case of (20) by substituting the pitch accented *Mary* with other contextually accessible people: {{Mary prefers x}, {Lilly prefers x}, {Victor prefers x}, …}. However there is still no account of when themes are used and why.

Theme and rheme themselves are further divided into a *focus* part and a *background* part which correspond to the accented and unaccented material respectively. The following example[4] illustrates the division of a sentence into the theme and rheme parts and also the internal structure of each of these partitions:

(21)   Q: *What will the pop stars sing after the prime minister's speech about China?*

       A: [*The FEmale pop stars*]   [*will sing*] [*SONGS about China*]

            L+H*   LH%   H*   LL%

           Focus Background   *Background* *Focus*   *Background*

                Theme   *Rheme*

Compared to the Büring model, the Steedman model utilizes one less category: where the former makes an initial partition of the utterance into three parts, Contrastive Topic, Background, and Focus, the latter recognizes two categories, the Rheme which is analogous to Büring's Focus, and the Theme, which is analogous to Contrastive Topic and Background combined. In (21), then, the verb *is wearing* is part of the theme whereas in Büring it would be the Background. As far as the accenting properties of the verb itself are concerned, both models make the same predictions, i.e., in both the verb does not carry any pitch accent. However, I believe that the Steedman model makes wrong predictions about the location of the boundary: the LH% movement in (21) comes at the end of *Ann* not at the end of the verb. This of course is subject to empirical verification.

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[4] I thank Daniel Büring for this example.

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1.3.2.3 Vallduví's *Link, Tail, and Focus*

In the model described in Vallduví (1992, 1993), and Vallduví and Engdahl (1996) utterances are partitioned into three components: *Focus, Link,* and *Tail*, where the latter two together are called the *Ground*, shown in (22).

(22)   Utterance

```
              Ground      Focus

        Link       Tail
```

I believe Vallduví's major contribution is showing that different languages encode information categories differently. In Catalan these different components are syntactically encoded through constituent order: Link material is clitic dislocated to the left, tail material is clitic dislocated to the right, and only focus material stays within the main clause. In chapter 2 I will show that Greek shares these characteristics with Catalan. That is, Links are dislocated to the left and Tails can be—but don't have to be—dislocated to the right. However in Greek Links also have special prosodic 'Topic' intonation, which is presumably absent from Catalan Links. In English, intonation and constituent order can signal information structure. According to Vallduví, in English Focus is marked by intonational prominence, in particular H*, Links are marked by

L+H* pitch accents and optionally leftward dislocation, and Tails are typically de-accented.

For the interpretation of the different components of information structure Vallduví adopts a complex 'file-update' metaphor. The focus is defined as the part that really updates the hearer information. Links 'designate a specific file card in the input file where information update is to be carried out' (Vallduví and Engdahl (1996):9). Tails indicate 'how then focus fits there' (Vallduví and Engdahl (1996):9). Vallduví's theory of interpretation has received criticism in the literature for not being explicit and leaving issues unclear (Hendriks (2002), Dekker and Hendriks (1994), (1996)). I will not examine this issue since it is not crucial for our purposes. What is interesting is that each component recognized in this model receives a different interpretation and realization, in prosody, morphology, syntax, or any combination of them, depending on the language.

I repeat (21) labeled according to Vallduví system, in (23). Boundary tones aren't shown here because they are not mentioned in Vallduví. Comparing this labeling to that of the previous two models, the differences and similarities among them become clear.

(23)   Q: What are people wearing to the concert?

A: [ANN   is   wearing]   [a black   PANT   suit]
   L+H*   H*

Link   Tail   ?   Focus   ?

Ground   Focus

1.3.3 Comparison of the three models

Vallduví's Link can be equated with Steedman's Theme and Büring's CT; Vallduví's Focus to Steedman's Rheme and Büring's Focus. The information structural component that is missing from Vallduví's model is the 'background' part of the Focus and Link phrases. Table 1 is probably helpful in clearing up the unfortunate ambiguity of all these terms. In Vallduví's model there is no description of the internal structure of Link and Focus and no prediction about the accent distribution within them. I think that Tail should not be equated with the background/unaccented part of Links, but with the Background proper found in the Büring system and missing from the Steedman system. One reason is that, according to Vallduví Links but not Tails can undergo leftward dislocation. Another reason is that Links and Tails receive different interpretations.

	TOPIC	BACKGROUND	FOCUS
Büring	CT ⏜ Background · Focus	Background	Focus ⏜ Background · Focus
Steedman	Theme ⏜ Background · Focus	¿Missing?	Rheme ⏜ Background · Focus
Vallduví	Link ⏜ ¿Missing? · Focus	Tail	Focus ⏜ ¿Missing? · Focus

Table 1-1. Correspondence of the terms used for the information structural categories in the models of Büring, Steedman, and Vallduví.

Consider the following examples which show the difference between a Tail and the background part of the Focus. In (24) the Information Structure division is different from that in (25) because their contexts are different. Specifically the change involves the labeling of the verb *drinks*. In (24) it is part of the focus because it is new, but in (25) it is part of the ground because it is part of the context ('What does he drink?'). This difference is recognized in Vallduví (where these examples were taken from (Vallduví and Engdahl (1996):8)). The verb in (25) qualifies as Tail because it is part of the Ground and it is not a Link. However in (24) there is no account for why the verb is unaccented. Although in these particular examples there is no difference in the realization of the verb in the two sentences (it is unaccented in both) we can see a difference in their realization once elision is considered: the answer to (25) can be just *Beer* but the answer to (24) does not allow for elision—*Beer* is an inappropriate answer to it.

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(24) Q: What about John? What does he do?

   A: [[John]_{Link}]_{Ground} [drinks BEER]_F

(25) Q: What about John? What does he drink?

   A: [[John]_{Link} drinks]_{Ground} [BEER]_F

Summarizing, in this section I showed that, abstracting away from details, researchers' views about the realization and interpretation of the major categories in Information Structure are starting to converge. They agree on the opposition between focus and the rest of the utterance and furthermore they agree that the structure of this 'rest of the utterance' has a rich structure and contributes to the interpretation of the utterance. In (26-28) I give schematic representations of the three models we examined for easy reference and comparison.

The Büring model is shown in (26):

(26)

The Steedman model is shown in (27):

(27)   Utterance
                        /   \
                  Theme   Rheme
                  /   \   /   \
            Focus   Background Focus   Background

The Vallduví model is shown in (28):

(28)   Utterance
                        /   \
                  Ground   Focus
                  /   \
              Link   Tail

The number of information structural categories is different in each model. Further research is necessary before we can decide whether we need to make distinctions for more or fewer categories of Information structure. Generally, the predictions of these models about the prosodic realization of utterances have not been experimentally tested and the realizations of the utterances they describe have not been instrumentally shown.

One area that needs further exploration is the realization of Tails, or non-topicalized given material. We need to investigate how they are distributed, realized and interpreted. I will offer some thoughts on this subject in chapter 2. I will adopt the

account of the use and interpretation of topics developed in Büring for the Greek data presented in this dissertation and the representation of Links and Tails developed in Vallduví.

The remaining chapters in this thesis are organized as follows:

In chapter 2, I present some basic intonation patterns in Greek affirmative and negative statements, polar interrogatives and wh-interrogatives. I show what contexts each one is appropriate in and the relation in prosodic structure between questions and answers. Furthermore I show what information structure categories are necessary in Greek.

In chapter 3, I present two experiments showing evidence that the disambiguating effects of intonation on scopally ambiguous sentences are best understood through a pragmatic account. The experiments involve scope interactions between negation and adnominal quantifiers (experiment 1) and negation and *because*-clauses (experiment 2).

In chapter 4, I present the third experiment which gives further support to the conclusions reached in chapter 3. This experiment involves scope interactions between two adnominal quantifiers, one in subject the other in object position.

In Chapter 5, I discuss all the experimental results and offer some concluding remarks.

CHAPTER 2

Pragmatics and intonational structure of Greek

The purpose of this chapter is to give an overview of the most basic patterns of the intonation of declaratives and interrogatives in Greek and show in what contexts they are used. In particular, looking first at the sentence level structure of utterances, I will go over the inventory of tunes employed in Greek to differentiate between declarative and interrogative utterances, show the differences among the different types of interrogatives (polar and wh-questions), and also differentiate between broad focus and narrow focus across all these types of utterance. In addition, looking in more detail within utterances, I will show how the information structure of sentences is prosodically realized in Greek. More specifically, I will show how the sentence level tunes described above are composed of different parts such as the topic and focus parts, and how this kind of articulation of intonational structure relates to the context of an utterance, thus connecting intonation and information structure. Finally I will briefly go over the relations among intonation, information structure and word order.

This analysis will provide the basis for understanding the experimental results of the following chapters. More specifically, we will need to understand the internal structure of the melody of utterances and how this melody is shaped according to the context they are uttered in before we can make sense of the findings of the experiments that will be presented in chapters 3 and 4.

I would like to state at the outset that I will not propose any semantic analysis for the structures presented here. Instead, I will assume the formal semantic machinery developed in Büring (1997, 1999) to account for the parts of sentences called 'focus' and 'topic' in this thesis.

The prosodic labeling of the utterances that I present is based on the analysis of the prosodic and intonational structure of Greek developed in Arvaniti & Baltazani (2000), (to appear) within the autosegmental/metrical framework of intonational phonology (Pierrehumbert 1980; Pierrehumbert and Beckman 1988; Ladd 1996) and the system created for the annotation of Greek spoken corpora based on that analysis, Greek ToBI (GRToBI).

The structure of the rest of the chapter is as follows: section 2.1 briefly introduces the terminology of intonational phonology that will be used throughout this thesis; section 2.2 briefly lists the inventory of tones and tunes assumed in GRToBI, which I will be using to analyze utterances; section 2.3 presents an analysis of the intonation structure of some basic melodies in Greek and discusses the difference in use among them; section 2.4 relates some word order phenomena in Greek to the information structure and intonation structure of utterances; section 2.5 shows how context questions determine the intonation/information structure of their answers; section 2.6 concludes this chapter.

2.1 Intonational Phonology

Intonational Phonology, the model of intonation proposed by Pierrehumbert and her colleagues (Pierrehumbert (1980), Liberman & Pierrehumbert (1984), Beckman and Pierrehumbert (1986), Pierrehumbert & Beckman (1988), Pierrehumbert and Hirschberg (1990)), assumes a hierarchical prosodic structure of an utterance. The melody of an utterance, according to this model, consists of a sequence of High (H) and Low (L) tones, which defines a prosodic unit. The highest level of prosodic unit in English is the Intonational Phrase (IP), which consists of one or more intermediate phrases (ip), which in turn contain one or more pitch accents. Intonational phrases may correspond to syntactic clauses, but not necessarily, and the prosodic organization of an utterance is not strictly a by-product of syntactic phrasing but is also affected by other factors, such as focus, length, and rate of speech. Prosodic organization is seen as a contributing factor to the interpretation of an utterance, reflecting the informational or the semantic structure of the utterance.

According to their alignment in a phrase, tones are classified as either *pitch accents* or *phrase tones*. In general, pitch accents align with the stressed syllable of a word, whereas phrase tones occur at the edges of phrases (although we will see some exceptions to this generalization in the intonational system of Greek). Pitch accents consist of one tone (i.e., H*, L*) or two (i.e., H*+L, H+L*). In bi-tonal pitch accents, the "starred" tone is the one aligned with the stressed syllable and the non-starred tone simply precedes or follows the head tone by some constant distance. In the

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Pierrehumbert system, the last pitch accent in an intermediate phrase is called the Nuclear Pitch Accent (NPA[5]). In IPs containing several ips, there are therefore several NPAs, however the IP final NPA is often felt by native speakers to have a special status, be more prominent than the others. This IP final NPA has been referred to as the 'main stress' of the sentence and I will sometimes refer to it as the 'main stress' or the 'nucleus' of the sentence. Phrase tones at the edges of intermediate phrases are called *phrase accents* (i.e., H⁻ or L⁻) and at the edges of intonational phrases are called *boundary tones* (i.e., H% or L%). The end of an Intonational Phrase is by definition also the end of an intermediate phrase. This implies that we always find a sequence of a phrase accent followed by a boundary tone at the end of IPs (i.e., H⁻ L%).

The contour of any given sentence is obtained by combining (a) the local pitch excursions of pitch accents, (b) the linear interpolation between pitch accents, (c) the pitch of phrase accents (which are claimed to cover any available syllables from the end of the NPA word to the end of the ip boundary) and, (d) the pitch of boundary tones, realized on the final syllable of the intonational phrase. Different combinations of pitch accents and phrase tones are used for different types of sentence. For example, an English declarative usually ends in a H* L⁻L% tone configuration, whereas yes/no questions end in a L* H⁻ H%.

A version of the Pierrehumbert intonational analysis of English is incorporated into ToBI, a proposed standard for labeling prosodic features of digital speech databases

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[5] The NPA is always the last *pitch accent* of the phrase, but does not necessarily align with the last *word* of the phrase. In some cases, for example when focus is assigned to a word other than the last one in the phrase, all the post-focal words are 'de-accented', that is, they do not carry any pitch accent.

in English (Silverman et al. 1992; Beckman and Ayers 1994; Beckman and Hirschberg 1994; Pitrelli, Beckman, and Hirschberg 1994). A ToBI transcription contains several 'tiers' of labels, the most important of which contain labels for the To(nes) and for the B(reak) I(ndices), which label the strength of boundaries. These two tiers gave the labeling system its name. A number of similar labeling systems have been developed for languages other than English. In the following section I will briefly present the labeling system developed for Greek and the intonational analysis it was based on.

2.2 Greek ToBI (GRToBI)

A phonological model of Greek intonation has recently been developed by Arvaniti and Baltazani (2000), (to appear) based on previous work on Greek prosodic structure (Nespor & Vogel, (1986); Arvaniti, (1991, 1992, 1994)) and intonation (Arvaniti & Ladd, (1995); Arvaniti, Ladd, & Mennen, (1998); Botinis, (1998); Baltazani & Jun, (1999); Arvaniti & Ladd, (forthcoming); Arvaniti, Ladd & Mennen, (in press); Arvaniti, Ladd & Mennen, (in rev.)).

In the Arvaniti and Baltazani (2000) model, Greek has three prosodic levels like English (IP, ip, and Prosodic word), five pitch accents, L*+H, L+H*, H*, H*+L, and L*, and a rich inventory of phrase accent/boundary tone combinations. The bitonal L*+H is the most common pre-nuclear pitch accent, followed by a H*, H*+L, or L+H* nuclear pitch accent in declaratives. The typical declarative phrase accent/boundary tone combination is L⁻ L%.

In Figure 2-1, I show the typical alignment of the three pitch accent types that will figure the most in our discussion. The Greek letter α is used to represent a syllable, and ά to represent a stressed syllable.

α ά α   α ά α   α ά α

L*+H   L+H*   L*

Figure 2-1. Typical alignment of three pitch accents with the stressed syllable in Greek.

In polar questions, the typical nuclear pitch accent is a L*, with a H⁻ L% boundary (Arvaniti et al. (in rev.), and Baltazani & Jun (1999)). The L* nuclear pitch accent is also used in topic phrases before a H⁻ boundary tone[6] (Baltazani & Jun (1999)). In wh-questions, there is either a L⁻L% or a L⁻!H% boundary preceded by a L*+H nuclear pitch accent (also described in Arvaniti (2001); Arvaniti and Ladd (ms.)). The two melodies used for wh-questions are also characteristic of negative declaratives.

In what follows I will present examples of these types of utterance and I will also give a brief description of the role of context in the choice and location of nuclear pitch accent for each of the distinct melodies, a task that has not yet been undertaken in the Greek intonation literature to my knowledge.

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[6] Sometimes topic phrases form an IP instead of an ip (Arvaniti and Baltazani (2000)).

2.3 Inventory of basic melodies in Greek

The analysis presented in this chapter is based, in addition to GRToBI, on instrumental investigation of F_0 contours of new utterances collected for this chapter, ranging among naturally occurring speech (radio talk shows and film dialog), read aloud excerpts of books, and simple question-answer pairs. The utterances presented throughout in the figures were produced by the author so that they are comparable, however, the patterns shown were consistently produced by all speakers examined. The utterances were digitized using the *Pitchworks* (Scicon) program.

Figure 2-2 serves the purpose of clarifying how information is displayed in the pitch-tracks I will be using to show the contour of utterances from now on.

Figure 2-2 Illustration of the layout of pitch-tracks

All pitch tracks are divided horizontally in three parts: (A) the top part contains text in three (in chapters 3 and 4, there are four) separate rows (tiers) with annotations for the prosodic analysis in terms of pitch accents (e.g. L+H*) and boundary tones (eg. L⁻ H%) in the *tones* tier, the transliterated Greek text of the utterance in the *words* tier, and the word-for-word gloss in the *gloss* tier, (and when applicable, the scope relation between the two quantifiers in the *scope* fourth tier); (B) the middle part shows the waveform of the utterance; and (C) the bottom half shows the continuous line with peaks and valleys which is a record of how pitch (in Hz) changes across time (in ms.) throughout the utterance. Vertically, all the information is aligned in the following way: The waveform and the pitch track are temporally aligned, i.e. the figure shows what the frequency is for each specific part of the utterance as shown in the waveform. The text is aligned with the waveform and pitch track word for word: there is a vertical line[7] at the right edge of each word showing how the waveform and pitch track align with the right edge of words [8]. The vertical lines for tones occur at the right edge of the tone symbol and show where the tone is realized in the waveform and the pitch track. It is useful to keep in mind that pitch accents align with stressed syllables—which are shown in the transliteration given in the caption of each figure—and edge tones (pitch accents and boundary tones) occur at the right edge of the last word in the phrase, with a few exceptions which are clearly described in the text.

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[7] There is no significance to the fact that some of the vertical lines are thinner than others; this is just an idiosyncrasy of the program.
[8] The alternative of showing the end of each syllable instead showing the end of each word has the unfortunate consequence of cluttering the picture with too many vertical lines, so I decided against it.

In the following sections I present the patterns of declaratives (2.3.1), negatives (2.3.2), polar interrogatives (2.3.3), and wh-interrogatives (2.3.4). The findings we accumulate are summarized in section 2.3.5 and a table with the different melodies is also given in this section.

2.3.1 Broad focus and narrow focus declaratives

We will first look at broad focus in declarative sentences. Figure 2-3 shows the typical shape of a declarative sentence uttered in an 'all new' context, where no word carries narrow focus, a pattern known as the 'broad focus'. The particular statement is *tha páme sinemá* (will go-1pl movies-acc) 'We're going to the movies'. Such a statement is very natural at the beginning of a conversation after initial greetings, as a form of invitation, followed by *erxese?* 'Wanna come?' The tune is L*+H (L+) H* L⁻ L%, with the typical L*+H pre-nuclear pitch accent, a H* nuclear pitch accent (NPA), followed by a L⁻ L% combination of phrase accent and boundary tone.

Figure 2-3. Typical contour for a declarative sentence in Greek: *tha páme sinemá* (will go-1pl movies-acc) 'We're going to the movies' <u>Fig2-3.wav</u>

Figure 2-4 shows the same utterance with a long subject to illustrate the use of the L*+H pre-nuclear pitch accents. The sentence is *I Eléni ki o Manólis tha páne sinemá* (the Eleni and the Manolis will go-2p movies) 'Eleni and Manolis will go to the movies'. All three pre-nuclear words, *Eleni, Manolis,* and *pane,* carry a L*+H pitch accent, and the last constituent, *sinema,* carries the H* NPA. This utterance can be used in an all new context after greetings and can be followed by *thelis na pas mazi tus?* 'Do you want to go with them?'

Figure 2-4. The typical pre-nuclear pitch accent, L*+H, in *I Eléni ki o Manólis tha páne sinemá* (the Eleni and the Manolis will go-2p movies) 'Eleni and Manolis will go to the movies' Fig2-4.wav

Recall that in the literature of focus in English discussed in the previous chapter, the nuclear pitch accent is seen as the realization of an abstract focus feature F, assigned in the syntax, and the word carrying this accent is called the *focus exponent*[9]. Very often, however, it is not just the word carrying the pitch accent which is the intended focus of the utterance, but rather the entire phrase, sometimes even higher syntactic constituents containing that phrase. Rules that allow 'F' to 'project' to the entire constituent have been proposed for English (see for example Selkirk (1995)). The rules underlying this process are termed the rules of *focus projection* in the literature and the highest syntactic node having the F-feature is called the *focus* of the sentence (in Selkirk (1995) it is called the FOC). We can represent the focus structure of the utterance in

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[9] In the literature reference is made to the 'sentence stress', or to 'pitch accent'. In GRToBI sentence stress is the NPA.

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Figure 2-4 as shown in (1), with the capitals marking the location of the NPA and the square brackets indicating the focus.

(1) [[*I Eleni ki o Manolis*]$_F$ [*tha pane*]$_F$ [*SINEMA*]$_F$]$_{Foc}$ (all new context)

(2) *I Eleni ki o Manolis* [[*tha pane*]$_F$ [*SINEMA*]$_F$]$_{Foc}$ ('What will Eleni and Manolis do?')

(3) *I Eleni ki o Manolis tha pane* [[*SINEMA*]$_F$]$_{Foc}$ ('Where will Eleni and Manolis go?')

The utterance shown in Figure 2-4 can also be the answer to a question like 'what will Eleni and Manolis do?' the focus structure of which is shown in (2). In this case F does not project to the whole sentence but only up to the VP level *tha pane sinema* since the subject is given in the context. This utterance with exactly the same melody as that used for (1) and (2) can also be the answer to the question 'Where will Eleni and Manolis go?' Here F does not project higher than the object since both the subject and the verb are already given in the context, as shown in (3). The FOC is limited to the smallest constituent, the object of the verb, *sinema*. The extent of the FOC then is determined by context.

We have seen that the focus structures in (1), (2), and (3), have the same prosodic realization, that in Figure 2-4. An additional fact that Figure 2-4 nicely illustrates is that unlike in English where some content words can be left de-accented (i.e., verbs don't need an accent if their objects carry the NPA—the *integration* cases), in Greek all pre-nuclear content words must have accents. In particular, *Eleni* and *Manolis* in (2) and (3) are given but nevertheless they must carry accents; also the verb

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pane in all three focus structures must carry a pitch accent. The data from the corpus for this thesis as well as the corpus used for GRToBI suggest that this is an invariable property of intonation structure in Greek and this may be evidence for a phonological phrase smaller than the intermediate phrase in Greek as the domain of the pitch accent, with each pitch accented word forming one of those small phonological phrases. For a proposal about the existence of small phonological phrases and their effects on focus-related word order variation in Spanish see Büring and Gutiérrez-Bravo (2000).

If we abstract away from the pitch accent requirement on every word in Greek, the focus structure of the utterance in Figure 2-4 obeys the same rules of focus projection as similar sentences in English. That is, in simple SVO sentences main prominence—that is a NPA—on the object does not necessarily indicate narrow focus on that object, but can 'project' F, that is, indicate larger constituents as focus domains, up to the sentence level. Such structures are then multiply ambiguous as to the extent of the focus domain, but listeners can disambiguate among them based on the context at hand[10]. I will therefore adopt the theory in Selkirk (1995), outlined in chapter 1, to account for these patterns as well as the narrow focus patterns that we will shortly see. For problems with this theory as concerns prosodic patterns in English see Schwarzschild (1999). In this thesis I leave open the questions of how well the Selkirk theory can account for more complex sentences in Greek and what kinds of adjustments to it will be necessary so that it can account for the prosodic properties of Greek.

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[10] I should note here that for those question-answer pairs for which the focus domain is not the whole sentence, the more natural answers are those containing only the focus constituents, i.e., the verb phrase only in (2) and the object only in (3).

I now turn to narrow focus in declaratives. The melody of the sentence in Figure 2-4 will change in the context of the question 'who will go to the movies?' to indicate narrow focus on the subject, shown in Figure 2-5. The meaning of this utterance is 'It's Eleni and Manolis that will go to the movies'.

Figure 2-5. Narrow focus on the subject in *I Eléni ki o Manólis tha páne sinemá* (the Eleni and the Manolis will go-2p movies) 'It is Eleni and Manolis that will go to the movies' Fig2-5.wav

The subject in this utterance is marked for narrow focus, and the nuclear pitch accent in this utterance is on the last content word in the subject phrase, *manolis*. Notice that narrow focus here is realized with a L+H* nuclear pitch accent, whereas the broad focus NPA in Figure 2-4 was H*. Impressionistically it seems to be very often the case that in Greek broad focus is realized with a H* or a H*+L NPA and narrow focus with a L+H* NPA. However, no experimental study to confirm this correlation has been undertaken to my knowledge.

(4)   *[I Eleni ki o MANOLIS]*_{Foc} *tha pane sinema.*

The VP, *tha pane sinema* 'will go to the movies' is old information as it is contained in the context question and and gets de-accented, realized as a low plateau at around 150Hz, because it occurs after the NPA.

The Information Structure system takes advantage of these prosodic properties whenever possible to encode categories like 'given' and 'new'. More specifically, for affirmative declaratives, de-accented material always encodes given information, but crucially not the other way around, as we already saw in connection to the examples in (1) − (3). We already see that the mapping between prosodic categories and informational categories is not one-to-one. Later on we will see more structures in which de-accenting and given-ness do not coincide.

Narrow focus on the verb is illustrated in Figure 2-6. This utterance can be used as an answer[11] to the question 'Will Eleni and Manolis go to the movies?' and its focus marking is shown in (5). The meaning of this utterance is equivalent to the English 'Eleni and Manolis WILL go to the movies', in which the polarity of the verb is focused,

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[11] The most natural and most common answer to such a question would be *tha pane* 'they will go', where the old information (i.e., the subject and the object) is omitted, but there are situations in which the answer shown in Figure 4 is natural as well. One such case is when this answer indicates that although Eleni and Manolis will go to the movies, there are other relevant people who will not go. In other words, the subject in this case serves as contrastive topic even though it is not marked with the typical topic tune (L* H⁻).

the so called *verum* focus. I will discuss the focus marking of this sentence in connection to its context in more detail in section 2.4.

(5)   *I Eleni ki o Manolis* [*tha* PANE]F *sinema*

Figure 2-6. Illustration of a sentence with narrow focus on the verb in *I Eléni ki o Manólis tha páne sinemá* (the Eleni and the Manolis will go-2p movies) 'Eleni and Manolis *WILL* go to the movies' Fig2-6.wav

In this utterance the verb carries the nuclear pitch accent, L+H*, both words in the subject phrase carry pre-nuclear pitch accents, and the object is de-accented, realized as a low plateau.

We have now seen all the prosodic patterns possible in simple SVO sentences, that is, prominence on each one of the constituents and also on bigger syntactic constituents containing them. Discussion of the prominence patterns in more complex sentences is outside the scope of this thesis. Discussion of word order variation, prominence patterns, and the effect of context on them will be taken up in section 2.5.

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For more information on word order variation in Greek see, among others, Agouraki (1990), Alexiadou (1996,1999), Alexiadou & Anagnostopoulou (1995, 1997, 1998), Anagnostopoulou (1994), Iatridou (1990, 1993), Philippaki-Warburton (1985), Tsimpli (1995).

Summarizing, main prominence on the object indicates the utterance is an appropriate answer in contexts targeting either the object alone or any bigger constituents containing the object[12]. Utterances with prominence on any of the other two constituents are appropriate answers only in contexts targeting these specific constituents and not any bigger ones containing them. These patterns of broad and narrow focus are very similar to the ones displayed in simple SVO sentences in English. Also in both languages post-nuclear material cannot carry accents. One difference between Greek and English is the requirement in Greek for pitch accents on pre-nuclear material.

The similarities in prosodic structure between Greek and English, however, do not extend beyond affirmative declaratives. As we will see in the following sections, all three additional types of sentence presented in this chapter—negatives, polar interrogatives, and wh-interrogatives—display patterns which we do not encounter in English. The interrogative patterns found in Greek have also been reported to occur in other languages: both polar and wh-question patterns in Hungarian, Turkish and Slavic languages (Ladd (1996)) where unlike English, in all-new contexts the nucleus aligns with the verb in polar questions and the wh-word in wh-questions, not with the

rightmost constituent. I do not know whether negative sentences in these languages align focus with the rightmost constituent or not.

2.3.2 Negative declaratives

In this section I will briefly describe the melodies possible for negative declarative sentences. This presentation is necessary in order to understand the results of the first experiment, which exclusively examines negative utterances and which will be the topic of the next chapter.

Recall that the melody of negative declaratives as described in GRToBI is either L*+H L⁻ !H% or L*+H L⁻ L%. I would like to refine this statement here and make clear that these tunes are used for negative sentences when the negation represents new information. When the negation is old information, that is, when it is already in the context, a different tune is used. Let us look at an example to make the difference between the two types of negation, which I will call *old negation* and *new negation*, clear.

We will look first at new negation. Imagine that a friend and I are talking about how many people are coming to a party we're giving. If my friend asks me if Eleni and Manolis are coming and I reply negatively, as in (6A), then either L*+H L⁻ !H% or L*+H L⁻ L% can be used in my answer because the negation is new information in this context.

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[12] Although I have not presented data for any other word orders, main prominence on the right-most

(6)   Q: *Tha érthun I   Eléni ki   o Manólis?*

           will come-3p the Eleni   and the Manolis

    'Will Eleni and Manolis come?'

    A: *Nomízo den tha érthun I   Eléni ki   o Manólis.*

       Think-1s not will   come-3p the Eleni   and the Manolis

    'I think Eleni and Manolis will not come'

The pitch track of the utterance in (6A) is shown in Figure 2-7. The negation is carrying the L*+H NPA, and F_0 falls during the following verb, reaching the bottom level of the speaker's range. After that there is a low stretch that ends right before the final syllable which is aligned with the !H% boundary tone, which reaches only the middle level of the speaker's range. There is a L⁻ at the stressed syllable of the last word, which forms an 'elbow', the turning point from the L⁻ to the !H%. The focus domain in (6) is restricted to the negative particle, since everything else is given in that sentence. The focus structure for this sentence is given in (7):

(7)   [*DEN*]Foc *tha érthun I   Eléni ki   o Manólis*

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constituent also results in an all-new reading for VSO and VOS orders.

Tones	L*+H	L*+H					L–	!H%
words	nomizo]	de]	tha]	erthun]	i Eleni]		ki	o Manolis]
gloss	think-1s	not	will	come-3s	the Eleni-nom		and	the Man-nom

Hz
350
300
250
200
150
100
ms   400   800   1200   1600   2000

Figure 2-7. Typical realization of a negative utterance containing 'new' negation, in *Nomízo den tha érthun I Eléni ki o Manólis* (Think-1s not will come the Eleni and the Manolis) 'I think Eleni and Manolis will not come' Fig2-7.wav

Let us turn now to the old negation. Imagine again that my friend and I are talking about the people coming to the party. If my friend wants to know which people are not coming to the party and I use a sentence string identical to the one in (6A) to answer her question, the negation in my answer is old information since it is already in the context (8Q).

(8)   Q: *posoi   den tha erthun sto party?*

    how-many   not will   come-3p to-the party

    'How many people are not coming to the party?'

    A: *Nomízo den tha érthun I   Eléni ki   o Manólis.*

    Think-1s   not will   come   the Eleni   and the Manolis

    'I think that Eleni and Manolis will not come'

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The information status of the negation makes a difference for the melody I will use to utter the sentence in Greek: the negation cannot carry the nuclear pitch accent in this case and moreover, the L*+H L⁻ !H% tune cannot be used here. The melody used for (8A) is shown in Figure 2-6. The negation is part of a topic phrase (I will present details on the use and intonational structure of topics in section 2.4), which forms a separate intermediate phrase (ip) comprising the 'old information' negation + verb, with a L* NPA on the verb *erthun* and a H⁻ phrase accent at the end of the ip. The second ip contains the subject phrase *i Eleni ki o Manolis* with the H*+L NPA[13] on the second name, and there is a L⁻L% boundary. The 'main stress' or nucleus of the utterance is this final pitch accent, and informally put, this type of sentence does not have the feel of a negative sentence at all. The illocutionary type of a sentence is not negative, unless the nucleus of the utterance is aligned with negation in Greek. In their written form then, sentences like (6A) and (8A) are not distinguished out of context, and it is prosody alone which can disambiguate them out of context.

The focus structure of the utterance in (8A) is shown in (9). The FOC is the subject phrase and the rest of the material in the utterance forms the topic which has the meaning 'As for who will not come…'

(9)   [*den tha erthun*]Topic [*I   Eleni   ki   o   MANOLIS*]Foc

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[13] In GRToBI a falling NPA is transcribed H*+L.

Figure 2-8. Melody for a negative utterance containing 'old information' negation in *Nomízo den tha érthun I Eléni ki o Manólis* (Think-1s not will come the Eleni and the Manolis) 'I think it is Eleni and Manolis that will not come'. Fig2-8.wav

As already mentioned, this difference between the two types of negative utterance will prove to be crucial for the analysis of the experimental results discussed in the following chapter. As we will see there, information status correlates with the ability of negation to take wide scope.

Are all-new negative utterances possible in Greek? The answer is yes. Imagine that one day I meet my good friend Manolis who I believe to be happily married to Eleni, and who looks distressed. Upon my asking what's troubling him he says something like (10) without any previous mention either of his marriage or Eleni.

(10) *Den tin adého állo tin Eléni.   Tha ti horíso.*

Not   her bear-1s   more the Eleni-acc   will her divorce-1s

'I can't stand Eleni anymore. I'll ask her for a divorce.'

The pitch track for this utterance is shown in Figure 2-9 below, which has the same intonational structure as the utterance in Figure 2-5. That is, the L*+H nucleus is still on the negation and all post-nuclear material carries no accents, despite the fact that it is new. In fact, in all negative sentences in Greek the nucleus is the negative particle, with the exception, of course, of old negation as we already saw.

Figure 2-9. Typical melody of an 'all-new' negative utterance: *Den tin adého állo tin Eléni* (Not her bear-1s more the Eleni-acc) 'I can't stand Eleni anymore.' Fig2-9.wav

The focus structure of utterance (10) is shown in (11). The focus domain is the whole sentence and the sole pitch accent is the one on negation. This pattern—an early nucleus followed by new material which is de-accented—is one that we will see again and again with different sentence types in Greek. In fact, the only sentence type that shows accenting patterns similar to English, that is, placement of the sentence nucleus at the right edge in simple SVO sentences, is the affirmative declarative. Other than

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that, all the other sentence types in Greek shift the nucleus leftwards. I will discuss the similarity in intonational structure among the sentence types as we meet each new type. In the case at hand, the nucleus shifts to negation, which is the element indicating the type or 'force' of the sentence.

(11)   [*DEN tin adeho allo ti Eleni*]_{Foc}

Summarizing what we saw, when negation is new information it must become the nucleus of the utterance and when it is old information it cannot form the nucleus of the utterance, but instead forms part of a topic phrase. Furthermore, we saw that negation is the nucleus of the utterance regardless of the status of the rest of the sentence as all new or given.

2.3.3 Broad focus and narrow focus polar interrogatives

Polar questions in Greek are string identical to declaratives and are only distinguished from declaratives by intonation. The tune for polar questions has been described in the literature as a L* nuclear pitch accent followed by a H⁻ L% boundary. Baltazani and Jun (1999) attribute the type of NPA in polar questions to the influence of the H⁻ L% boundary. Specifically they claim that the H⁻L% boundary marking polar questions reverses the tonal type of nuclear pitch accent, which is realized as a L* instead of the H*+L NPA of the declarative.

The H⁻ part of the boundary shows two patterns of alignment, depending on the position of the nucleus (Arvaniti (in press); Arvaniti and Baltazani (2000), Baltazani

and Jun (1999); Grice, Ladd, and Arvaniti (2000)). Specifically, if the nucleus of the question is *not* on the final word of the utterance, the H⁻ aligns with the stressed syllable of the final word. If the nucleus is on the final word, the H⁻ and L% are realised together at the right edge of the utterance.

Figure 2-10 illustrates the broad focus/all new pattern for polar questions. The question here is *páme sinemá?* (go-1p movies) 'Shall we go to the movies?' This question can be uttered at the beginning of conversation after greetings, as an invitation, without any preceding context. The nucleus is on the verb *pame* and the object *sinema* carries no pitch accent. The H⁻ tone aligned with the stressed syllable of the object, *–ma,* is the phrase accent described in the preceding paragraph which is not realized at the edge of the IP, but inside the phrase, aligned with the last stressed syllable. The fact that this tone is not a pitch accent but a phrase tone has been shown in Baltazani and Jun (1999) and Arvaniti (in press).

Figure 2-10. Broad focus pattern for polar interrogatives shown in *páme sinemá?* (go-1p movies) 'Shall we go to the movies?' Fig2-10.wav

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In Figure 2-11 a temporal adverbial phrase, *ávrio to vrádi* 'tomorrow night', is added after the object, *sinema*. The object in this new configuration is realized as a low plateau without a pitch accent and the Hˉ tone aligns with the stressed syllable of the last word of the added temporal phrase. This suggests that this Hˉ seeks the last stressed syllable of the Intonational Phrase. As we will see in Figure 2-14, when the NPA aligns with the last word in the IP, the Hˉ phrase accent is 'pushed' to the right because of the presence of the NPA on the stressed syllable.

Figure 2-11. Illustration of the Hˉ phrase accent alignment in polar questions, shown in *páme sinemá ávrio to vrádi?* (go-1p movies tomorrow the night) 'Shall we go to the movies tomorrow night?' Fig2-11.wav

The same sentence with overt subjects added is shown in Figure 2-12 to illustrate pre-nuclear pitch accents in polar interrogatives, which are the same type as those in declaratives, namely L*+H. The question shown in Figure 2-12 is *I Eléni ki o Manólis tha páne sinemá?* 'Will Eleni and Manolis go to the movies?' Notice that the nuclear pitch accent still falls on the verb.

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tones	L*+H	L*+H	L*	H–	L%
words	i Eleni]	ki o Manolis]tha]	pane]		sinema?]
gloss	Eleni	and Manolis will	go	(to the) movies	

Figure 2-12. Illustration of the L*+H pre-nuclear pitch accents in polar interrogatives, shown in *I Eléni ki o Manólis tha páne sinemá?* 'Will Eleni and Manolis go to the movies?' Fig2-12.wav

This location of the nucleus is referred to as 'early nucleus' in Arvaniti (in press) in contradistinction to nucleus on a verb argument, which is referred to as 'late nucleus', but no information is given about when each of them is used. My corpus suggests that the prosodic pattern shown in the three figures presented so far is the typical pattern for 'all-new' polar questions and the whole sentence is F-marked: the nucleus is on the verb, pre-nuclear content words necessarily carry the L*+H pitch accent, and post-nuclear material is de-accented, notwithstanding its status as new information, just like the pattern we saw in negative utterances. In contrast, nucleus on any other constituent, such as the object for example, results in narrow focus, that is, F cannot project from the NPA to higher constituents in this case.

The focus marking for the all new question in Figure 2-9 is shown in (12). Small caps as usual indicate the NPA and square brackets indicate the focus domain.

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(12)   [*PAME sinemá ávrio to vrádi?*]_{Foc}

      go-1p   movies tomorrow the night

    'Shall we go to the movies tomorrow night?'

Recall that in affirmative declaratives this prosodic pattern with a verb nucleus is used only for narrow focus on the verb, as we saw in the discussion for Figure 2-6 in section 2.3.1, and cannot project. In polar questions though, F can project from the verb and uttering post-nuclear material without pitch accents can be sustained for impressively long stretches, like the following example:

(13)   *Páme sinemá apópse na dúme mia kainúrgia tainía ton adelfón   Koén?*

      go-1p   movies tonight   to watch-1p a   new   movie   the brothers-gen Cohen

   'Shall we go to the movies tonight to see a new Cohen brothers' movie?'

This question, shown in Figure 2-13, is realized exactly like the examples we have seen so far, with the nucleus on the verb and no other pitch accent on any of the post-nuclear words. The stretch after the L* NPA is accent-less, with the F_0 slowly rising from the L* to the H⁻ phrase accent on the final word. The fact that F_0 slowly rises between the L* and the H⁻ suggests absence of any tone targets; instead there is interpolation from the low target to the high one. As far as information structure is concerned, everything in the utterance is new so it is all F-marked. Of course a sentence like (13) is not typical in everyday language, it is shown to make a point. A more

natural way to deliver the content of (13) is to use two sentences: 'There's a new movie by the Cohen brothers on. Do you wanna go see it?'

Tones	L*								H–	L%	
words		pame]	sinema]	apopse	na dume]	mia]	kenurgia]	tenia]	ton adelfon]		Koen?]	
gloss		go-1p	movies	tonight	to see	a	new	movi	the brothers-gn		Cohen	

Figure 2-13. All new long polar question shown in *Páme sinemá apópse na dúme mia kainúrgia tainía ton adelfón   Koén?* (go-1p   movies   tonight   to   watch-1p a new movie   the brothers-gen Cohen) 'Shall we go to the movies tonight to see a new Cohen brothers' movie?' <u>Fig2-13.wav</u>

In polar all-new questions, just like in negative sentences, the nucleus is the element that indicates the type/force of the sentence. Greek polar questions are string identical to and only distinguished from declaratives by intonation. Greek, unlike English, has no 'do-support,' no obligatory subject-aux inversion and since word order is flexible, there is no syntactic way to mark sentence type. This shift of the prosodic nucleus to the verb seems to perform the same function that the syntactic operation of 'do-support' performs in English polar questions, namely indicating the illocutionary type of the sentence. As we will see in the next section, wh-questions, for which do-support is also necessary in English, display in Greek this shifting of the nucleus to the element that indicates the type of sentence, that is, the wh-word.

Turning now to narrow focus polar questions, the nucleus in those questions is not on the verb. The focus structure of the question in Figure 2-14, *páme sinemá?* (go-1p movies) 'Shall we go to the movies?' is shown in (14).

(14)   *pame* [[*SINEMA*]F]FOC*?*

This question can be used as an answer to 'Where shall we go?' with the wh-question as an antecedent for the polar question, inducing narrow focus on the object *sinema*. The verb *pame* is old information here, as it was already present in the context and does not bear the NPA (note, however, that it still carries a pitch accent, the typical L*+H pre-nuclear one). The L* nucleus is on the narrowly focused object and because of 'tonal crowding' (it has to share the stressed (and last) syllable with the H⁻ phrase accent and the L% boundary tone) it is pushed left to the very beginning of the stressed vowel, which is considerably lengthened. Unlike in affirmative sentences where focus projects from the internal argument of the verb onto the verb and then to the whole VP, in polar questions F cannot project from the object. Focus on the verb is ambiguous between narrow focus on the verb and focus on higher phrases (VP, sentence).

Figure 2-14. Polar question with narrow focus on the object, shown in *páme sinemá?* (go-1p movies) 'Shall we go to the movies?' [Fig2-14.wav](Fig2-14.wav)

Figure 2-15 shows an all-new negative polar question. This negative question is used as a kind of invitation for coffee: *den érxese spíti gia kafedáki?* (not come-2s home for coffee-diminutive) 'Why don't you come over for coffee?' It is interesting in that it seems to combine characteristics both of polar questions and negative sentences. The nucleus type is L* as in all polar questions, but the location of the nucleus shifts to the negative particle like in all negative sentences.

tones	L*						H-		L%
words	den]	erxese]	spiti]	gia]				kafedaki?]
gloss	not	come-2s	home	for				coffee-dimin

Figure 2-15. Negative polar question: *den érxese spíti gia kafedáki?* (not come-2s home for coffee-diminutive) 'Why don't you come over for coffee?' Fig2-15.wav

Summarizing this section, in all-new/broad focus positive polar questions in Greek the nucleus is the verb. In negative all-new polar questions on the other hand, the nucleus in on negation. These patterns are different from those in declaratives and nucleus marks the type of sentence. Any other pattern of prominence in polar questions shows narrow focus.

2.3.4 Broad focus and narrow focus wh interrogatives

The tune for wh-questions has been described in the literature as a L*+H nuclear pitch accent aligned with the wh-word, followed by a L⁻ !H% boundary, with the L⁻ spreading between the nuclear pitch accent and the final !H%, which remains approximately in the middle of the speaker's range. (Arvaniti (in press); Arvaniti and Baltazani (2000)).

Unlike polar questions, the nucleus in wh-questions invariably stays with the wh-words, a pattern reminiscent of that of negative declaratives. To take a very

common all-new broad focus wh-question, *pos se léne?* (how you call-3p) 'What's your name?' illustrated in Figure 2-16, shows that the L*+H nucleus is on the wh-word. The L⁻ phrase accent is aligned with the stressed syllable *le-* of the last word *lene* and F_0 rises after that to the !H% boundary at the last syllable.

Figure 2-16. All new wh-question, *pos se léne?* (how you be-called-3p) 'What's your name?' Fig2-16.wav

The focus structure of the question in Figure 2-16 is

(15)   [*POS se lene?*]_{Foc}

and again the nucleus is not aligned with the right edge element, even though all the constituents are new. Note that in English wh-questions behave just like affirmatives, that is, the focus structure of this question in English would be [*what's your NAME?*]_F.

The question illustrated in Figure 2-17 is *me pión tha fáme símera?* (with who-acc will eat-1p today) 'Who are we eating with today?' The preposition *me* has been

included to show the initial F$_0$ rise associated with the L*+H NPA which again is aligned with the wh-word *pion*. The post-nuclear words form part of the low plateau stretching all the way until the final rise to the !H% boundary at the last syllable. In this case the L⁻ phrase accent is not aligned with a stressed syllable but with the penultimate syllable –*me*- of the last word. Just as experimentally shown in Arvaniti (2001), the wh-question phrase accent does not display the same pattern of alignment as the polar phrase accent H⁻ which always aligns with the stressed syllable of the last word if one is available. Once more we see that Greek, unlike English, aligns the nucleus with the wh-word for the construction of these questions. The focus structure of this question is shown in (16).

(16)   [*me PIÓN tha fáme símera?*]$_{Foc}$

Figure 2-17. Typical wh-question melody shown in *me pión tha fáme símera?* (with who-acc will eat-1p today) 'Who are we eating with today?' Fig2-17.wav

The same melody L*+H L⁻ !H% is shown in Figure 2-18, realized on one word, *giati* 'why'. The word *giati* is stressed on the second syllable, *-ti* and the whole melody has to be squeezed in that one syllable, which is lengthened to accommodate all three tones. The L*+H NPA is realized very early in the syllable due to tonal crowding and rises to 250 Hz instead of the usual 350 Hz for this speaker and neither is the trough for the low as deep (near 200 instead of 150Hz), so that the whole rise-fall-rise movement can be realized in a limited time.

Figure 2-18. Wh-question melody realized on only one word, *giatí* 'why' Fig2-18.wav

Figure 2-19 shows the wh-question melody for a long question which makes clear the absence of accents on the material following the wh-word. The question is *pión ídes sto párty me tin Eléni extés?* (who-acc saw-2s at-the party with the Eleni-acc yesterday) 'Who did you see at the party with Helen yesterday?'. F_0 rapidly falls after

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the wh-word and remains low until the last stressed syllable which is the lowest L target (marked with a L⁻ phrase accent) before the rise for the !H% boundary.

Figure 2-19. The wh-question melody realized on a long question, *pión ídes sto párty me tin Eléni extés?* (who-acc saw-2s at-the party with the Eleni-acc yesterday) 'Who did you see at the party with Helen yesterday?' Fig2-19.wav

There is another type of wh-question that has not been described in the literature whose melody is slightly different: L+H* LL%. One context in which it is used is for clarification questions. Imagine a situation in which I tell you 'I left with him' and you don't know who I'm talking about. In this situation you can ask *me pión éfiges?* 'Who did you leave with?' and the L*+H L⁻!H% melody is not appropriate. Instead, L+H* LL% is used in this case, shown in Figure 2-20. The difference in use between the two melodies is that L*+H L⁻ !H% is used in all new contexts, whereas L+H* L⁻ L% is used when the part of the question apart from the wh-word is old, that is on questions with narrow focus on the wh-word.

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Figure 2-20. Melody for wh-questions with narrow focus on the wh-word. *me pión éfiges?*(with who-acc left-2s) 'Who did you leave with?' Fig2-20.wav

In English it is possible to place narrow focus on some constituent other than the wh-word. For example, suppose we are discussing who left with who last night. After someone says 'Bill left with Mary', it is natural to ask (17) with narrow focus on *John*, if in addition to Bill I want to know about John's partner.

(17)   *Who did JOHN leave with*?

An analogous utterance in Greek with the NPA on a noun phrase instead of the wh-word can only be used for correction: someone will utter (18), shown in Figure 2-21, to correct me if I mishear or misunderstand the name. What's implied by (18) is something like 'No, that's not what I asked. I want to know…' The wh-word here does

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not carry the NPA but a pre-nuclear L*+H pitch accent. The H*+L NPA is on the subject, *Manolis*.

(18) *me pion efige* [*o* MANÓLIS]_{FOC} *(oxi o Mihalis)*

   with who-acc left-3s the Manolis-nom not the Mihalis-nom

   'Who did MANOLIS leave with (not Mihalis)'

Figure 2-21. An indirect wh-question: *me pion efige* [*o* MANÓLIS]_{FOC} *(oxi o Mihalis)* (with who-acc left-3s the Manolis-nom not the Mihalis) 'Who did MANOLIS leave with (not Mihalis)' Fig2-21.wav

In Greek, (18) cannot be used as a question with the narrow focus meaning analogous to the English (17). Instead, to ask such a question, the name *Manolis* must be fronted and topicalized (19), shown in Figure 2-22, and the wh-word must be the nucleus of the utterance, carrying the L*+H NPA. The prosodic structure of topics in wh-questions will be further discussed in section 2.4.1.

(19) [*o Manólis*]_{Topic} *me* [PION]_{FOC} *éfige?*

   the Manolis-nom with who-acc left-3s

   'Who did MANOLIS leave with?'

Figure 2-22. Wh-question with a topic phrase: [*o Manólis*]_Topic *me* [*PION*]_FOC *éfige?* (the Manolis-nom with who-acc left-3s) 'Who did MANOLIS leave with?' Fig2-22.wav

In all the wh-questions we examined, then, the nucleus is the wh-word, the element that indicates the type of the sentence, just like in negative sentences and polar questions.

2.3.5 Summary of focus structure patterns across sentence types

I present here a table that shows the focus structure patterns of all the sentence types we examined in section 2.3 for easy reference. For all sentence types, pre-nuclear and post-nuclear rules are the same, that is, there must be pitch accents on content words if they occur before the nucleus and there can't be any accents after the nucleus. The default prominence pattern, 'place the NPA on the element at the right edge', is displayed by affirmative declaratives which do not have narrow focus on any specific element. Otherwise prominence is either on a narrowly focused element or on an element that

indicates sentence type. Topics play no role in the determination of sentence type and that is as it should be since topics only serve the function of linking the sentence with previous discourse. In the last column of the table below I give the types of NPA and boundary that compose the melody of each sentence type. Pre-nuclear pitch accents are not included as they are the same across sentence types, i.e., L*+H.

Sentence type	All-new nucleus	Narrow focus nucleus	NPA	Boundary
Affirmative	IP right edge	Focused constituent	(L+)H*	L⁻ L%
Negative	Negation	Negation	L*+H	L⁻ !H%
Positive polar Q.	Verb	Focused constituent	L*	H⁻ L%
Negative polar Q.	Negation	Focused constituent	L*	H⁻ L%
Wh-question	Wh-word	Wh-word	L*+H	L⁻!H%

Table 2-2. Location and type of NPA across sentence types.

2.4 Word order and information structure

Greek has a flexible constituent order. For a simple SVO sentence, all six constituent permutations (SVO, SOV, VSO, VOS, OVS, OSV) are permitted and this flexibility has been connected in the literature to the rich inflectional system available in Greek (for more details on the syntactic analysis of word order see Agouraki (1990), Alexiadou (1996,1999), Alexiadou & Anagnostopoulou (1995, 1997, 1998), Anagnostopoulou (1994), Iatridou (1990, 1993), Philippaki-Warburton (1985), Tsimpli (1990)). However, there are restrictions in the use of each of the word orders, some of which relate to

intonational structure as reflection of information structure, and which I will present in this section.

The rest of this section is organized as follows. In sub-section 2.4.1 I present the intonational structure of topics in declarative, negative, and interrogative sentences, in 2.4.2 I show how F-marking interacts with word order and in 2.4.3 I show how topic marking interacts with word order. At the end of the section I give a table summarizing all the findings.

2.4.1 The intonational structure of topics

The difference between topics and foci is marked syntactically as well as prosodically in Greek. Starting with the syntactic characteristics, several authors working on Greek have described the differences between topics and foci (Philippaki-Warburton (1985, 1987), Iatridou (1995), Tsimpli (1995), among others). They all note that topics[14] have a different intonation from foci, topics encode old information—whereas foci encode new—and they also differ in the following structural terms: In (20), a topicalized object will obligatorily trigger the appearance of an object pronoun ("*tin*") cliticizing on the verb (known as clitic-doubling), as in (20a). If the clitic is omitted the result is ungrammatical, as shown in (20b). On the other hand, a focused object will not allow clitic-doubling, as shown in example (21). Sentence (21a) without a clitic is correct, whereas (21b) with a clitic included, is ungrammatical. A topicalized object triggers clitic-doubling (20), but a focussed object does not allow clitic-doubling (21):

(20) (a) *ti Maria,   tin   ide   o Petros*

       the Maria$_{acc}$ her-clit saw   the Peter$_{nom}$

    (b)**ti Maria,*   ----   *ide   o Petros*

       'As for Maria, Peter saw her.'

(21) (a) *TI MARIA*   ----   *ide   o Petros*

       the Maria$_{acc}$ her-clit saw   the Peter$_{nom}$

    (b) **TI MARIA   tin   ide   o Petros*

       'It was MARIA that Peter saw.'

Work on the prosodic realization of focus has shown that focused items are associated with a rising NPA—typically a L+H* pitch accent—high f0, longer duration, and post-focal de-accenting (Botinis (1989), Arvaniti, Ladd, and Mennen (in rev.), Baltazani & Jun (1999), Arvaniti and Baltazani (2000, to appear)). Furthermore, work on the prosodic realization of topics has shown that topics usually form a separate prosodic phrase (IP or ip) with a L* NPA and a H⁻ boundary (Baltazani & Jun (1999), Arvaniti and Baltazani (2000, to appear)).

More specifically, Baltazani & Jun (1999) show that both focus and topic are distinguished by phrasing, type of pitch accent, and boundary tone: L+H* nuclear pitch accent followed by de-accented material for foci and L* NPA with no possibility of de-accenting for topics; L⁻ L% boundary for foci, H⁻ or H⁻ H% boundary for topics.

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[14] Although this construction has been given many names (topicalization, left dislocation, clitic left

Moreover, if topics are placed after foci, as a type of parenthetical phrase, their accents are obliterated post-focally, whereas no such influence is exerted by topics. In GRToBI topics have been found to sometimes have L*+H NPA.

Let us now go through some examples. In Figure 2-23, the sentence is *Tis Lídas ti duliá tin anagnorízun oli I viológi* (the Lida-gen the work-acc clitic recognize all the biologists-nom) 'As for Leda's work, all biologists recognize it'. This utterance is meant to be spoken in the context of a question like 'And what about Leda? What can you tell me about her work?' The topic phrase *tis Lidas ti dulia,* forms an ip with a L*+H pre-nuclear pitch accent, a L* NPA and a H⁻ boundary tone. The remaining material forms a second ip, the focus phrase which is all new, with L*+H pre-nuclear pitch accents, a H*+L nuclear pitch accent, and a L⁻ L% boundary tone. Since one more category, topic, has been added to prosodic/information organization of utterances we are examining, we need to enrich the focus structure we have been employing so far with labels indicating topics. The topic-focus structure of the utterance in Figure 2-23 is shown in example (22) below. As usual, square brackets indicate the domain of focus or topic and capitalized words indicate the location of NPA. Although a topic phrase has a NPA as well this will not be indicated since in Greek all evidence so far suggests that it is invariably located on the last element of the topic phrase. Notice that the location of NPA for topic phrases is the same as the default location of focus phrases, aligned with the right edge of the phrase. The topic focus articulation will play an important role in scope disambiguation as we will see in the following chapters.

dislocation) in the syntactic literature, I will call it topicalization to allude to its prosodic structure.

(22)　　[*Tis Lidas ti dulia*]_T　[*tin anagnorizun oli i VIOLOGI*]_F

(22)　　[*Tis Lidas ti dulia*]T　[*tin anagnorizun oli i VIOLOGI*]F

Figure 2-23. Declarative sentence with a topic phrase: *Tis Lídas ti duliá tin anagnorízun oli I viológi* (the Lida-gen the work-acc clitic recognize all the biologists-nom) 'As for Leda's work, all biologists recognize it' [Fig2-23.wav](Fig2-23.wav)

Baltazani and Jun also examined the realization of topics and foci in polar questions. Figure 2-24 shows a question taken from that study that corresponds to the declarative sentence of Figure 2-22. As we saw in section 2.3, polar questions have a L* NPA and a H⁻L% boundary.

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Figure 2-24. Polar interrogative with a topic phrase: *Tis Lídas ti duliá tin anagnorízun oli I viológi* (the Lida-gen the work-acc clitic recognize all the biologists-nom) 'As for Leda's work, do all biologists recognize it?' Fig2-24.wav

Baltazani and Jun claim that the H⁻L% boundary marking polar questions reverses the tonal type of nuclear pitch accent and boundary tone in the topic phrase (and in the focus phrase as was mentioned in section 2.3.3): the topic NPA on *dulia* is L* and the topic boundary is H⁻ in Figure 2-23, but they are L+H* and L⁻ respectively in Figure 2-24.

Figure 2-25 shows a negative sentence with a topic. The utterance shown is *o Manólis den girízi akóma* (the Manolis-nom not returning-3s yet) 'As for Manolis, he's not returning yet'. This utterance can be used after a question like 'How about your colleagues? Are they returning from their vacation?' if the speaker wants to give a person-by-person answer and could be continued 'As for Eleni, she's returning today, and the rest came back three days ago.' The topic phrase *o Manolis* has a L* NPA on the last word followed by a H⁻ boundary. The negative particle carries the L+H* NPA

of the following intermediate phrase. Topics in negative utterances then, have the same L* H⁻ melody of topics in declaratives.

Figure 2-25. Negative sentence with a topic phrase: *o Manólis den girízi akóma* (the Manolis-nom not returning-3s yet) 'As for Manolis, he's not returning yet' Fig2-25.wav

Figure 2-26 shows a wh-question with a topic. The utterance shown is *ke o Manólis me pión éfige?* (and the Manolis-nom with who-acc left-3s) 'And what about Manolis? Who did he leave with?' and can be used after 'Eleni left with Mary'. The topic phrase and focus phrase melodies in wh-questions are exactly the same as those of negative declaratives.

Figure 2-26. Wh-question with topic phrase: *ke o Manólis me pión éfige?* 'And what about Manolis? Who did he leave with?' Fig2-26.wav

The following table is useful in keeping track of the realization of topic and focus phrases across the different sentence types. Pre-nuclear pitch accents (L*+H) are omitted.

Sentence type	Topic melody		Focus melody	
	NPA	Boundary	NPA	Boundary
Affirmative declarative	L*	H⁻	(L+)H*(+L)	L⁻L%
Negative declarative	L*	H⁻	L*+H	L⁻ !H%
Polar question	L+H*	L⁻	L*	H⁻L%
Wh question	L*	H⁻	L*+H	L⁻ !H%

Table 2-3. Topic and focus melodies across sentence types.

In the next two sections I will show how the distribution of topic and focus phrases within an utterance is regulated by the context.

2.4.2 Information structure and word order

Word order in Greek is partly regulated by focus-topic structure. In this section I will show the interdependence between F marking and word order, in that certain focus structures can only be expressed in certain word orders. Moreover, I will show that a third category in addition to topic and focus needs to be added to the information structure inventory to account for the infelicity of some word orders in certain contexts. I will refer to this third category as *tail,* a term used, as we saw in chapter 1, in Vallduví (1990, 1993) and Vallduví and Engdahl (1996), because the realization and use of tails in Catalan is analogous to those in Greek: Tails represent given information. Generally they occur after the focus phrase, and because of their post-focal position they are prosodically realized as de-accented material. However, as I will show in section 2.5, it is not true that all de-accented constituents are tails, nor is it true that all tails are realized as de-accented material.

Consider the dialogues in (23) and (24). The question in (23), 'Who did Maria praise in the meeting?' requires an answer with narrow focus on the object *Gianni*, whereas the question in (24), 'What did Maria do in the meeting?' requires an answer with VP focus. As we have already seen, utterances (23-A1) and (24-A1) have the same prosodic realization, that is a NPA on the object and a L*+H pre-nuclear pitch accent on the verb, shown in Figure 2-27. The utterance in (23-A2) and (24-A2), on the other hand, is realized with the NPA on the moved object and no accents on the verb, which like all post-nuclear material is de-accented, as shown in Figure 2-28.

(23)   Q: *Poion   epenese I Eleni   sto simvoulio*?

      who-acc praised-3s   the Eleni-nom in-the meeting

    'Who did Eleni praise in the meeting?'

A1: *Epénese* [*to VÍRONA*]$_F$

    praised-3s   the Virona-acc

A2: [*to VÍRONA*]$_F$ *epénese*

    the Virona-acc praised-3s

    'She praised Virona'

(24)   Q: *Ti   ekane I   Eleni   sto simvoulio*?

    what did-3s   the Eleni-nom in-the meeting

    'What did Eleni do in the meeting?'

A1: [*Epénese to VÍRONA*]$_F$

    praised-3s   the Virona-acc

A2: #[to *VÍRONA*]$_F$ *epénese*

    the Virona-acc praised-3s

    'She praised Virona'

Figures 2-27 and 2-28 show the utterances in A1 and A2 respectively.

Figure 2-27. Sentence with VO order, answer to both VP and object focus question: *Epénese to Vírona* (praised-3s the Virona-acc) 'She praised Virona' Fig2-27.wav

Figure 2-28. Sentence with OV order, appropriate answer to object focus question only: *to Vírona epénese* (the Virona-acc praised) 'She praised Virona' Fig2-28.wav

The felicity of these answers depends on the context. Either of the answers in A1 or A2 is acceptable for question (23), but A2 is infelicitous in the context of question (24). Let us see why. The object *Virona* carries the NPA and when it moves to the left, the verb, like all post-nuclear material, must be unaccented. In other words, the verb becomes the tail. This makes no difference in (23) because the verb there is old information and does not have to carry accent. In (24), however, the whole VP is F

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marked since it is not given. Leftward movement of the object leaves the verb, which not given, in the tail and this results in infelicity.

Informally stated, the rule is that material in the tail must be given. Note, however, that given material does not have to be in the tail, as answer (24-A1) suggests. The verb there is given and although it is not in the tail, the utterance is perfectly acceptable in the context. In other words, Greek does not prosodically mark pre-nuclear given material. (Recall that in an analogous sentence in English the verb usually remains unaccented.) The three information structure categories that Greek does mark prosodically are *topic*, *focus,* and *tail[15]*, which occur in this order in every utterance. I repeat the answers of the examples in (23, 24) adding the label for the new category, *tail*.

(25)   A. [*Epenese to VIRONA*]$_F$

B. *Epenese* [*to VIRONA*]$_F$

C. [*to VIRONA*]$_F$ [*epenese*]$_{Tail}$

 I left the marking in (25B) incomplete: the verb there is neither part of the focus nor part of the tail. Prosodically it is realized just like the verb in (25A), but informationally its status is the same as the verb in (25C), that is, it is given information. That is, there is neutralization of two different information structure objects under one prosodic realization.

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[15] There is a fourth category that needs to be investigated not only in the informational system of Greek but cross-linguistically, that of elided material, the distribution and use of which has not systematically been studied (but see Merchant 2001). We will see the importance of this category in connection to

2.4.3 Topic marking and word order

In this section we will see more detailed examples of the use of topics, thus completing the presentation of the use of all three categories of information structure in Greek. As already stated in the previous section, Greek behaves in some respects similarly to Catalan as has it been described by Vallduví, in that word order plays a role in marking information structure. In addition to word order though, Greek uses intonation to mark the different components of information structure, in a way similar to English, modulo the word order differences between the two languages.

Recall from our discussion in the previous chapter that a question like "Who ate the beans?" can be answered in English in two ways, as shown in (26) and (27). The difference between the two answers is that when a speaker uses (26) to answer the question she implies that there are other people who ate other things, that latter meaning resulting from the Contrastive Topic marking (a L+H* NPA with a L⁻ H% boundary tone) of the object *beans* (for a more complete discussion refer to Büring (1999)); on the other hand, when a speaker uses (27) to answer the question she does not imply any such thing.

(26)   Q: Who ate the beans?

A: [Fred]$_F$ ate [the beans]$_{CT}$

(27)   Q: Who ate the beans?

A: [Fred]$_F$ ate the beans

---

negative sentences in section 2.5, but other than that, I will have nothing more to say on the subject in this thesis.

Topics in Greek can be used in a similar way. (28A) – (28D) can all be answers to the question in (28Q), in the sense that (26A) and (27A) could be answers to the same question in English.   However, although these four sentences (28A-28D) are appropriate answers to a question like (28Q), they are not always interchangeable, as we will see, because they imply different things about their context.

(28)   Q: *Kai ta maroulia poios ta   efage*?

      and the lettuces-acc who   them ate-3s

   "And what about the lettuce? Who ate it?"

    A.[*o MANOLIS*]_F [*ta efage ta maroulia*]_{Tail}   S cl-V O

      the Manolis   them ate   the lettuces-acc

    B. [*ta maroulia*]_{Topic} *ta efage* [*o MANOLIS*]_F   O cl-V S

      the lettuces-acc   them ate   the Manolis

    C. [*ta maroulia*]_{Topic} [*o MANOLIS*]_F [*ta efage*]_{Tail}   O S cl-V

      the lettuces-acc   the Manolis   them ate

    D. [*ta efage*]_{CT} [*o MANOLIS*]_F [*ta maroulia*]_{Tail}   cl-V S O

       them ate   the Manolis   the lettuces-acc

We'll look at their prosodic realization first. In all sentences, regardless of word order, the subject *o Manolis* carries a focus pitch accent (H*, L+H*), since it is the constituent that corresponds to the wh-element in the question. Sentence 28A is different from the other three in terms of both word order and prosodic marking of the

non-focal material: it has SVO order and everything except the subject is de-accented, forming the tail. The prosodic realization of this utterance is shown in Figure 2-29.

Figure 2-29. Realization of a sentence containing only Focus and Tail (25A): [*o MANÓLIS*]_F [*ta éfage ta maroúlia*] _{Tail} (the Manolis them ate the lettuces-acc) 'It is Manolis who ate the lettuce' Fig2-29.wav

In (28B) the object and the verb appear to the left of the subject and the 'fronted' material carries pitch accents, as shown in Figure 2-30. The object, *marulia*, forms the topic phrase, being marked with a L* NPA and ending in a H⁻ boundary. The verb is given but it carries a pre-nuclear L*+H pitch accent, and the subject carries the focus phrase NPA.

Figure 2-30. Realization of a sentence containing only Topic and Focus (25B): [*ta maroulia*]$_{Topic}$ *ta efage* [*o MANOLIS*]$_F$ (the lettuces-acc them ate the Manolis) 'As for the lettuce, it was Manolis who ate it.' Fig2-30.wav

In (28C) the object appears to the left of the subject and the verb is final, as shown in Figure 2-31. The object, *marulia*, again forms the topic phrase, aligned with a L* NPA and ending in a H- boundary; the unaccented clitic-doubled verb forms the tail.

Figure 2-31. Realization of a sentence containing object Topic, subject Focus, and verb Tail (25C). [*ta maroulia*]$_{Topic}$ [*o MANOLIS*]$_F$ [*ta efage*] $_{Tail}$ (the lettuces-acc the Manolis them ate) 'As for the lettuce, it was Manolis who ate it.' Fig2-31.wav

In (28D), the verb is the topic and the object is the tail, as shown in Figure 2-32.

Figure 2-32. Realization of a sentence containing verb Topic, subject Focus, and object Tail (25D): [*ta efage*]$_{CT}$ [*o MANOLIS*]$_F$ [*ta maroulia*] $_{Tail}$ (them ate the Manolis the lettuces-acc) 'As for who ate it, it was Manolis who ate the lettuce' Fig2-32.wav

Topics in Greek have the same meaning as those in English and German (Büring (1997a, b, 1999), Roberts (1996)). They indicate the explicit or implicit presence of sub-questions to a question asked. To give an English example, a speaker may choose to answer the question 'Who ate what' by saying *Fred$_F$ ate the beans$_{CT}$* : topic marking of the object implies that there are other relevant dishes in the discourse and that the question is answered by a set of sub-questions like 'Who ate the beans', 'Who ate the pasta', 'Who ate the salmon', and so on. If instead a speaker says *Fred$_{CT}$ ate the beans$_F$* then topic marking of the subject implies that there are other relevant people in the discourse in addition to Fred and that the speaker has chosen a different strategy to

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answer the super question, going person by person instead of dish by dish: 'What did Fred eat?' 'What did Mary eat?' and so on.

We return to the Greek examples. In (29), the question is 'And what about the veggie dishes? Who ate them?', which is a super-question to that in (28Q). Only two out of the four answers in (28) are appropriate as answers to (28Q):

(29)   Q: *Kai ta   diafora piata   me   ta laxanika poios   ta   efage*?

        and the various dishes with the veggies   who   them   ate

       'And who ate the veggie dishes?'

       A. # [*o MANOLIS*]$_F$ [*ta efage ta maroulia*] $_{Tail}$

           the Manolis-nom them ate-3s the lettuces-acc

       B. [*ta maroulia*]$_{Topic}$ *ta efage* [*o MANOLIS*]$_F$

           the lettuces-acc   them ate-3s the Manolis-nom

       C. [*ta maroulia*]$_{Topic}$ [*o MANOLIS*]$_F$ [*ta efage*] $_{Tail}$

           the lettuces-acc   the Manolis-nom   them ate-3s

       D. # [*ta efage*]$_{CT}$ [*o MANOLIS*]$_F$ [*ta maroulia*] $_{Tail}$

           them ate-3s   the Manolis-nom   the lettuces-acc

The answer in A is inappropriate because the object *ta marulia* is in the tail without having been mentioned in the context and as we have already seen, new material cannot be in the tail. For the same reason, the answer in D is inappropriate too. The remaining two answers, B and C, are both appropriate. Their difference is that the verb in C is in the tail whereas in B it is not, but since the verb is mentioned in the

question it is given information and as such it can appear either in the tail or pre-focally (cf. the discussion on (25)). In both B and C, the object *ta marulia* is topic marked and this prosodic marking indicates that the speaker is following a 'dish by dish' strategy of answering the question in (29) and her answer implies there are other relevant dishes in the discourse. Crucially, the material in the topic phrase counts as given in the discourse even though it has not been previously mentioned. When the speaker topic-marks a phrase that is uttered in the context for the first time she performs two actions: she introduces the topic making it a relevant part of the discussion and she also retro-actively declares it part of the background for her own utterance by implying an unspoken but understood question which contains that topic material. This is the difference between topics and tails: though both contain given material, tails can only contain *explicitly* given material.

A nice illustration of topics as implicitly given material can be seen in relation to negation. We have seen that new information negation aligns with the nucleus of the utterance whereas old information negation does not. Imagine a situation where I ask a house-hunting friend of mine her opinion about a house she recently saw. My question and her answer are given in (30):

(30) Q. *Pos su   fanike   to spiti*?
          How you-gen looked-3s the house-nom
          'What did you think of the house?'

A. [*De mu árese*]_T [*i KUZÍNA*]_F, *alla* [*ksetrelathika*]_T [*me ton kipo ke ta bania*]_F.

Not me pleased-3s   the kitchen-nom but   was-crazy-1s   about the garden-acc and the baths

'I didn't like the kitchen but was crazy about the garden and the bathrooms.'

Although nothing in the answer is given, the verbs in both clauses are in topic phrases showing that my friend has chosen to answer me impression by impression. She could also have chosen to go room by room and in that case the objects would go in topic phrases. The reason for mentioning this example is the fact that we can see the given-information status of the material in the first topic phrase through prosody: negation there is non-focused negation (not aligned with the L* nucleus which is the verb, but carrying a pre-nuclear pitch accent) although it was not mentioned anywhere in the context (see Figure 2-33 for the prosodic realization of the first clause).

Figure 2-33. Old negation inside a topic phrase: [*De mu árese*]_T [*i KUZÍNA*]_F (Not me pleased-3s   the kitchen-nom) 'I didn't like the kitchen' Fig2-33.wav

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In the next section, we will see how the information and prosodic structure in a context question is related to those in the answer.

2.5 Question-answer pairs

In this section I look more closely at question-answer pairs in order to determine the connection between the prosodic structure of the question and that of the answer. The connection between polar questions and affirmative answers in Greek is different from that in English. Let us look at some concrete examples.

First, recall that in the all new prosodic pattern for a polar question the nucleus aligns with the verb. Figure 2-34 shows the question *agórasan banánes*? (bought-3p bananas-acc) 'Did they buy bananas?' with the L* NPA aligned with the verb.

Figure 2-34. Polar question as context for a declarative: *agórasan banánes*? (bought-3p bananas-acc) 'Did they buy bananas?' Fig2-34.wav

The answer, *agórasan banánes* (bought-3p bananas-acc) 'They DID buy bananas,' is shown in Figure 2-35, where the H* NPA is also aligned with the verb. That is, the affirmative answer to the polar question exactly mimics the prosodic marking[16] of its antecedent question, as shown in (31).

(31)   Q: [*AGORASAN bananes*]Foc?

    A: [*AGORASAN*]Foc *bananes*

Figure 2-35. Answer to the broad focus polar question shown in Figure 2-32: *agórasan banánes* (bought-3p bananas-acc) 'They DID buy bananas' Fig2-35.wav

Recall that in declaratives in Greek the NPA aligns with the verb only when the verb has narrow focus. The object in the answer is given and so it appears in the tail. The problem is that the verb was also mentioned in the question and although old, it carries the NPA of the sentence. The answer to an analogous question in English would contain a de-accented verb and the NPA would instead align with the auxiliary (or a modal), which probably expresses the polarity of the verb/sentence (i.e., *they DID buy*

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[16] Of course, only the location of NPA is the same—the tone type is different.

bananas), a construction that is called *verum* focus. I take it that aligning the nucleus with the verb in Greek in this answer is also an instance of verum focus. Since Greek has no auxiliary verbs that can be used comparable to the English 'do,' the verb itself has to fill that function.

Answers mimic the prosodic structure of their context polar questions also when no verum focus is involved. Look for example at the question in Figure 2-36, whose focus structure is shown in (32Q), an instance of narrow focus on the object: *agórasan banánes*? (bought-3p bananas-acc) 'Is it bananas that they bought?' The L* NPA is aligned with the object. The answer (32A) has the NPA aligned with the object, just like the question, and is illustrated in Figure 2-37.

(32)   Q: *agorasan* [*BANANES*]Foc?

       A: *agorasan* [*BANANES*]Foc

Figure 2-36. Narrow focus polar question as antecedent to declarative in Figure 2-35: *agórasan banánes*? 'Is it bananas that they bought?' Fig2-36.wav

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I believe that in a comparable question answer pair in English, the NPA in the answer would align with the object 'bananas' just like in Greek (i.e., Q: *Did they buy* [*BANANAS*]_{Foc}? A: *Yes, they bought* [*BANANAS*]_{Foc}).

Figure 2-37. Answer to the narrow focus polar question shown in Figure 2-34: *agórasan banánes* (bought-3p bananas-acc) 'It is bananas that they bought' Fig2-37.wav

Once again, both verb and object are old information in the answer and yet they both receive pitch accents. What's worse, the object carries the NPA and I don't think this can count as verum focus.

The same utterance as in (32A) can be the answer to a wh-question, 'What did they buy?' Since the verb is given in this sentence it can also be in the tail, as shown in Figure 2-38. Note that this answer with an OV order is not appropriate for a VO polar question, unless the object in the question is different from that in the answer, that is, contrastive. For example if my question is 'Is it apples that they bought?' in VO order,

then I can use the OV utterance shown in Figure 2-38 as the answer 'They bought bananas (not apples).'

Figure 2-38. Answer with fronted focused object: *banánes agórasan* (bananas-acc bought-3p) 'It is bananas that they bought' Fig2-38.wav

The fronted object can also become topic in an answer to a question like 'Did they buy everything I asked for?': *banánes*_T *[agórasan]*_{Foc} (bananas-acc bought-3s) 'As for bananas, they bought them'. This answer, shown in Figure 2-39, answers a sub-question to the one I asked, and it means that they bought one of the things I asked for. Once more we see the use of NPA on the verb as verum focus.

Figure 2-39. Answer with a fronted topicalized object: *banánes_T agórasan_F* (bananas bought-3s) 'As for bananas, they bought them' [Fig2-39.wav](Fig2-39.wav)

Let us now turn to question answer pairs in which the answer is a negative sentence. In negative declaratives the nuclear pitch accent is invariably aligned with the negative particle *den* 'not' and everything following negation is de-accented. This has a neutralizing effect on intonation qua indicator of focus structure, since it is impossible to use pitch accents to signal narrow focus on any constituent other than the negation.

For example, it is impossible to tell what the focus structure is in the utterance *den tha páo sto théatro* (not go-1s theater) 'I am not going to the theater', shown in Figure 2-40. That is, there is no differentiation between narrow focus on the verb versus narrow focus on the object. The L*+H NPA is on the negation and the following verb is de-accented.

Figure 2-40. Typical contour of a negative declarative utterance: *den tha páo sto théatro* (not go-1s theater) 'I am not going to the theater' Fig2-40.wav

This utterance could be used after the VP focus utterance *[pao THEATRO]*Foc (go-1s theatre-acc) 'I'm going to the theater' to negate it; it could also be used after a narrow focus utterance like *[PAO]*Foc *theatro* or *pao [THEATRO]*Foc with the negation then applying only to the focused constituent. The negative utterance of Figure 2-40 then could be continued …*[tha KOIMITHO]* Foc (will sleep-1s) 'I'll sleep'; or …*[GIRIZO]*Foc *apo to theatro* (return-1s from the teater-acc) 'I'm coming back from the theater'; … *pao [sto PARKO]*Foc (go-1s to-the park-acc) 'I'm going to the park'. In other words, the NPA on negation indicates sentence type here, not focus.

Since prosodic prominence cannot help differentiate among these different focus structures, Greek has a syntactic way to overcome the neutralizing effect of negation. Consider the following situation. If I meet Manolis' mother and I ask her *o Manolis [tha PAEI sinema?]*F 'will Manolis go to the movies?' and her answer is (33A), shown in Figure 2-41, I will understand that to mean that he won't go anywhere, he'll probably

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stay at home. However, if her answer is (33B), shown in Figure 2-42, I will understand that to mean that he won't go to the cinema, but he will go somewhere else. In other words, how much material is elided in the answer makes a difference in the meaning by determining the target of negation. If only the verb is repeated, then negation has the whole VP as target, that is, something equivalent to VP focus. If in addition the object is repeated, then the object is the target of negation. This latest structure corresponds to prosodic narrow focus on the object. This way of marking the target of negation will be important in the following chapter in understanding how listeners work backwards from a negative sentence to reconstruct the context question corresponding to that sentence even when they have not heard the question.

(33)   A. *DE* [*tha paei* ____]_{Foc}

         not   will   go-3s

     B. *DE tha paei* [*sinema*] _{Foc}

        not will   go-3s   movies

Figure 2-41. Negative answer with elided given object: *de tha pái* (not will go-3s) 'He won't go' Fig2-41.wav

Figure 2-42. Negative answer with given object repeated: *de tha pái   sinemá* (not will go-3s movies-acc) 'He won't go to the movies' Fig2-42.wav

In figures 2-29 to 2-32 I showed also that in an answer to a wh-question—like 'who ate the lettuce'—the focus NPA aligns with the word that corresponds to the wh-word in the wh-question. A wh-question (Figure 2-43) can also take a negative answer

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(Figure 2-44) and then the focus does not align with the word corresponding to the wh-element, but with negation.

The question in (34) is shown in Figure 2-43 with the L*+H NPA on the wh-word and the typical L-!H% boundary.

(34)   *PÓTE tha girísi o manólis?*

      when will return-3s the manolis-nom

    'When will Manolis return?'

Figure 2-43. A wh-question the negative answer to which is shown in Figure 2-42: *PÓTE tha girísi o manólis?* (when will return-3s the manolis-nom) 'When will Manolis return?' Fig2-43.wav

The negative answer in (35) is shown in Figure 2-44 and it has the typical prosodic structure of negative sentences, with the L*+H NPA on the negation and a L-!H% boundary. Experiment 1, which will be discussed in chapter 3, investigates question-answer pairs with a wh-question and a negative answer.

(35)   *DE tha girísi norís*

not will return-3s soon

'He won't be back soon'

Figure 2-44. Negative answer to a wh-question: *DE tha girísi norís* (not will return-3s soon) 'He won't be back soon' Fig2-44.wav

Summarizing, we saw that affirmative answers to polar questions in Greek mimic the prosodic pattern of their context questions and we also saw that negative answers to polar questions cannot mimic the prosodic pattern of their context questions because of a prosodic constraint requiring the nucleus of negative utterances to align with the negative particle—the same prosodic pattern also used for negative answers to wh-questions. Greek instead uses a syntactic way, elision, to mark correspondences between the focus marking of the question and that of the answer.

2.6 Conclusion

In this chapter I showed how information structure is realized in some types of Greek utterances. I showed the need to recognize three separate basic categories, topic, focus, and tail. Much more research is necessary to determine the finer details of information structure of course. In here I merely gave a very general picture covering a few types of utterances. We saw that in some cases these information structure categories very cleanly map to prosodically distinct entities: topics form their own prosodic phrase with a specific melody, foci form a second prosodic phrase containing the main stress of an utterance and tails get typically de-accented. However I also showed types of utterances like negatives in which prosody is not used for the encoding of information structural categories but to indicate the illocutionary force of the utterance: for these utterances focus constituents do not get accented and de-accenting does not show old information.

These results show that there is no 1-to-1 relation between prosody and information structure. Concentrating on the information structure categories of Focus and Tail, which encode new and given information respectively, we saw that they are realized in different ways across sentence types in Greek, shown in Table 2-3.

Sentence type	Focus = new	Tail = given
Statement	Pitch accents (pre-nuc, NPA)	De-accenting
Negative	Pitch accents, de-accenting	Elision
Polar question	Pitch accents, de-accenting	?
Wh-question	Pitch accents, de-accenting	?

Table 2-4. Prosodic realization of Information structure categories across sentence types.

In statements, the constituents in focus phrases are typically realized with (pre-nuclear or nuclear) pitch accents and the constituents in tails are de-accented, as shown schematically in Figure 2-45:

Utterance (statements)

Topic   Focus   Tail   ← Information structure

PA   NPA   PA   NPA   De-accent ← Prosodic realization

Figure 2-45. Information structure and its prosodic realization in statements in Greek (PA= prenuclear pitch accent; NPA= nuclear pitch accent).

However, in non-statements, de-accented material is part of the focus phrase. And, moreover, tails in negative sentences are elided, as shown schematically in Figure 2-46. So neither are de-accented constituents always tails nor are tails always realized as de-accented constituents. The prosodic realization of tails in interrogatives has not been examined here and is left as an open question.

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                         Utterance (negatives)


            Topic           Focus           Tail   ← Information structure


        PA      NPA    NPA  Deacc      Elision  ← Prosodic realization
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Figure 2-46. Information structure and its prosodic realization in negatives in Greek

These findings are also relevant to the larger field of prosody and its interpretation. There have been many efforts to give some interpretation to prosodic entities, particularly so to prosodic focus. It has been characterized as 'presentational', 'salient', 'new', 'interesting', and 'contrastive', among other terms. Each of these terms is successful for some contexts but not in others and no one meaning has been found to cover all the possible uses of prosodic focus. I believe that the meaning of focus has proved elusive because focus in itself carries no meaning, but instead is used in grammar as a pointer to connect the current utterance to prior discourse.

In the chapters that follow I will present experimental results which support this pragmatic view of focus.

CHAPTER 3

Experiments 1 and 2:

The scope of negation and intonation structure

In this chapter I present data from two experiments carried out to investigate the relation between the intonation structure of utterances and their interpretation, especially the scope of negation. The experimental results suggest that intonation in Greek can be used to encode each of the different truth conditional interpretations of ambiguous sentences like (1) and (2) in Greek. Both these sentences are ambiguous and their interpretations are given in (a) and (b). The two experiments are similar in that the sentences they were designed to examine contain negation. They differ in that the sentences in experiment 1 involve scope relations of negation with a quantified object (e.g. 'many apples') and those in experiment 2 involve scope relations of negation with a *because* clause.

(1)   *den efagan polla mila*

       not   ate-3pl   many   apples

       'They did not eat many apples'

       a. 'The apples they ate are not many'   [NOT > MANY]

       b. 'There are many apples they didn't eat'   [MANY > NOT]

(2)   *den vlepei tileorasi giati   variete*

        not   watch-3s   TV   because   is-bored

        'He isn't watching TV because she's bored'

        a. 'Boredom is not the reason he's watching TV'   [NOT > BECAUSE]

        b. 'Because he's bored, he's not watching TV'   [BECAUSE > NOT]

Strings like (1) and (2) are ambiguous only in written form in Greek; once they are uttered they are no longer ambiguous, since each of the two possible scope interpretations of the string is delivered with a distinct melody. I will show that in both these experiments intonation disambiguated sentences like (1) and (2): speakers delivered each of the two meanings of these sentences with a distinct melody and listeners attached a distinct interpretation to each of the two melodies that speakers produced, even though these utterances were played to them without any disambiguating context.

Similar facts about the disambiguating function of prosody in sentences involving the scope of negation have been noted cross-linguistically, too. To take one example, the English sentence in (3) has been widely reported to have at least two interpretations (the most frequently cited early reference for such examples is Jackendoff 1972), shown in (3a) and (3b). Each of these interpretations is realized with a different intonation of the sentence, what Jackendoff (1972), adopting Bolinger (1958), called contour A for (3a) and contour B for (3b). The meaning difference in (1a) and (1b) is attributed to

different scope relations between *all* and *not* (for further discussion on the relation between prosodic structure and scope interpretation see, among others, Jackendoff (1972), Ladd (1980, 1996), Steedman (1991, 2000), Büring (1997, 1999)).

(3)   *All the men didn't go*

     a. 'No man went'   [ALL > NOT]

     b. 'Some men went'   [NOT > ALL]

Several issues arise in connection to such sentences: To begin with, it is not entirely clear in what way the intonation structure of utterances like (1) - (3) contributes to the determination of their meaning. In other words, what is the rule or process that links the interpretation of such sentences to the way they are uttered? In this chapter I propose that prosody does not directly encode scope but the disambiguation ensues through a link of prosody with the context in which the utterances are produced[17]. Furthermore, it is not clear how extensive this disambiguating effect of prosody is. Does it apply to sentences containing any type of quantifier, or is it restricted to some types only? The experimental results discussed in this thesis suggest that, at least for Greek, the latter is true. That is, it turns out that prosody helps disambiguate the scope only in sentences containing negation. In the third experiment, presented in chapter 4, no effect of prosody on the interpretation of sentences containing two nominal quantifiers was found, even though these sentences display scope ambiguities. Finally, no detailed

experimental study of the exact nature of the prosodic structure of such utterances and its relation to the resulting meaning has been undertaken to my knowledge.

Each experiment consists of a production and a perception part: In the production part, the speakers—who are different for each experiment and also different from the listeners in the perception experiment—read aloud mini-dialogues containing the target sentences. The utterances of speakers were recorded and prosodically analyzed to determine what kind of intonation was used for the delivery of the two meanings. In the perception part, listeners—different ones in each experiment—heard the target sentences out of context and had to decide what they mean based on their intonation alone.

The prosodic structure of the utterances that give rise to each of the interpretations was analyzed to determine which prosodic differences result in a different interpretation, and what prosodic features are consistently connected to each particular interpretation.

The structure of this chapter is as follows: section 3.1 presents experiment 1, section 3.2 presents experiment 2 and section 3.3 presents general discussion of the results.

3.1 Experiment 1: *Not* – object quantifier

In this part, I present the production method in section 3.1.1, the production results in section 3.1.2, discuss these results in 3.1.3, and I present the perception method and

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[17] For an analysis of English sentences like (1) and (2) very similar to the one proposed here also see Kadmon and Roberts (1986).

results in sections 3.1.4 and 3.1.5 respectively. 3.1.6 is general discussion of the experiment.

3.1.1 Production method

The hypothesis I set out to examine in this production part of the experiment was that a different intonation would indeed be used consistently by speakers to deliver each of the two meanings in sentences like (1) above.

8 speakers participated in the production part, 4 male and 4 female, all speakers of Athenian Greek, and ranging in age between 25 and 40. Their utterances were produced in a quiet room and recorded directly on an IBM laptop. The material they read were question answer pairs like (4Q-4A1) or (4Q-4A2) and (5Q-5A1) or (5Q-5A2). The template of all the sentences is the same: [negation + verb + quantifier + noun phrase (NP)]. The quantified NP is the object of the verb. Word order was varied in the target sentences between the 'default' VO order and OV order to examine whether a change in word order would affect (a) the interpretation of these sentences and (b) the intonation used to deliver such meaning. The target sentences in (4A1) and (5A1) show the VO order and those in (4A2) and (5A2) show the OV order.

(4)   Q: *Posa   provlimata elisan   i mathites?*

         how many   problems   solved   the students

    'How many problems did the students solve?'

A1: *Den elisan polla provlimata*   VO [NOT > MANY]- linear

   not solved-3pl many problems-acc

A2: *Polla provlimata den elisan*   OV [NOT > MANY]- inverse

   many problems-acc not solved-3pl

'The problems they solved are not many'

(5) Q: *Posa   provlimata den elisan i mathites?*

   how many problems not solved the students

'How many problems didn't the students solve?'

A1: *Den elisan polla provlimata*   VO [MANY > NOT] - inverse

   not solved-3pl many problems-acc

A2: *Polla provlimata den elisan*   OV [MANY > NOT] - linear

   many problems-acc not solved-3pl

'The problems they didn't solve are many'

The quantifier varied among [*many, more than n, few, at most n*]. These quantifiers were chosen so that both increasing quantifiers (*many, more than n*) and decreasing ones (*few, at most n*) could be examined to determine whether they behave differently, since in English and other languages the latter have been claimed to be unable to take inverse wide scope (Szabolcsi and Zwarts (1993) and references in there).

  The sentences in (4A) are about the number of solved problems, those in (5A) about the number of unsolved problems. I created two different context questions for each sentence to induce the two desired interpretations of the sentences: One question has a positive polarity verb, shown in (4Q), and asks about solved problems, asking in

essence 'tell me about the solved problems; how many were there'. An appropriate answer to that should also be about solved problems, that is, either of the answers in 4 would be appropriate answers. The other question has a negative verb, shown in (5Q), and asks about unsolved problems, asking in essence 'tell me about the *un*solved problems; how many were there'. An appropriate answer to that should also be about unsolved problems, that is, either of the answers in 5 would be appropriate answers.

Note that (5Q) is unambiguous because negation cannot scope above the wh-word. That is it means 'tell me how many the unsolved problems are' and it cannot mean 'tell me for what number x is it true that you didn't solve x problems'. The inability of negation to scope over the wh-word in some wh-questions (for example *why, how* and *how many* questions) has been attributed in the English literature to a syntactic/semantic constraint called 'a weak island effect' (Szabolcsi and Zwarts (1993), Cinque (1991), Rizzi (1990), among others). I assume that the possibility of only negation narrow scope interpretation for the wh-questions in this experiment (like (5Q)), is a result of a weak island effect in Greek, just like for the English analogous question. This syntactic/semantic property of negation will prove to play a central role in the analysis of the experimental results.

Four different token sentences were used for each quantifier, resulting in 64 target sentences: 4 quantifiers X 4 tokens X 2 word orders X 2 question contexts. Each speaker only read one of the interpretations for each token sentence. The list with all the sentences used for each quantifier is given in Appendix A. The utterances produced were prosodically labeled following GRToBI conventions.

3.1.2 Production results

Four patterns in the structure of these utterances emerged from the analysis of the data, correlating with the two word order variants of an utterance and the two different context questions preceding it, confirming the experimental hypothesis. In this section I present the prosodic structure of the utterances produced and in the next section I discuss how this structure relates to their information structure, the context they are appropriate in, and—assuming the discussion on sentence types in chapter 2—their interpretation.

Figures 3-(1, 5, 7, and 9) illustrate the four utterance patterns produced across speakers and quantifiers[18] in the experiment. The examples show two word order variants of the same sentence in response to each of the two different context questions. I will call context questions of the form 'How many N(ouns) did they V(erb)?' positive and 'How many Ns didn't they V?' negative indicating the presence and absence of negation respectively.

The two prosodic realizations of the VO order are presented before those of the OV order. After discussion of each pattern three additional examples of the same pattern are shown. These examples were selected to show the invariance of the prosodic structure (a) across different speakers and (b) across quantifiers[19]. Furthermore, the number of tokens that conformed to each of the four patterns is given in Table **3-**1 so

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[18] I will discuss one exception to this generalization in section 3.1.2.1.
[19] Ideally, support for the claim that the prosodic pattern for each meaning is invariable would be provided if these utterances were labeled by independent transcribers, but unfortunately no labelers with knowledge of GRToBI except the author were available.

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that we can get a clear picture of the consistency in the production of the patterns. Figures presented in this chapter have a fourth tier added, to show the scope between the two quantifiers, under the tiers for tones, transliteration, and gloss.

Figure 3-1 shows the VO order utterance *den élisan pollá provlímata* (not solved many problems) 'The solved problems were not many', produced in response to the positive context question 'How many problems did the students solve?' Its prosodic pattern is the same as the typical pattern of negative sentences containing new information negation (i.e., negation that was not in the context) that we saw in chapter 2: The L*+H NPA aligns with negation, all the words following it are de-accented, forming a low plateau, and there is a L-!H% boundary (the circle shows the location of stress on the second word, which I will discuss shortly).

Figure 3-1. The sentence *den élisan pollá provlímata*, (not solved-3p many problems-acc) 'The solved problems are not many' in VO order, as uttered by speaker 1 in response to the question 'How many problems did they solve?'

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Before we continue with the second pattern, I would like to clarify an issue about NPA alignment. The NPA in Figure 3-1 is transcribed as <L*+H. The < symbol means that this pitch accent is aligned earlier than typical. Under normal circumstances, when there is no tonal crowding, there is a rise all through the stressed syllable and the peak of L*+H is realized after the stressed syllable. In this utterance, however, the peak aligns with the middle of the stressed syllable which is characteristic of the L+H* pitch accent. Figure 3-2 (shown also in chapter 2, Figure 2-1) is a schematic representation of the alignment of different pitch accents with the stressed syllable. The Greek letter α is used to represent a syllable, and ά to represent a stressed syllable.

Figure 3-2. Typical alignment with the stressed syllable of three pitch accents in Greek.

The reason I have not labeled the NPA in Figure 3-1 L+H* is that this early peak in negative sentences correlates with the presence of lexical stress on the initial syllable of the following verb (*élisan*) (the stressed syllable of the verb is circled). When the following verb has initial stress, the pitch accent on the negation is pushed to the left and in realization this pitch accent looks like the L+H* accent.

The utterance in Figure 3-3 is *den eksétasan lígus asthenís* (not examined few patients) produced in response to the question 'How many patients did they examine?'

The verb in this example carries stress on a non-initial syllable, (*eksétasan* 'examined', with its stressed syllable circled). Compare the NPA in Figure 3-3 and Figure 3-1: in Figure 3-3 the peak of the L*+H accent occurs after the vowel of the negative particle.

Figure 3-3. Alignment of the L*+H pitch accent under normal circumstances (no stress initial word following). The utterance is *den eksétasan lígus asthenís* (not examined few patients). Compare the NPA here with the pitch accent in Figure 3-1, which is realized early due to the following stress-initial word. This utterance was produced by speaker 2. Fig3-3.wav

The correlation between an early L*+H NPA on negation and initial stress on the verb can be also seen in Figure 3-4. The top panel in Figure 3-4 shows an early NPA before a stress-initial verb (*plírosa* 'paid') and the remaining two figures show typical alignment of L*+H because the verbs carry non-initial stress (*episkéftike* 'visited' and *eksétasan* 'examined') for the middle and bottom panel respectively; see Arvaniti and Ladd (1995), and Arvaniti, Ladd, and Mennen (2000) for discussion of alignment of tones in Greek.

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Figure 3-4 presents more examples of VO order utterances produced in response to positive context questions. These were produced by different speakers and contain different quantifiers. The top panel shows the utterance *den plírosa páno apo tris klísis* (not paid-1s more than three tickets-acc) 'The tickets I paid are not more than three'. The middle panel shows the utterance *den episkéftike to polí tésera tmímata* (not visited-3s the many four centers-acc) 'The centers he visited are not at most four'. The bottom panel shows *den eksétasan lígus asthenís* (not examined-3p few patients-acc) 'The patients they examined are not few'. They all have the L*+H NPA followed by de-accented material until the boundary.

This pattern was consistently used to encode this particular meaning across speakers and quantifiers: 14 out of 16 utterances produced had this pattern, 7 out of the 8 utterances containing increasing quantifiers (the remaining one utterance was produced in a very careful style with every word focused) and also 7 out of the 8 utterances containing decreasing quantifiers (the remaining one was produced with the quantifier focused instead of the negation). Across tokens there is, of course, variation in the speaker range, but the tonal targets are the same throughout: there is rising during the negation, falling during the first post-accentual stressed syllable, a sustained low valley throughout the post nuclear material and the final movement for the boundary[20].

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[20] As already mentioned in chapter 2, the boundary of negative sentences shows two patterns, a rise to mid range (L- !H%) and a fall (LL%). No meaning difference associated with these two ways to end a negative sentence has been found (Arvaniti and Baltazani (2000), (to appear)), so the matter will not concern us here.

Figure 3-4. VO utterances with linear scope interpretation [NOT > Q]. Top: *den plírosa páno apo tris klísis* (not paid-1s more than three tickets-acc) 'The tickets I paid are not more than three'; speaker 2. Middle: *den episkéftike to polí tésera tmímata* (not visited-3s the many four centers-acc) 'The centers he visited are not at most four'; speaker 4. Bottom: *den eksétasan lígus asthenís* (not examined-3p few patients-acc) 'The patients they examined are not few'; speaker 5. Fig3-4-Top.wav Fig3-4-Mid.wav Fig3-4-Bot.wav

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The second pattern observed in the prosodic structure of the utterances is shown in Figure 3-5. This utterance, *den élisan pollá provlímata* (not solved-3p many problems-acc), 'The unsolved problems were many' was uttered in response to the negative context question 'How many problems didn't the students solve?' It is string identical to that in Figure 3-1, but it is produced with a different melody. This prosodic structure is the one expected for utterances containing old information negation (i.e., negation that was in the context): the nucleus of the sentence does not align with negation. The negative particle and the verb form a separate prosodic topic phrase which ends with a H⁻ phrase accent and the quantified object forms the second prosodic phrase in which the quantifier *many* is aligned with the L+H* nuclear pitch accent.

Figure 3-5. The sentence *den élisan polá provlímata* (not solved-3p many problems-acc) 'The unsolved problems were many' [MANY > NOT], in VO order, produced by speaker 3. Fig3-5.wav

Figure 3-6 shows representative examples of this pattern in utterances containing other quantifiers and produced by different speakers. The utterance in the top

panel is *den édose hári se lígus katadíkus* (not gave-3s pardon to few convicts-acc) 'The convicts she didn't pardon are few'and was produced by speaker 5. In the middle panel, *den prokálese zimiés se páno apo téseris géfires* (not caused-3s damage to over than four bridges-acc) 'The bridges it didn't cause damage to were more than four' by speaker 3. In the bottom panel, *den ékrine akatálila to polí éksi arnákia* (not judged-3s unsuitable at most six lambs-acc) 'The lambs he didn't judged unsuitable were at most six' by speaker 5. This pattern was used for all 16 of the tokens, 8 containing increasing quantifiers and 8 containing decreasing ones. There was some variation in the location of the NPA in the second intermediate phrase. Some speakers aligned it with the quantifier and de-accented the object, while other speakers focused the whole quantified object, using a pre-nuclear pitch accent on the quantifier and aligning the NPA with the noun. This variability did not seem to matter in the perception experiment, except in one case. The prosodic realization of one of the utterances, which contains the quantifier *pano apo tessera* 'more than four', did make a difference in the perception results. It will be discussed together with the perception results, in section 3.1.5.1. In general, the factors which determine the exact alignment of focus NPA in quantified objects are unclear and should be further investigated experimentally.

Figure 3-6. VO utterances with inverse scope interpretation [Q > NOT]. Top: *den édose hári se lígus katadíkus* (not gave-3s pardon to few convicts) 'The convicts she didn't pardon are few'; speaker 5. Middle: *den prokálese zimiés se páno apo téseris géfires* (not caused-3s damage to over than four bridges) 'The bridges it didn't cause damage to were more than four'; speaker 3. Bottom: *den ékrine akatálila to polí éksi arnákia* (not

judged-3s unsuitable at most six lambs) 'The lambs he didn't judge unsuitable were at most six'; speaker 5. Fig3-6-Top.wav Fig3-6-Mid.wav Fig3-6-Bot.wav

The third pattern observed is illustrated in the utterance in Figure 3-7, *pollá provlímata den élisan* (many problems-acc not solved-3p) 'The solved problems were not many'. This shows the OV order answer to the positive context question 'How many problems did the students solve?' The contour is similar to that in Figure 3-5 but it is realized over different lexical material: while the negation and the verb form the prosodic topic phrase as in Figure 3-5, here the quantified object forms the topic phrase.

Figure 3-7. The utterance *pollá provlímata den élisan* (many problems-acc not solved-3p) 'The solved problems were not many' [NOT > MANY], in OV order. Fig3-7.wav

There were two different patterns in the prosodic structure used for this combination of context and word order. This is the only instance in the experiment when the contour is determined by the type of quantifier in the utterance. For utterances containing increasing quantifiers, the intonation contour used is that just shown in

Figure 3-7 above: The quantified object in this utterance is moved to the left and is prosodically realized with the typical topic marking[21] (L* H⁻) of negative sentences. In the second prosodic phrase, the new information negation carries the L*+H NPA and is followed by de-accented material. Seven out of eight tokens containing increasing quantifiers displayed this contour (the remaining utterance was produced in a very careful style with every word focused).

For the utterances containing decreasing quantifiers instead, the fronted quantifier carries the early NPA and all following material is de-accented, as shown in Figure 3-8. This contour used for the decreasing quantifiers is similar to the contour used in response to the negative question 'How many problems didn't the students solve?' shown in Figure 3-10 below. In other words for the decreasing quantifiers the two interpretations are not prosodically differentiated in the OV order. Among the eight tokens containing decreasing quantifiers in OV order, seven displayed the contour with a focused quantifier (as in Figure 3-8) and only one was produced with a topicalized quantifier (as in Figure 3-7). We will discuss this unexpected pattern in subsection 3.1.3.1.

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[21] As seen in this example there is some variation between a L* and a L*+H NPA in the topic NPA. For details on this variability see Arvaniti and Baltazani 2000.

tones		L∗+H		L+H∗								LL%
words		to poli]		se dodeka]		vrefi]		den]				ekanan]
gloss		at most		to twelve		infants-acc		not				gave-3p
scope												not>at most 12

Figure 3-8. The utterance *to polí se dódeka vréfi den ékanan* (at most to twelve infants-acc not gave-3p) 'They didn't give (a shot to) at most twelve infants', in OV order, as produced by speaker 2. Fig3-8.wav

Figure 3-9 shows more examples of the contour used in response to the positive context question. There is only one example containing a decreasing quantifier since all the other tokens were produced with a different melody. The top panel shows the utterance *se páno apo téseris géfires den prokálese zimiés* (to over than three bridges-acc not caused-3s damage) 'The bridges damaged were not more than four', as produced by speaker 7. The bottom one shows the utterance *to polí tris teníes den éxo di* (at most three movies-acc not have-1s seen) 'The movies I have seen are not at most three', as produced by speaker 3.

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Figure 3-9. OV utterances with inverse scope interpretation [NOT > Q]. Top: *se páno apo téseris géfires den prokálese zimiés* (to over than three bridges-acc not caused-3s damage) 'The bridges damaged were not more than four'; speaker 7. Bottom: *to polí tris teníes den éxo di* (at most three movies-acc not have-1s seen) 'The movies I have seen are not at most three'; speaker 3. Fig3-9-Top.wav Fig3-9-Bot.wav

The fourth and final pattern is shown in Figure 3-10, the utterance in which is *pollá provlímata den élisan* (many problems-acc not solved-3p) 'There were many unsolved problems' an example of the OV order answer to the negative context question 'How many problems didn't the students solve?' The contour of this utterance is similar to that in Figure 3-1: an early NPA followed by de-accented post-nuclear material. The difference between the utterances in Figure 3-1 and Figure 3-10 is word order—VO for

Figure 3-1 and OV for Figure 3-10—and as a result, in the latter the NPA aligns with the quantifier in the fronted object phrase instead of the negation.

Figure 3-10. The utterance *pollá provlímata den élisan* 'The unsolved problems were many' [MANY > NOT], in OV order, as produced by speaker 6. Fig3-10.wav

Figure 3-11 shows representative examples of this pattern in utterances with other quantifiers and speakers. The top panel is *to polí tésera tmímata den episkéftike* (at most four centers not visited-3s) 'The centers he did not visist are at most four', produced by speaker 1. The middle panel is *líga kondília den enékrine* (few budgets not approved-3s) 'The budgets he did not approve are few', produced by speaker 7. The bottom panel is *páno apo trís klísis den plírosa* (more than three tickets not paid-1s) 'The tickets I did not pay are more than three', produced by speaker 8. All 16 tokens in this category were produced with this contour.

Figure 3-11. OV utterances with linear scope interpretation [Q > NOT]. Top: *to polí tésera tmímata den episkéftike* (at most four centers not visited-3s) 'The centers he did not visist are at most four'; speaker 1. Middle: *líga kondília den enékrine* (few budgets not approved-3s) 'The budgets he did not approve are few'; speaker 7. Bottom: *páno apo trís klísis den plírosa* (more than three tickets not paid-1s) 'The tickets I did not pay are more than three'; speaker 8. Fig3-11Top.wav Fig3-11Mid.wav Fig3-11Bot.wav

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Table 3‑1 summarizes the information given throughout this section about the number of utterances produced with each prosodic pattern. There are eight columns, four per each context question preceding the utterance (either a positive question about solved problems, or a negative one about unsolved problems). The four columns for each context question are divided again, two per type of quantifier contained in the answer—increasing (many, more than) or decreasing (few, at most)—and finally, each column within each pair shows VO or OV order. The rows show which of the answers were produced with focus on negation or focus on the quantifier.

These results show a consistent pattern: a positive context question correlates with focus on the negation (NegF) and a negative context question with focus on the quantified object (QF). There is only one exception to this pattern shown in the fourth column (circled): utterances containing decreasing quantifiers in the OV order produced in response to a positive context question had focus on the quantifier instead of the negation. Almost all speakers (7/8) produced utterances in that category with this unexpected pattern. These utterances represent 10% of the data and I will discuss them in section 3.1.3.1.

	POSITIVE CONTEXT QUESTION				NEGATIVE CONTEXT QUESTION			
	INCREASING		DECREASING		INCREASING		DECREASING	
	VO	OV	VO	OV	VO	OV	VO	OV
Neg F	7/8[22]	7/8	7/8	1/8	0	0	0	0
Q F	0	0	1/8	7/8	8/8	8/8	8/8	8/8

Table 3-1. Number of utterances produced with each prosodic pattern.

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[22] The remaining utterance was produced with each word focused, in a very careful style.

To sum up, the results show (ignoring for a minute the one problematic case) that every ambiguous string was uttered in two different ways in response to the two different questions preceding it, regardless of word order, or quantifier: focus on the negation correlates with a positive context question and focus on the quantifier correlates with a negative context question.

We turn now to the relation between prosodic structure, information structure and interpretation of these utterances.

3.1.3 Discussion of production results

In this section I discuss how the prosodic structure of the produced utterances relates to their information structure, the context they are appropriate in, and—using the knowledge we accumulated about sentence types in chapter 2—the interpretation they receive. The analysis of the focus-background structure of the experimental utterances presented here relies on the conclusions we reached in chapter 2 about the relation between prosodic structure and the focus-background structure of the utterance and by extension the contexts it is appropriate in. The discussion in this section is also the background against which we will view the results of the perception experiment: whatever 'rules' speakers follow to prosodically construct their utterances according to the context they are given are also used by listeners in the reverse direction to reconstruct appropriate contexts for the prosodic structures they hear. One of the claims of this thesis is that the disambiguating effects of prosody found in the two experiments presented in this chapter arise through this linking of prosody with context: the

particular contexts that listeners arrived at through this process were unambiguous and therefore the interpretation of these utterances was unambiguous.

Before going over the four patterns in the prosodic structure of the experimental utterances, I briefly repeat the relevant points from the discussion on negative sentences from chapter 2:

- Sentences containing negation were divided in two groups

  - 'new information' negation in which negation is aligned with the utterance nucleus and used when negation is not explicit in the context

  - 'old information' negation in which negation is not aligned with the utterance nucleus and used when negation is explicit in the context; such utterances do not have negative 'force'

- There is a crucial difference between affirmative and old negation utterances on one hand and new negation negative utterances on the other:

  - in the former, prosodic marking (sentence nucleus, phrasing, de-accenting) indicates information structure (focus, topic, tail) and pragmatic status (new, given) of the sentence constituents

  - in the latter, prosodic marking is used to indicate sentence type and the location of the nucleus never varies; instead information structure and pragmatic status are indicated through the syntactic process of elision. Concretely, for sentences containing a verb and an object after the negative particle, we saw that an elided object indicates VP focus and a non-elided one indicates narrow focus on this object. In the experimental utterances the

object is never elided, so we expect the new negation utterances in the experiment to indicate narrow focus on the object and not VP focus.

The information structure of utterances with a positive context question and VO order is shown in (6). It is important to remember that the marking[23] of the utterances I present here reflects the information structure as predicted by the *pragmatics* rather than the prosody. Three different focus structures are possible for such utterances, shown in (6a-c): either the whole object DP is focused (6a) or only one of its constituents is, either the quantifier (6b) or the noun (6c).

(6) a. [*DEN*]F *elisan* [*polla provlimata*]F 'What they solved is not many problems'

   b. [*DEN*]F *elisan* [*polla*]F *provlimata* 'The solved problems are not many'

   c. [*DEN*]F *elisan polla* [*provlimata*]F 'It's not PROBLEMS that they solved a lot of'

       not   solved-3s many   problems-acc

Each of the three is appropriate for a different context. Here are contexts for each of them. Suppose among the questions in an exam, there were riddles, puzzles, and problems to solve.

▪ You ask me whether the students solved many problems. My answer has the focus structure in (6a) and the meaning it conveys is 'What they solved is not many problems (but, for instance, half the riddles)'.

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[23] Capitals indicate the location of the NPA. Umarked material is taken to be part of the ground.

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- You ask me how many problems the students solved. I don't know the answer to that but I do know that the number is not large. My answer then has the focus structure in (6b) and the meaning it conveys is 'The solved problems are not many'.

- You ask me which type of question the students solved a lot of. I don't know the answer to that but I do know that the number of problems they solved was small. My answer then has the focus structure in (6c) and the meaning it conveys is 'It's not PROBLEMS that they solved a lot of'.

Notice that for all three contexts negation has wide scope over the quantifier: 'solve' is not a property of 'many problems'.

The meaning we expect an utterance like (6) to convey in the perception experiment—regardless which of the three focus structures listeners assume—is negation wide scope ('linear scope'). We expect listeners who hear this utterance to work their way backwards from the utterance to recover a context in which this utterance would be appropriate: negation is new and focused (it carries the NPA), therefore it was absent from the context; and as we saw any of the three contexts related with different parts of the DP being focus marked helps listeners recover the negation wide scope interpretation.

The information structure of utterances with a negative context question and VO order is shown in (7).

(7)   [*Den elisan*]_{Topic} *POLLA*_F *provlimata*

Listeners working backwards from the prosody reconstruct a context where the negation is old and the quantity of problems is unknown, and (7) used as an answer conveys a meaning like 'As for the unsolved problems, they are many,' that is, the quantifier scoping over the negation ('inverse scope').

The information structure of utterances with a positive context question but OV order is shown in (8).

(8)   [*Polla provlimata*]_{Topic}   [*DEN*]_F *elisan*

Listeners reconstruct a context where the negation is absent and the quantity of problems is unknown, and (8) used as an answer conveys a meaning like 'As for whether the solved problems are many, that's not the case' (the translation is not very faithful here). The implicature brought about by the topic marking of the quantified object is that one of the sub-questions in the set above will receive a positive answer. In a round-about way this is the same meaning as that of utterance (6). We expect listeners to give an interpretation like 'the solved problems are not many' for this utterance too, i.e., negation wide scope (inverse scope).

The information structure of utterances with a negative context question and OV order is shown in (9). A speaker indicates and a listener can deduce from the backgrounded material that the context is about unsolved problems and from the focus that the quantity of those unsolved problems is *many*, that is MANY > NOT (linear scope).

(9)   [*POLLA*]F *provlimata den elisan*

To sum up, the four example utterances (6-9) and a schematic representation of the contour each one was realized with are shown in (10) and (11). In (10) I show the two utterances produced after a positive context. They have negation wide scope interpretation; the one on the left expresses linear scope and the one on the right inverse scope. The two utterances produced after a negative context (11) have negation narrow scope interpretation, the one on the right linear scope and the one on the left inverse scope.

(10)   Q: How many problems did the students solve? [NOT > MANY]

VO	**OV**
(6) [*DEN*]F *elisan* [*polla*]F *provlimata*	(8) [*Polla provlimata*]Topic [*DEN*]F [*elisan*]Tail

LINEAR	INVERSE

(11)   Q: How many problems didn't the students solve? [MANY > NOT]

VO	**OV**
(7) [*Den elisan*]T *POLLA*F [*provlimata*]Tail	(9) [*POLLA*]F [*provlimata den elisan*]Tail

INVERSE	LINEAR

Notice that the same pattern is used for linear scope across word orders: the nucleus of the sentence aligns with the quantifier we expect to receive wide scope interpretation. Inverse scope is realized with the narrow scoping quantifier in a prosodic topic phrase. Generalizing still more, we can make the following statement

(12)   Wide scope = prosodic nucleus

         Narrow scope = background

As we will see, the generalization in (12) is only epiphenomenal. Experiment 3, which will be discussed in chapter 4, gives evidence that there is no deep connection between being a prosodic nucleus and being interpreted as wide scope. In other words, the claim here is that there is no rule in the grammar like (12). Instead, prosody is consistently linked with information structure, that is, prosody gives us clues about the context an utterance is appropriate in. If this context happens to be unambiguous, as in experiment 1 (and experiment 2 as we will see shortly), then prosody, which points to this context, disambiguates. If on the other hand this context is ambiguous then prosody cannot disambiguate and a rule like (12) makes the wrong predictions.

Before proceeding with the perception part of the experiment, I will discuss the residual 10% of utterances whose prosodic structure did not conform to the general pattern.

3.1.3.1 Decreasing quantifiers and OV order

Utterances with OV order containing the decreasing quantifiers *liga* 'few' and *to poli* 'at most' were produced with focused quantifier/non-focused negation even for positive context questions. That is, speakers treated negation as old in their responses even though negation was not in the context. Why didn't they follow the same rules for the prosodic construction of their answers in these cases? Although at the present moment I do not have an account for this exceptional pattern, I would like to note that the answer should lie with the semantics of quantifiers since there is an asymmetry in this respect between decreasing quantifiers which display the exceptional pattern and increasing ones which do not. Moreover, as we will see in the perception results section, there is a difference also in the way utterances containing focused increasing and decreasing quantifiers were interpreted in the OV order: while focused increasing quantifiers were judged to have wide scope, focused decreasing ones were judged to have narrow scope. Perhaps the semantic properties of decreasing quantifiers have a neutralizing effect on the prosodic realization of these utterances. This is an interesting new question that future research should address. An additional question to be addressed by future research is connected to the previous one: how is the missing prosodic pattern interpreted? The prosodic pattern of OV utterances with non-focused decreasing quantifiers/focused negation is possible—even though it was not produced in this experiment—and its interpretation should be explored. In this experiment there was only one utterance produced with this pattern, shown in the bottom panel of Figure 3-9, which in the perception test was judged 'vague' by 11/13 listeners.

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The main argument in this thesis is that the prosodic realization of constituents in a sentence—for example focusing—does not have a specific, invariable truth-conditional interpretation, but only indirectly acquires whatever interpretation is available through specific contexts. Prosody regulates what contexts the sentence is appropriate for. This main argument is not weakened by the exceptional patterns of utterances containing decreasing quantifiers. The fact remains that focus does not consistently receive a wide scope interpretation: for this exceptional pattern focus receives narrow scope interpretation. What the exceptional pattern shows is that the link between context and prosodic realization is more complex than described here and is sensitive to the contents of the sentence.

For the purposes of this thesis I will put aside the exceptional pattern and concentrate on the general pattern instead. In the next section we will look at the perception part of the experiment.

3.1.4 Perception method

The aim of the perception experiment was to determine whether listeners can distinguish between the two scope interpretations of the ambiguous strings based only on the intonation of the given utterance, without any context. 42 listeners—different from the participants in the production experiment—participated in this part of the experiment. They heard the utterances out of context and each participant heard only one of the two intonation patterns of each token sentence. The listeners' task after listening to each utterance was to decide which one of 5 answers given to them best

matched the utterance meaning. The five choices were presented to the listeners in the form of a table, like the one shown in Figure 3-12 for the utterance *den elisan pola provlimata* 'not solved-3p many problems-acc' produced with two different melodies, and they had to circle the best answer. Listeners were shown examples illustrating their task at the beginning of the perception experiment.

Elisan 'solved'	*Den elisan* 'not solved'
A 2	B 2
C 20	D 20
E *Asafis* 'vague'	

Figure 3-12. Example of the listeners' task.

The table with the five choices always had the structure of the one in Figure 3-12 and what varied was the verb in the top cell, which matched the verb of each particular utterance the listeners heard. There are two columns, the left one labeled with the affirmative form of the verb and the right one with the negative form of the verb, in the case of the example in Figure 3-12, 'solved' and 'not solved'. In each of the columns there are two cells with numbers: 2 at the top cells, representing a small

quantity and 20 at the bottom cells, representing a large quantity, and this convention was explained to the participants at the beginning of the perception test. Answer A represents the meaning 'small quantity solved', answer C 'large quantity solved', answer B 'small quantity unsolved', and answer D 'large quantity unsolved'. Answer E is there for sentences that listeners might find unclear.

For example, suppose that listeners hear the utterance '*den elisan polla provlimata*' (= not solved many problems) with focus on negation. If they interpret this as negation wide scope then they should choose answer A, that is, 'the problems they solved are not many.' Suppose now that listeners hear the utterance with focus on the quantifier. If they interpret this as quantifier wide scope they should choose answer D, that is, 'the problems they did not solve are many'. Answers B and C are irrelevant for this sentence but should be used with decreasing quantifiers, like 'few': answer B would represent the meaning 'the problems they did not solve are few' (few > not), and answer C, 'the problems they solved are not few' (not > few).

The hypothesis in this part of the experiment is that listeners will interpret the focused element as having wide scope and the back-grounded one as having narrow scope.

3.1.5 Perception results

For most cases, listeners gave a wide scope interpretation to the focused element in the experimental utterances. There are exceptions to this generalization, involving

utterances containing focused decreasing quantifiers. I will therefore report the results of the increasing and the decreasing quantifiers separately.

3.1.5.1 Increasing quantifiers results

Tables 3-2 and 3-3 show the results for utterances containing *many* and *more than n,* respectively. The first column in each table shows the word order of the utterance and the second the location of focus: either negation (NEG FOC) or quantifier (Q FOC). The third column, 'Focus wide scope,' shows the number of answers in which the focused item was judged to have wide scope. The fourth column, 'Focus narrow scope,' shows the number of answers in which the focused item was judged to have narrow scope. The fifth column 'Vague' shows the number of answers for which listeners could not understand or could not decide upon a meaning. According to the discussion so far we predict more answers in the F wide scope column.

For the quantifier *many* the answers in the F wide scope column are more than those in the F narrow scope, as shown in Table 3-2. The difference is statistically significant for the utterances with VO order containing focused negation ($\chi^2(1)=11.967$, $p<.001$), and those with OV order containing a focused quantifier ($\chi^2(1)=4.878$, $p<.027$). For the VO utterances with a focused quantifier and the OV utterances with a focused negation the difference, though in the right direction, is not significant ($\chi^2(1)=2.513$, $p=.113$ and $\chi^2(1)=.190$, $p=.663$, respectively).

ORDER	FOCUS	F WIDE SCOPE (%)		F NARROW SCOPE (%)		VAGUE (%)	
OV	NEG FOC	30/68	(44%)	27/68	(40%)	11/68	(16%)
	Q FOC	35/68	(51%)	21/68	(31%)	12/68	(18%)
VO	NEG FOC	42/68	(62%)	20/68	(29%)	6/68	(9%)
	Q FOC	31/68	(46%)	22/68	(32%)	15/68	(22%)

Table 3-2. 'Many' responses

For the quantifier *more than n* the answers in the F wide scope column are more, as shown in Table 3-3. The difference is statistically significant for the utterances with VO order containing focused negation ($\chi^2(1)$=12.800, p<.0001), and those with OV order containing a focused quantifier ($\chi^2(1)$=32.013, p<.0001). For the OV utterances with a focused negation the difference approaches but does not reach significance ($\chi^2(1)$=3.082, p<.079).

ORDER	FOCUS	F WIDE SCOPE (%)		F NARROW SCOPE (%)		VAGUE (%)	
OV	NEG FOC	30/68	(44%)	20/68	(29%)	18/68	(26%)
	Q FOC	42/68	(62%)	9/68	(13%)	17/68	(25%)
VO	NEG FOC	38/68	(56%)	16/68	(24%)	14/68	(21%)
	Q FOC	26/68	(38%)	27/68	(40%)	15/68	(22%)

Table 3-3. 'More than' responses

For the VO utterances with a focused quantifier the difference is not significant ($\chi^2(1)$= .051, p=.821) and moreover, pointing in the wrong direction. However, this result is probably due to the influence of one utterance with a disfluent production which in the production experiment was judged differently then the rest and reversed

the trend of the results. In particular, this utterance is *den katametríthikan páno apó tésera ekatomíria psífi* (not be-counted-3p more than four million votes-nom) 'There were more than four million uncounted votes'. The prosodic division of the utterance does follow the general pattern in its category, having the negation and the verb (*den katametrithikan*) in a topic phrase and the rest of the material (*pano apo tesera ekatomiria psifi*) in a focus phrase, shown in Figure 3-13. However, the focus phrase was disfluent: the first word, *pano,* is aligned with a L+H* pitch accent (which in general signals narrow focus and is followed by de-accenting) and the following two words (*apo tesera*) are de-accented but the speaker changes his mind after that and places accents on the last two words (*ekatomiria psifi*).

Figure 3-13. An utterance with a disfluent focus phrase: *den katametríthikan páno apó tésera ekatomíria psífi* (not be-counted-3p more than four million votes-nom) 'There were more than four million uncounted votes' Fig3-13.wav

In the perception experiment, this utterance was judged to have negation wide scope 12/21 (57%) times and quantifier wide scope 4/21 (19%) times. The other three

utterances in this category were judged more often to have negation wide scope (24/49 or 49%) than quantifier wide scope (15/49 or 31%). If this one problematic utterance is not taken into consideration, then the difference between wide and narrow scope answers are in the right direction.

Although not all the results are statistically significant, they point to the direction of the original hypothesis, that listeners will judge the focused element in the utterance to take wide scope. Notice that the focused element was given a wide scope interpretation across word orders.

3.1.5.2 Decreasing quantifiers results

Tables 3-4 and 3-5 show the results for *few* and *at most* respectively. In both we see that, most often, negation is judged to have wide scope,[24] even when the quantifier is focused, contra our predictions and the general pattern of the increasing quantifiers.

For the quantifier *few*, when negation is focused in the VO order, the answers in the F wide scope column are significantly more ($\chi^2(1)=21.235$, p<.0001), that is focused negation is interpreted with wide scope. When the quantifier is focused the answers in the F narrow scope column are significantly more, both in the VO order ($\chi^2(1)= 4.545$, p<.033) and the OV order ($\chi^2(1)=10.714$, p<.001), that is, the non-focused negation scopes wide.

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[24] Recall that for the OV order the contour with a focus on negation was not produced.

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ORDER	FOCUS	F WIDE SCOPE(%)		F NARROW SCOPE (%)		VAGUE (%)
OV	Q FOC	37/136	(27%)	77/136	(57%)	22/136(16%)
VO	NEG FOC	36/68	(53%)	10/68	(15%)	22/68(32%)
	Q FOC	23/68	(34%)	37/68	(54%)	8/68(12%)

Table 3-4. 'Few' responses

For the quantifier *at most n,* negation was most often judged to have wide scope. When negation was focused in the VO order, the answers in the Vague column were significantly more both than answers in the F wide column ($\chi^2(1)$=7.184, p<.007) and than in the F narrow column ($\chi^2(1)$=26.797, p<.0001). Apparently listeners had trouble interpreting these utterances. Among the utterances that they *were* able to interpret, there were significantly more answers in the F wide scope column than in the F narrow one ($\chi^2(1)$=7.364, p<.007), that is, focused negation was judged to take wide scope. On the other hand, when the quantifier was focused, in the OV order the answers in the F narrow scope column are significantly more ($\chi^2(1)$=9.800, p<.002) and in the VO order more but not significantly so ($\chi^2(1)$=.563 p=.453), that is, the non-focused negation scopes wide, contrary to the hypothesis.

ORDER	FOCUS	F WIDE SCOPE (%)		F NARROW SCOPE (%)		VAGUE (%)
OV	Q FOC	35/136	(26%)	74/136	(54%)	27/136(20%)
VO	NEG FOC	21/68	(31%)	9/68	(13%)	38/68(56%)
	Q FOC	20/68	(29%)	24/68	(35%)	24/68(35%)

Table 3-5. 'At most' responses

Why do speakers give focused quantifiers narrow scope interpretation? Remember we assume that since the information structure of these utterances is the same across quantifiers, the same context will be reconstructed for them, that is, a negative question like 'How many Ns didn't they V?' If this is indeed the context listeners reconstruct, and if the reconstructed context aids the interpretation of the utterances, as we assumed, then the interpretation should be 'the un-V-ed Ns are Q', because negation is old. For example, for the quantifier 'few' the interpretation should be 'the unsolved problems are few'. In the perception task, therefore, we expected listeners to choose cell B (I repeat the table given to listeners below), but instead they chose cell C.

Solved	Not solved
A 2	B 2
C 20	D 20
E VAGUE	

Figure 3-14. Example of the listeners' perception task.

Answers in cells B and C are related, that is, one can arrive from 'few unsolved problems' to 'many solved problems,' at least on their proportional reading (i.e., when

they mean 'many of the problems' and 'few of the problems'). It seems that the majority of speakers did exactly that, that is, they translated in their heads 'few of the problems were unsolved,' which is the meaning of cell B, to 'many of the problems were solved,' which is the meaning of cell C and analogously, from 'at most 2 of the problems were unsolved,' which is the meaning of cell B, to 'more than 2 of the problems were solved,' which is the meaning of cell C. However, this is an extra step for the calculation of the meaning of utterances containing decreasing quantifiers which listeners did not take when they heard utterances with increasing quantifiers. It is not clear why they did so, but these results tell us that listeners preferred a negation wide scope interpretation when decreasing quantifiers were involved. Notice that negation was given wide scope over the focused quantifier even in the OV order where presumably it is in a hierarchically lower position than the quantifier in terms of syntactic structure. Therefore the standard observation in the English literature about the inability of decreasing quantifiers to take inverse wide scope cannot be invoked here because that would not account for the utterances in the OV order where these quantifiers cannot even take *linear* wide scope. This difference in the perception results between the increasing and decreasing quantifiers remains an open problem.

In general, summing up the results in both the production and perception parts of experiment 1, speakers encoded and listeners understood wide scope through prosodic focus. The connection between prosodic focus and wide scope interpretation is discussed in the following section.

3.1.6 General discussion on experiment 1

As I have already repeated several times, prosody is viewed here as a pointer to the contexts an utterance is appropriate in (references for this view are given in chapter 1). Different formalizations of the link between prosody and pragmatic interpretation can be found in Steedman (1991, 2000), Rooth (1992, 1996), Büring (1997b, 1999, to appear), Schwarzschild (1999).

Different focus-ground divisions of the same string make that string appropriate in different contexts. If context takes the form of a question[25], focused constituents in the answer address information requested by the question, and back-grounded constituents repeat information already present in the question. In this sense, only answers whose prosodic structure adheres to this heuristic are seen as 'congruent', that is, as appropriate answers[26].

Experiment 1 illustrates this use of prosody as link to context: speakers realized the sentences they were given with different focus-ground divisions according to the context. Furthermore prosody helped disambiguate the experimental strings for listeners: different focus-ground divisions made the strings appropriate in two different contexts. One of the contexts contained negation ('How many problems <u>didn't</u> they solve?'), the other did not ('How many problems <u>did</u> they solve?'). Both of these context questions are unambiguous: In the former, negation cannot scope over the wh-word and in the latter there is no negation therefore no ambiguity arises. In turn, the

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[25] In Experiment 1 context came in the form of a question, but as we will see in experiment 2, context can come in other forms too.

context questions help with the scope interpretation of the answer. In other words, the accent pattern of an utterance is not directly related to scope interpretation according to the account given here. The accent pattern has to do with the information structure of the utterance but can be indirectly linked to scope interpretation through context. If context is unambiguous, then the prosody of the answers helps disambiguate because it points to that unambiguous context. We will see in chapter 4 that if context is ambiguous, then prosody cannot solve the ambiguity in the answers.

We will see further support for this relation between the lack of ambiguity in context question and the ensuing disambiguating effect of prosody in the next section, 3.2, where experiment 2 is presented. The target sentences in that experiment contain *because* and negation.

3.2 Experiment 2: *Not – Because*

The sentences examined in this experiment contain negation and a *because*-clause. Such sentences are ambiguous both in English (20) and in Greek (21). The two interpretations of these sentences are shown in (a) and (b).

(20)   *She didn't yell because she was scared.*

    a. She didn't yell. The reason is that she was scared.

    b. She yelled. We don't know why, but we know that it was not out of fear

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[26] A more detailed discussion of these notions can be found in chapter 1.

(21)   *Den   gelai   giati   zilevi*

      not   laughs   because   is-jealous

    a. 'He is not laughing and the reason for that is because he's jealous'

    b. 'The reason he's laughing is not that he's jealous (but something else)'

In interpretation (20b) and (21b), negation scopes over *because* (linear scope), whereas in (20a) and (21a), *because* scopes over negation (inverse scope). This experiment was designed to determine (a) whether in Greek the two interpretations differ in prosodic structure and if they do (b) what the prosodic structure associated with each interpretation is. We expect this experiment to confirm the conclusions reached in the previous section.

There was a production and a perception part to this experiment too. In the production part, the speakers read aloud mini-dialogues containing these target sentences. The sentences they produced were analyzed to determine what kind of intonation was used for the delivery of the two meanings. In the perception part, listeners heard the target sentences out of context and had to decide what they mean based on their intonation alone. I present the production method of the experiment in section 3.2.1, the production results in 3.2.2, and the perception method and results in sections 3.2.3 and 3.2.4 respectively.

3.2.1 Production method

We expect sentences like (21) to be produced with two distinct melodies, reflecting their different contexts and their different interpretations. As I have already mentioned, the context does not to have to come in the form of a question. In this experiment, the contexts were statements before the target sentences like the ones in (22) and (23). The context in (22) contains the phrase 'lets the barrel empty', which is equivalent to the phrase 'does not fill it' in the target sentence; in this sense negation is in the context, even though the negative particle itself is not mentioned in the context[27]. On the other hand, the context in (23) is positive because it contains the phrase 'fills the barrel' and thus the negation in the target sentence is new. The target sentences were followed by another statement to end the little discourse and so make it more natural.

(22)   Context: *I Mina afini to vareli panda adio.*
                       the Mina lets the barrel always   empty
         Target: *Den to gemizi giati   vareni.*
                        not it fills   because gets-heavy
         End: *Meta prepei na to sikoni.*
                     after   has to   it   lift

         "Mina always leaves the barrel empty. She doesn't fill it because it gets

           heavy (when she does). Afterwards she has to lift it."

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[27] The very interesting question of what can count as 'given' or 'background' for an utterance has not yet received a conclusive answer in the literature, as far as I know. However, the most common among the

(23)   Context: *I Mina   panda gemizi to vareli.*

             the Mina always fills   the barrel

    Target: *Den to gemizi giati   vareni.*

           not it   fills   because gets-heavy

    End: *To gemizi gia na min kserenete.*

           it   fills   for to   not get-dry

"Mina always fills the barrel. Her reason for filling it is not because it gets heavy (that way). She fills it so that it doesn't dry out."

There were 10 contexts created aiming at the production of 10 unambiguous utterances (5 sentences X 2 prosodic structures). Five speakers of Athenian Greek, three female and two male, ranging in age between 25 and 40, read two of the contexts each. To avoid exaggerated intonations, no reader was given both interpretations of a sentence. The five ambiguous sentences are listed in Table 3-6.

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notions employed to characterize 'background' is the property of having been mentioned in the context, followed closely by that of being insinuated by the mention of related meanings.

1. *den   to gemizi   giati   vareni*

   not   it   fills   because   gets-heavy

   'She doesn't fill it because it gets heavy'

2. *den   gelai   giati   zilevi*

   not laughs because   is-jealous

   'He doesn't laugh because he's jealous'

3. *den to ligizi   giati   vidoni*

   not   it   bends because screws

   'She doesn't bend it because it must be screwed'

4. *den to maloni giati   murmurizi*

   not   it   scold   because whines

   'She doesn't scold him because he whines'

5. *den magirevi giati   malonune*

   not cooks   because   fight

   'He doesn't cook because they fight'

Table 3-6. The five ambiguous sentences used in experiment 2.

The same procedures as in experiment 1 were followed for experiment 2. The target utterances produced by speakers were prosodically labeled following the conventions of GRToBI presented in chapter 2.

3.2.2 Production results

Two distinct intonation patterns in the structure of these utterances emerged from the analysis of the data, correlating with the two different contexts preceding an utterance, as expected.

Figures 3-15 and 3-17 show the two patterns. The utterance in Figure 3-15, *den geláei giatí zilévi* (not laugh-3s because is-jealous), has exactly the same contour of new information negation utterances in experiment 1. Negation carries the L*+H NPA and there is a low plateau ending in a L⁻!H% boundary. The context of this utterance positive and, like in experiment 1 utterances, focused negation has wide scope.

Figure 3-15. Negation wide scope utterance, *den geláei giatí zilévi.* Fig3-15.wav

More examples of the same pattern, negation wide scope, are shown in Figure 3-16, each by a different speaker. The utterance in the top panel is *den geláei giatí zilévi,* produced by speaker 2. In the middle panel we see *den to málone giatí murmúrize* (not

it scolded-3s because whined-3s) 'She didn't scold it because it whined' by speaker 4.

In the bottom panel we see *den to ligízi giatí vidóni (*not it bend-3s because screws-3s)

'She doesn't bend it because it must be screwed' produced by speaker 5.

Figure 3-16.   Examples of the negation wide scope prosodic pattern. Top: *den geláei giatí zilévi*, speaker 2. Middle: *den to málone giatí murmúrize* 'She didn't scold it because it whined', speaker 4. Bottom: *den to ligizi giatí vidóni* 'She doesn't bend it because it must be screwed', speaker 5. Fig3-16-Top.wav Fig3-16-Mid.wav Fig3-16-Bot.wav

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The pattern for negation narrow scope is shown in Figure 3-17, *den geláei giatí zilévi* (not laugh-3s because is-jealous). The utterances realized with this prosodic structure were produced in response to negative contexts. Speakers back-grounded negation, making it a prosodic topic phrase with a L* NPA and a H⁻ phrase accent, because it is old and placed the *because*-clause in a separate intermediate phrase with a H* or L+H* focus NPA because it is new. The same pattern was used for utterances with negation narrow scope in experiment 1, that is, unfocused negation has narrow scope.

Figure 3-17. Negation wide scope utterance, *den geláei giatí zilévi*. Fig3-17.wav

More examples of the same pattern, negation narrow scope, are shown in Figure 3-18 for different utterances; each of these utterances was produced by a different speaker. In the top panel the utterance *den to ligízi giatí vidóni (*not it bend-3s because screw-3s) 'She doesn't bend it because it must be screwed' was produced by speaker 3. In the middle panel the utterance *den magirévi giatí malónume* (not cook-3s because

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fight-1p) 'He doesn't cook because we fight' produced by speaker 4. In the bottom panel we see the utterance *den to malóni giatí murmurízi* (not it scold-3s because whines) 'She doesn't scold it because it whines' produced by speaker 5.

Figure 3-18. Top: *den to ligízi giatí vidóni* 'She doesn't bend it because it must be screwed', produced by speaker 3. Middle: *den magirévi giatí malónume* 'He doesn't cook because we fight', produced by speaker 4. Bottom: *den to malóni giatí murmurízi* 'She doesn't scold it because it whines', produced by speaker 5. Fig3-18-Top.wav Fig3-18-Mid.wav Fig3-18-Bot.wav

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The results in this part were very robust: All speakers (100%) used these two prosodic structures to disambiguate the sentences.

3.2.3 Perception method

The 10 unambiguous *because* sentences produced in the previous experiment were extracted from their contexts. These sentences were presented in the author's home to 27 native Greek subjects, all speakers of Athenian Greek between the ages of 18 and 30, (10 sentences X 27 speakers) whose task was to listen to each sentence and choose the one of two answers, *yes* or *no,* following a simple question related to the utterance's meaning, shown in (24). This question followed the sentence 'She doesn't fill it because it gets heavy'.

(24)   *Gemizi to vareli*?

    "Does she fill the barrel?"

    a. *Ne* "Yes"   [NOT > BECAUSE]

    b. *Ohi* "No"   [BECAUSE > NOT]

The reasoning behind a question like (24) is that the difference between the two scope interpretations of the utterance has to do with whether negation scopes over the matrix verb, which is used in (24): if the matrix verb has a positive polarity interpretation, then negation scopes over the 'because' clause (answer (24a)); otherwise,

if the negation scopes only over the matrix verb (giving it a negative polarity) the 'because' clause has wide scope (answer (24b)).

It is worth repeating here that the contexts of the utterances produced in this experiment were unambiguous, just like in experiment 1. Therefore, if our assumptions about the link between context and interpretation are right, listeners should be able to differentiate between two interpretations of these utterances because the two different prosodic structures they were produced with point to two unambiguous contexts.

3.2.4 Perception results

Listeners distinguished between the two interpretations when they heard the utterances just based on the prosody. Recall that we expect the focused item to be interpreted with wide scope.

The raw numbers and percentages of matches (in bold) between a focused element and a wide scope interpretation for it are given in Table 3-7. Listeners differentiated very successfully between the two interpretations even though they heard the utterances out of context.

Interpretation	*not* focus	*because* focus
Not > bec	**117/135 (86.67%)**	18/135 (13.33%)
Bec > not	3/135 (2.22%)	**132/135 (97.78%)**

Table 3-7. Perception results of experiment 2.

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The clear majority of the utterances containing focused negation were given a negation wide scope interpretation (the difference is highly significant ($\chi^2(1)$=54.760, p<.0001). Analogously, focus in the *because*-clause resulted in a *because* wide scope interpretation ($\chi^2(1)$=92.160, p<.0001). The results of this experiment support the claims made in section 3.1.6 about the ability of prosody to disambiguate when the context of the utterances is unambiguous. The following, and last section of the chapter summarizes the findings of both experiments.

3.3 Discussion

In chapter 2 we saw that prosody mainly serves to connect a certain utterance to its context: it indicates to the listener what parts the speaker views as new or old even in the absence of explicit context. Discourse participants in their role as speakers indicate through prosody the relevance of their utterances to the rest of the discourse by focusing the new information they contribute and linking this new information to what has already been mentioned or is implicitly relevant by prosodically back-grounding it. Discourse participants in their role as listeners work their way from the accent pattern to the context.

In experiments 1 and 2 presented in this chapter we saw that sometimes this function of prosody as indicator of the context of an utterance can have truth conditional effects. In particular, the prosody of ambiguous strings that contain quantifiers can indicate one of the possible interpretations of the string. This is done via the context indicated by the particular prosodic structure—provided this context is unambiguous.

The form of the context was different in each experiment. In experiment 1 the context was a question and in experiment 2 the context was a declarative. In both experiments, these contexts were unambiguous because one context involved negation with set scope (under the wh-word in experiment 1 and under the *because* clause in experiment 2) and the other context did not involve negation at all. Accordingly, the experimental utterances reflected the scope relations of their contexts: the negation either scoped under the other expression in the utterance, or over the whole sentence. In both cases the prosodically focused quantifiers were the ones given wide scope interpretation.

Despite this generalization, we decided against equating wide scope interpretation with prosodic focus because as we will see in experiment 3, such a move would not account for the results there: the prosodic structure of the utterances in experiment 3 is the same as those in the first two experiments but focus is not related to wide scope interpretation. Therefore experiment 3 gives evidence that there is no deep connection between being a prosodic nucleus and being interpreted as wide scope. Instead, prosody in all three experiments is consistently linked with information structure, giving us clues about the context an utterance is appropriate in. The contexts in experiment 3 are ambiguous and because of that prosody cannot disambiguate the experimental utterances.

Finally, a brief comment on the different listeners' performance in Experiment 1 and 2 is in order. The results of the first experiment were not as clear as those of the second experiment. I believe this is so because the utterances of the first experiment

contained quantifiers and calculating the meaning of quantificational sentences is notoriously hard. In addition to that the task in the perception part of experiment 1 was much more complicated than that of experiment 2. Listeners not only had to interpret the utterances they heard but also try to match the meaning of the utterance with one of the five cells, which required extra calculations. It is conceivable that a simpler task would bring about better results.

CHAPTER 4

Experiment 3:

Scope between DP quantifiers and intonation structure

In this chapter I present data from the third experiment which I carried out to investigate the relation between intonation structure and interpretation in sentences that contain two DP quantifiers, in subject and object position, without any negation. It is noteworthy that although there has been much discussion in the cross-linguistic literature on the disambiguating role of intonation for sentences containing negation, there has been little such discussion for bi-quantificational sentences that do not contain negation. Certainly no consensus seems to exist about the melody attached with each of the meanings of scopally ambiguous sentences that contain quantifiers in the subject and object position. I think this is because the intuitions regarding them are less clear. This experiment helps to shed more light in that area, at least for Greek.

Specifically, the experiment investigated ambiguous sentences like (1), whose interpretations are given in (a) and (b). The experimental results suggest that, unlike in the sentences containing negation as seen in chapter 3, intonation cannot disambiguate the different truth conditional interpretations of ambiguous sentences like (1) in Greek.

(1)   *Dio ipourgoi   parakoluthisan kathe sigkendrosi*

Two ministers-nom attended-3p   every   meeting-acc

'Two ministers attended every meeting'

a. 'Two specific ministers attended all meetings'   (2 > EVERY)

b. 'Each meeting was attended by two, possibly different, ministers' (EVERY > 2)

I will show that for such sentences, the subject is interpreted with wide scope in general, regardless of the intonation. We will see in the production part (section 4.2) that the intonation structure of the utterances exhibits the same patterns as those described in chapter 3. Moreover, just like in chapter 3, the choice of pattern depends on the context preceding each utterance. The interpretation results coming from the perception experiment shown in section 4.4 show no correlation between the melody of the utterances and the scope interpretation attached to them. I argue that the difference between the results presented in chapter 3 and those presented here is related to the context: in chapter 3 the context of each utterance was unambiguous and as a result the utterances themselves were unambiguous; for the utterances investigated in this experiment, context is ambiguous and therefore the intonation with which each utterance is realized links this utterance with its ambiguous context—therefore we get no disambiguating effect.

There were two parts in this experiment, a production and a perception one, as in the first two experiments, presented in sections 4.1, 4.2 and 4.3, 4.4 respectively. In the production part, the utterances of speakers were recorded and prosodically analyzed; in

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the perception part, listeners heard these utterances and were asked to give judgments about their meaning.

I present the production method in section 4.1 and the production results in section 4.2. The perception method and results are given in 4.3 and 4.4 respectively, and 4.5 is the conclusion.

4.1 Production method

The hypothesis I set out to examine in this production part of the experiment was that a different melody will be used by speakers to deliver each of the two meanings in sentences like (1) above.

Eight speakers, three male and five female, participated in the production part, distinct from the participants in experiments 1 and 2. They were all speakers of Athenian Greek, ranging in age between 18 and 40.

The speakers read question-answer pairs like (2), and (3). These mini dialogs are examples of the question answer pairs that were used as triggers for two different intonations in this experiment: as shown by the focus marking in these examples, the focused element in the answer corresponds to the wh-word in the question. Note here that these context questions—unlike the context questions in the previous chapter—are ambiguous. For example, (2Q) can be paraphrased either as 'For each meeting x, how many ministers attended x?' or as 'For how many ministers is it true that they attended all the meetings?' The ambiguity of these answers will figure in the account given for the inability of intonation to disambiguate the experimental utterances.

The two answers in (2) and (3) are string identical but have different intonation structure because their context questions are different: in (2Q) the wh-word is part of the subject, but in (3Q), it is part of the object. Accordingly, the subject quantifier is focused in (2A) and the object quantifier in (3A). Everything else in these two utterances is old information/the background. The difference in the location of the focus in the two utterances matters for the realization of the backgrounded material. In (2A) the focus is early and all the backgrounded material is post-focal. We have seen that for Greek this means that this material must be de-accented. On the other hand, in (3A) the focus is late and therefore the pre-focal material must carry accents. We will see in the next section that the DP preceding the focus is realized as a prosodic topic phrase. Regardless of the word order, these two intonation structures, early and late focus, are the ones used for the realization of all the experimental utterances.

(2) Q: *Posoi   ipourgoi   parakoluthisan kathe sigkendrosi?*

   how many   ministers-nom   attended-3p   every   meeting-acc

   'How many ministers attended every meeting?'

   A: *[DIO]F ipourgoi   parakoluthisan kathe sigkendrosi*   S$_F$VO

   Two   ministers-nom attended-3p   every   meeting-acc

   'Two ministers attended every meeting'

(3) Q: *Poses   sigkendrosis   parakoluthisan dio ipourgoi?*

   how many meetings-acc   attended-3p   two ministers-nom

   'How many meetings did two ministers attend?'

A: *Dio ipourgoi   parakoluthisan [KATHE]$_F$ sigkendrosi*   SVO$_F$

    Two   ministers-nom attended-3p   every meeting-acc

'Two ministers attended every meeting'

Word order varied in the target sentences between SVO and OVS to examine whether a change in word order would affect (a) the interpretation of these sentences and (b) the intonation used to deliver such meaning. The sentences in (2A) and (3A) above show the SVO order and those in (4A) and (5A) below show the OVS order, with the fronted objects.

(4)   Q: *Posoi   ipourgoi   parakoluthisan kathe sigkendrosi?*

      how many ministers-nom attended-3p   every meeting-acc

  'How many ministers attended every meeting?'

A: *kathe sigkendrosi parakoluthisan [DIO]$_F$ ipourgoi*   OVS$_F$

    every meeting-acc attended-3p   two   ministers-nom

'Two ministers attended every meeting'

(5)   Q: *Poses   sigkendrosis   parakoluthisan dio ipourgoi?*

      how many meetings-acc   attended-3p   two ministers-nom

 'How many meetings did two ministers attend?'

A: *[KATHE]$_F$ sigkendrosi parakoluthisan dio ipourgoi*   O$_F$VS

    every   meeting-acc attended-3p   two ministers-nom

 'Two ministers attended every meeting'

Furthermore, in this experiment I also included variants with clitic left dislocated objects to investigate whether there is any difference in the prosodic realization between OVS and O-clitic-VS orders. To distinguish between the two, I will call the object in O-clitic-VS orders *clitic left dislocated* and the object in OVS orders *fronted*. Both kinds of objects were included in this experiment because I wanted to verify whether, as was mentioned in chapter 3 (section 3.1.3.1), clitic left dislocated objects are always interpreted with wide scope, unlike fronted ones. Example (6A) shows a string with this O-clitic-VS order.

(6)   Q: *Poses   sigkendrosis   tis   parakoluthisan dio ipourgoi?*

      how many meetings-acc   them attended-3p   two ministers-nom

   'How many meetings were attended by two ministers?'

   A: *kathe   sigkendrosi tin parakoluthisan* [*DIO*]$_F$ *ipourgoi*   O-clitic-VS$_F$

      every   meeting-acc   it attended-p3   two ministers-nom

   'Every meeting was attended by two ministers[28]'

The quantifiers varied among 5 pairs [*few-every,* number-number, *every-*number*, many-at least, most-some*]. These quantifiers were chosen so that both increasing quantifiers and decreasing ones could be examined to determine whether they behave differently, since in English and other languages the latter have been claimed to be unable to take inverse wide scope, and strong quantifiers like *each* and

every have been reported to take inverse wide scope easily. For each quantifier pair I examined both quantifier-argument position permutations: for example, in the *every-two* pair, I constructed sentences with *two* in subject position and *every* in object position (examples 2-6), and also the same sentences with *every* in subject position and *two* in object position, shown in examples (7-11). Appendix B shows all the sentences used in the experiment.

(7) Q: *Posoi   ipourgoi   parakoluthisan dio sigkendrosis?*

how many   ministers-nom   attended-3p   two   meetings-acc

'How many ministers attended two meetings?'

A: *[KATHE]_F ipourgos   parakoluthise dio sigkendrosis*   S_FVO

every   minister-nom   attended-3s   two   meetings-acc

'Every minister attended two meetings'

(8) Q: *Poses   sigkendrosis parakoluthise kathe ipourgos?*

how many meetings-acc   attended-3s   every   minister-nom

'How many meetings did each/every minister attend?'

A: *Kathe ipourgos   parakoluthise [DIO]_F sigkendrosis*   SVO_F

every minister-nom attended-3s   two   meetings-acc

'Two ministers attended every meeting'

---

(9) Q: *Posoi   ipourgoi   parakoluthisan dio sigkendrosis?*

      how many   ministers-nom   attended-3p   two   meetings-acc

    'How many ministers attended two meetings?'

    A: *dio sigkendrosis parakoluthise [KATHE]_F ipourgos*   OVS_F

      two   meetings-acc   attended   every   minister-nom

    'Every/each minister attended two meetings'

(10) Q: *Poses   sigkendrosis   parakoluthise kathe ipourgos?*

      how many meetings-acc   attended-3s   every minister-nom

    'How many meetings did every/each minister attend?'

    A: *[DIO]_F   sigkendrosis parakoluthise kathe ipourgos*   O_FVS

      Two   meetings-acc   attended-3s   every minister-nom

     'Every/each minister attended two meetings'

(11) Q: *Poses   sigkendrosis tis   parakoluthise kathe ipourgos?*

      how many meetings-acc   them attended-3s   every minister-nom

    'How many meetings were attended by every minister?'

    A: *dio   sigkendrosis tis parakoluthise[KATHE]_F ipourgos*   O-clitic-VS_F

      two   meetings-acc them   attended-3s   every minister-nom

    'Two meetings were attended by every minister'

There were 200 utterances in this experiment. Four token sentences were used for each type of quantifier pair. The speakers were divided in two groups of four, each person in the group reading 50 out of 200 utterances, to make their task more manageable, and also to expose them to only one of the two prosodic versions of each

token sentence. This means that the 200 different tokens were read twice, once per group of four speakers. Therefore there was a total of 400 utterances to analyze: 5 quantifier pairs [*few-every,* number-number*, every-*number*, many-at least, most-some*] X 2 positions for each quantifier in the pair [subject or object] X 3 word orders [SVO, OVS, and O-clitic-VS] X 2 locations of focus [subject or object] X 4 token sentences for each quantifier pair[29] X 2 groups of speakers.

4.2 Production results

The utterances produced were prosodically labeled following GRToBI conventions. The patterns in the prosodic structure of these utterances are similar to the ones we saw in chapter 3. That is, there is either an early NPA followed by de-accented material ('early focus', Figure 4-1A) or the sentence is divided in two intermediate phrases, a topic ip and a focus ip ('late focus', Figure 4-1B). The focus NPA is in general a L+H* pitch accent followed by a low plateau ending in a LL% boundary and the topic has a L* NPA and ends in a H⁻ tone.

A. NPA de-accenting
EARLY FOCUS

B. Topic   Focus
LATE FOCUS

Figure 4-1. Schematic representation of the intonation contour patterns of 'early focus' (A) and 'late focus' (B).

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[29] The total number of tokens comes to 240, but for the O-cl-VS sentences only one prosodic structure is possible, namely focus on the subject, which brings the total of sentences down to 200.

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These patterns occur across word orders. Figures 4-(2-6) illustrate different combinations of these two prosodic patterns with SVO, OVS, and O-clitic-VS word orders. The results show that the prosodic structure of the experimental utterances depends on the context question preceding them: the focus in the answer is the constituent (either the subject or object) that corresponds to the wh-word in the question; if that constituent is early in the answer then the early focus contour (A) is produced; if the constituent is late in the answer, the late focus contour (B) is produced. In the rest of this section I present examples of these contours across word orders.

Figure 4-2 shows the utterance *dío ipurgí parakolúthisan káthe sigkéntrosi* (two ministers-nom attended-3p ever meeting-acc) 'Two ministers attended every meeting', in response to the question 'How many ministers attended every meeting?' The utterance has SVO order. The focus is the subject quantifier, the word *dio* (= 'two'), which answers the wh-word *posi* (= 'how many'). The rest of the material in the answer is de-accented because it is post-focal. This is the early focus contour.

Figure 4-2. Example of an SVO early focus utterance, dío ipurgí parakolúthisan káthe sigkéntrosi, (two ministers-nom attended-3p ever meeting-acc) 'Two ministers attended every meeting', produced by speaker 5. Fig4-2.wav

In Figure 4-3, I give more examples of S_FVO early focus utterances produced in response to a wh-question with a subject wh-word. The examples shown were produced by different speakers and involve different token sentences to show the invariance in the pattern. The figure in the top panel shows the utterance *lígi diefthidés apéripsan káthe ipopsífio* (few managers-nom turned-3p down every candidate-acc) 'Few managers turned down every candidate' with the early NPA on *few*. The middle panel shows the utterance *trís nosokómes voíthisan káthe kardiológo* (three nurses-nom helped-3p every cardiologist-acc) 'Three nurses helped every cardiologist' with the early NPA on *three*. The bottom panel shows the utterance *lígi kritikí ídan káthe tenía sto festival* (few critics-nom saw-3p every movie in the festival-acc) 'Few critics saw every movie in the festival' with the early NPA on *few*.

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Figure 4-3. Examples of the S$_F$VO early focus pattern. Top: *lígi diefthidés apéripsan káthe ipopsífio,* (few managers-nom turned-3p down every candidate-acc) 'Few managers turned down every candidate', speaker 7. Middle: *trís nosokómes voíthisan káthe kardiológo,* (three nurses-nom helped-3p every cardiologist-acc) 'Three nurses helped every cardiologist', speaker 1. Bottom: *lígi kritikí ídan káthe tenía sto festival,* (few critics-nom saw-3p every movie in the festival-acc) 'Few critics saw every movie in the festival', speaker 2. Fig4-3-Top.wav Fig4-3-Mid.wav Fig4-3-Bot.wav

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An example of the SVO$_F$ late focus contour is shown in Figure 4-4, realized on the same string as that in Figure 4-2, *dío ipurgí parakolúthisan káthe sigkéntrosi* (two ministers-nom attended-3p every meeting-acc) 'Two ministers attended every meeting'. The context question preceding this utterance is 'How many meetings did two ministers attend?' therefore the accent pattern is different: the object quantifier *kathe* (= 'every') is focused this time since it answers the wh-word *poses* (= 'how many'). The subject forms a prosodic topic phrase, with a L* NPA and a H⁻ boundary. The topic intonation of the subject phrase implies that some other group of people probably attended fewer meetings.

Figure 4-4. Example of an SVO$_F$ late focus utterance, dío ipurgí parakolúthisan káthe sigkéntrosi, (two ministers-nom attended-3p every meeting-acc) 'Two ministers attended every meeting' produced by speaker 8. Fig4-4.wav

In Figure 4-5 I give more examples of SVO$_F$ late focus pattern. These utterances were produced in response to a wh-question with an object wh-word. The examples shown were produced by different speakers and involve different token sentences to

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show the invariance in the pattern. The figure in the top panel shows the utterance *káthe kritikós íde líges teníes sto festival* (every critic-nom saw-3s few movies-acc at the festival) 'Every critic saw few movies in the festival' with the focus NPA on *few*. The middle panel shows the utterance *tuláhiston dío pianístes ékanan polá láthi sto recital* (at least two pianists-nom made-3p many mistakes-acc at the recital) 'At least two pianists made many mistakes at the recital' with the focus NPA on *many*. The bottom panel shows the utterance *káthe stratiótis flértare péde kalesménes sto horó* (Every soldier-nom flirted-3p with five guests-acc at the dance) 'Every soldier flirted with five guests at the dance' with the focus NPA on *five*. As we've already seen in chapter 3, the NPA in the topic phrase is in general a L* pitch accent, but is sometimes realized as a L*+H pitch accent. It is yet to be determined what influences the choice between the two types of pitch accent.

Figure 4-5. Examples of the SVO late focus pattern. Top: *káthe kritikós íde líges teníes sto festival,* 'Every critic saw few movies in the festival', speaker 5. Middle: *tuláhiston dío pianístes ékanan polá láthi sto recital,* 'At least two pianists made many mistakes at the recital', speaker 7. Bottom: *káthe stratiótis flértare péde kalesménes sto horó,* 'Every soldier flirted with five guests at the dance', speaker 3. Fig4-5-Top.wav Fig4-5-Mid.wav Fig4-5-Bot.wav

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Figure 4-6 shows an example of the O_FVS early focus pattern realized over an utterance with OVS order, where the object is in focus. The utterance is *káthe sigkéntrosi parakolúthisan dío ipurgí* (every meeting-acc attended-3p two ministers-nom) 'Two ministers attended every meeting' produced in response to 'How many meetings did two ministers attend?' Since the object, which carries the focus NPA is the first constituent in this word order, the only pitch accent is the NPA and all post-focal words are de-accented.

Figure 4-6. Example of an OVS early focus utterance, káthe sigkéntrosi parakolúthisan dío ipurgí, (every meeting-acc attended-3p two ministers-nom) 'Two ministers attended every meeting' produced by speaker 3. Fig4-6.wav

In Figure 4-7 I give more examples of O_FVS early focus pattern utterances produced in response to a wh-question with an object wh-word. The examples shown were produced by different speakers and involve different token sentences to show the invariance in the pattern. The figure in the top panel shows the utterance *éna bukáli krasí ániksan trís servitóri* (one bottle wine-acc opened-3p three waiters-nom) 'Three

waiters opened one bottle of wine' with the focus NPA on *one*. The middle panel shows the utterance *líga provlímata élise káthe mathitís stis eksetásis* (few problems-acc solved-3s every student-nom in the exams) 'Every student solved few problems in the exams' with the focus NPA on *few*. The bottom panel shows the utterance *tus perisóterus giatrus éhun ladósi merikí asthenís* (the most doctors-acc have-3p bribed some patients-nom) 'A few patients have bribed most of the doctors' with the focus NPA on *most*.

Figure 4-7. Examples of the OVS early focus pattern. Top: *éna bukáli krasí ániksan trís servitóri,* (one bottle wine-acc opened-3p three waiters-nom) 'Three waiters opened one bottle of wine', speaker 8. Middle: *lígi mathités élisan káthe próvlima stis eksetásis,* (few problems-acc solved-3s every student-nom in the exams) 'Every student solved few problems in the exams', speaker 4. Bottom: *tus perisóterus giatrus éhun ladósi merikí asthenís,* (the most doctors-acc have-3p bribed some patients-nom) 'A few patients have bribed most of the doctors', speaker 5. Fig4-7-Top.wav Fig4-7-Mid.wav Fig4-7-Bot.wav

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Figure 4-8 shows the OVS_F late focus pattern realized over an utterance with OVS order, that is, the subject which comes last in this utterance is in focus and the object phrase which precedes the subject is a prosodic topic phrase with a L* NPA and a H⁻ boundary. The utterance is *káthe sigkéntrosi parakolúthisan dío ipurgí* (every meeting-acc attended two ministers-nom) 'Two ministers attended every meeting' produced in response to 'How many ministers attended every meeting?' This topic intonation implies that for different numbers of meetings the ministers attending them differed too.

Figure 4-8. Example of an OVS late focus utterance, káthe sigkéntrosi parakolúthisan dío ipurgí, (every meeting-acc attended two ministers-nom) 'Two ministers attended every meeting', produced by speaker 2. Fig4-8.wav

In Figure 4-9 I give more examples of OVS_F late focus pattern utterances produced in response to a wh-question with a subject wh-word. The examples shown were produced by different speakers and involve different token sentences to show the invariance in the pattern. The figure in the top panel shows the utterance *káthe tenía*

ídan lígi kritikí sto festival (every movie-acc saw-3p few critics-nom at the festival) 'Few critics at the festival saw every movie' with the focus NPA on *few*. The middle panel shows the utterance *káthe tést asfalías pérasan líga aftokínita* (every safety test-acc passed-3p few cars-nom) 'Few cars passed every safety test' with the focus NPA on *few*. The bottom panel shows the utterance *Polá mnimía fotográfisan tuláhiston tris turístes* (many monuments-acc photographed-3p at least three tourists-nom) 'At least three tourists photographed many monuments' with the focus NPA on *at least three*.

Figure 4-9. Examples of the OVS late focus pattern. Top: *káthe tenía ídan lígi kritikí sto festival,* 'Few critics at the festival saw every movie', speaker 5. Middle: *káthe tést asfalías pérasan líga aftokínita,* 'Few cars passed every safety test', speaker 2. Bottom: *Polá mnimía fotográfisan tuláhiston tris turístes,* 'At least three tourists photographed many monuments', speaker 4. Fig4-9-Top.wav Fig4-9-Mid.wavFig4-9-Bot.wav

Figure 4-10 shows the O-clitic-VS$_F$ late focus pattern realized over an utterance with O-clitic-VS order. The clitic doubled object is topicalized[30] and the subject is focused. The utterance is *káthe sigkéntrosi tin parakolúthisan dío ipurgí* (every meeting-acc it-acc attended-3p two ministers-nom) 'Every meeting was attended by two ministers' produced in response to 'How many ministers was every meeting attended by?' Note that the translation of this example is different from the translation given for the OVS example: the object here is given a wide scope interpretation, and the focused subject has narrow scope. In the Greek literature clitic left dislocation of objects is associated with a strong/specific interpretation (see Alexiadou (1999), Alexiadou and Anagnostopoulou (1997), (1998), Giannakidou (1997), and references in there). The results of the perception experiment also support this claim about the different interpretation of objects in the OVS and O-clitic-VS orders.

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[30] This particular utterance has two topic phrases, one containing the object and one containing the verb. The verb may otionally form a topic phrase but in most O-clitic-VS$_F$ utterances produced for this experiment it did not, but was in the same prosodic phrase with the subject carrying a L*+H pre-nuclear pitch accent. Whether the verb is in a second topic phrase or not makes no difference foe the purposes of this experiment.

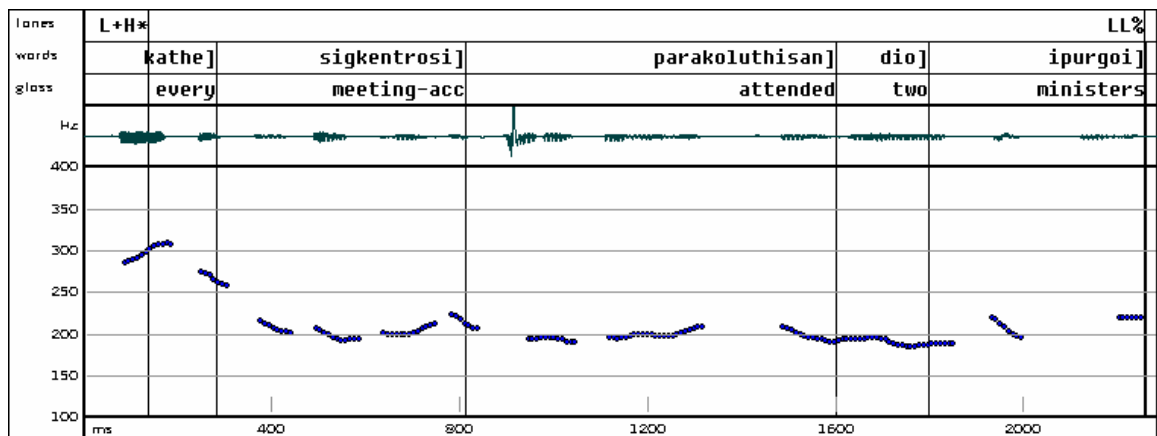| Tones	L*+H		L*	H−		L*	H−	L+H*			LL%
words	kathe		sigedrosi			tibarakluthsan			dio		ipurgi
gloss	every		meeting			it attended			two		ministers

Figure 4-10. Example of an O-clitic-VS late focus utterance, káthe sigkéntrosi tin parakolúthisan dío ipurgí, (every meeting-acc it-acc attended-3p two ministers-nom) 'Every meeting was attended by two ministers', produced by speaker 1. Fig4-10.wav

In Figure 4-11, I give more examples of O-clitic-VS$_F$ late focus pattern utterances produced in response to a wh-question with a subject wh-word. The examples shown were produced by different speakers and involve different token sentences to show the invariance in the pattern. The figure in the top panel shows the utterance *tuláhiston dío láthi ta ékanan polí pianístes sto recital* (At least two mistakes-acc them-acc made-3p many pianists-nom at the recital) 'At least two mistakes were made by many pianists at the recital' with the focus NPA on *many*. The middle panel shows the utterance *péde tragúdia ta épeksan dío sigrotímata* (five songs-acc them-acc played-3p two bands-nom) 'Five songs were played by two bands' with the focus NPA on *two*. The bottom panel shows the utterance *merikús giatrús tus exun ladósi I perisóteri asthenís* (some doctors-acc them-acc bribed-3p most patients-nom) 'A few doctors have been bribed by most patients' with the focus NPA on *most*.

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Figure 4-11. Examples of the O-clitic-VS_F late focus pattern. Top: *tuláhiston dío láthi ta ékanan polí pianists sto recital*, 'At least two mistakes were made by many pianists at the recital', speaker 7. Middle: *péde tragúdia ta épeksan dío sigrotímata*, 'Five songs were played by two bands', speaker 4. Bottom: *merikús giatrús tus exun ladósi I perisóteri asthenís*, 'A few doctors have been bribed by most patients' speaker 3. Fig4-11-Top.wav Fig4-11-Mid.wav Fig4-11-Bot.wav

As we just saw, the link between prosodic structure and context/information structure holds for these utterances just like it did for utterances in the experiments presented in chapter 3. The location of the prosodic focus and background in the utterances is regulated here as well by which parts of the utterances are new and which old.

The perception experiment described in the following section was designed to explore the question whether this prosodic structure helps disambiguate the scope interpretation for this type of utterances as it did for the utterances in experiments 1 and 2.

4.3 Perception method

The aim of the perception experiment was to determine whether listeners can distinguish between the two scope interpretations of the ambiguous strings based only on the intonation of the given utterance, without any context. More concretely, one hypothesis for the perception part was that the focused phrases in the SVO and OVS word orders would be interpreted by listeners as having wide scope. As we will see this hypothesis was refuted.

The second hypothesis examined in the perception experiment was that there would be a difference in the interpretation of fronted objects. As mentioned in the hypothesis, clitic left dislocated objects were expected to receive wide scope interpretation but fronted ones were expected to receive narrow scope interpretation. This hypothesis was borne out by the data. Notice that in the O-clitic-VS order where clitic left dislocated objects occur, focus aligns with the subject. This means we expect a

focused subject to scope over a fronted object but under a clitic left dislocated one. According to the hypotheses that were made at the outset of the experiment, there should be a hierarchy according to the ability of each constituent to take wide scope:

1. clitic left dislocated object > focused subject

2. focused subject or object > backgrounded object or subject

Only prediction 1 was confirmed.

92 listeners participated in this part of the experiment, divided in five groups[31]. The sentences were also divided in five parts of 40 sentences each, one part for each group of listeners, to make their task easier. Also, each listener did not hear different prosodic realizations of the same sentence, thus preventing any effect of contrast. Each group heard the same type of sentences but different tokens for each type.

The listeners' task was to choose one of four answers given to them as interpretations of the sentences. For a sentence like (12), the questions corresponding to it looked like the ones shown in Figure 4-12. Recall that the working hypothesis was that scope interpretation in this sentence is [3 > *every*] when 3 is focused, and [*every* > 3] when *every* is focused. All sentences were followed by questions like the ones shown in Figure 4-7, where the two possible scope interpretations were represented by graphs similar to those in A and B, and also by a paraphrase under each graph. Two more answers were included, C for utterances judged by listeners to have neither subject nor object wide scope, and D for utterances that were unclear to listeners.

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[31] The number of participants in each group varied. The average was 18 participants per group with +/- 4 variation.

(12)   *Treis nosokomes voithisan kathe kardiologo*

three   nurses   helped   every cardiologist

A	ΚΑΡΔΙΟΛΟΓΟΙ	ΝΟΣΟΚΟΜΕΣ	B	ΚΑΡΔΙΟΛΟΓΟΙ	ΝΟΣΟΚΟΜΕΣ
	K1	N1 / N2 / N3		K1 / K2 / K3 / K4	N1
	K2	N2 / N4 / N5		K1 / K2 / K3 / K4	N2
	K3	N3 / N4 / N6		K1 / K2 / K3 / K4	N3
	K4	N7 / N8 / N9			

For each of the cardiologists there were 3 (perhaps different) nurses.	There are 3 particular nurses, each of which helped every cardiologist.
C. Neither A nor B.	**D.** Unclear

Figure 4-12. Example of the choice of answers corresponding to sentence (12) for the perception part of experiment 2.

Answer A represents object wide scope: there are three, possibly different nurses for each doctor. Answer B represents subject wide scope: each of three specific nurses helped every doctor. The order in which subject and object wide scope graphs were presented in the figure varied.

4.4 Perception results

Listeners did not consistently give a wide scope interpretation to the focused item. Instead they gave subjects a wide scope interpretation, except in the O-cl-VS order where they consistently gave the object wide scope interpretation, effects that have

already been noticed in the literature (Alexiadou (1999), Alexiadou and Anagnostopoulou (1997), (1998), Giannakidou (1997) among others), but, to my knowledge, not established experimentally until now.

Table 4-1 shows how often a subject was given wide scope interpretation (columns 2 and 3) and how often an object was given wide scope (columns 4 and 5). The columns for 'other' (6 and 7) pool the answers for 'neither A nor B' and 'unclear'. In general subjects were given wide scope 56% of the times while objects only 22%, a significant difference[32] ($p<0.003$), regardless of word order, quantifier, or location of focus in the sentence. The difference between subject wide scope and object wide scope answers is significant for each pair of quantifiers: *every-number* $\chi^2=17.391$, $p<.0001$; *most-some* $\chi^2=3.753$, $p<.053$; *many-at least* $\chi^2=26.450$, $p<.0001$; *every-few* $\chi^2=25.390$, $p<.0001$; *number-number* $\chi^2=8.960$, $p<.003$ (for this quantifier pair the difference between 'subject wide scope' answers and 'unclear' answers is not significant $\chi^2=.762$, $p=.383$). Note that these results only include the SVO and OVS orders. O-clitic-VS results are shown separately in Table 4-2.

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[32] Listeners had great difficulty with sentences containing two number quantifiers. As the table shows 46% of the answers involving these quantifiers received an 'unclear' answer with an almost equal number of answers in the 'neither A nor B' and 'unclear' categories. In the literature it has been noted that sentences with two cardinals show preferably independent readings in which neither quantifier scopes over the other.

Quantifiers	S-wide scope		O-wide scope		other		total
Every-number	329	66%	132	26%	39	8%	500
Most-some	241	47%	154	30%	118	23%	513
Many-at least	343	63%	91	17%	109	20%	543
Every-few	305	67%	93	20%	60	13%	458
number-number	193	38%	82	16%	236	46%	511

Table 4-1. Perception results organized according to how many utterances were judged to have subject wide or object wide scope.

Figure 4-13 below shows the same results graphically.

Figure 4-13. Distribution of answers in SVO and OVS orders.

The following table shows how many times the object was judged to have wide scope in the O-clitic-VS order. Again columns 2 and 3 show 'subject wide scope' answers and columns 4 and 5 'object wide scope' abswers. Object wide scope interpretation was significantly higher than the rest (p=0.004). In general, objects were judged to scope wide 58% of the times while subjects 23%. The difference between subject wide scope and object wide scope answers is significant for each pair of quantifiers, except for *most-some*: *every-number* χ^2=38.290, p<.0001; *most-some* χ^2=1.280, p=.258[33]; *many-at least* χ^2=16.490, p<.0001; *every-few* χ^2=11.630, p<.001; *number-number* χ^2=28.490, p<.0001 (for this quantifier pair the difference between 'object wide scope' answers and 'unclear' answers is not significant χ^2=.696, p=.404).

Quantifiers clitic	S-wide scope		O-wide scope		other		total
every-number	20	17%	92	77%	7	6%	119
most-some	44	34%	57	44%	29	22%	130
many-at least	31	23%	81	60%	24	18%	136
Every-few	46	28%	99	60%	19	12%	164
number-number	10	9%	57	50%	48	42%	115

Table 4-2. Perception results for the O-clitic-VS order.

Figure 4-14 shows the graph for these results.

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[33] For this pair of quantifiers it made a difference which of the two quantifiers was in subject position: when *most* was subject, the left dislocated object *some* took wide scope (69% of the answers were object wide scope versus 11% for subject wide scope a significant difference) but when *some* was subject, the left dislocated object *most* took narrow scope (22% the answers were object wide scope versus 54% for subject wide scope—a significant difference)

Figure 4-14. Distribution of answers in the O-cl-VS order.

The relation between focus and wide scope was not consistent. We need to look at these results separately for focused subjects and focused objects in order to get a clear picture, because the fact that subjects take wide scope whether they are focused or not is a confounding factor. We cannot decide whether focused subjects take wide scope because they are focused or because as subjects they c-command and therefore scope over the objects. However it turns out that focused objects take narrow scope under unfocused subjects and this suggests that focus is not related to wide scope.

Table 4-3 shows the results for focused subjects. Columns 3 and 4 show how often a focused subject was given a wide scope interpretation and columns 5 and 6 how

often it was given a narrow scope interpretation. In general 58% of the focused subjects were judged to have wide scope and 22% to have narrow scope. The difference was highly significant (p<0.0005). The difference between focus wide scope and focus narrow scope answers is significant for each pair of quantifiers: *every-number* χ^2=14.400, p<.0001; *most-some* χ^2=6.530, p<.011; *many-at least* χ^2=30.480, p<.0001; *every-few* χ^2=22.750, p<.001; *number-number* χ^2=13.340, p<.0001 (for this quantifier pair the difference between 'focus wide scope' answers and 'unclear' answers is not significant χ^2=.976, p=.323).

Quantifiers	focus	F-wide scope		F-narrow scope		other		Total
every-number	S	162	63%	69	27%	25	10%	256
most-some	S	145	52%	81	29%	53	19%	279
many-at least	S	171	66%	41	16%	49	19%	261
every-few	S	149	67%	50	22%	24	11%	223
Number-number	S	128	46%	47	17%	101	37%	276

Table 4-3. Perception results for how many focused subjects received wide scope interpretation

Figure 4-15 shows a graphical representation of these results.

Distribution of wide scope answers for focused subjects

Figure 4-15. Wide scope answers for focused subjects

Table 4-4 shows how often focused objects were given a wide scope interpretation. Columns 3 and 4 show the number of 'object wide scope' answers and columns 5 and 6 the number of 'object narrow scope' answers. In general focused objects were <u>not</u> judged to have wide scope. They were judged to take narrow scope 53% of the time and to take wide scope 21% of the times, a significant difference (p<0.01). The difference between focus wide scope and focus narrow scope answers is significant for each pair of quantifiers, except *most-some*: *every-number* χ^2=18.760, p<.0001; *most-some* χ^2=1.380, p=.239; *many-at least* χ^2=23.400, p<.0001; *every-few* χ^2=27.420, p<.001; *number-number* χ^2=3.930, p<.047 (for this quantifier pair the

difference between 'focus narrow scope' answers and 'unclear' answers is significant χ^2=9.894, p<.002).

Quantifiers	focus	F-wide scope		F-narrow scope		Other		total
every-number	o	63	26%	167	68%	14	6%	244
most-some	o	73	31%	96	41%	65	28%	234
many-at least	o	50	18%	172	61%	60	21%	282
every-few	o	43	18%	156	66%	36	15%	235
Number-number	o	35	15%	65	28%	135	57%	235

Table 4-4. Perception results for how many focused subjects received wide scope interpretation

Figure 4-16 shows a graphical representation of these results.

Figure 4-16. Wide scope answers for focused objects

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4.5 Conclusion

Summarizing the results of experiment 3 we saw that, like in experiments 1 and 2, speakers prosodically realized the target sentences according to the context. The same string was produced with different focus-ground divisions in response to different context questions: that is, the focus part in the answer corresponded to the wh-word in the question, and the remainder of the answer was backgrounded. In other words, the link between prosodic structure of an utterance and its context is constant for all three experiments. However there was a difference in the perception results between experiments 1 and 2 on the one hand and experiment 3 on the other. Whereas intonation helped listeners disambiguate the scope ambiguous sentences in the first two experiments it failed to do so in the third experiment described in this chapter. In chapter 5, I will give a pragmatic account of this difference between the experiments.

CHAPTER 5

General discussion and conclusion

In this thesis I argued that the main function of intonation is to anchor utterances within their context. Part of the argument involved showing what the prosodic realization of information structure categories is in Greek, that is, how prosody encodes the old and new elements of an utterance. In chapter 2 I showed some intonation patterns of different sentence types in Greek and how these patterns relate to context. I hope it became evident that a difference in intonation structure generally does not bring about a difference in truth conditions. We do however understand different prosodic realizations of the same sentence to 'mean' different things because as speakers we know that different intonational packaging of a sentence—i.e., a different distribution of its old and new parts—makes it felicitous only in certain contexts and infelicitous in others. In other words, the different prosodic renditions are not interchangeable in context. This 'meaning' difference, then, arises from pragmatics. By extension, in the absence of context, the implicit knowledge of the function of intonation helps listeners decode the different melodic realizations of the utterances to recover their context.

Terms such as focus and background are used in this thesis as pragmatic categories of information structure, which do not make any truth conditional contribution but which get interpreted differently for different contexts and different

sentence types. In other words, I linked the disambiguating effect of intonation to pragmatic principles and showed that it is not due to any semantic contribution of focus.

I also showed in chapter 2 how information structure is realized in some types of Greek utterances. I recognized three separate basic categories, topic, focus, and tail. We saw that in some cases these information structure categories very cleanly map to prosodically distinct entities: topics form their own prosodic phrase with a specific melody, foci form a second prosodic phrase containing the main stress of an utterance, and tails get typically de-accented. However I also showed types of utterances like negatives in which prosody is not only used for the encoding of information structural categories but also to indicate the illocutionary force of the utterance: for these utterances focus constituents do not always get accented and de-accenting does not show old information.

The production results of the three experiments presented in this thesis suggest that the realization of information structure categories indeed is a function of context. However, categories such as focus or background did not receive an invariant truth-conditional interpretation in the perception parts of the three experiments, which I take as an argument against dealing with focus in the semantics proper. As we saw, in the first two experiments, listeners interpreted the focused quantifier with wide scope. However, in the third experiment listeners gave subjects a wide scope interpretation, regardless the intonation. The crucial question is, of course: Why didn't intonation disambiguate utterances in experiment 3 like it did in experiments 1 and 2? The answer, I believe, lies with the context questions.

Let us take another look at the context questions of experiments one and three repeated below. The questions in experiment 1, questions (1) and (2), are unambiguous, just like those in experiment 2. However, those in experiment 3, questions (3) and (4) are ambiguous. Let us see why this makes a difference for the interpretation of their answers.

(1)   How many problems <u>did</u> they solve?   EXPERIMENT 1

(2)   How many problems <u>didn't</u> they solve?   EXPERIMENT 1

(3)   How many ministers attended every meeting?   EXPERIMENT 3

(4)   How many meetings did two ministers attend?   EXPERIMENT 3

(1) is unambiguous because there is only one quantifier in it. It asks about solved problems, and focus on negation in the answer cues listeners to the absence of negation from context. The answer to this question must also be about solved problems, i.e., the polarity of the verb is positive too, and the negation scopes over the quantifier instead. (2) is unambiguous in Greek, as well as in English, since the negation cannot scope over the wh-word (a weak island effect). The unfocused negation in the answer cues listeners to the presence of negation in the context, therefore to the fact that this answer must be about unsolved problems. Since the negation scopes over the verb it cannot scope over the quantifier.

On the other hand, the context questions (3) and (4) are ambiguous in Greek, and also in English: (3), for example, could be about counting ministers each of which

has the property of attending every meeting, or about counting the ministers by meeting, each meeting having a different group of ministers attending it.

The hypothesis made in chapter 3 about the indirect connection between scope interpretation and prosody through information structure predicts exactly this difference in the experimental results between experiments 1 and 2 on one hand and experiment 3 on the other: in experiments 1 and 2, listeners can proceed from prosodic structure to information structure to scope calculation, based on the unambiguous context questions, but in experiment 3, the same chain of inference cannot result in scope disambiguation since the potential source of disambiguation, the questions, are ambiguous themselves. In the case of the clitic left dislocated objects, their syntactic structure is not ambiguous.

I should repeat the point made in chapter 3 that the experimental results in this thesis suggest that the wide scope interpretation given to focus is an epiphenomenon and no deep connection (i.e. no rule in the grammar) exists between the two.

Even though a syntactic or semantic analysis of the sentences explored here is outside the scope of this thesis, I need to stress that the account given here is compatible with a syntactic/semantic explanation for the scope interpretation facts. One instance where a syntactic constraint played a role in the account I give was the wh-weak island effect on negation in examples like (2). A syntactic property was also invoked for the wide scope interpretation of clitic left dislocated objects, which are commonly assumed to occupy a very high position in a syntactic tree, and therefore get highest scope. Furthermore, the fact that the answers of ambiguous context questions were interpreted with subject wide scope could also receive a syntactic/semantic explanation: perhaps

this was the preferred interpretation because subjects—as is commonly assumed—occupy a higher position than objects, therefore they are given a wide scope interpretation. Why and how word orders like OVS which presumably have an object in a higher position than the subject are still interpreted with the subject taking wide scope is an open question for syntactic research.

The fact remains that throughout all the experiments undertaken in this thesis, context played a role in determining whether intonation will have a disambiguating effect in the experimental sentences: for unambiguous contexts intonation showed a disambiguating effect and for ambiguous contexts no such effect was found.

Further research is necessary to establish the correspondence between information structure and prosodic structure for different types of sentence in Greek. The work done in this dissertation has established this correspondence for major sentence types, but, of course, this is a very rich field that needs to be further explored.

Another field this dissertation has made a contribution in is establishing experimentally the interpretation native speakers give to scope ambiguous sentences. More experimental work is necessary to clarify issues such as the difference in interpretation between increasing and decreasing quantifiers that arose in experiment 1.

Appendix A
Experiment 1 sentences

For all the sentences in this experiment, context questions had the same form. The positive context question was of the form 'How many N(oun) did they V(erb)?' and the negative context question was 'How many N(oun) didn't they V(erb)?'. The positive context question translated in English and the answers to these questions are given below.

1.   *How many problems did they solve?*
       Den elisan polla provlimata
       Not solved-3p many problems-acc
       'They didn't solve many problems'

2.   *How many refugees did they accept?*
       Den dehtikan pollous prosfiges
       Not accepted-3p many refugees-acc
       'They didn't accept many refugees'

3.   *How many paintings did she sell?*
       Den poulise pollous pinakes
       Not sold-3s many paintings-acc
       'She didn't sell many paintings'

4.   *How many newspapers did he give an interview to?*
       Den edose se polles efimerides
       Not gave-3s to many newspapers-acc
       'He didn't give (an interview) to many newspapers'

5.   *How many patients did they examine?*
       Den eksetasan ligous astheneis
       Not examined3p few patients-acc
       'They didn't examine few patients'

6.   *How many convicts did he pardon?*
       Den edose hari se ligous katadikous
       Not gave-3s pardon to few convicts-acc
       'He didn't pardon few convicts'

7.   *How many tenants did she collect the rent from?*
        Den ta eiseprakse apo ligous enoikous
        Not them collected-3s from few tenants-acc
        'She didn't collect it from few tenants'

8.   *How many budgets did she approve?*
        Den enekrine liga kondilia
        Not approved-3s few budgets-acc
        'She didn't approve few budgets'

9.   *How many documents did you sign?*
        Den ipegrapsa panw apo pente egrafa
        Not signed-1s more than five documents-acc
        'I didn't sign more than five documents'

10.   *How many tickets did you pay?*
        Den plirwsa panw apo treis kliseis
        Not paid-1s more than three tickets-acc
        'I didn't pay more than three tickets'

11.   *How many bridges did the earthquake cause damage to?*
        Den prokalese zimies se panw apo tessereis gefires
        Not caused-3s damage to more than four bridges-acc
        'It didn't cause damage to more than four bridges'

12.   *How many ballots were counted during the first night?*
        Den katametrithikan panw apo tessera ekatomuria psifi
        Not be-counted-3p more than four million ballots-nom
        'There were not more than four million ballots counted'

13.   *How many lambs did the vet judge unsuitable?*
        Den ekrine akatallila to poly eksi arnakia
        Not judged-3s unsuitable at most six lambs-acc
        'He didn't judge unsuitable at most six lambs'

14.   *How many movies have you seen?*
        Den exw dei to poli treis tainies
        Not have-1s seen at most three movies-acc
        'I haven't seen at most three movies'

15.   *How many voting centers did the candidate visit?*
        Den episkeftike to poli tessera tmimata
        Not visited-3s at most four centers-acc
        'He didn't visit at most four centers'

16. *How many infants did they give the vaccination to?*
    Den ekanan to poli se dwdeka vrefi
    Not gave-3p it to at most twelve infants-acc
    'They didn't give it to at most twelve infants'

This is the list of the sentences used in the production part of experiment 3. The sentences are listed by the quantifier pair they contain. For the first pair of quantifiers, *three-every,* I list all the permutations (1-10) used in the experiment, resulting from variation in word order, context question and the resulting intonation expected, and which of the two quantifiers in the sentence is the subject or the object. For the remaining sentences I only give the matrix sentence from which the remaining nine permutations can be derived by following the example of sentences 1-10. For sentences that contained two cardinal quantifiers (eg. Three-four) I only used five permutations per matrix sentence because it did not make sense to use the permutations that invert quantifiers for the subject and the object position. For the five unused permutations, I used completely new sentences, as shown below in 121-156.

For the number-*every* pair:

Three-every

1.   Q: *Poses nosokomes voithisan kathe kardiologo*?
          How many nurses-nom helped-3p every cardiologist-acc
          'How many nurses helped every cardiologist?'
        A: *Tris nosokomes voithisan kathe kardiologo* S_FVO
          Three nurses-nom helped-3p every cardiologist-acc
          'Three nurses helped every cardiologist'

2.   Q: *Posus kardiologus voithisan tris nosokomes*?
          How many cardiologists-acc helped-3p three nurses-nom
          'How many cardiologists did three nurses help?'
        A: *Tris nosokomes voithisan kathe kardiologo*   SVO$_F$
          Three nurses-nom helped-3p every cardiologist-acc
          'Three nurses helped every cardiologist'

3.   Q: *Poses nosokomes voithisan kathe kardiologo*?
          How many nurses-nom helped-3p every cardiologist-acc
          'How many nurses helped every cardiologist?'

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A: *Kathe kardiologo voithisan tris nosokomes*   OVS$_F$
  every cardiologist-acc helped-3p three nurses-nom
  'Three nurses helped every cardiologist'

4.   Q: *Posus kardiologus voithisan tris nosokomes*?
      How many cardiologists-acc helped-3p three nurses-nom
      'How many cardiologists did three nurses help?'
      A: *Kathe kardiologo voithisan tris nosokomes*   O$_F$VS
        every cardiologist-acc helped-3p three nurses-nom
        'Three nurses helped every cardiologist'

5.   Q: *Poses nosokomes voithisan kathe kardiologo*?
      How many nurses-nom helped-3p every cardiologist-acc
      'How many nurses helped every cardiologist?'
      A: *Kathe kardiologo ton voithisan tris nosokomes*   O-clitic-VS$_F$
        every cardiologist-acc him helped-3p three nurses-nom
        'Every cardiologist was helped by three nurses'

Every-three

6.   Q: *Poses nosokomes voithisan tris kardiologus*?
      How many nurses-nom helped-3p three cardiologists-acc
      'How many nurses helped three cardiologist?'
      A: *Kathe nosokoma voithise tris kardiologus*   S$_F$VO
        Every nurse-nom helped-3s three cardiologists-acc
        'Every nurse helped three cardiologists'

7.   Q: *Posus kardiologus voithise kathe nosokoma*?
      How many cardiologists-acc helped-3s every nurse
      'How many cardiologists did every nurse help?'
      A: *Kathe nosokoma voithise tris kardiologus*   SVO$_F$
        Every nurse-nom helped-3s three cardiologists-acc
        'Every nurse helped three cardiologists'

8.   Q: *Poses nosokomes voithisan tris kardiologus*?
      How many nurses-nom helped-3p three cardiologists-acc
      'How many nurses helped three cardiologists?'
      A: *Tris kardiologus voithise kathe nosokoma*   OVS$_F$
        three cardiologists-acc helped-3s every nurse-nom
        'Every nurse helped three cardiologists'

9.   Q: *Posus kardiologus voithise kathe nosokoma*?
       How many cardiologists-acc helped-3s every nurse
       'How many cardiologists did every nurse help?'
       A: *Tris kardiologus voithise kathe nosokoma* O_FVS
       three cardiologists-acc helped-3s every nurse-nom
       'Every nurse helped three cardiologists'

10.   Q: *Poses nosokomes voithisan tris kardiologus*?
       How many nurses-nom helped-3p three cardiologists-acc
       'How many nurses helped three cardiologists?'
       A: *Tris kardiologus tus voithise kathe nosokoma* O-clitic-VS_F
       three cardiologists-acc helped-3s every nurse-nom
       'Three cardiologists were helped by every nurse'

11.   *Teseris eksetastes vathmologisan kathe grapto sto scholio mas*
       Four examiners-nom graded-3p every paper-acc in our school
       'Four examiners graded every paper in our school'

21.   *Dio ipurgi parakoluthisan kathe sigkentrosi*
       Two ministers-nom attended-3p every meeting-acc
       'Two ministers attended every meeting'

31.   *Pente stratiotes flertaran kathe kalesmeni sto horo*
       Five soldiers-nom flirted-3p with every guest-acc at the dance
       'Five soldiers flirted with every guest at the dance'

For the *some-most* pair:

41.   *Meriki asthenis ehun ladosi tus perisoterus giatrus*
       some patients-nom have bribed-3p most doctors-acc
       'Some patients have bribed most doctors'

51.   *Meriki dimosiografi sigkalipsan ta perisotera skandala tis kivernisis*
       some reporters-nom covered up-3p most of the government scandals-acc
        'Some reporters covered up most of the government scandals'

61.   *Meriki inokritiki dokimasan ta perisotera krasia stin ekthesi*
       some wine critics-nom tasted-3p most wines-acc at the show
       'Some wine critics tasted most wines at the show'
71.   *Meriki servitori eksipiretisan tue perisoterus pelates*
       some waiters-nom helped-3p most customers-acc
       'Some waiters helped most customers'

For the many-at least pair:

81. *Poli turistes fotografisan tulahiston tria mnimia*
many tourists-nom photographed-3p at least three monuments-acc
'Many tourists photographed at least three monuments'

91. *Poli pianistes ekanan tulaxiston dio lathi sto recital*
many pianists-nom made-3p at least two mistakes-acc at the recital
'Many pianists made at least two mistakes at the recital'

101. *Poles turtes ixan tulaxiston tesera luludia*
many cakes-nom had-3p at least four flowers-acc
'Many cakes had at least four flowers'

111. *Poli kipuri kladepsan tulaxiston pede thamnus*
many gardeners-nom pruned-3p at least five bushes-acc
'Many gardeners pruned at least five bushes'

For the number-number pair:

121. *Eksi pelates ipian dio kafedes*
six customers-nom drank-3p two coffees-acc
'Six customers drank two coffees'

126. *Pede sferes xtipisan okto stohus*
five bullets-nom hit-3p eight targets-acc
'Five bullets hit eight targets'

131. *Pente kalesmeni eferan tria dora*
five guests-nom brought-3p three presents-acc
'Five guests brought three presents'

136. *Tris gates genisan tria gatakia*
three cats-nom had-3p three kittens-acc
'Three cats had three kittens'

141. *tris ktiniatri emvoliasan dodeka skilus*
three vets-nom injected-3p twelve dogs-acc
'Three vets injected twelve dogs'

146.   *dodeka paiktes evalan dio gol*
        twelve players-nom scored-3p two goals-acc
        'Twelve players scored two goals'

151.   *Dio sigkrotimata epeksan pede tragudia*
        two groups-nom played-3p five songs-acc
        'Two groups played five songs'

156.   *tris servitori aniksan ena bukali krasi*
        three waiters-nom opened-3p one bottle-acc of wine
        'Three waiters opened one bottle of wine'

For the few-every pair:

161.   *Ligi kritiki idan kathe tenia sto festival*
        few critics-nom saw-3p every movie-acc at the festival
        'Few critics saw every movie at the festival'

171.   *Ligi mathites elisan kathe provlima stis eksetasis*
        few students-nom solved-3p every problem-acc at the exams
        'Few students solved every problem at the exams'

181.   *Liga aftokinita perasan kathe test asfalias*
        few cars-nom passed-3p every security test-acc
        'Few cars passed every security test'

191.   *Ligi diefthintes aperipsan kathe ipopsifio*
        few managers-nom turned down-3p every candidate-acc
        'Few managers turned down every candidate'

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